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Risk Factors Associated with Periodontal Diseases among Yemeni Adult Patients

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Research Article

ABSTRACT

Objectives: This study aimed to investigate the possible risk factors associated with periodontal diseases among adult patients in Yemen.

Methods: The study population comprised of 805 patients attending the teaching dental hospital in Dhamar city, Yemen. The first part of the investigation was an interview including age, gender, systemic diseases, pregnancy, as well as tooth brushing, smoking, and Qat chewing habits and dentist interval visits. The second part was clinical examination including the periodontal parameters. Data were analyzed and presented in terms of frequencies, percentages or means and standard deviations, as appropriate. Chi-squared test was used for associations and Mann-Whitney U test was used for differences. Regression analysis was utilized for the determinants of the periodontal disease. A P-value<0.05 was considered significant.

Results: The bivariate analyses revealed significant differences between the independent variables (proposed risk factors) groups in relation to the periodontal parameters except for systemic disease in relation to gingival index (GI) and bleeding index (BI), visiting dentist in relation to calculus index (CI), BI, and gingival recession (GR), and pregnancy in relation to plaque index (PI), GI, CI, and BI. The regression analyses revealed that the age, smoking, and brushing teeth are significant determinants for all periodontal parameters. Whereas, systemic disease was a significant determinant for GR, and sex for BI.

Conclusions: Age, brushing teeth and smoking are the significant determinants of periodontal health. Education about the side effects of bad habits as well as maintaining good oral hygiene should be implemented.

Keywords: Periodontal Health, Risk Factors, Teeth, Oral Hygiene, Yemen.

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Introduction

Periodontal disease is a complex polymicrobial inflammatory process/condition spread worldwide and can experienced by up to 90% of populations.[1,2] The disease is multifactorial in origin; it can affect all ages, particularly adult individuals, and include all pathological conditions such as gingivitis and periodontitis.[3] Gingivitis is a reversible inflammation of soft tissue (gingiva) with the absence of attachment loss which is recognized by changing in color and/or by bleeding on gentle probing within the gingival sulcus or pocket orifice. If gingivitis is left untreated, the disease may extend into alveolar bone causing pathological periodontal pocket formation, loss of periodontal attachment, and chronic destruction of the tissues that surround and support the teeth; the condition is characterized as periodontitis.[4,5] Both gingivitis and periodontitis are initiated primarily by dental plaque and are influenced by the inflammatory and immune responses of each individual.[6] People with poor oral hygiene are more affected by excessive accumulation of soft and hard deposits which can eventually result in caries, gingivitis and periodontitis.[7] Despite of periodontal disease is mainly induced by dental biofilm, it can be modified by several factors including age, sex, genetic, habits (such as: smoking, Qat chewing, faulty brushing technique), and iatrogenic factors.[8,9] Some epidemiological studies in the literature have clearly demonstrated that the prevalence, extent and severity of periodontal disease are seen to increase with age.[10,11] However, other studies suggested that the rate of periodontal destruction is the same throughout adulthood up to 70 years; and concluded that age may not be considered as a risk factor for people under 70.[12,13] Prevalence and severity of periodontal disease may be associated with gender with more affected males than females.[14] However, other studies showed a

