

Risk factors for periodontal diseases among Yemeni type II diabetic patients. A case-control study.

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Receipt: 06/27/2017 **Revised:** 07/10/2017
Acceptance: 07/28/2017 **Online:** 07/28/2017

Conflict of interests: None.

Ethics approval: The study protocol was approved by the Ethical Committee of the Faculty of Medicine at UST-Yemen (confirmation No.2017/05). All the subjects in this research had an explanation of the study and written informed consent to confirm their participation.

Funding: None.

Authors' contributions: The manuscript was carried out, written, and approved in collaboration between all authors.

Acknowledgements: The authors would like to thank the management of the Faculty of Dentistry and the Hospital at the University of Science and Technology, the Al-Thawrah Hospital, and the Department of Endocrinology staff for their assistance and support.

Cite as: Shamala A, Al-Hajri M & Al-Wesabi MA. Risk factors for periodontal diseases among Yemeni type II diabetic patients. A case-control study. *J Oral Res* 2017; 6(7):176-181. doi:10.17126/joralres.2017.055

Abstract: Background: Chronic periodontal diseases are one of diabetes mellitus complications. The present study aims to compare the periodontal status of type II diabetic patients to a control group and assess the role of risk factors in both groups. Materials and methods: A case-control study was conducted of 270 individuals (132 type II diabetics and 138 non-diabetics). Full mouth periodontal examination including plaque index, gingival bleeding, gingival recession, clinical attachment loss (CAL), tooth mobility, furcation involvement and the number of missing teeth. The case group was subdivided according to glycosylated hemoglobin (HbA1c) status (poorly controlled HbA1c >8 and well controlled HbA1c ≤8) Likewise, the duration of diabetes mellitus as short or long duration (DM ≤10 or >10). The diabetic group was also subdivided according to smoking and Khat chewing habits. Result: The severity of periodontal disease among type II diabetic patients were significantly higher compared to the control group regarding the plaque index 2.6 (1.6-4.3), bleeding on probing 3.5 (2.3-13.0), gingival recession 2.0 (1.2-3.4), furcation involvement 4.0 (2.3-6.7), clinical attachment loss 5.7 (3.1-10.5), tooth mobility 2.0 (1.2-3.4), and number of missing teeth 4.4 (2.3-8.5). In addition, poorly controlled type II DM and long duration had higher CAL and number of missing teeth than well-controlled DM and short duration. No significant differences were found between smokers/nonsmokers and Khat chewers/non-chewers among the diabetic group. Conclusion: Type II diabetic patients have severe periodontal destruction and tooth loss compared to non-diabetic people and there were no differences within the diabetic group in regards to smoking and Khat chewing habits.

Keywords: periodontal disease, diabetes mellitus type 2, smoking, Catha, Yemen.

INTRODUCTION.

Periodontal diseases (PD) are inflammatory diseases affecting the supporting tissues of teeth causing clinical attachment loss (CAL) by specific or group-specific microorganisms.¹ All over the world, the prevalence of PD is 50% of the population, which increases with the age.² It is reported that the prevalence of PD ranged from 0.0% to 54.6% among the Arab population.³ In Yemen, 71.2% of population had CAL more than 1mm.³ Another study reported that 60.5% of the population had gingival recessions.^{4,5}

Diabetes mellitus is a chronic metabolic disorder characterized by

an increased level of glycemia (hyperglycemia) due to the defect of insulin secretion and/or insulin function leading to impairment of glucose, lipid and protein metabolism.⁶ The prevalence of diabetes mellitus has increased from 4.7% to 8.5% in the world.⁷ In Yemen, the prevalence of diabetes mellitus is nearly 4.6%, more than 80% of which are over the age of 40 years, an impaired fasting glucose was observed in 2.2%.⁸ There are many chronic complications associated with hyperglycemia such as atherosclerosis, micro and macrovascular complication, nerve damage, increased mortality and morbidity, nephropathy, retinopathy, premature death, and PD.⁹

It is documented that patients with a hyperglycemic disorder have oral findings such as periodontitis and gingivitis, recurrent fungal infections, impaired healing of wounds, dry mouth (xerostomia), dental caries, cheilitis, higher levels of glucose in saliva, gingival enlargement, abscess formation, pedunculated or sessile polyps or polypoid proliferations of gingival tissue, mouth and tongue burning, predominance of hemolytic streptococci, staphylococci and *Candida albicans*.^{10,11} The association between diabetes and PD is bidirectional. Both of PD and hyperglycemia are epidemic, chronic, and multifactorial diseases.^{12,13} Other risk factors for PD are Khat chewing and smoking.^{14,15}

There is no available published data on the effect of systemic conditions such as diabetes mellitus on periodontal tissue and the extent of PDs and their severity in Yemeni type II diabetic patients compared to non-diabetic. Therefore, this study is timely as the first to assess the clinical and epidemiological link between the periodontitis and diabetic related factors as well as to evaluate the synergistic action of the risk factors such as Khat chewing and smoking associated with their close relationship in Yemen.

