

## The Prevalence of Tooth Wear among a Group of Yemeni Adults.

La prevalencia del desgaste dental entre un grupo de adultos Yemeníes.

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**Abstract:** This study aimed at investigating tooth wear prevalence and determining the associated factors among a group of Yemeni adults. It is a preliminary cross-sectional and analytical investigation conducted on 600 participants aged 20–50 years. The participants were purposively selected from two main cities (Sana'a and Aden) with an equal sample size and divided equally by gender. For administering a questionnaire, interviews were conducted with all participants before clinically examining them. Using the Tooth Wear Index (TWI), tooth wear was assessed. Data were analyzed using the chi-square test to identify the relationship between tooth wear and associated factors. Tooth wear was prevalent among 78.67% of the participants; of which 64.83% were in anterior teeth, 63.83% in posterior teeth, 74% in maxillary teeth, and approximately 74.5% in mandibular teeth. It also was 100% prevalent in the 31-40 and 41-50 age groups, while it was 67.2% in the 20-30 age group. This showed that tooth wear prevalence was significantly higher in the two oldest groups than in the youngest group ( $p < 0.001$ ). Moreover, khat chewing, location, highly frequent consumption of foods and high frequency of acidic drinks consumption were critical indicators of tooth wear. Besides, a low education level, smoking and a low socio-economic status were associated with tooth wear. Finally, the study revealed that tooth wear is highly prevalent among adults in two Yemeni cities, and socio-behavioral risk indicators such as khat chewing and cigarette smoking have a significantly association with tooth wear.

**Keywords:** *Tooth wear; prevalence; risk factors; socioeconomic factors; adult; Yemen.*

**Resumen:** Este estudio tuvo como objetivo investigar la prevalencia del desgaste dental y determinar los factores asociados en un grupo de adultos yemeníes. Es una investigación preliminar analítica y transversal que se lleva a cabo en 600 participantes de entre 20 y 50 años. Los participantes fueron seleccionados a propósito de dos ciudades principales (Sana'a y Aden) con un tamaño de muestra igual y divididos por igual por género. Para administrar un cuestionario, se realizaron entrevistas con todos los participantes antes de examinarlos clínicamente. Usando el Índice de Desgaste Dental, se evaluó el desgaste dental. Los datos se analizaron utilizando la prueba de chi-cuadrado para identificar la relación entre el desgaste dental y los factores asociados. El desgaste dental tuvo una prevalencia del 78,67% de los participantes; de los cuales 64,83% en dientes anteriores, 63,83% en dientes posteriores, 74% en dientes maxilares y aproximadamente 74,5% en dientes mandibulares. Fue 100% prevalente en los grupos de edad 31-40 y 41-50, mientras que la prevalencia fue 67,2% en el grupo de edad 20-30. Esto demostró que la prevalencia del desgaste dental fue significativamente mayor en los dos grupos de personas mayores que en el grupo más joven ( $p < 0.001$ ). Además, mascar khat, la ubicación, el consumo muy frecuente de alimentos y la alta frecuencia de bebidas ácidas fueron indicadores críticos del desgaste dental. Además, el bajo nivel educativo, el tabaquismo y el bajo nivel socioeconómico se asociaron con el desgaste dental. Finalmente, el estudio reveló que el desgaste dental es altamente prevalente entre los adultos en dos ciudades yemeníes, y los indicadores de riesgo socioconductual como la masticación de khat y el tabaquismo tienen una asociación significativa con el desgaste dental.

**Palabras Clave:** *Desgaste de los dientes; prevalencia; factores de riesgo; factores socioeconómicos; adulto; Yemen.*

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## INTRODUCTION.

Tooth wear is a destructive, non-carious and irreversible process, which causes functional losses of dental hard tissue surfaces, caused by a multifactorial condition.<sup>1</sup> Without bacterial plaque involvement, the chemical and/or mechanical process leads to tooth wear,<sup>2,3</sup> which is consequently considered an age-dependent and physio-logical process. Nonetheless, the pathological status cannot be reached until the teeth appearance is affected, their functionality is reduced, and they become very worn.<sup>4</sup>

Tooth wear is caused by several overlapping mechanisms, which are frequently described as dental erosion, abrasion and attrition although it may also include demastication and abfraction.<sup>5</sup> Parafunction (bruxism) and/or function cause attrition, which is mechanical wear,<sup>6</sup> because of tooth-tooth contact.

