

ORIGINAL ARTICLE



Prevalence of dentin hypersensitivity among the residents of Xi'an city, China

Xiao Liang^{a,b}, Zhiyuan Wei^a, Deyu Hu^c and Jianping Ruan^a

^aClinical Research Center of Shaanxi Province for Dental and Maxillofacial Diseases, Stomatology College of Xi'an Jiaotong University, Xi'an City, Shaanxi Province, China; ^bDepartment of Clinical Medicine, University of Bergen, Bergen, Norway; ^cState Key Laboratory of Oral Diseases, Sichuan University, Chengdu City, Sichuan Province, China

ABSTRACT

Objective: To investigate the prevalence and intra-oral distribution of dentine hypersensitivity (DH) and to evaluate the related risk factors.

Material and methods: A total of 1320 subjects, aged between 20 and 69 years old, were selected from six communities in the urban areas of Xi'an, China. The data were collected by conducting individual interviews using a standard questionnaire; then, the clinical examination was performed for patients who reported about the discomforts they felt in their teeth when subjected to chemical, mechanical and thermal stimuli. Dentine hypersensitivity (DH) was diagnosed by a subject short, sharp pain in response to a blast of cold air from a triple syringe.

Results: While replying to the questionnaire, 445 subjects reported about signs of discomfort in the teeth. DH was diagnosed in 336 persons by clinic examination. Thus, the overall prevalence of DH was 33.7% in the questionnaire and 25.5% in the intraoral test. The prevalence of DH was higher in females (33.8%) than in males (22.2%). Furthermore, we found that the prevalence of DH was highest in the age group of 50–59 years (39.3%). The most common initiation factors were acid (37.7%) followed by cold stimuli (35.8%). In general, most subjects with sensitive teeth had a higher educational background.

Conclusions: The prevalence of DH was 25.5% in the population of Xi'an City in China. More emphasis should give to middle-aged and old females while planning oral health intervention campaigns. In addition, premolars and cervical surfaces should be examined for the prevention of DH.

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Introduction

Dentine hypersensitivity (DH) is a very common clinical condition in which the patient experiences pain or discomfort when subjected to thermal (cold or hot beverages), chemical (sugary or citrus foods), or mechanical (touch, grinding) stimuli [1,2]. Due to the diffused nature of pain, the diagnosis of DH is not always easy. Recent studies have provided us with a lot of information about DH; however, many of its aspects are still poorly understood by dentists [3]. Similarly, there are gross variations in the prevalence of DH (4–74%); various research methods indicated vast discrepancy in the prevalence of DH in different populations [4–14]. Even within the same study, prevalences differ when tactile or thermal tests are applied [15]. In addition, the clinical settings (e.g. general practice and hospital or special clinic) and approaches (e.g. clinical and questionnaire) of studies have contributed to the vast discrepancy in the prevalence of DH [16].

Studies conducted on population-based samples include hospital patients [4–6,8,10,11]; these studies have overestimated the prevalence of DH in general population as they do not present real numbers. On the other hand, a number of studies [8,10,11] have been conducted using a questionnaire. The questionnaire studies are highly subjective in

nature and have inherent problems. Hence, they are less likely to correctly figure out the prevalence of DH [17]. The exact prevalence of DH may be biased due to several factors. For example, while answering a questionnaire, the subjects may not understand or misunderstand a particular question; some subjects may not be sufficiently concerned to decipher the exact intention of the question. Therefore, they may give an answer that is regarded as right or they may attempt to please an investigator by providing misleading answers [18]. Alternatively, conducting individual interviews is considered to be time-consuming and laborious; however, it eliminates the issues pertaining to questionnaires [18].

Amarasena et al. reported the intra-oral distribution of DH and its association with age, sex, symptoms, stimuli, pre-disposing factors and management strategies in a private practice patient population in Australia [16]. In this study, we conducted individual interviews using standardized questionnaire. Subsequently, we conducted a clinical examination of patients to minimize the biases associated with true prevalence. Thus, in this study, we aimed to investigate the prevalence and intra-oral distribution of DH. In addition, among the residents of Xi'an city in north-west China, we explored the association of DH with demographic parameters, such as age, gender, education, social class, symptoms and stimuli.