high prevalence of periodontal disease among pregnant women.[15,16] One recent cross-sectional study among Yemeni adult population concluded that females has more prevalence for gingival recession and periodontitis, but males have more teeth affected by gingival recession and furcation involvement[17]. Several studies suggested that tobacco smoking is a known risk factor that affects the oral environment and ecology, vascularization of the periodontium, immune and inflammatory responses and the healing potential of the periodontal connective tissues.[18,19] Certain systemic diseases have also been associated with an increased risk of attachment loss and can adversely affect host defense systems.[20,21] The relationship between oral hygiene and systemic illnesses (such as diabetes mellitus, bacterial pneumonia, and cardiovascular disease) is a bidirectional, which means that negligence of one can aggravate the disease in the other.[22,23] Moreover, some habits can cause or exacerbate the periodontal disease. In Yemen, Qat chewing is most commonly used as social chewing habit. Qat or Gat (*Catha edulis*) is a natural stimulant from the *Catha edulis* plant, originated in the flowering evergreen tree or large flowering shrub of Celastraceous family, which grows mainly in Yemen and other regions as Ethiopia, Somalia, Kenya, Saudi Arabia, and Madagascar.[24,25] Most of the population in these countries used to chew its leaves for its stimulating and euphoric effects attributed to cathinone, an amphetamine-like stimulant.[26,27] Fresh Qat leaves are placed on the buccal cavity on one side or sometimes in both sides and chewing continuously for several hours to extract the juice.[28] The chewing process may take up to 6 hours or more causing a drying effect on the oral mucosa, and its users tend to consume a great quantity of fluids.[29] Qat chewing is prevalent among Yemeni people, with a higher prevalence in males than females.[30] There are several oral and dental disorders have been associated with the long-term Qat chewing such as keratotic white lesions, mucosal pigmentation, plasma cell stomatitis, tooth loss, teeth attrition and discoloration, gingival recession, periodontal diseases, and temporomandibular joint disorders.[31,32] Some studies among Yemeni adult population found a positive relationship between the frequency and duration of Qat chewing and severity of periodontal diseases.[8,33,34] Investigation of the different factors which might be associated with the individual's dental health problems is of utmost importance to explore the effect of these factors on the community health and to build up the appropriate preventive measures. The objective of the present study, therefore, was to evaluate some possible risk factors that may be associated with periodontal health status among adult Yemeni patients.

Materials and Methods

This was a cross-sectional study comprised of Yemeni adults randomly recruited from patients attending the teaching hospital of the Faculty of Dentistry in Dhamar city, seeking for dental treatment or check-up. The sample was consecutively recruited during the academic year 2018/2019. A total of 805 adult dental patients were recruited. The inclusion criteria included age of 18 and above, and having ≥ 20 teeth, while fully edentate patients and those having complete dentures were excluded. Before commencing the study, ethical approval was obtained from Research and Ethics Committee, Faculty of Dentistry, Thamar University (Ref#: 2018003). Before commencing the study, aims of the study were explained to all participants and they were asked to give their written or verbal consent to participate. Data was collected by interview and clinical examination as follows:

- Interview: A specially-designed questionnaire was used to include the important information that would assess to detect the possible association between periodontal health status and some risk factors such as age, gender, systemic diseases, pregnancy, as well as brushing teeth, smoking, Qat chewing habits and visit to the dentist.

- Clinical examination: Examination of all permanent fully erupted teeth, excluding the third molars, was performed. Dental plaque and gingival inflammation were measured by PI and GI, respectively on a scale of 0-3.[35,36] The presence or absence of supra- and/or subgingival calculus (CI) was determined.[37] BI, which was introduced by Ainamo and Bay (1975)[37], was performed through gentile probing of the orifice of the gingival crevice. If bleeding occurred within 10 seconds, a positive finding was recorded and the number of positive sites was recorded, and then expressed as a percentage of the number of sites examined. GR was measured from cementoenamel junction (CEJ) to the gingival margin in millimeters at six sites per tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual) using a 0.4 mm periodontal probe (Hu-Friedy's WHO-style probe, Hu-Friedy Inc., Chicago, IL, USA). The measured recession was then classified according to Miller's classification.[38] In case when the CEJ was covered by calculus or lost due to carious lesions, the location of such junction was estimated on the basis of the adjacent teeth. All clinical parameters were measured under sufficient illumination.

Statistical Analysis

Data was entered into a spreadsheet (MS Excel 2016), coded and transferred to analysis software program (SPSS v25; IBM Corp.). Results were presented in terms of frequencies and percentages or means and standard deviations, as appropriate. Chi-squared and Man Whitney U tests were used for differences between categorical variables and between continuous variables, respectively. Regression analysis models were used to further explore the effect of the different factors on the periodontal parameters. A P-value <0.05 was considered significant.

Results

The study investigated a total of 805 dental patients with mean age 29.2±9.6 years old, ranging from 16 to 60 years. Most of the participants were ≤30 years (68%), males (75%), with no systemic disease (92%), non-smokers (77%), Qat chewers (75%), not brushing their teeth (73%), non-regular dental attendants (76%), and non-pregnant (for women; 96%). More details regarding the characteristics of the study sample are presented in Table 1.