Besides, factors including nail or pen-biting habits and certain tooth brushing procedures cause abrasion, another cause of mechanical tooth wear. Erosion is chemical wear as a result of dissolution of the dentin hard tissue by extrinsic or intrinsic acids.<sup>2,3,7</sup> Abfraction is caused by the tooth flexure (biomechanical loading force) when the tooth pathologically loses its substance. Away from the loading point especially in the cervical third, enamel fatigue and dentine result due to such loss of substance.<sup>8</sup>

Excessive tooth wear leads to tooth hypersensitivity and exposed dentin. It may also lead to exposed pulp, pulpitis, and pulp necrosis, which cause esthetic problems because of the loss of the vertical dimension. It also leads to serious damage to the oral health of an individual.<sup>9</sup> Therefore, tooth wear has been recognized as a significant health issue in many countries, which is likely to continue as more natural teeth are retained into old age.<sup>10</sup>

Various epidemiological studies were conducted with regard to tooth wear. They found that tooth wear is highly prevalent among children and adolescents. Furthermore, they showed significant variance in relation to age, gender, dietary intake and pattern of tooth wear across different cultures in different geographical locations. Moreover, they found that tooth wear has an association with various dietary habits and lifestyle changes in both developing and developed countries.

These studies indicated that the prevalence of tooth

wear varies from a population to another. It was reported as 22% in Iceland,<sup>11</sup> 30% in the Netherlands,<sup>12</sup> 60% in UK,<sup>13</sup> 40% in USA and Great Britain,<sup>14</sup> 64% in Norway,<sup>15,16</sup> 75% in Sweden,<sup>17</sup> and 95% in Saudi Arabia.<sup>15</sup>

Increases in dental wear are of growing concern and create a need for more knowledge on this topic among clinicians, who treat patients with tooth wear, and among researchers, so more related studies can be published, as well as among the general public.

Tooth wear is considered as a clinical problem that is becoming important in the aging population. A previous study exhibited a high level of tooth wear; 15% in adults, 16% in adolescents, and 17% in children.<sup>19</sup> In another study, the results of a survey of 1007 patients showed that, for the 15-26 years group, 5.73 % of tooth surfaces were worn to an unacceptable degree. Tooth wear was 8.19% in the 56-65 years group and 8.84% in the >65 years group.<sup>20</sup>

Yemen is a developing country located on the South-West of the Arabian Peninsula, specifically south of the Kingdom of Saudi Arabia. Unlike health care, dental care is not generally associated with the same intuitive quality of life among most of Yemeni people. Additionally, Yemen has been grappling with serious health problems, including malnutrition and tuberculosis, resulting in high mortality rates; however, oral health is not yet regarded as a high priority by the Yemen government.<sup>21</sup> Therefore, primary dental care is not accessible to the Yemeni population, who never has access to any dental preventive/educational programs and/or projects. Besides, baseline information on the Yemeni oral health status is scarce.

As tooth wear prevalence in other countries was identified, it is timely to start unraveling its prevalence in the Yemeni population and attempt to make various comparisons among similar age groups. So far, only one relevant published study was conducted in Yemen,<sup>22</sup> involving a group aged 5-19 years old in the city of Sana'a. However, the present study –according to the researchers' best knowledge– is the first that investigates tooth wear among an adult group aged 20-50 years old in two different areas: Sana'a province in the Northern mountain area and Aden province in the Southern coastal area, which represent very different geographic locations.

Yemeni cultural habits and eating patterns differ from

region to region and diet is considered as a factor that has an association with tooth wear; however, the literature data available among Yemeni population is rare. Therefore, the present study aimed at investigating the prevalence of tooth wear in various types of teeth among Yemeni adults of both genders and of different ages from different geographical locations and socio-economic classes.

## MATERIALS AND METHODS.

### Study Design

This is a preliminary cross-sectional study.

