Clinical and Experimental Health Sciences

# Association Between Etiological Factors and Dentin Hypersensitivity: A Cross-Sectional Study in Turkey

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**ABSTRACT**

**Objective:** This study purposed to estimate the prevalence of DH and how effective the etiological factors are in the development of DH in Turkey.

**Methods:** Demographic features, hygiene habits, bruxism, beverage habits, parafunctional habits, smoking, and other medical problems were asked. Air was blasted to the teeth via the air-water syringe for 3 seconds. The Visual Analogue Scale was used to measure DH sensitivity, and data were recorded in the 0-100 mm range, and 5 mm and higher were considered DH. The attrition, abrasion, erosion, abfraction per dental type (Incisal OR Canine OR Premolar OR Molar) were recorded. The same procedure was applied for abnormal tooth position and gingival recession.

**Results:** A total of 4476 teeth and 236 individuals were evaluated. Significantly higher DH frequency was observed in females (p= .034), the 40-55 age range (p= .009), and non-smokers (p= .016). Those who brushed their teeth three times a day or more (p< .001), preferred horizontal technique (p= .017), used toothbrushes with a hard bristle (p< .001) exhibited higher DH frequency. There was no significant difference in DH regarding bruxism, acidic beverage consumption, vomiting, and reflux (p> .05).

**Conclusion:** DH is a multi-etiological symptom affected by demographic attributes, hygiene, and other habits. Clinicians should painstakingly distinguish the source of DH to gain the long-term success of DH treatment, which depends on many etiological factors.

**Keywords:** Dentin hypersensitivity, dentin sensitivity, cross-sectional studies

## 1. INTRODUCTION

Dentin hypersensitivity (DH) is a clinical finding frequently encountered in the population, characterized by short-term sharp pain due to thermal, chemical, or mechanical stimuli, not associated with dental defects or caries (1). Commonly, patients state that pain occurs when they drink cold or hot beverages, brush their teeth, or eat sweet foods (2). The most accepted theory explaining the mechanism of DH is based on the stimulation of baroreceptors in the pulp and dentin due to the movement of the fluids in the exposed dentinal tubules after chemical and physical changes. Accordingly, pain sensitivity occurs (3).

Dentin tubules are generally covered with enamel and cementum to be isolated from the external environment. Dentin tubules can be exposed in cases where the enamel or cementum is corrupted due to erosion, abrasion, attrition, and abfraction (4). Erosion is a type of wear on the teeth caused by excess acid in the mouth due to heartburn, gastritis reflux, constant vomiting, excessive acidic drinks, and food consumption. As a result of bruxism, attrition may occur in the tubercules and incisal of the teeth, and abfraction in the cervical regions. Another critical etiological factor for DH is the gingival recession. It has been stated that the root surface exposed due to gingival recession is the highest risk factor for DH (5).

Studies report that DH prevalence ranges from 2.8% to 74% in adult populations (2,6-8). It has been hypothesized that this wide variation in prevalence may link to the different methodologies and populations in the studies. The only study measuring the prevalence of DH among patients in Turkey was conducted in Kırıkkale in 2012 (9) and a novel study was required. This study aimed to measure the prevalence of DH and how effective the etiological risk factors are in the development of DH in Turkey.



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## 2. METHODS

The Clinical Research Ethics Committee of Sutcu Imam University approved this study (2019/68) on 06.03.2019. A written consent form was obtained from the patients who were involved.

### *2.1. Study Population*

This study was carried out by conducting a questionnaire and clinical examination on patients who applied to Sutcu Imam University between April 2019 and April 2020. Turkish patients older than 18 years, in good health, and who approved to participate in the study were included. Patients who had previously undergone bleaching or currently undergoing orthodontic treatment or receiving professional dentin sensitivity treatment were excluded from the study. All teeth which did not have caries, cracks, fractures, and restorations were included in the study, except the third molar tooth.

