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Oral mucosal lesions, xerostomia, and burning sensation among diabetic and non-diabetic patients in Benghazi, Libya: A comparative cross-sectional study

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Keywords:
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A B S T R A C T

Background: Diabetes mellitus is associated with oral complications that may adversely affect quality of life and may provide clinically relevant clues to metabolic dysregulation. Objective: To compare the prevalence of oral mucosal lesions (OMLs), subjective xerostomia, and oral burning sensation among diabetic and non-diabetic patients in Benghazi, Libya. Methods: This comparative cross-sectional study included 303 participants aged 15-75 years: 153 diabetic patients and 150 non-diabetic controls. Data were collected from September 2024 to February 2025 using a structured questionnaire, clinical oral examination, and glycated hemoglobin (HbA1c) assessment. Subjective xerostomia was evaluated using a study questionnaire adapted from Torres et al. Statistical analysis was performed using descriptive statistics, the chi-square test, and Fisher's exact test, with statistical significance set at $p<0.05$. Results: OMLs were recorded in 189 participants (62.4%) and were significantly more prevalent among diabetic patients than controls (92.8% vs 31.3%, $p<0.001$). Fissured tongue and coated tongue were the most frequently recorded lesions. Oral burning sensation was more common among diabetic patients than non-diabetic controls (13.7% vs 2.0%, $p<0.001$). Moderate and severe subjective xerostomia were observed only among diabetic patients (30.1% and 37.3%, respectively; $p<0.001$). Poor glycemic control was associated with a greater burden of OMLs, burning sensation, and more severe xerostomia. Conclusion: Diabetic patients in Benghazi had a substantially higher burden of oral manifestations than non-diabetic controls. Routine oral examination and closer collaboration between dental and medical professionals may support earlier recognition and improved management of diabetes-related oral complications.

الآفات المخاطية الفموية وجفاف الفم والإحساس بالحرقان لدى المرضى المصابين وغير المصابين بداء السكري في بنغازي، ليبيا: دراسة مقطعية مقارنة

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الكلمات المفتاحية:
الإحساس بالحرقان
الآفات المخاطية الفموية
جفاف الفم
داء السكري
المظاهر الفموية

الملخص

الخلفية: يرتبط داء السكري بمضاعفات فموية قد تؤثر سلبًا في جودة الحياة وقد توفر مؤشرات سريرية ذات صلة باضطراب التنظيم الأيضي. الهدف: مقارنة انتشار الآفات المخاطية الفموية، وجفاف الفم الذاتي، والإحساس بالحرقان الفموي بين المرضى المصابين وغير المصابين بداء السكري في بنغازي، ليبيا. الطرق: شملت هذه الدراسة المقطعية المقارنة 303 مشاركين تتراوح أعمارهم بين 15 و75 سنة؛ 153 مريضًا بالسكري و150 من غير المصابين. جُمعت البيانات من سبتمبر 2024 إلى فبراير 2025 باستخدام استبيان منظم وفحص

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سريري للفم وقياس الهيموغلوبين السكري (HbA1c). جرى تقييم جفاف الفم الذاتي باستبيان دراسة مقتبس من Torres وآخرين. استُخدمت الإحصاءات الوصفية واختبار كاي-تربيع واختبار فيشر الدقيق، واعتُمد p<0.05 للدلالة الإحصائية. النتائج: سُجلت الآفات المخاطية الفموية لدى 189 مشاركًا (62.4%) وكانت أكثر شيوعًا بصورة معنوية لدى مرضى السكري مقارنة بغير المصابين (92.8% مقابل 31.3%، p<0.001). وكان اللسان المتشقق واللسان المغطى أكثر الآفات شيوعًا. كما كان الإحساس بالحرقان الفموي أكثر شيوعًا لدى مرضى السكري (13.7% مقابل 2.0%، p<0.001). ولوحظ جفاف الفم المتوسط والشديد فقط لدى مرضى السكري (30.1% و37.3% على التوالي؛ p<0.001). وارتبط ضعف التحكم السكري بعبء أكبر من الآفات والأعراض الفموية. الاستنتاج: يعاني مرضى السكري في بنغازي عبئًا أعلى بكثير من المظاهر الفموية مقارنة بغير المصابين، وقد يسهم الفحص الفموي الروتيني وتعزيز التعاون بين أطباء الأسنان والأطباء في الاكتشاف المبكر وتحسين التدبير.