### Setting

The study was conducted in the Dental Polyclinics of the Dental College at University of Science and Technology (UST), Sana'a city, Yemen and Dental Polyclinics of the Faculty of Dentistry at Aden University (AU), Aden city, Yemen. These two universities are located in Yemeni main cities, one in the northern mountain area and one in southern coastal area, representing high altitude (Sana'a) and low altitude (Aden). The data were collected during 5 months from December 2016 – April 2017.

### Bioethical Considerations

Ethical approval was obtained from the Faculty of Medicine and Health Sciences at UST (MECA NO.: 2017/02), and subject of anonymity was strictly respected. Written informed consent was also obtained from the study participants.

### Participants

The study was conducted on adult patients who visited the Dental College at UST and the Dental Faculty at AU during the period of December 2016-April 2017. The inclusion criteria of this study comprised subjects with normal occlusal relationships and individuals aged between 20 and 50 years old. Subjects were excluded from the study if they had prosthetic covering occlusal and/or incisal surfaces, subjects using orthodontic appliances, had any restorations or caries. Besides, fractured, carious teeth, remaining root, deciduous teeth and traumatic teeth were excluded from the analysis because they are easy to fracture. Third molars were also excluded.

### Study sample size

The study sample was calculated according to the OpenEpi® sample size calculator, considering  $p=5%$ , and power of 80%. The sample size determined was 591

subjects, and 9 cases were added to avoid any missing in data. Therefore, 600 subjects (300 males and 300 females) were included. Besides, they were equally selected from both cities: Sana'a and Aden.

### Variables

The study was conducted to investigate the prevalence of tooth wear among a group of Yemeni adults and estimate its association with the possible risk factors to know the need for occlusal prosthetic treatment. Therefore, the study variables consisted of socio-demographic variables (*i.e.*, gender, age, socio-economic status, education level and location), dietary habits variables (*i.e.*, beverages and acidic food consumption), and social habits variables (*i.e.*, khat chewing and smoking). The study variables of the examination included temporomandibular joint (TMJ) and masticatory muscles.

### Interview Questions

All participants were interviewed to anonymously fill in the questionnaire concerning their socio-demographic characteristics, dietary habits and social habits.

### Clinical Examination

All clinical examinations were done by one examiner (S.A.) using standardized methods of clinical dental examinations, and the criteria of assessing the oral cavity were performed according to the World Health Organization (WHO) specification<sup>23</sup> of oral health surveys by using a disposable dental mirror, disposable explorer and gauze (to remove food debris, if necessary), under standard illumination from a dental operating light.

Oral health assessment was performed on dental chairs with the aid of compressed air, blunt probe, halogen light and mirror. All teeth, except third molars, were examined for tooth wear. The examination started with maxillary incisors, canines, premolars and molars, and ended with mandibular incisors, canines, premolars and molars. After scoring, temporomandibular joint (TMJ) and masticatory muscles were examined according to Yadav *et al.*,<sup>24</sup> TMJ examination included TMJ sounds (*i.e.*, crepitus and clicking) observed by hearing and auscultation, as well as TMJ tenderness through examining the palpation of the lateral side of both joints and the external auditory meatus, and through any signs of referred pain during opening or closing of the mouth.

Masticatory muscles examination included

1) muscle tenderness for which the muscles of mastication and the neck muscles were palpated,

2) temporalis in which the origin was palpated extra-orally between the superior and inferior temporal lines just above the ear, and the insertion was palpated extra-orally where the tendon inserts into the coronoid process,

3) masseter which was palpated bimanually by placing one finger intraorally and another on the cheek.

Finally, prosthetic and restorative treatment needed for each individual was defined. The reliability of clinical examinations was assessed by performing a second measurement within 1-2 weeks on 50 participants. Values of simple and weighted intra-individual Cohen's kappa were calculated. They were 0.81 and 0.86, respectively.

#### Grading of Tooth Wear

Table 1 shows the criteria for scoring all the incisal and occlusal surfaces of the teeth, according to the Tooth Wear Index of Smith *et al.*<sup>25</sup>

According to the tooth wear severity, scores from 0-4 were given to assessed tooth surfaces.