### *2.2. Power Analysis*

Based on a previous study conducted in Turkey, the prevalence of DH was found to be 7.6% (9). It was calculated with 95% confidence that at least 108 patients should be attended with a 5% alpha margin of error. It was decided to include at least 108 patients in the study.

### *2.3. Calibration and Intra-reliability of the Examiner*

Before the study protocol, the examiner (O.H.) was initially trained and calibrated to detect DH. Afterward, an oral examination of 10 subjects (not part of the study sample) was carried out by the examiner (O.H.) at Sutcu Imam University to test the intra-reliability through Intra-class Correlation Coefficient (ICC). The examiner was trained and calibrated until ICC was higher than 0.70 (between 0.70 and 0.90 is considered sufficient).

### *2.4. Questionnaire*

A researcher (F.P.H.) formulated the structured questionnaire. The questionnaire had adequate reliability with a Cronbach alpha coefficient of 0.833. Demographic features [age, gender (male OR female), hygiene habits [Tooth-brushing frequency (Once daily OR twice daily OR more) and tooth-brushing technique (horizontal+vertical OR horizontal OR vertical), bristle hardness (soft OR medium OR hard)], bruxism (none OR sometimes OR often), acidic beverage (none OR sometimes OR often), vomiting (none OR sometimes OR often), reflux (none OR sometimes OR often), parafunctional habits (none OR sometimes OR often), smoking (none OR sometimes OR often) were asked (Table 1).

***Table 1.*** *The questionnaire that was used in the study*

| |
|---|
| 1. Age? |
| 2. Gender? |
| 3. How often do you brush your teeth? |
| 1 |
| 2 |
| 3 |
| 4. With which method do you brush your teeth? |
| Horizontal+Vertical |
| Vertical |
| Horizontal |
| 5. What is the hardness of the toothbrush you use? |
| Soft |
| Medium |
| Hard |
| 6. Do you have bruxism? |
| None |
| Sometimes |
| Often |
| 7. How much do you consume acidic beverages? |
| None |
| Sometimes |
| Often |
| 8. How much do you vomit? |
| None |
| Sometimes |
| Often |
| 9. How much do you experience reflux? |
| None |
| Sometimes |
| Often |
| 10.Do you have a habit of smoking? |
| None |
| Sometimes |
| Often |

### *2.5. Evaluation of Dentin Hypersensitivity and Non-Carious Lesions*

The Visual Analogue Scale (VAS) was used to measure DH in participants. VAS was formed as a horizontal line of 0-100 mm, and “0 mm” was accepted as “no pain” and “100 mm” as severe pain. Air was blasted for 3 seconds, 2 mm away and perpendicular to the tooth, through the air-water syringe. The patient was asked to mark which value corresponded to the severity of the pain between 0-100 mm. Teeth with values of 5 mm and higher were considered as having DH. A Google form page was created on the internet to save the data. In order to determine the non-carious lesions that may affect the DH, the number of attrition, abrasion, erosion, and abfraction per dental type (Incisal OR Canine OR Premolar OR Molar) were recorded. The same procedure was applied for abnormal tooth position and gingival recession.

### *2.6. Statistical Analysis*

Jamovi 1.6.23 statistical program was used for the statistical analysis. The frequencies of non-caries lesions and DH were determined. Chi-squared test was used to detect the relationship between etiologic factors and DH. Significance was set at p<.05.

## 3. RESULTS

A total of 236 individuals, 156 (66%) female, and 80 (34%) male were recruited and 4476 teeth were examined. The mean age of the individuals was 35.13±14.06. The age pyramid according to gender is presented in Figure 1. Of them 7.69 % (n=344) of teeth and 12.3% (n=29) of individuals were diagnosed with DH (Figure 2). The frequencies of NCLs, gingival recession, and abnormal tooth position were 14.63% (n=655), 9.07% (n=406), 4.83% (n=216), respectively. Also, in the same sequence, the frequencies of DH were 15.42%, 3.9%, and 8.81%, respectively. While attrition was the most frequent NCL (9.34%, n=418), abfraction was the least (0.16%, n=7). While abfraction caused the highest DH (100%), attrition caused the least (13.10%) (Table 2).