Methods

Study design and sample size

A cross-sectional study was conducted in the urban area of Xi'an city in China. The participants were included based on the following criteria:

1. Have been living more than 6 months in Xi'an city until the investigation performed;
2. Aged between 20 and 69 years;
3. Good state of health;
4. Signed inform consent letter.

The exclusion criteria were a slightly modified form of the conditions specified by Taani and Awartani (2002) [19] and Gillam (2002) [20]. Following points were considered:

1. Orthodontic appliances;
2. A history of any disease that is treated with various classes of drugs, such as analgesics, tranquilizers, or mood altering medications;
3. Any teeth with crowns, enamel cracks, caries, restorations, or root filling;
4. Abutment teeth for bridge or denture.

A random sampling method was performed in this study to evaluate a multi-stage stratified equivalent capacity. The sample size was calculated according to the following

formula [21]:

$$n = \left(\frac{\mu_{\alpha}}{\delta} \right)^2 p(1-p)$$

The expected prevalence of DH among adults was approximately 30% ($p=.3$, $1-p=.7$) according to the pre-survey of Xi'an city in China.

When $\alpha=0.05$, $\mu_{\alpha}=2$, $\delta=0.2p$, so according to the formula: $n = (2/0.2*0.30)^2 * 0.30 * 0.70 \approx 233$.

There were 240 subjects in each age group. We also ensured that there was gender evenness in the sample population, which included a total of 1200 subjects across all five age groups. Besides, we added additional 10% members to ensure that the effective sample size was not less than 1200.

We randomly collected subjects from six urban districts of Xi'an city (Figure 1) in China. Thus, one community was randomly selected from each district. In total, 1320 participants (660 males, 660 females) were included from the six selected communities. Among them, 220 participants of each community were divided into five groups based on their age. Each group contained 44 participants (22 males and 22 females, respectively).

Individual interviews and clinical examination

The two dental investigators implemented the study protocol specified by the Chinese Association of Dental Public Health in Wuhan, China; the association had held a symposium on



Figure 1. Locations of study sites.

DH and prescribed the study protocol [22]. Each dental investigator was trained in the diagnosis and management of DH according to the method recommended by the Canadian Advisory Board on Dentine Hypersensitivity [23]. Ten university students were examined by each investigator after trained, the inter-examiner agreement was excellent with a Kappa of 0.83. Data were collected by conducting individual interviews using a standardized questionnaire. The investigators asked and explained the questions to each of the participants, and the answers from the participants were recorded by a trained assistant.

Further oral examination was performed on the participants who complained about discomfort or pain associated with tooth sensitivity. The diagnosis of HD was established only when the hypersensitivity was confirmed by clinical examination, i.e. the subject suffered a short, sharp pain when exposed to cold air-blast from a triple syringe from 1 cm in distance for 3 seconds. Gingival recession and periodontal attachment loss (LOA) associated with the sensitive teeth were measured. LOA were recorded when the attachment loss was 3 mm or more.

Statistical analysis

The data were analyzed using Statistical Package for the Social Sciences (SPSS 15.0; IBM, Armonk, NY). Chi-square tests were used to determine the differences between the variables. The results were considered to be statistically significant when $p < .05$.

Ethical issue

This study was approved by Ethics Committee of Xi'an Jiaotong University, Shaanxi, China. All the participants

signed a written informed consent letter before proceeding with the investigation.

Results

The distribution of the investigation spots in Xi'an city were shown in Figure 1. A total of 445 (33.7%) participants reported the discomfort or pain they experienced due to tooth sensitivity. Among them, 336 (25.5%) were diagnosed with DH by clinical examination (Table 1). In this group of patients, 133 were males and 203 were females, yielding an overall male: female ratio of 1:1.53 ($p < .01$).