#### Statistical Analysis

SPSS version 21 was used to analyze the collected data. In order to investigate the relationship between tooth wear and its associated factors, the Chi-square test was used. The significance level was set at  $p < 0.05$ .

#### RESULTS.

All 600 patients were assessed, and 470 (78.3%) showed tooth wear signs. Table 2 shows the distribution of tooth wear according to the position (anterior/posterior, maxilla/mandible). Tooth wear occurrence rates were 74.0% and 74.5% for maxillary teeth and mandibular teeth, respectively.

No significant difference was found, neither for the maxilla nor for the mandible ( $p > 0.05$ ). In the anterior teeth, the occurrence of tooth wear (64.8%) was slightly

**Table 1.** Smith and Knight tooth wear index.

Criteria	Score	Criteria
0	Buccal/Lingual/Occlusa/Incisal	No loss of enamel surface characteristics
1	Buccal/Lingual/Occlusa/Incisal	Loss of enamel surface characteristic
2	Buccal/Lingual/Occlusa	Loss of enamel, exposing dentine on less than one-third of surface
3	Incisal	Loss of enamel, just exposing dentin
4	Buccal/Lingual/Occlusal	Loss of enamel, exposing dentin on more than one third of surface
	Incisal	Loss of enamel and substantial loss of dentin
	Buccal/Lingual/Occlusal	Complete enamel loss, pulp exposure, secondary dentin exposure
	Incisal	Pulp exposure or exposure of secondary dentin

**Table 2.** Distribution of the affected teeth according to position (anterior/posterior, maxilla/mandible) among the study participant who showed tooth wear.

		n	%
Anterior teeth affected	Yes	389	64.8
	No	83	13.8
	Tooth wear score of the patient is zero	128	21.3
Posterior teeth affected	Yes	383	63.8
	No	89	14.8
	Tooth wear score of the patient is zero	128	21.3
Maxillary teeth affected	Yes	444	74.0
	No	28	4.6
	Tooth wear score of the patient is zero	128	21.3
Mandibular teeth affected	Yes	447	74.5
	No	25	4.1
	Tooth wear score of the patient is zero	128	21.3

**Table 3.** The relationship between tooth wear and associated factors among the studied population.

Associated factors		Tooth wear		p-value
		No	Yes	
Age	20-30 yrs.	128 (32.7%)	263 (67.2%)	0.000
	31-40 yrs.	0 (0.0%)	170 (100.0%)	
	41-50 yrs.	0 (0.0%)	39 (100.0%)	
Gender	Male	44 (14.66%)	256 (85.33%)	0.000
	Female	84 (28.0%)	216 (72.0%)	
Location	Sana'a	21 (7.0%)	279(93.0%)	0.000
	Aden	107 (35.6%)	193 (64.3%)	
Socio-economic status	High	8 (19.5%)	33 (80.5%)	.062
	Moderate	68 (25.8%)	196 (74.2%)	
	Low	52 (17.6%)	243 (82.4%)	
Educational achievement primary	Non	9 (10.5%)	77 (89.5%)	.058
	Primary	30 (22.1%)	106 (77.9%)	
	Secondary	40 (22.3%)	139 (77.7%)	
	University	49 (24.6%)	150 (75.4%)	
Frequency of acidic drinks and foods consumption	Low	17 (15.5%)	93 (84.5%)	.064
	High	111 (22.7%)	379 (77.3%)	
Khat chewing	Yes	9 (3.27%)	266 (96.72%)	0.000
	No	119 (36.6%)	206 (63.3%)	
Pipe smoking	Yes	0 (0.0%)	21 (100.0%)	0.018
	No	128 (22.1%)	451(77.8%)	
Cigarette smoking	Yes	2 (2.38%)	82 (97.6%)	0.000
	No	126 (24.4%)	390 (75.5%)	
Masticatory muscle tenderness	Yes	0 (0.0%)	68 (100.0%)	0.000
	No	128 (24.0%)	404 (75.9%)	
Masticatory muscle pain	Yes	0 (0.0%)	7 (100.0%)	0.582
	No	128 (21.5%)	465 (78.4%)	

**Table 4.** Association between tooth wear index and age groups, gender, location and treatment needs among the studied population