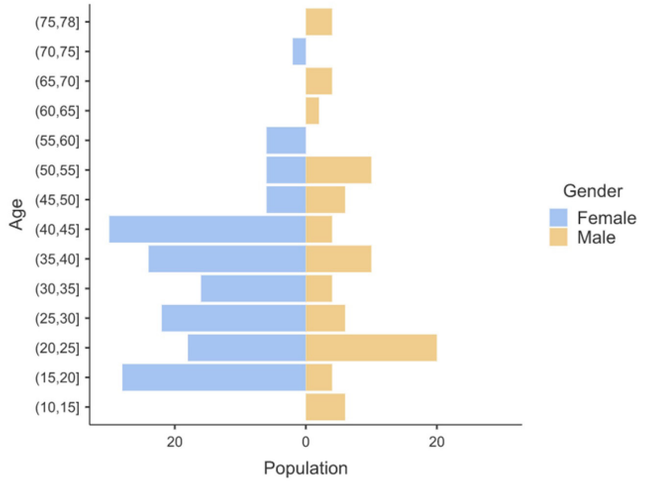


***Figure 1.*** *The age pyramid according to gender.*

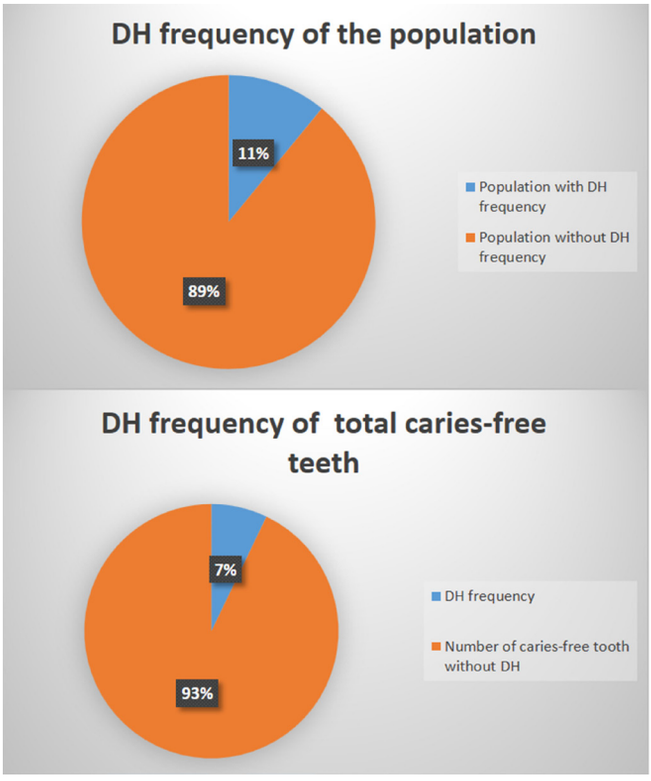


***Figure 2.*** *The frequency of DH according to population and number of caries-free tooth*

***Table 2.*** *Frequency and rate of DH in terms of non-carious lesions, other etiological factors, and tooth type.*

| | Frequency % | Rate of DH % |
|---|---|---|
| Non-carious lesions | | |
| Abfraction (n=7) | 0.16% | 100% |
| Attrition (n=418) | 9.34% | 13.10% |
| Erosion (n=20) | 0.45% | 53.33% |
| Abrasion (n=210) | 4.69% | 33.43% |
| Total | 14.63% | 15.42% |
| Other Etiological Factors | | |
| Gingival recession (n=406) | 9.07% | 3.9% |
| Abnormal tooth position (n=216) | 4.83% | 8.81% |
| Tooth Type | | |
| Incisal (n=808) | 18.05% | 5.69% |
| Canine (n=1604) | 35.84% | 6.98% |
| Premolar (n=1218) | 27.21% | 11.33% |
| Molar (n=846) | 18.90% | 5.67% |
| Total DH frequency | | |
| DH frequency of total caries-free teeth (n=344) | - | 7.69% |
| DH frequency of population (n=29) | - | 12.3% |