Abbreviations and Acronyms

DM: diabetes mellitus; HbA1c: glycated hemoglobin; OMLs: oral mucosal lesions; SPSS: Statistical Package for the Social Sciences.

1. Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from insufficient insulin secretion, impaired insulin action, or both [1]. It is recognized as a major noncommunicable disease of global concern [2]. In 2019, diabetes affected an estimated 9.3% of the world's population, and prevalence is projected to rise to 10.9% by 2045 [3]. Libya reflects this increasing burden. Earlier national data reported prevalence rates of 3.8% among women and 3.2% among men [4], while later estimates from the World Health Organization and the International Diabetes Federation indicated substantially higher rates [5], [6].

The pathological effects of DM extend beyond the classical microvascular and macrovascular complications involving the eyes, kidneys, nerves, and cardiovascular system [7], [8]. Oral health is also affected. In 2009, the International Diabetes Federation issued guidance encouraging the integration of oral health care into diabetes management [9].

Oral manifestations associated with diabetes include xerostomia [10], [11], dental caries and tooth loss [12],[13], periodontal disease [14], [15], oral candidiasis [16], burning sensation [17], altered taste [18], fissured tongue and coated tongue [16], [19], [20], oral lichen planus [21], recurrent aphthous stomatitis, and impaired wound healing [22], [23]. These complications may adversely affect oral-health-related quality of life and may complicate metabolic control [24], [25].

This study aimed to compare the prevalence of oral mucosal lesions (OMLs), subjective xerostomia, and oral burning sensation between diabetic and non-diabetic patients attending clinical centers in Benghazi, Libya.

2. Materials and Methods

2.1 Study design and setting

A comparative cross-sectional study was conducted from September 2024 to February 2025 at the Department of Oral Medicine, Oral Pathology, Oral Diagnosis and Oral Radiology, Faculty of Dentistry, University of Benghazi, and the National Center for Diabetes Diagnosis and Treatment in Benghazi, Libya.

2.2 Study population and sampling

A convenience sampling approach was used. The study included 303 participants aged 15-75 years: 153 diabetic patients and 150 non-diabetic controls. The sample size was estimated using G*Power software for a two-tailed independent comparison, assuming a medium effect size, a significance level of 0.05, and 80% power.

Diabetic participants had a confirmed medical diagnosis of DM. Individuals initially classified as non-diabetic were screened to confirm group allocation. Exclusion criteria included systemic diseases independently affecting oral health (such as Sjogren syndrome and immunosuppressive disorders), a history of chemotherapy or head and neck radiotherapy, psychiatric or cognitive impairment affecting self-reporting, pregnancy, refusal to participate, and incomplete clinical examination or questionnaire data.

Among the diabetic participants, glycemic control was categorized using glycated hemoglobin (HbA1c) as good control (HbA1c < 7%) or poor control (HbA1c >= 7%). The 7% threshold was used to classify glycemic control among patients already diagnosed with diabetes; it was not used as a diagnostic threshold. The HbA1c value of 6.5% was used when screening non-diabetic controls for possible undiagnosed diabetes.

2.3 Data collection

Data were collected using a structured electronic questionnaire and a clinical oral examination. The questionnaire recorded sociodemographic characteristics, medical history, oral hygiene practices, previous dental attendance, oral symptoms, duration of diabetes, glycemic control, and diabetes treatment category. Treatment categories were diet only, oral hypoglycemic agents, insulin therapy, combination therapy, and no treatment. Specific drug names and pharmacological classes were not recorded.

Clinical oral examinations were performed in dental units under direct illumination and in accordance with standard oral examination protocols. A mouth mirror, explorer, gauze, cotton rolls, and gloves were used. OMLs were documented clinically and photographed when appropriate. Radiographic investigations and biopsy were performed when clinically indicated. Burning sensation was recorded as a self-reported binary outcome (present or absent). No numerical severity score for burning sensation was used.