MATERIALS AND METHODS.

Study design and population

The present study utilized a case-control study design, and was conducted from August 2016 to March 2017 based on periodontal examinations of the case-control groups. The minimum sample size was calculated as 110 (power of 80% alpha level of 0.05, the

ratio of case to control 1:1 and odds ratio of 3). The final sample size was 270 patients.

The diabetic group (132) comprised type II diabetic individuals who attended endocrinology clinics in the University of Science and Technology Hospital (USTH) and Al-Thawrah Hospital. The control group (138) was comprised by patients of the clinics of the Dental College at the University of Science and Technology (UST) Sana'a, Yemen. The participants were from different socioeconomic status to ensure the representativeness of study sample. Matching of the two groups was made by age, gender, and socioeconomic status.

The inclusion criteria were: the case group had diabetes mellitus type II, were ≥ 30 years old, while the control group was non-diabetic and free from systemic diseases. The exclusion criteria were individuals who were treated with periodontal therapy in the last 6 months, used systemic or topical antimicrobials, non-steroidal anti-inflammatory drugs and/or steroids within the past three months; under orthodontic treatment, did not have other general complicated health problems such as cardiovascular, kidney and liver diseases, or immunologic disorders, human immunodeficiency virus infection/acquired immunodeficiency syndrome.

Data collection and clinical examination

The questionnaire included age, gender, education level (literate/illiterate), smoking (Yes/No), Khat chewing (Yes/No), tooth brushing frequency. Medical records were checked to determine the diabetic related factors such as onset, duration, blood glucose level and percentage of HbA1c. Well controlled DM was considered as $HbA1c \leq 8$ and poorly controlled as $HbA1c > 8$.

Full mouth periodontal examination was performed by a single examiner, an experienced periodontologist. The measures were taken using a Michigan probe 0 with William's marking probe and under the same conditions. The examinations were performed and provided to all participants. Plaque index was recoded in ($<$ or \geq median),¹⁶ bleeding on probing (Yes/No),¹⁷ gingival recession was recoded in (Yes/No),³ furcation involvements (FI) measured in three categories and

then reordered as (Yes/No), CAL was recoded in (\leq or >4 mm),¹⁸ tooth mobility was recorded as (Yes/No),¹⁶ and the number of missing was recoded in ($<$ or ≥ 8 missing teeth).

Third molars, teeth with iatrogenic restorative procedures and remaining roots were excluded. All the teeth were measured at six sites (mesiobuccal, mid-buccal, distobuccal, distolingual/palatal, mid-lingual/palatal, and mesiolingual/palatal) on all upper and lower teeth.¹⁹

Periodontitis was defined as the presence of PD as ≥ 4 mm and CAL ≥ 1 mm.²⁰ The severity of periodontitis was classified as mild (CAL < 2 mm), moderate (CAL 3-4mm), and severe (CAL > 4 mm).¹¹

Ethical approval

The study protocol had the ethical approval and confirmation number (2017/05) from The Ethical Committee of the Faculty of Medicine at UST-Yemen.

The study was explained to all subjects and their written informed consent was obtained to confirm anonymous enrollment in the study.

Statistical analysis

The collected data was ordered and labeled. The median and standard deviation were calculated for describing the quantitative data. Prevalence tables were used to sort the qualitative data.

Statistical significance level was set at $p < 0.05$. The Mann-Whitney test was used to evaluate the differences in continuous variables between the smokers/non-smokers and Khat chewers/non-chewers in the diabetic group. The Chi-Square test was used for risk estimation between the case and control groups, as well as between well-controlled and poorly-controlled, and short and long duration diabetes mellitus type II (< 10 years and > 10 years).

The binary logistic regression analysis was done to examine the adjusted odds ratio and rolling out of the confounding factors for the main outcomes were dichotomized such in the clinical attachment loss (\leq or > 4 mm CAL) and number of missing teeth ($<$ or ≥ 8 missing teeth). Analyses were performed using SPSS® 21.0 (IBM, USA).

RESULTS.