In terms of gender, a significantly higher DH frequency was observed in females compared to males in premolar (p= .04), molar (p= .04), and total (p= .03). In terms of age range, a significantly higher DH frequency was found in the 40-55 years compared to the other age ranges in canine (p< .01),

premolar (p< .01), molar (p< .01), and total (p= .04). In terms of tooth brushing frequency, individuals who brush their teeth three times a day or more exhibited significantly higher DH than others (p< .05)

In terms of tooth brushing technique, significantly higher DH frequency was observed in individuals brushing teeth with the horizontal technique in incisal (p< .01), molar (p< .01), and total (p= .07). In terms of bristle hardness, a significantly higher DH was observed in individuals who use a toothbrush with a hard bristle in all tooth types and total (p< .01) (Table 3).

There was no significant difference in DH frequency in all dental groups and total regarding bruxism, acidic beverage consumption, vomiting, and reflux (p> .05). In terms of smoking, although there was no significant difference in all dental groups, a significant difference was observed in total (p< .05). Higher DH frequency was observed in non-smokers (Table 4).

***Table 3.*** *The presentation of the association between etiologic factors and DH frequency using the Chi-squared test (Part 1)*

| | | Incisal | | Canine | | Premolar | | Molar | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Age Range | | DH | None | DH | None | DH | None | DH | None | DH | None |
| 18-40 | (N=152) | 22 (55%) | 130 (66%) | 10 (38%) | 142 (68%) | 28 (58%) | 124 (66%) | 12 (46%) | 140 (67%) | 54 (66%) | 98 (64%) |
| 40-55 | (N=66) | 16 (40%) | 50 (26%) | 16 (62%) | 50 (24%) | 20 (42%) | 46 (24%) | 14 (54%) | 52 (25%) | 26 (32%) | 40 (26%) |
| 55-78 | (N=20) | 2 (5.0%) | 16 (8.2%) | 0 (0%) | 18 (8.6%) | 0 (0%) | 18 (9.6%) | 0 (0%) | 18 (8.6%) | 2 (2.4%) | 16 (10%) |
| Test Statistic | | $X^2$=3.86, p=.14 | | $X^2$=17.43, p<.01* | | $X^2$=9.55, p=.01* | | $X^2$=11.06, p<.01* | | $X^2$=6.09, p=.04* | |
| Gender | | | | | | | | | | | |