There were highly significant differences between age groups concerning the plaque index, gingival index, calculus index, gingival recession (P<0.001), and bleeding index (P=0.009); with individuals of >30 years having higher values than their counterparts. Males demonstrated significantly worse periodontal conditions compared with females. However, there were no significant differences in periodontal condition between females with and without pregnancy (P>0.05). Subjects with systemic diseases demonstrated significant differences in plaque index, calculus index, and gingival recession compared with healthy individuals (P=0.004, P=0.005, P<0.001; respectively). Highly significant differences in periodontal condition (P<0.001) were found between subjects in relation to brushing teeth, chewing Qat, and smoking. Similarly, there were differences in periodontal condition between subjects who visit a dentist or not with statistical significance only in plaque index and gingival index (P<0.001, P=0.002, respectively). More details are presented in Tables 2 and 3.

The results of the linear regression analyses revealed that age, smoking, and brushing teeth had a highly significant effect on plaque index and gingival index (P<0.001, P=0.002, P<0.001, respectively. In contrast, there was no evidence that gender, systemic diseases, chewing Qat, and visiting dentist influence these indices. Related to the gingival recession classification, age, systemic diseases, smoking, and brushing teeth significantly impacted the periodontal conditions (P<0.001, P=0.003, P<0.001, P=0.038, respectively), whereas gender and chewing Qat had no significant effect (Table 4).

Moreover, the logistic regression analysis revealed a significant impact of age on calculus (P=0.001) and bleeding (P=0.013) indices. However, gender affected only the bleeding index (P<0.001). Subjects who practice teeth brushing were 0.6 and 0.5 less likely to have calculus and bleeding, respectively. Whereas subjects who smoke were 1.8 and 1.9 more likely to have calculus and bleeding, respectively (Table 5).

Table 1. Characteristics of the study sample

		Frequency	%
Age	≤30	547	68
	>30	258	32
Sex	Male	605	75
	Female	200	25
Systemic Diseases	Yes	63	8
	No	742	92
Smoking	Yes	182	23
	No	623	77
Chewing Qat	Yes	601	75
	No	204	25
Brushing Teeth	Yes	217	27
	No	588	73
Visit Dentist	Yes	196	24
	No	609	76
Pregnancy (N= 200)	Yes	7	4
	No	193	96
Calculus Index	No	270	34
	Yes	535	66
Bleeding Index	No	206	26
	Yes	599	74
Gingival recession	No recession	281	35
	Class I	331	41
	Class II	112	14
	Class III	48	6
	Class IV	33	4
Age (Mean±SD)		29.2±9.6	
Plaque index (Mean±SD)		1.6±0.6	
Gingival index (Mean±SD)		1.4±0.6	

Table 2. Differences between risk factors in relation to plaque index and gingival index

		Plaque index			Gingival index		
		Mean±SD	Diff. (95% CI)	P[a]	Mean±SD	Diff. (95% CI)	P[a]
Age	≤30	1.6±0.6	-0.3 (-0.4,-0.2)	<0.001	1.3±0.5	-0.3 (-0.4,-0.2)	<0.001
	>30	1.8±0.6			1.6±0.6		
Brushing Teeth	Yes	1.3±0.6	-0.4 (-0.5,-0.3)	<0.001	1.2±0.6	-0.3 (-0.4,-0.3)	<0.001
	No	1.8±0.6			1.5±0.5		
Gender	Male	1.7±0.6	0.1 (0.0,0.2)	0.013	1.5±0.5	0.2 (0.1,0.3)	0.001
	Female	1.5±0.7			1.3±0.7		
Systemic Diseases	Yes	1.9±0.7	0.2 (0.1,0.4)	0.004	1.5±0.7	0.1 (0.0,0.3)	0.093
	No	1.6±0.6			1.4±0.6		
Visit Dentist	Yes	1.4±0.6	-0.3 (-0.4,-0.2)	<0.001	1.3±0.6	-0.1 (-0.2,0.0)	0.002
	No	1.7±0.6			1.4±0.6		
Chewing Qat	Yes	1.7±0.6	0.2 (0.0,0.3)	<0.001	1.5±0.5	0.2 (0.1,0.3)	<0.001
	No	1.5±0.7			1.3±0.7		
Smoking	Yes	1.9±0.6	0.3 (0.2,0.4)	<0.001	1.6±0.6	0.3 (0.2,0.4)	<0.001
	No	1.6±0.6			1.4±0.6		
Pregnancy	Yes	1.4±0.6	-0.2 (-07,0.3)	0.260	1.6±0.7	0.4 (-0.2,0.9)	0.260
	No	1.6±0.7			1.3±0.7		