The prevalence and distribution of DH have been summarized according to demographic characteristics (Table 1). The highest prevalence (35.6%) of clinical diagnosed DH goes to the age-group of 50–59 years ($p < .01$), whereas those in the group of 20–29 years old had the lowest (13.3%). Compared to the low education group, the prevalence of clinical diagnosed DH was higher in the high education group; however, the difference was not statistically significant ($p < .05$). The relationship between DH and social class was also analyzed. It

Table 2. Distribution and mean number of sensitive teeth were classified according to gender and age groups during clinical examination.

	Number of sensitive teeth (%)	Mean number of sensitive teeth	<i>p</i> value
Gender			.4878
Male	758 (40.0) [#]	5.7	
Female	1139 (60.0)	5.6	
Age groups (years old)			.5539
20~29 y	131 (6.9)	3.7	
30~39 y	328 (17.3)	4.8	
40~49 y	506 (26.7)	6.4	
50~59 y	544 (28.7) [#]	5.8	
60~69 y	388 (20.5)	6.5	
Total	1897	5.6	

[#] $p < .05$.

Table 1. The distribution and prevalence of participants with self-reported and clinical DH.

	Clinical DH		Self-reported DH	
	Number of subjects with DH	Prevalence of DH (%)	Number of subjects with DH	Prevalence of DH (%)
Gender				
Male	133	22.2**	181	30.2**
Female	203	33.8	264	44.0
Age groups (years old)				
20~29 y	35	13.3**	57	21.6**
30~39 y	68	25.8	89	33.7
40~49 y	79	30.0	102	38.6
50~59 y	94	35.6	117	44.3
60~69 y	60	22.7	80	30.3
Education				
Illiterate (0)	3	9.4*	3	9.4*
Primary (0–6)	17	19.8	27	31.4
High school (7–9)	55	27.1	67	33.0
Higher sec. (10–12)	111	28.1	148	37.5
Undergraduate (13–16)	69	27.2	91	35.8
Postgraduate (≥17)	81	23.1	109	31.1
Social class				
Professional	81	0.29*	109	0.39*
Managerial and lower professional	10	0.20	16	0.33
Skilled, non-manual	98	0.22	126	0.29
Semi-skilled, manual	24	0.25	31	0.33
Unskilled	123	0.27	163	0.36
Total	336	25.5	445	33.7

They were classified on their demographic characteristics during interview and clinical examination.

* $p < .05$.

** $p < .01$.

is presented that the majority of subjects with DH belonged to the Professional group ($p < .05$) (Figure 3).

Table 2 depicted the distribution and mean extent of sensitive teeth according to gender and age groups. As presented, 1897 teeth were affected with DH. In general, females have more sensitive teeth (60%) than males; the age group of 50–59 years had the highest number of sensitive teeth (544, 40%) ($p < .05$). Furthermore, 1897 diagnosed sensitive teeth in 337 subjects indicated that there were about 5.6 sensitive teeth in each person. No significant difference was observed between the mean extent of sensitive teeth in male (5.7) and female (5.6) ($p > .05$). While classifying patients according to age-groups, we did come across some differences, but they were not statistically significant.

Considering of the affected teeth, the premolars were affected mostly (39.4%), whereas canines were the least affected (11.5%) (Figure 2). Particularly, the second premolar in the upper right was a sensitive tooth in most cases (6.0%),