| Female | (N=158) | 28 (70%) | 128 (65%) | 20 (77%) | 136 (65%) | 38 (79%) | 118 (63%) | 22 (85%) | 134 (64%) | 62 (76%) | 94 (61%) |
| Male | (N=80) | 12 (30%) | 68 (35%) | 6 (23%) | 74 (35%) | 10 (21%) | 70 (37%) | 4 (15%) | 76 (36%) | 20 (24%) | 60 (39%) |
| Test Statistic | | $X^2$=.28, p=.60 | | $X^2$=1.45, p=.23 | | $X^2$=4.40, p=.04* | | $X^2$=4.35, p=.04* | | $X^2$=4.77, p=.03* | |
| Tooth-brushing Frequency | | | | | | | | | | | |
| 1 per day | (N=122) | 22 (55%) | 98 (50%) | 8 (31%) | 112 (53%) | 20 (42%) | 100 (53%) | 10 (38%) | 110 (52%) | 36 (44%) | 84 (55%) |
| 2 per day | (N=104) | 12 (30%) | 92 (47%) | 14 (54%) | 90 (43%) | 22 (46%) | 82 (44%) | 12 (46%) | 92 (44%) | 36 (44%) | 68 (44%) |
| 3 per day | (N=12) | 6 (15%) | 6 (3.1%) | 4 (15%) | 8 (3.8%) | 6 (12%) | 6 (3.2%) | 4 (15%) | 8 (3.8%) | 10 (12%) | 2 (1.3%) |
| Test Statistic | | $X^2$=11.65, p<.01* | | $X^2$=9.27, p=.01* | | $X^2$=7.78, p=.02* | | $X^2$=7.17, p=.03* | | $X^2$=14.02, p<.01* | |
| Tooth-brushing Technique | | | | | | | | | | | |
| Horizantal+vertical | (N=166) | 16 (40%) | 148 (76%) | 16 (62%) | 148 (70%) | 28 (58%) | 136 (72%) | 16 (62%) | 148 (70%) | 50 (61%) | 114 (74%) |
| Vertical | (N=44) | 14 (35%) | 30 (15%) | 4 (15%) | 40 (19%) | 10 (21%) | 34 (18%) | 2 (7.7%) | 42 (20%) | 18 (22%) | 26 (17%) |
| Horizantal | (N=28) | 10 (25%) | 18 (9.2%) | 6 (23%) | 22 (10%) | 10 (21%) | 18 (9.6%) | 8 (31%) | 20 (9.5%) | 14 (17%) | 14 (9.1%) |
| Test Statistic | | $X^2$=2.35, p<.01* | | $X^2$=3.61, p=.162 | | $X^2$=5.51, p=.06 | | $X^2$=11.08, p<.01* | | $X^2$=5.19, p=.07 | |
| Bristle-Hardness | | | | | | | | | | | |
| Soft | (N=46) | 4 (10%) | 42 (21%) | 0 (0%) | 46 (22%) | 12 (25%) | 34 (18%) | 6 (23%) | 40 (19%) | 16 (20%) | 30 (19%) |
| Medium | (N=160) | 20 (50%) | 140 (71%) | 12 (46%) | 148 (70%) | 22 (46%) | 138 (73%) | 6 (23%) | 154 (73%) | 44 (54%) | 116 (75%) |
| Hard | (N=30) | 16 (40%) | 14 (7.1%) | 14 (54%) | 16 (7.6%) | 14 (29%) | 16 (8.5%) | 14 (54%) | 16 (7.6%) | 22 (27%) | 8 (5.2%) |
| Test Statistic | | $X^2$=32.69, p<.01* | | $X^2$=46.61, p<.01* | | $X^2$=18.06, p<.01* | | $X^2$=47.70, p<.01* | | $X^2$=23.41, p<.01* | |