[a]Mann-Whitney U test

Table 3. Differences between risk factors in relation to calculus index, bleeding index, and gingival recession

		Calculus index		P*	Bleeding index		P*
		No	Yes		No	Yes	
Age	≤30	208 (38.0)	339 (62.0)	<0.001	155 (28.3)	392 (71.7)	.009
	>30	62 (24.0)	196 (76.0)		51 (19.8)	207 (80.2)	
Brushing Teeth	Yes	101 (46.5)	116 (53.5)	<0.001	88 (40.6)	129 (59.4)	<0.001
	No	169 (28.7)	419 (71.3)		118 (20.1)	470 (79.7)	
Gender	Male	169 (27.9)	436 (72.1)	<0.001	114 (18.8)	491 (81.2)	<0.001
	Female	101 (50.5)	99 (49.5)		92 (46.0)	108 (54.0)	
Systemic Diseases	Yes	11 (17.5)	52 (82.5)	.005	10 (15.9)	53 (84.1)	.071
	No	259 (34.9)	483 (65.1)		196 (26.4)	546 (73.6)	
Visit Dentist	Yes	68 (34.7)	128 (65.3)	.728	58 (29.6)	138 (70.4)	.158
	No	202 (33.2)	407 (66.8)		148 (24.3)	461 (75.7)	
Chewing Qat	Yes	165 (27.5)	436 (72.5)	<0.001	117 (19.5)	484 (80.5)	<0.001
	No	105 (51.5)	99 (48.5)		89 (43.6)	115 (56.4)	
Smoking	Yes	32 (17.6)	150 (82.4)	<0.001	20 (11.0)	162 (89.0)	<0.001
	No	238 (38.2)	385 (61.8)		186 (29.9)	437 (70.1)	
Pregnancy	Yes	5 (71.4)	2 (28.6)	.445	2 (28.6)	5 (71.4)	.456
	No	96 (49.7)	97 (50.3)		90 (46.6)	103 (53.4)	

		Gingival recession					P*
		No recession	Class I	Class II	Class III	Class IV	
Age	≤30	216 (39.5)	243 (44.4)	61 (11.2)	17 (3.1)	10 (1.8)	<0.001
	>30	65 (25.2)	88 (34.1)	51 (19.8)	31 (12.0)	23 (8.9)	
Brushing Teeth	Yes	96 (44.2)	95 (43.8)	15 (6.9)	9 (4.1)	2 (0.9)	<0.001
	No	185 (31.5)	236 (40.1)	97 (16.5)	39 (6.6)	31 (5.3)	
Gender	Male	174 (28.8)	284 (46.9)	91 (15.0)	34 (5.6)	22 (3.6)	<0.001
	Female	107 (53.5)	47 (23.5)	21 (10.5)	14 (7.0)	11 (5.5)	
Systemic Diseases	Yes	8 (12.7)	25 (39.7)	15 (23.8)	6 (9.5)	9 (14.3)	<0.001
	No	273 (36.8)	306 (41.2)	97 (13.1)	42 (5.7)	24 (3.2)	
Visit Dentist	Yes	64 (32.7)	96 (49.0)	21 (10.7)	8 (4.1)	7 (3.6)	.096
	No	217 (35.6)	235 (38.6)	91 (14.9)	40 (6.6)	26 (4.3)	
Chewing Qat	Yes	171 (28.5)	280 (46.6)	91 (15.1)	37 (6.2)	22 (3.7)	<0.001
	No	110 (53.9)	51 (25.0)	21 (10.3)	11 (5.4)	11 (5.4)	
Smoking	Yes	16 (8.8)	84 (46.2)	54 (29.7)	17 (9.3)	11 (6.0)	<0.001
	No	265 (42.5)	247 (39.6)	58 (9.3)	31 (5.0)	22 (3.5)	
Pregnancy	Yes	1 (14.3)	2 (28.6)	3 (42.9)	1 (14.3)	0 (0.0)	.035
	No	106 (54.9)	45 (23.3)	18 (9.3)	13 (6.7)	11 (5.7)	