2.4 Assessment of subjective xerostomia

Subjective xerostomia was assessed using a study questionnaire adapted from Torres et al. [31], [32]. The five yes/no items asked whether participants: [1] felt dry mouth during meals; [2] perceived a small amount of saliva in the mouth most of the time; [3] felt dry mouth at night or on awakening; [4] felt dry mouth during the day; and [5] chewed gum or used mints to relieve oral dryness. A symptom score was calculated according to the number of affirmative responses. Participants who answered "yes" to one item were classified as having very mild xerostomia, those with two affirmative responses as having mild xerostomia, those with three affirmative responses as having moderate xerostomia, and those with four or five affirmative responses as having severe xerostomia. These categories describe the severity of self-reported symptoms; unstimulated and stimulated salivary flow rates were not measured.

2.5 HbA1c assessment

HbA1c values were recorded for diabetic participants. The On Call A1c device was used to screen participants initially classified as non-diabetic to confirm group allocation and identify previously undiagnosed cases. Participants with newly detected diabetes were reclassified into the diabetic group for analysis.

2.6 Ethical considerations

The study protocol was approved by the Ethics Committee of the Faculty of Dentistry, University of Benghazi, and registered within the postgraduate research system under registration number 0218. Written informed consent was obtained from all participants before enrollment.

2.7 Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics were used to summarize

demographic and clinical variables. Comparisons between subgroups were performed using the chi-square test or Fisher's exact test, as appropriate. Statistical significance was set at $p<0.05$. Values reported as $p=0.000$ in the statistical output are presented as $p<0.001$.

3. Results

A total of 303 participants were included: 153 diabetic patients and 150 non-diabetic controls. Five participants initially recruited as controls were newly identified as having diabetes during screening and were reclassified into the diabetic group. The study sample included 166 females (54.8%) and 137 males (45.2%). Diabetic participants were generally older than non-diabetic controls.

Table 1: Sociodemographic characteristics of diabetic and non-diabetic participants

Characteristic	Diabetic (%)	Non-diabetic (%)
15-25	1.3	26.7
26-35	0.7	24.7
36-45	11.8	19.3
46-55	24.2	14.7
56-65	39.2	9.3
66-75	22.9	5.3
Female	57.5	53.3
Male	42.5	46.7
High education level	3.9	15.3
Middle education level	53.6	38.7
Low education level	42.5	46.0

Among the 153 diabetic participants, 149 (97.4%) had type 2 diabetes mellitus and only four (2.6%) had type 1 diabetes mellitus. Therefore, the findings of the present study predominantly reflect the oral manifestations observed in patients with type 2 diabetes, and no separate conclusions were drawn regarding type 1 diabetes. More than half of the diabetic participants had been living with the disease for over 10 years, and combination therapy was the most commonly reported treatment modality.

Table 2: Distribution of diabetic participants according to duration of diabetes

Duration of diabetes	n	%
<1 year	8	5.2
2-5 years	26	17.0
6-10 years	33	21.6
>10 years	86	56.2
Total	153	100.0

Note: Percentages may not total 100% because of rounding.

Table 3: Distribution of diabetic participants according to treatment category

Treatment category	n	%
Oral hypoglycemic agents	47	30.7
Insulin therapy only	22	14.4
Combination therapy	80	52.3
No treatment	4	2.6
Total	153	100.0

Note: Combination therapy included more than one treatment modality. Specific names and classes of oral hypoglycemic agents were not recorded.

Among the 303 participants, at least one oral mucosal lesion (OML) was recorded in 142 of 153 diabetic participants (92.8%) and 47 of 150 non-diabetic participants (31.3%). Multiple lesions could occur in the same participant. Fissured tongue was the most frequent lesion, observed in 104 diabetic participants (68.0%) and 17 non-diabetic participants (11.3%), followed by coated tongue in 91 (59.5%) and 13 (8.7%), respectively. Depapillation or atrophic glossitis was also more common among diabetic participants (22 [14.4%]) than among non-diabetic participants (4 [2.7%]). Table (4) presents the lesion-type frequencies stratified by diabetic status. Because a participant could have more than one lesion, lesion-type frequencies should not be summed as participant counts.