**p<0.05, statistically significant*

***Table 4.*** *The presentation of the association between etiologic factors and DH frequency using the Chi-squared test (Part 2)*

| | | Incisal | | Canine | | Premolar | | Molar | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bruxism | | DH | None | DH | None | DH | None | DH | None | DH | None |
| None | (N=130) | 16 (40%) | 112 (57%) | 8 (31%) | 120 (57%) | 26 (54%) | 102 (54%) | 12 (46%) | 116 (55%) | 38 (46%) | 90 (58%) |
| Sometimes | (N=62) | 14 (35%) | 48 (24%) | 14 (54%) | 48 (23%) | 14 (29%) | 48 (26%) | 8 (31%) | 54 (26%) | 28 (34%) | 34 (22%) |
| Often | (N=46) | 10 (25%) | 36 (18%) | 4 (15%) | 42 (20%) | 8 (17%) | 38 (20%) | 6 (23%) | 40 (19%) | 16 (20%) | 30 (19%) |
| Test Statistic | | $X^2$=4.16, p=.12 | | $X^2$=11.93, p=.07 | | $X^2$=.45, p=.80 | | $X^2$=.84, p=.66 | | $X^2$=4.72, p=.09 | |
| Acidic Beverage | | | | | | | | | | | |
| None | (N=150) | 22 (55%) | 126 (64%) | 20 (77%) | 128 (61%) | 34 (71%) | 114 (61%) | 20 (77%) | 128 (61%) | 48 (59%) | 100 (65%) |
| Sometimes | (N=68) | 14 (35%) | 54 (28%) | 6 (23%) | 62 (30%) | 14 (29%) | 54 (29%) | 6 (23%) | 62 (30%) | 30 (37%) | 38 (25%) |
| Often | (N=20) | 4 (10%) | 16 (8.2%) | 0 (0%) | 20 (9.5%) | 0 (0%) | 20 (11%) | 0 (0%) | 20 (9.5%) | 4 (4.9%) | 16 (10%) |
| Test Statistic | | $X^2$=1.33, p=.51 | | $X^2$=3.66, p=.16 | | $X^2$=5.64, p=.06 | | $X^2$=3.66, p=.16 | | $X^2$=5.06, p=.08 | |
| Vomiting | | | | | | | | | | | |
| None | (N=228) | 38 (95%) | 188 (96%) | 26 (100%) | 200 (95%) | 46 (96%) | 180 (96%) | 24 (92%) | 202 (96%) | 78 (95%) | 148 (96%) |
| Sometimes | (N=10) | 2 (5.0%) | 8 (4.1%) | 0 (0%) | 10 (4.8%) | 2 (4.2%) | 8 (4.3%) | 2 (7.7%) | 8 (3.8%) | 4 (4.9%) | 6 (3.9%) |
| Test Statistic | | $X^2$=.08, p=.78 | | $X^2$=1.28, p=.26 | | $X^2$=.00, p=.99 | | $X^2$=.88, p=.35 | | $X^2$=.14, p=.71 | |
| Reflux | | | | | | | | | | | |
| None | (N=172) | 26 (65%) | 146 (74%) | 20 (77%) | 152 (72%) | 36 (75%) | 136 (72%) | 18 (69%) | 154 (73%) | 58 (71%) | 114 (74%) |
| Sometimes | (N=54) | 10 (25%) | 42 (21%) | 4 (15%) | 48 (23%) | 8 (17%) | 44 (23%) | 6 (23%) | 46 (22%) | 16 (20%) | 36 (23%) |
| Often | (N=12) | 4 (10%) | 8 (4.1%) | 2 (7.7%) | 10 (4.8%) | 4 (8.3%) | 8 (4.3%) | 2 (7.7%) | 10 (4.8%) | 8 (9.8%) | 4 (2.6%) |
| Test Statistic | | $X^2$=2.81, p=.25 | | $X^2$=1.18, p=.55 | | $X^2$=2.32, p=.31 | | $X^2$=.45, p=.80 | | $X^2$=6.11, p=.05 | |
| Parafunctional habits | | | | | | | | | | | |
| None | (N=220) | 40 (100%) | 178 (91%) | 24 (92%) | 194 (92%) | 48 (100%) | 170 (90%) | 26 (100%) | 192 (91%) | 80 (98%) | 138 (90%) |
| Sometimes | (N=10) | 0 (0%) | 10 (5.1%) | 0 (0%) | 10 (4.8%) | 0 (0%) | 10 (5.3%) | 0 (0%) | 10 (4.8%) | 0 (0%) | 10 (6.5%) |
| Often | (N=8) | 0 (0%) | 8 (4.1%) | 2 (7.7%) | 6 (2.9%) | 0 (0%) | 8 (4.3%) | 0 (0%) | 8 (3.8%) | 2 (2.4%) | 6 (3.9%) |
| Test Statistic | | $X^2$=3.93, p=.14 | | $X^2$=2.86, p=.24 | | $X^2$=4.92, p=.09 | | $X^2$=2.39, p=.30 | | $X^2$=5.93, p=.05 | |
| Smoking | | | | | | | | | | | |
| None | (N=198) | 36 (90%) | 160 (82%) | 24 (92%) | 172 (82%) | 44 (92%) | 152 (81%) | 26 (100%) | 170 (81%) | 76 (93%) | 120 (78%) |
| Sometimes | (N=12) | 2 (5.0%) | 10 (5.1%) | 2 (7.7%) | 10 (4.8%) | 2 (4.2%) | 10 (5.3%) | 0 (0%) | 12 (5.7%) | 2 (2.4%) | 10 (6.5%) |
| Often | (N=28) | 2 (5.0%) | 26 (13%) | 0 (0%) | 28 (13%) | 2 (4.2%) | 26 (14%) | 0 (0%) | 28 (13%) | 4 (4.9%) | 24 (16%) |
| Test Statistic | | $X^2$=2.14, p=.34 | | $X^2$=4.13, p=.13 | | $X^2$=3.56, p=.17 | | $X^2$=5.90, p=.05 | | $X^2$=8.08, p=.02* | |