Characterization of the study population is shown in Table 1, and clinical parameters are shown in Table 2.

Table 3 shows the clinical parameters according to smoking and Khat chewing, and Table 4 according to duration and control of diabetes mellitus type 2.

Finally, Table 5 shows the regression analysis adjusting for confounding factors (smoking, Khat chewing, age, and education level) for CAL and missing teeth.

Table 1. Demographic characteristics of the study sample.

Categories		Diabetic n (%)	Non-diabetic n (%)
Gender	Male	81 (61.4)	59 (42.8)
	Female	51 (38.6)	79 (57.2)
Age	30-35	25 (18.9)	39 (28.3)
	36-40	15 (11.4)	25 (18.1)
	41-45	18 (13.6)	13 (9.4)
	46-50	17 (12.9)	13 (9.4)
	> 50	57 (43.2)	48 (34.8)
Education	Illiterate	94 (71.2)	76 (55.1)
	Literate	38 (28.8)	62 (44.9)
Khat chewing	No	43 (32.6)	47 (34.1)
	Yes	89 (67.4)	91 (65.9)
Smoking	No	106 (80.3)	102 (73.9)
	Yes	26 (19.7)	36 (26.1)
Tooth brushing	Irregular	65 (49.2)	98 (71)
	Regular	67 (50.8)	40 (29)

Table 2. The clinical periodontal parameters of the study sample according to diabetic status.

Categories		Diabetic n (%)	Non-diabetic n (%)	p-value*	OR (95% CI)
Plaque index	Low < median	56 (42.4)	91 (65.9)	<0.001	2.6 (1.6-4.3)
	High ≥ median	76 (57.6)	47 (34.1)		
Gingival bleeding	No bleeding	45 (34.1)	103 (75.2)	<0.001	3.5 (2.3-13.0)
	Bleeding	87 (65.9)	35(24.8)		
Gingival recession	No recession	10 (7.5)	20 (14.5)	.004	2.0 (1.2-3.4)
	Recession	122 (92.5)	118 (85.5)		
Furcation involvement	No	40 (30.3)	91 (65.9)	<0.001	4.0 (2.3-6.7)
	Yes	92 (69.7)	47 (34.1)		
Clinical attachment loss	≤4mm CAL	57 (43.1)	89 (81.7)	<0.001	5.7 (3.1-10.5)
	>4mm CAL	74 (56.9)	20 (18.3)		
Tooth mobility	No	45 (34.1)	70 (63.1)	.003	2.0 (1.2-3.4)
	Yes	87 (65.9)	68 (45.3)		
Number of missing teeth	<8 missing teeth	66 (50)	71 (81.6)	<0.001	4.4 (2.3-8.5)
	≥8 missing teeth	66 (50)	16 (18.4)		

*Chi-square test was used.

Table 3. Median gingival recession, CAL, and missed teeth of smokers and Khat chewers among diabetic group.

	Diabetic group					
	Smokers	Non-Smokers	p-value*	Khat Chewers	Non-Khat Chewers	p-value*
Gingival recession	4.2	3.7	0.4	3.9	3.4	0.1
Clinical attachment loss	4.8	4.6	0.8	4.6	4.5	0.7
Missing teeth	8.6	8.6	0.7	8.1	7.8	0.2

*Mann-Whitney U test was used. OR: Odds ratio; CI: Confidence interval. CAL: Clinical attachment loss

Table 4. Association between glycated hemoglobin levels and duration of hyperglycemia and clinical periodontal parameters.

		Glycated hemoglobin level				Duration of diabetes mellitus			
		Well controlled		p-value*	OR (95% CI)	Short duration		p-value*	OR (95% CI)
		HbA1c ≤8 n (%)	Poorlycontrolled HbA1c >8 n (%)			DM ≤10 years n (%)	Long duration DM >10 years n (%)		
Furcation involvement.	No	20 (55.5)	24 (25)	.001	4.1 (1.7-9.4)	36 (40.4)	8 (18.6)	.02	2.7 (1.1-6.7)
	Yes	16 (44.5)	72 (75)						
Clinical attachment loss.	≤4 CAL	21 (58.3)	36 (37.5)	.01	3.4 (1.3-9.3)	47 (52.8)	11 (25.5)	.007	3.1 (1.3-7.0)
	>4 CAL	14 (41.7)	60 (62.5)						
Tooth mobility.	No	19 (52.7)	26 (27.1)	.005	3.2 (1.4-2.3)	38 (42.6)	7 (16.2)	.005	3.6 (1.4-9.1)
	Yes	17 (47.3)	70 (72.9)						
Number of missing teeth	<8 missing teeth	26 (72.2)	40 (41.6)	< .001	6 (2-17.5)	49 (55.1)	17 (39.5)	.03	2.5 (1.1-5.7)
	≥8 missing teeth	10 (27.8)	56 (58.4)						

*Chi-square test is used. OR: Odds ratio; CI: Confidence interval

Table 5. Multivariable analysis for selected independent variables as predictors for TIIDM.