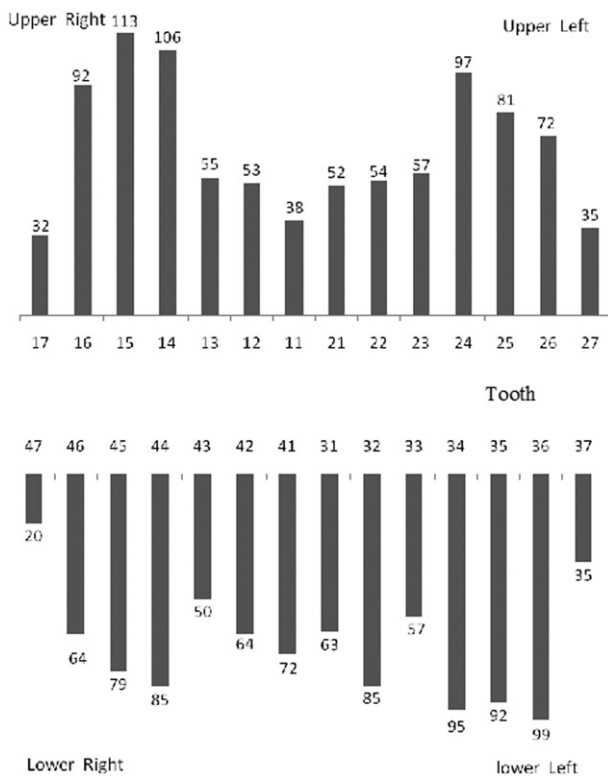


Figure 2. Frequency of sensitive teeth by quadrant, tooth type and site.

followed by the upper right first premolar (5.6%) and the lower left first molar (5.2%). Among the 1897 sensitive teeth, 488 (25.7%) had some sort of gingival recession, while 221 (11.6%) were detected with periodontal attachment loss, predominantly in the incisors (Figure 3).

The most (94.5%) sensitive areas of the teeth were observed on the cervical surfaces (Figure 4). As shown in Figure 5, compared to pain, discomfort was the most commonly (99.5%) reported symptom of DH. Furthermore, sensitivity was most commonly observed when patients were subjected to acidic (37.7%) and cold (35.8%) stimuli. Meanwhile, nearly half (46.8%) of the total 445 subjects had experienced hypersensitivity for more than 5 years (Figure 6). Unfortunately, 84.0% of them did not consult or receive any professional treatment for DH (Figure 7).

Discussion

Today, dentin hypersensitivity is essentially a diagnosis of exclusion. There are up to 12 different diagnostic tools in the case of patients suffering from dentin hypersensitivity, for example, air jet, dental explorer, or cold test. The validity and quality of the diagnosis corresponds to the value of the numerous existing differential diagnoses. Tactile, cold and evaporative air stimuli are physiological and easy controllable. Therefore, these stimuli are mostly used and widely

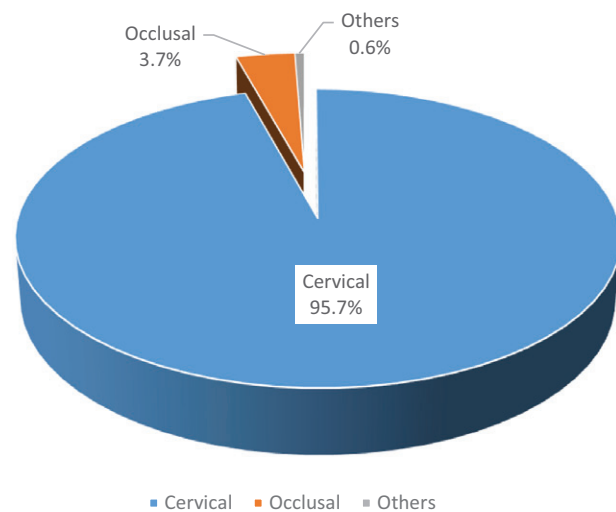


Figure 4. Frequency of sensitive surface.

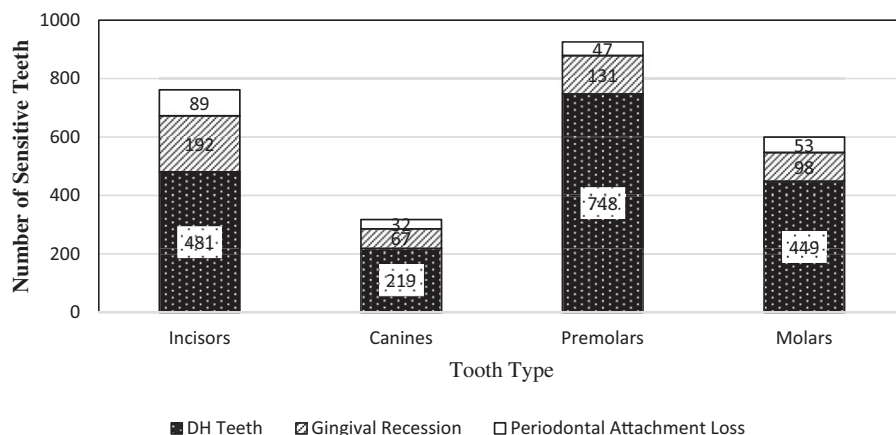


Figure 3. Distribution of different types of sensitive teeth with gingival recession and periodontal attachment loss.