* Chi-Square test

Table 4. Multiple Regression analysis of the risk factors for plaque index, bleeding index, and gingival index

	Plaque index			Bleeding index			Gingival recession		
	B	(95% CI)	P	B	(95% CI)	P	B	(95%CI)	P
Age	0.2	(0.1,0.3)	<0.001	0.2	(0.1,0.3)	<0.001	0.5	(0.3,0.6)	<0.001
Sex	0.0	(-0.2,0.1)	0.847	0.0	(-0.2,0.1)	0.516	0.0	(-0.3,0.2)	0.798
Systemic Diseases	-0.1	(-0.2,0.1)	0.267				-0.4	(-0.7,-0.1)	0.003
Smoking	-0.2	(-0.3,-0.1)	0.001	-0.2	(-0.3,-0.1)	0.001	-0.5	(-0.7,-0.4)	<0.001
Chewing Qat	0.0	(-0.2,0.1	0.557	-0.1	(-0.2,0.1)	0.265	-0.1	(-0.3,0.2)	0.541
Brushing Teeth	0.3	(0.2,0.4)	<0.001	0.3	(0.2,0.4)	<0.001	0.2	(0.0,0.3)	0.038
Visit Dentist	0.1	(0.0,0.2)	0.143	-0.1	(-0.2,0.0)	0.093			

Table 5: Multiple Regression analysis of the risk factors for calculus index and bleeding index

	Calculus index				Bleeding index			
	B	S.E.	Exp(B)	P	B	S.E.	Exp(B)	P
Age	-0.6	0.2	0.5	0.001	-0.5	0.2	0.6	0.013
Sex	0.5	0.3	1.6	0.091	1.1	0.3	2.9	<0.001
Systemic Diseases	0.6	0.4	1.8	0.105				
Smoking	0.6	0.2	1.8	0.01	0.6	0.3	1.9	0.016
Chewing Qat	0.5	0.3	1.7	0.071	0.1	0.3	1.1	0.644
Brushing Teeth	-0.4	0.2	0.6	0.012	-0.7	0.2	0.5	<0.001

Discussion

This study assessed the effect of established risk factors on five periodontal parameters. Our results found highly significant differences between age groups regarding plaque index, gingival index, calculus index, gingival recession, and bleeding index. These results are similar to previous studies [39,40], where older participants were found to have poorer oral health. The combined impact of exposure to risk factors may result in increased vulnerability to periodontal destruction with aging throughout a lifetime.[41] In the study by Garanayak et al.[42], a strong positive correlation was found between age and plaque deposition and gingivitis. Other studies[43,44] also demonstrated that the prevalence of gingival recession is age-dependent.

In the current study, similar to previous publications[45,46], males demonstrated a greater risk of developing worse periodontal conditions compared with females. Sanadi et al [47] assessed the oral hygiene of 209 dental students and found gender differences, reflecting a greater incidence of gingival disease in males than in females. This may be related to the behaviors of oral health and hygiene status, which is affected by lifestyle factors. Despite our data reported that gender had an impact on bleeding index only, this result is similar to previous study.[48] However, it is in contrast to the findings of the study of Chen et al.[49], which reported gender as a strong determinant for most of the oral health determinants.

Some studies[50,51] have reported that the increased level of sex hormones during pregnancy may cause a significant elevation in gingival inflammation (gingival index and bleeding index) in pregnant women, but with no significant differences in plaque scores. These findings are similar to our findings concerning plaque index, while dissimilar to the gingival index and bleeding index. These

differences may be related to the small sample size of pregnant women in our study.