Categories		Tooth wear severity					p-value
		0	1	2	3	4	
Age	20-30 years	128 (32.7%)	246 (62.9%)	17 (4.4%)	0 (0.0%)	0 (0.0%)	0.000
	31-40 years	0 (0.0%)	8 (4.7%)	160 (94.1%)	2 (1.2%)	0 (0.0%)	
	41-50 years	0 (0.0%)	0 (0.0%)	12 (30.8%)	24 (61.5%)	3 (7.7%)	
Gender	Male	44 (14.67%)	126 (42%)	106 (35.33%)	21 (7%)	3 (1%)	0.000
	Female	84 (28%)	128 (42.66%)	83 (27.67%)	5 (1.67%)	0 (0%)	
Location	Sana'a	21 (7%)	120 (40%)	132 (44%)	24 (8%)	3 (1%)	0.000
	Aden	107 (35.67%)	134 (44.66%)	57 (19%)	2 (0.67%)	0 (0%)	
Treatment need	Yes	0 (0%)	0 (0%)	61 (67.78%)	26 (28.89%)	3 (3.33%)	0.000
	No	128 (25.1%)	254 (49.8%)	128 (25.1%)	0 (0%)	0 (0%)	

higher than that in the posterior teeth (63.8%). There were no significant differences of prevalence rates between anterior and posterior teeth ( $p>0.05$ ).

According to results from the chi-square test, there are associations between tooth wear occurrence rates and various factors, as shown in Table 3. The prevalence of tooth wear increased with increasing age. There was 100% prevalence in the 31-40 and 41-50 age groups, while 67.2% in the 20-30 age group showed tooth wear. Differences according to the age variable had a statistical significant association with tooth wear ( $p<0.0001$ ). Moreover, the majority of the study sample (85.33% of males and 72.0% of females) showed tooth wear.

In males, it was observed that there is a significant increase ( $p<0.0001$ ) of tooth wear. Besides, significant differences in the rates of tooth wear between the patients from Sana'a (93.0%) and Aden (63.0%) were found ( $p<0.0001$ ). At the lowest socio-economic and education level, there were higher prevalence rates of tooth wear; however, it was not significant ( $p>0.05$ ). Individuals who chew khat showed a high prevalence of tooth wear (96.7%) compared to those who do not (63.3%). All individuals (100%) with a habit of pipe smoking had tooth wear, while 97.6% of those with habits of cigarette smoking showed tooth wear. The difference was statistically significant at ( $p<0.0001$ ) for both habits: chewing khat and smoking tobacco. All patients who complained of masticatory muscle tenderness and pain had tooth wear.

Association between severity of tooth wear and age, gender, location and treatment needs is shown in Table 4. Grade 1 was the most prevalent among the 20-30 age group, while grades 2 and 3 were the most prevalent among the 31-40 and 41-50 age groups ( $p<0.0001$ ), respectively. Regarding gender, grades 1 and 2 were the most prevalent among males and females.

Besides, grade 2 was higher and more severe among males than females ( $p<0.0001$ ). Regarding location, grade 2 was more prevalent among individuals from Sana'a city while grade 1 was more prevalent among those from Aden city ( $p<0.0001$ ).

## DISCUSSION.

Among dental patients, particularly adults, tooth wear has been considered a serious problem with increasing

age and decreasing tooth loss. Regarding aesthetics, it is perceived as one of the four risk factors due to the human dentition longevity and function behind acute trauma, loss of vertical diminution, caries and periodontal diseases.<sup>26</sup>

The prevalence of tooth wear has been investigated by many researchers in many countries who found it varies around the globe, but evidence in the Yemeni population is scarce. Therefore, the present study was conducted to investigate the epidemiological status of tooth wear in Yemen and to identify its risk factors so as to obtain comprehensive understanding and knowledge of the condition and establish appropriate prevention measures and meet treatment needs.