recommended for the clinical diagnosis of dentin hypersensitivity in dental practice in various publications. However, it would appear from the results of a recently published study that the tactile stimulus using a dental explorer is less effective than thermal or evaporative stimulation [24].

In this study, it was found that the overall prevalence of DH is 25.5% in Xi'an city of China, which is in agreement with the results reported by Flynn et al. in the West of Scotland [10]. The mean number of sensitive teeth per subject remained 5.6, which is higher than that reported by Orchardson and Collins [7] and Rees and Addy [5]. The higher mean number of sensitive teeth in this study is, probably due to eating habits and lifestyle, i.e. the residents of Xi'an city probably consume more vinegar or brush their teeth incorrectly. The different sample populations and the methodology used to diagnose may also be the reason for the higher prevalence rates of DH in this study [3]. In the recent study, Olley et al. reported a 56% prevalence of DH due to consumption of acidic beverages [25].

Approximately one-fourth of the adults in Xi'an City suffering from DH with about 5.6 affected teeth indicate the severity of DH in Xi'an city. Accordingly, in Xi'an city alone, as many as 10 million teeth may be affected with hypersensitivity since nearly two million people are afflicted with DH. These findings indicate that more attention should be paid

to the management of DH. It has been noticed that Olley et al. developed the Schiff Index into a Cumulative Hypersensitivity Index (CHI) to measure dentine hypersensitivity (DH) severity per subject. It is able to reflect the amount of DH occurring on each tooth surface and for varying amounts of DH [26]. It might be expected that CHI will

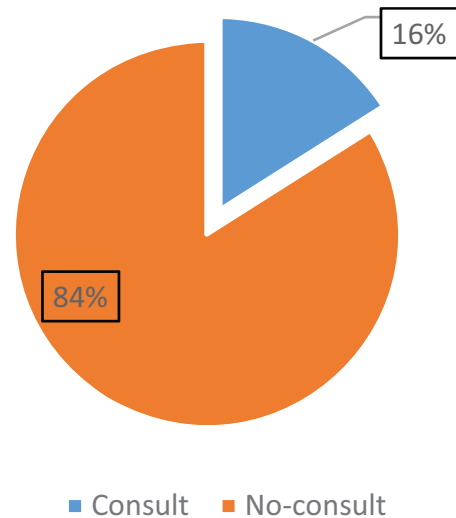


Figure 7. Consulting frequency of subjects with self-reported DH.

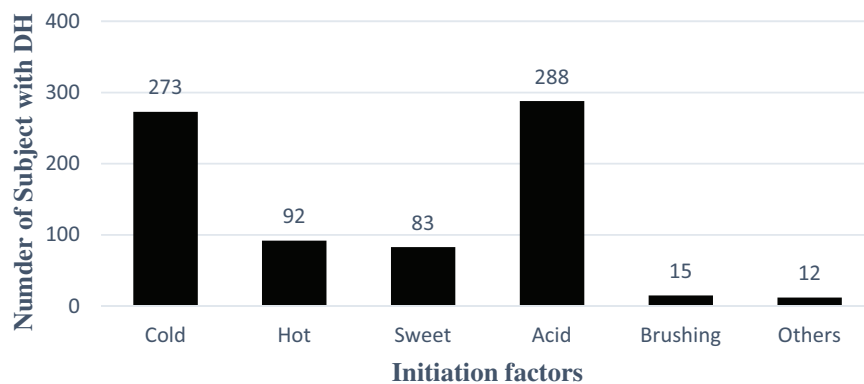


Figure 5. Frequency of self-reported initiating factors of DH.