According to the current findings, systemic diseases had no significant impact on the periodontal condition, although there were differences in plaque index, calculus index, and gingival recession between individuals with and without systemic diseases. In contrast, Jepsen et al.[52] found that some types of systemic diseases had a negative effect on the apparatus of periodontal attachment with a high prevalence of gingival recessions. Furthermore, Albandar et al.[53] reported that some systemic disorders can directly affect periodontal inflammation by altering the immune response of the host to periodontal infection, resulting in significant loss of periodontal attachment and alveolar bone. Furthermore, systemic diseases can activate host metabolic alterations, affecting the different tissues of the periodontal apparatus. The differences between these findings may be due to the differences in the systemic disorders that had been examined. In our study, a small number (8%) of systemic diseased patients were found, including different types of diseases, which will not clearly reflect the effect of the systemic diseases on periodontal health. Moreover, no more details about the types of systemic disease were included in the analysis due to the small number of diseased patients and to avoid the decrease in power analysis.

Similar to previous studies[54,55], the results of our study revealed that brushing teeth had a highly significant effect on oral health with highly significant differences in periodontal condition between subjects who brush their teeth or not. On the other hand, some studies[56,57] reported that brushing teeth improperly leads to trauma and abrasion of the gingiva that causes wear at the cemento-enamel junction resulting in supporting

periodontium destruction progression to gingival recession.

The findings of the present research proved worse periodontal health among Qat chewers compared to non-chewers. This result is in agreement with other studies.[58,59] In fact, the substantial destructive impact on the periodontium of Qat chewing is not a bacterial risk factor, but it is a mechanical risk factor. Since there was no scientific evidence to prove the fact that pathogens among Qat chewers caused periodontal infections. In the development of periodontal diseases, in particular attachment loss, pocket depth, and gingival recession, Qat chewing habits can be considered a mechanical risk factor.[59] However, other reports were not consistent with our findings[60,61] Likewise, interestingly, Al-hebshi and Al-Ak'hali[62] concluded a positive impact of Qat on the health of the gingiva. They found lower mean PI, GI, and BOP scores in Qat chewers compared with non-chewers. Differences between these results might be related to the differences in the sample size.

Tobacco smoking is a common behavior that has serious health consequences. While tobacco use was once known as a habit, it is now considered nicotine dependence and a chronic relapsing medical condition (International Classification of Diseases, Tenth Revision).[63] It is well known that smoking has a significant adverse impact on the periodontal supporting tissues.[64] Furthermore, Banihashemrad *et al.*[65] assessed the effect of smoking on the gingival recession of the buccal and palatal surfaces of all teeth and found a relationship between gingival recession and smoking, possibly through changes in immune response and topical changes, such as decreases in gingival circulation. This finding was in concurrence with our results. It is promoted that smoking may cause a change in the subgingival biofilm composition with an increase in the prevalence of the periodontal pathogen.[66] Moreover, smoking had been involved in slowing the recruitment of neutrophils and migration into periodontal tissues, accordingly compromising the acute immune response.[67] This would increase the aggression threshold needed to activate the inflammatory cascade in the periodontal tissue. Also, smoking was proposed to change the balance of neutrophil activities to a more destructive nature.[68] In contrary to the current study, Holde *et al.*[69] concluded that smoking decreases the tendency of gingival bleeding. The underlying mechanisms of smoking's impact on bleeding of the gingiva are somewhat unclear. There is limited evidence that smoking promotes human gingival vasoconstriction.[70]

The result of the present study revealed that the subjects who visited the dentist had less plaque and gingival index; which is in line with that of Chen *et al.*[49], who found that more dental visits are good predictors of better gingival status.

Although the study could clearly demonstrate the effect of some risk factors on the periodontal health, some limitations should be acknowledged. The sample size was limited to one dental school. Frequency of teeth brushing and Qat chewing as well as types of systemic diseases were not included in the analysis. Therefore, further large-scale studies including more patients and more variables are recommended to further confirm the current findings of the study.

Conclusions

Within the limitations of the present study, it can be concluded that the prevalence of periodontal disease among Yemeni patients was high. Older age, smoking, and non-brushing teeth are the significant determinants for worse periodontal condition. Initiatives and preventive programs should be implemented in the dental schools to educate people about the adverse effects of bad habits as well as the importance of maintaining good oral hygiene.

Acknowledgment

Conflicts of Interest

The authors declare no conflicts of interest.

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