		Diabetic n (%)	Non- diabetic n (%)	Adjusted odds ratio (95%CI) *	p-value*
Clinical attachment loss	≤4mm CAL	57 (39.1)	89 (60.90)	5.6 (3.0-10.4)	<0.001
	>4mm CAL	74 (78.7)	20 (21.3)		
Number of missing teeth	<8 missing teeth	66 (48.1)	71 (51.9)	4.0 (2.0-8.1)	<0.001
	≥8 missing teeth	66 (80.4)	16 (19.6)		

TIIDM: Type II diabetes mellitus. *OR: Odds ratios were calculated using binary logistic regression analyses adjusted for confounders. ** Statistically significant difference (P < 0.05) between DM2 and non-diabetic controls.

DISCUSSION.

To our knowledge, the present work is first in Yemen to study the triple relation of diabetes mellitus type II-related factors, Khat chewing, and smoking on periodontal condition. In our study, to avoid misdiagnosis and evaluate the periodontal status, full mouth examination by using many clinical periodontal parameters was done. The results of this study show that severe periodontal diseases is associated with diabetes mellitus type II.

Type II diabetic subjects displayed obvious features of chronic periodontitis features, which agreed with other published studies.¹⁶ However this data confirm other findings such as those reported by Campus *et al.*¹⁷ Javed *et al.*²¹ Kim *et al.*⁵ and Susanto *et al.*²² and consistent with findings from the close country Sudan.¹⁶

An evaluation of the triple relationship between diabetes mellitus type II, smoking, and Khat chewing effects on periodontium had been assessed in the diabetic group, which has no significant differences between smokers compared to non-smokers in the case group. Similarly, other findings revealed that there was no synergetic action of smoking/hyperglycemia on periodontium.²³ On the contrary to our finding, there was a study done by Orbak *et al.*²⁴ evaluating the smoking effect with diabetes mellitus type II on periodontal tissues that showed statistical differences between the groups.

Many studies reported Khat chewing as a risk factor for periodontitis,^{3,14} but the present study showed no significant periodontium differences between Khat chewers and non-chewers among the diabetic group. Other studies considered Khat as a beneficial factor for periodontium health by mechanical cleaning or due to prebiotic action on the oral microbiota.²⁵ In such type of studies which depend partly on the questionnaire, recall bias is a considerable concern due to absence of records, indices or tools that ensure onset,

duration, and former/current status of Khat chewers or smokers.

Association between poor glycemic control and periodontal diseases may be explained by the accumulation of advanced glycated end products leading to impairment of the phagocytic and chemotactic function of Polymorphonuclear leukocytes and the production of proinflammatory cytokines.²¹ Increased glucose levels in salivary flow and gingival crevicular fluid provide a convenient environment for plaque pathogens that are responsible for inflammation leading to periodontal destruction and attachment loss.^{16,21} On the other hand, periodontal disease alters the immune response by increasing the inflammatory mediators, which could explain the interrelationship between diabetic and periodontal condition.²²

The results of the association between poor controlled hyperglycemia and severe periodontal disease is consistent with other studies.^{16,17,21} Furthermore, duration of diabetes play a role in the severity of periodontal destruction, more significantly in long duration diabetes.^{5,16}

The findings of this study have many limitations such as diabetic/non-diabetic patients who attended the endocrinology or dental clinics could have done so for urgent needs. Therefore, they could overrepresent the severity of their conditions. Until recently, there was no published study that evaluated the synergistic effect of diabetes/Khat chewing on the periodontium, which makes this present work the first. The stress, conflict, and economic status as results of the situation in Yemen may be other risk factors that may compound the effects of diabetes mellitus, smoking, and Khat chewing.²⁶

The findings of this study contribute to planning programs and reflect the importance of meeting basic and urgent oral health needs and that are key to improve an oral health and diabetic care.

CONCLUSION.

Type II diabetic patients have severe periodontal destruction and tooth loss compared to non-diabetic

people and there were no any differences within the diabetic group regarding smoking and Khat chewing habits.

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