The purposes of tooth wear indices are to categorize and record the severity of events in epidemiological surveys. Therefore, numerous studies have used various indices to determine tooth wear among different populations.<sup>27-29</sup> However, there are no commonly accepted methods for evaluation and research. Of all indices, the tooth wear index has a considerable value in studying tooth wear and there is difficulty in handling and reconciling the clinical and experimental needs.<sup>30</sup> In the present study, tooth wear indices were used although a simple method for screening tooth wear was provided by the basic examination index of erosive wear according to a basic periodontal examination.<sup>31,32</sup>

This is so, as the four visible surfaces of teeth - occlusal/incisal, buccal, cervical and lingual - can be scored for wear by the TWI as a comprehensive system.<sup>10, 33</sup> The dentition functional surfaces include the occlusal surfaces *i.e.* molars and premolars surfaces, and the incisal surfaces *i.e.* canines and incisors surfaces.

This categorization highlights their roles in masticating and in providing guidance for the mandible excursive movements. In the present study, the anterior teeth showed a higher prevalence rate of tooth wear than the posterior teeth. These findings are consistent with those of Liu *et al.*,<sup>29</sup> This may be due to the thinner incisors and the canines' active role in excursive and masticatory movements of the jaws during function and parafunction. This may place a greater demand for anterior than for posterior teeth.

When comparing the tooth wear scores of the mandibular and the maxillary teeth, the former showed

higher scores than the latter. This is because of the lower incisal edges' role during the protrusive guidance process and when incising.<sup>29</sup>

The tooth wear prevalence rate in the this study was higher than that reported in Northwest China,<sup>29</sup> China<sup>28</sup> and India.<sup>34,35</sup> This variation may be because of the criteria used, difficulty in differentiating the main tooth wear types (*i.e.*, abrasion, attrition, and erosion), various age groups when analyzing permanent dentition, differences in the time of exposure to risk factors, and finally the sampling selection method.<sup>36</sup>

Reasonably, there is strong evidence proposing that tooth wear is a common phenomenon related to the age variable. In the present study, the tooth wear prevalence rate was 100% in the 31-40 and 41-50 years age groups, while it was 67.2% in the 20-30 years group. These findings are in the line with those of Spijker *et al.*,<sup>37</sup> who found that tooth wear increased from 3% in the 20-year-old age group to 17% in the 70-year-old age group, and Bernhardt<sup>38</sup> who found that tooth wear increased from 0.6 in the 20-29 age group to 1.4 in the 70-79 age group.

Regarding the severity of tooth wear, the present study showed that grade 1 was the most prevalent among the 20-30 age group, grade 2 was the most prevalent among the 31-40 age group, while grade 3 was the most prevalent among the 41-50 age group. This result is consistent with those reported by some previous studies.<sup>35,38</sup>

Tooth wear prevalence according to gender has been reported in several studies. It was reported to be more common in males than in females.<sup>39,40</sup> In the present study, tooth wear was significantly higher in males (85.33%) than in females (72.0%). Besides, the majority of individuals have grade 1 and 2 tooth wear among both genders. However, grade 2 was higher and more severe among males than females.<sup>39,40</sup> This can be because men have stronger masseter muscle function, greater muscle fiber mass, stronger ligaments, higher bite force and different dietary patterns compared to women.

Additionally, the present study showed a strong association between tooth wear and location, in which the prevalence of tooth wear among individuals from Sana'a city (93.0%) was higher than that among individuals from Aden city (63.0%). Besides, the majority of individuals from both cities have grade 1 and 2 wear. However, grade

2 was more prevalent among individuals from Sana'a city compared to those from Aden city. The reason for the variability of prevalence rates between both cities can be attributed to stress.<sup>40-42</sup> In addition, the differences in environmental and geographic factors could influence the outcome of prevalence data.<sup>36,43</sup>

Socio-economic status and level of education may also be associated with tooth wear occurrence. In the present study, the lowest socio-economic and education categories scored a higher prevalence rate of tooth wear. This finding is in line with numerous studies.<sup>44-46</sup> This association between tooth wear and socio-economic as well as educational level factors may be attributed to oral health awareness, diet or living habits. Furthermore, individuals having an increased level of dental related anxiety are known to have the lowest oral health condition. In addition, individuals in low socio-economic and education classes have the worst oral health condition and thus having higher chances to endure pain and sensitivity than those in the upper socio-economic and education classes.<sup>46,47</sup>

The role of acidic foods and drinks is likely important to the progression of tooth wear. Many studies have demonstrated that the consumption of acidic foods and drinks is associated with increasing tooth wear.<sup>48, 49</sup> Additionally, Ehlen *et al.*,<sup>50</sup> showed that beverages had the potential to erode dental hard tissue. Similarly, the present study showed that consumption of acidic drinks and food are associated with tooth wear. These results support the clinical conjecture and laboratory findings indicating that low pH acidic foods and drinks cause erosion of enamel and dentin.