**p<0.05, statistically significant*

## 4. DISCUSSION

DH is a symptom, not a disease. In detecting DH, a careful anamnesis should be taken from the patient to exclude all differential diagnoses, and then the patient should be examined in detail radiographically and clinically (10). Since the pain due to DH will disrupt the quality of life, the etiological factors leading to DH should be determined painstakingly.

The prevalence of DH in the population examined in the present study was 12.3%, which seems to increased compared to the previous study (7.6%) conducted in 2012 in Turkey.(9) Probably, dental hygiene habits that enhanced gradually may have caused this increase. Interestingly, our value is almost the same as the study conducted (11) in the United States in 2013. However, many studies found very low prevalence (Nigeria 1.3% (12), UK 2.8% (13)) as well as very high prevalence (China 34.5% (14), Brazil 46% (15)). In a meta-analysis conducted in 2019, the frequency of DH was reported to range between 4.8% and 62.3% (16). It can be supposed that the various diagnostic methods used to detect DH cause high variation outcomes between studies (17). DH can be clinically confused with the acute pains obtained from caries, restoration, cracked teeth, and a reversible or irreversible inflammatory process of the pulp. In order to eliminate the negative impacts of these factors, only healthy, decayed, and unrestored teeth were examined in our study.

Consistent with the results of several studies (13,18,19), the frequency of DH was found higher in females than in males. However, some studies indicate no significant difference between genders (17,20). The difference between genders may be attributed to females paying more attention to oral hygiene than males. Seymour et al. (21) found lower tolerance and higher sensitivity to toothache in females and reported that females more frequently applied to clinics. Walters (22) stated that the frequency of DH in females might be determined at higher rates since females' number of applications to dental practitioners is higher than that of males. In addition, diet differences and higher consumption of acidic foods and beverages in females may affect the consequence.

In the present study, a higher DH frequency was detected in individuals aged 40-55 years. This result is consistent with several studies (2,23). However, some studies found higher DH rate in 20-39 years (24). Our result may be associated with the more significant presence of gingival recession in adults (23,25). The low DH frequency obtained in olders, on the other hand, may explain the changes that occur in the dentin-pulp complex with age, dentin sclerosis, and secondary and tertiary dentin formation (18,26).

The present study observed that individuals who brushed teeth three or more a day experienced four times higher DH frequency than those who brushed less frequently. Consistent with the present study, many studies have reported that the risk of experiencing DH complaints can be minimized by brushing the teeth twice a day (27,28). Excessive frequency of brushing may cause a gingival recession, resulting in the development of cervical defects (29). Dentin abrasion occurring in the cervical region due to excessive brushing is frequently encountered. A study reported that the initial tooth was brushed longer than the last tooth during the toothbrushing cycle. Hence, it is considered that the frequency of sensitivity increases in teeth that are initiated to be brushed, and these teeth are generally premolar and canines (30).

Consistent with numerous studies (13,31,32), individuals who use toothbrush with a hard bristle exhibited significantly higher DH frequency in the present study. However, some studies have reported no relationship between brush bristle hardness and DH (17,33). This difference is more pronounced in the sound enamel tissue but not for affected and demineralized tissues. Therefore, the enamel surface properties investigated in the studies may have induced heterogeneity among outcomes.