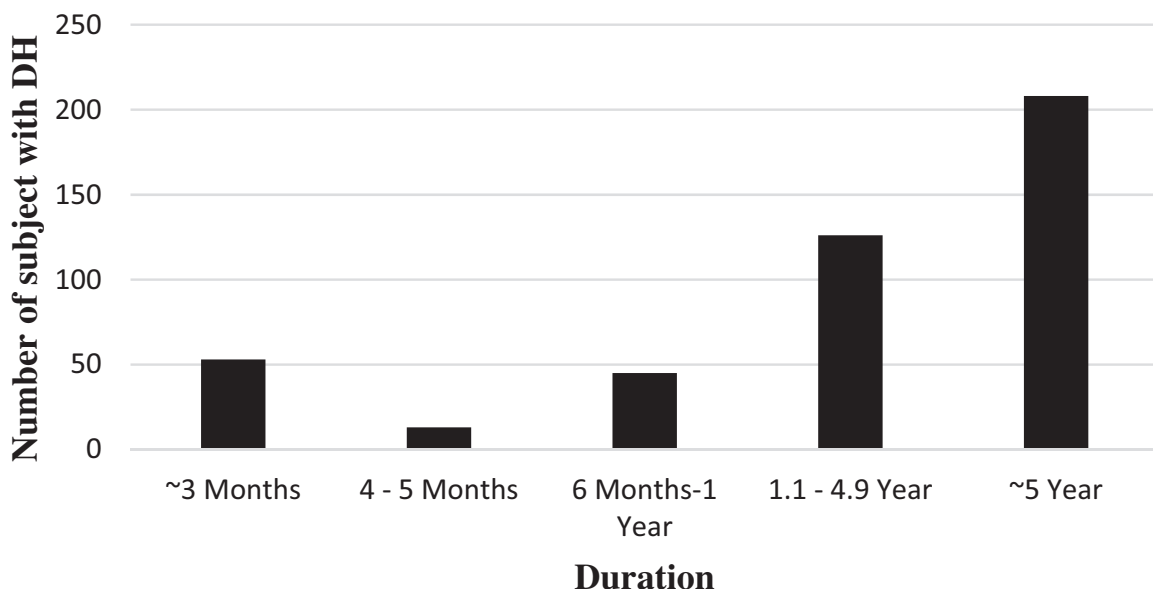


Figure 6. Frequency of self-reported duration of DH.

give us more detail information of DH distribution if used in future study.

It has been reported that DH is more prevalent in females [10,17]. However, we could not find out the exact reason for this gender discrepancy. Nevertheless, DH can be associated with subjects having good plaque control. It may be plausible that DH affects more women than men [13,16]. Furthermore, a higher prevalence in females may also be due to that women have a stronger urge to seek treatment for DH [14]. However, no significantly difference of mean extent of DH between men and women is found in this study, neither Amarasena's report (2011), which indicate that there is a tendency of over-representing women with underlying medical conditions; so, there is no conceivable relationship between DH and gender [16].

The age-group with the highest prevalence of DH reported by the previous researches is shown in Figure 3. In this study, it is found that a peak prevalence presents in age group of 50–59 years, and a propensity for the occurrence to decline after 50 years of age, which is agreed with the pattern reported by Liu et al. [9]. It is rational to expect a high prevalence of DH in elderly individuals, concomitant with various factors, such as an overall increase in lifespan and longer retention of teeth. Consequently, in aged people, retained teeth are more likely to be affected with gingival recession, tooth wear, cervical dentine exposure (cervical caries, wear), physiological loss of enamel and cementum, and increased tendency of developing periodontal diseases [16,27]. After the age of 60, the incidence of DH declined due to a retrogression of tooth pulp in aging people, which caused the tooth insensitive to stimulations. Dentin tissue responds to external stimuli through a number of mechanisms, such as development of secondary or sclerotic dentine and the occlusion of dentinal tubules; some of these factors are associated with the process of natural aging. These factors diminish the permeability of dentine, thereby reducing the occurrence of DH in older people [16,17]. In addition, decreasing tooth number in mouth of the old people could also be the explanation [15].