In the oral cavity, the loss of tooth structure may result from the repetitive oral habits behavior including regurgitation, parafunctional habits, brushing techniques, dietary habits and bruxism. Their effects depend on the duration, nature and onset of habits.<sup>10</sup>

Khat chewing is a common oral habit among Yemeni population which is also found in other countries, such as Australia, Israel, and several in Africa and its influence differs between individuals.<sup>51</sup> Therefore, this issue requires to globally expanding the results of this study and the impact of this factor for the benefit of researchers in other countries. This repetitive behavior includes dietary habits, brushing techniques, bruxism and parafunctional habits

which may result in the loss of tooth structure.

In the present study, the high frequency of khat chewing exhibited a strong association with tooth wear compared to those individuals who do not chew. Smoking is also an associated factor with tooth wear, but this does not mean that smoking alone can lead to tooth wear. An abrasive paste can be formed when saliva is mixed with tobacco products that contain abrasive silica and are chewed. Over time, teeth can be worn down by this abrasive paste. As long as the incidence and period of tobacco chewing increases, the number of pathologically worn surfaces also increases.<sup>52</sup>

The smoking habit is usually associated with a khat chewing habit among the Yemeni population.<sup>51</sup> In the present study, tooth wear was more prevalent among those who chew khat and smoke than those who only chew khat. This may elucidate why the prevalence rates of tooth wear in this study were higher than those in other studies conducted on different populations.

The present study revealed that tooth wear has an association with tenderness of the masticatory muscles, but it was non-significant. This finding is consistent with those of other studies.<sup>24,53</sup> This can be explained by muscle tenderness that can result from prolonged muscle hyperactivity, and parafunctional habits known to be factors associated with tooth wear.<sup>24</sup>

The magnitude of force applied on the masticatory system is largely increased by clenching as a parafunctional habit, which can lead to hard teeth structure, supportive teeth structure, breakdown of the muscles and tempo-mandibular joint disorders.

Raising the awareness of patients about tooth wear problems is a challenge faced by the dental professionals. The problem of tooth wear at its early stages of development may not be noticed by patients. However, because of the appearance and aesthetic interest, some patients may be concerned with this problem, particularly when the anterior teeth are involved. The present study found that patients started noticing and being aware of tooth wear at grade 3 and 4, when they started seeking treatment. Losing teeth surfaces can be limited by timely diagnosis and preventive care. This indicates the necessity of raising awareness of the tooth wear negative effects among populations.

There are some limitations in the present study. First,

age ranges assessed are not sufficient, it would be better to extend it to sixty or seventy years old. Second, the sample is not big enough so it is recommended to increase the sample size in future studies. Third, it would be better to extend studies on tooth wear into more than two geographic areas to be able to generalize the results to all Yemeni adults, since this study included only two areas; mountainous and coastal.

## CONCLUSION.

The study concluded that tooth wear has tendency to increase with age because it is a common age-related phenomenon. Demographic factors and khat chewing are obviously demonstrated as a cause of tooth wear. Furthermore, the tooth wear incidence increases with the very frequent consumption of acidic foods and drinks, a low educational level, and a low socio-economic status.

Proper preventive measurements are recommended to be taken by Yemeni individuals especially those who live in mountainous and coastal regions. Furthermore, it is essential to know the etiology of these lesions as an attempt for terminating the development of already existing lesions and preventing further lesions.

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**Conflict of interests:** The authors declare no conflict of interest of any kind.

**Ethics approval:** The study protocol was approved by the Ethics Committee of the Faculty of Medicine and Health Sciences at USTY (confirmation No. 2017/02). The study was explained to all the participants in this study and written informed consent was obtained from all.

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