Dietary acid is suspected for DH frequency because of its potential to erode cervical dentin (34). The present study found that the consumption of acidic drinks does not affect DH. In line with these outcomes, Rahiotis et al. (33) stated that even consuming acidic foods more than once a day did not induce DH. However, unlike these results, there are also studies reporting that acidic beverages such as orange juice, apple juice, cola, and wine increase tooth wear and are influential in forming DH by causing rapid dissolution of the smear layer (35,36). Differences in age ranges, pain threshold, psychological and physiological state, salivary buffering and flow rate, pellicle thickness and load, movements of soft tissues, distribution and duration of acidic fluid in the oral cavity, tooth structure, and remineralization potential may cause this varied outcomes among studies (37).

Consistent with some studies (31), non-smokers exhibited higher DH than smokers in our study, but some studies found the opposite (2,33). Smoking is a significant risk factor for periodontal disease and attachment loss, and it is assumed that it may increase DH by indirectly increasing gingival recession (17). However, some substances in cigarette may block dentinal tubules and reduce sensitivity; more detailed studies are needed to verify this.

DH is a common clinical condition that presents many associated factors that should be considered in diagnosis and treatment (38). Studies have shown that factors mainly associated with DH include hard tissue loss leading to dentin exposure (39,40). In the present study, the highest DH frequency was observed in erosion cases after abfraction and the lowest in attrition. Several studies have associated non-carious lesions with DH (28,41). In a study that did not evaluate the attrition parameter, erosion exhibited the highest frequency of DH and abfraction lowest (39); consistent with our study, the frequency of abfraction teeth was lower than other NCLs.

Varying the effects of acidic agents on enamel due to different biological, chemical, and behavioral factors (38) may cause some teeth to exhibit less erosion than others, even if they are exposed to the same acid challenge in the diet (37). Abrasion due to inappropriate brushing, wedge-shaped defects in teeth caused by poorly directed occlusal forces, parafunctional habits, stress occurring in the cervical, the erosion caused by the acids may lead to the dentinal tubules to be exposed (42).

The present study found no association between reflux, vomiting, and acidic beverages with DH. It is mistaken to presume that acidic beverages will yield DH in all patients. The surface of the exposed dentin area, the thickness of the remaining dentin layer, the condition of the root and coronal dentin, the molecular size of the agent that will pass through the dentin, the formation of dentin in the periphery, the size of the dentinal tubules, the presence of tertiary dentin near the pulp play an essential role in the formation of DH. The teeth with DH exhibit the number of tubules per unit area is eight times higher than non-sensitive teeth, and the diameter of the tubules is approximately two times larger (43,44).

This research revealed a relationship between DH and gingival recession, in line with the study conducted in Turkey by Yaylı et al. (45). Several studies have pointed to gingival recession as the main etiological factor for DH (33,34,39). In the United Kingdom, DH was observed in 50% of individuals with gingival recession (46). It has been shown in previous studies that areas with gingival recession tend to occur DH (47,48), and this sensitivity decreases with the closure of the recession area (49). Aesthetic, functional problems, and DH that may accompany areas with gingival recession disrupt the quality of life (50).

In the present study, premolars are the teeth where the highest DH occurs, consistent with several studies (2,51) due to their position in the dental arch. DH is most common in premolars since they are the teeth most exposed to brush forces, thus occurring gingival recession and hard tissue loss (11). A meta-analysis revealed that the greater force is applied to the premolars during tooth brushing, and therefore, orthodontic bracket loss is mainly seen in this region (52).

This study had some limitations; It can not be generalized because it was conducted on a specific ethnicity. The tooth groups were classified regardless of whether they were in the

maxilla or mandibula. Furthermore, the severity of DH was ignored; only the focus was given to its presence or absence.

## 5. CONCLUSION

The frequency of DH in Turkey corresponds to 12.3% of the population, and an increase is remarkable compared to 10 years ago. DH is more common in middle-aged individuals and females. Those who use toothbrushes with a hard bristle or brush their teeth three or more times a day or prefer horizontal technique experienced significantly higher DH. Interestingly, the DH frequency is lower in smokers. Also, NCLs and gingival recession are the main etiological factors for DH. Clinicians should accurately determine the source of DH to achieve the long-term success of DH treatment, which relies on many etiological factors.

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