DH occurs more frequently in affluent social groups [5,18], who seem to brush their teeth more frequently [11]. In contrast, the current study revealed that DH is more prevalent among the unskilled group. This discrepancy has been attributed to the fact that unskilled individuals in Xi'an are more likely to brush their teeth in the horizontal direction, excessive force and hard toothbrushes following the tradition of ancient China. Sehmi et al. found that at higher brushing forces, more tubules were exposed [28]. Low-income individuals usually have poor oral hygiene habit, e.g. brushing their teeth occasionally, or even no brushing. So, they are more vulnerable to exposing root surfaces and developing periodontal diseases [29]. Therefore, the prevalence of DH was lower in affluent groups of Xi'an city in China.

Premolars were the most commonly afflicted teeth with DH, while the canines were the least sensitive ones. These findings are in agreement with a number of previous studies [6,7,9–12,17]. However, Liu et al. [9] reported that both premolars and molars were highly sensitive teeth, while incisors

were the least sensitive teeth. Albandar and Kingman [27] as well as Tugnait and Clerehugh [30] have reported that the first pre-molar was the most frequently affected by gingival recession. Compared to other teeth and sites, gingival recession and DH is more common in premolars and cervical surfaces due to several factors, including tooth brushing habits, hard bristle toothbrushes, or indiscriminate use of toothbrushes [16]. However, Olley et al. believe that occlusal tooth surfaces suffer erosive, attritive and abrasive tooth wear, which is important in the aetiology of dentine hypersensitivity on these surfaces [25].

Differing from DH was most often caused by cold stimuli [7,10,17], the finding of this study identified acidic substances as the most common stimulus followed by cold substances. Diverse dietary habits could be the reason for this discrepancy:

- For instance, in China, especially in Xi'an city, adults consume warm drinks and food instead of chilled food, a trend that increases with age.
- Xi'an residents prefer sour and hot food in their daily diet;
- With economic development in China, fresh fruits, including apple, orange, grape, yogurt and soft drinks have almost been part of their daily diet. These eatables and drinks expose the tooth surface to many acidic stimuli.

Olley et al. confirmed in their study that DH is more likely initiated if subjects consume acidic beverages more recently [25]. In this study, most individuals had endured DH for more than 5 years. These results are similar to those reported by Rees et al. [31]. Liu et al. [9] and Fischer et al. [17] reported that a majority of DH patients have endured DH for a time-period of 1–5 years.

Although the subjects had endured DH for more than 5 years, most subjects with DH had never visited a hospital or clinic to consult or receive professional treatment. It appeared that DH was not perceived as a major dental problem by most people; this finding is in good agreement with other studies, including those of Collaert and Speelman [32] and Chabansli et al. [8].

In conclusion, the total prevalence of DH in the age group of 20–69 years in the urban areas of Xi'an city was 25.5%. Although the prevalence is lower than some results of previous studies [4–7,9,12], more than two million patients seem to suffer from DH, and there are about one million sensitive teeth in Xi'an city alone. These mammoth figures indicate the severity of the problem. The present findings indicated that DH is a commonly encountered clinical problem in Xi'an city of China. In general, women are most vulnerable to DH than men, and its occurrence is the highest in the age-group of 50–59 years. Nevertheless, the prevalence of DH declines in patients in the age group of 60–69 years. Premolars and cervical surfaces are the most common teeth and sites to be afflicted by this condition. These findings indicate that more factors should be taken into account while planning preventive and management strategies. Limiting the intake of dietary acids and cold foods is an effective strategy to minimize the

occurrence of DH. Furthermore, our findings also demonstrated that the patients could not get the required treatment in time to relieve the excruciating pain since less attention was paid to HD. More adequate studies for the standardized treatment strategies are needed. With the findings of this study, we plan to devise effective prevention and management strategies for DH. However, further studies must be conducted to determine the etiological and predisposing factors of DH in China.

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Disclosure statement

All the authors and investigators of this study have declared that they have no conflict of interests.

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