Table 4: Oral mucosal lesion frequencies stratified by diabetic status

Lesion type	Diabetic n	Diabetic %	Non-diabetic n	Non-diabetic %	Fisher exact p-value
Geographic tongue	3	2.0	1	0.7	0.623
Fissured tongue	104	68.0	17	11.3	<0.001
Coated tongue	91	59.5	13	8.7	<0.001
Depapillation / atrophic glossitis	22	14.4	4	2.7	<0.001
Frictional keratosis	5	3.3	10	6.7	0.195
Traumatic ulcer	14	9.2	5	3.3	0.056
Melanotic macule	3	2.0	3	2.0	1.000
Recurrent aphthous stomatitis	0	0.0	2	1.3	0.244
Fibroepithelial polyp / irritation fibroma	9	5.9	2	1.3	0.061
Epulis fissuratum	2	1.3	0	0.0	0.498
Vascular malformation / oral varicosities	4	2.6	2	1.3	0.684
Angular cheilitis	3	2.0	0	0.0	0.248
Denture stomatitis	10	6.5	1	0.7	0.010
Multifocal candidiasis	1	0.7	0	0.0	1.000
Central papillary atrophy	3	2.0	0	0.0	0.248
Oral lichen planus	4	2.6	0	0.0	0.123
Oral squamous cell carcinoma	2	1.3	2	1.3	1.000

Note: Multiple lesions could occur in the same participant; therefore, the total number of lesion occurrences exceeds the number of participants. Percentages are calculated within each diabetic-status group.

OMLs were significantly more common among diabetic patients than non-diabetic controls (92.8% vs 31.3%, $p<0.001$). Oral burning sensation was also more common in the diabetic group (13.7% vs 2.0%, $p<0.001$).

Table 5: Comparison of oral mucosal lesions and oral burning sensation between diabetic and non-diabetic participants

Outcome	Group	Present, n (%)	Absent, n (%)	p-value
OMLs	Diabetic	142 (92.8)	11 (7.2)	<0.001
OMLs	Non-diabetic	47 (31.3)	103 (68.7)	
Oral burning sensation	Diabetic	21 (13.7)	132 (86.3)	<0.001
Oral burning sensation	Non-diabetic	3 (2.0)	147 (98.0)	

Chi-square test or Fisher's exact test, as appropriate.

Moderate and severe subjective xerostomia were observed only among diabetic patients, whereas non-diabetic controls were classified as having very mild or mild symptoms ($p<0.001$).

Table 6: Comparison of subjective xerostomia severity between diabetic and non-diabetic participants

Severity	Scoring rule	Diabetic, n (%)	Non-diabetic, n (%)	p-value
Very mild	1 affirmative responses	36 (23.5)	117 (78.0)	<0.001
Mild	2 affirmative responses	14 (9.2)	33 (22.0)	

Severity	Scoring rule	Diabetic, n (%)	Non-diabetic, n (%)	p-value
Moderate	3 affirmative responses	46 (30.1)	0 (0.0)	
Severe	4-5 affirmative responses	57 (37.3)	0 (0.0)	

Severity represents subjective symptom categories derived from the Torres-adapted questionnaire; salivary flow rate was not measured.

Among diabetic participants with OMLs, 69.0% had HbA1c >=7%. Among diabetic participants reporting oral burning sensation, 76.2% had HbA1c >=7%. Moderate and severe subjective xerostomia were predominantly observed among participants with HbA1c >=7%.

Table 7: Oral manifestations according to glycemic control among diabetic participants

Outcome	Measure	HbA1c <7(n=54)	HbA1c >=7(n=99)	p-value
OMLs	n (%)	44 (31.0)	98 (69.0)	<0.001
Oral burning sensation	n (%)	5 (23.8)	16 (76.2)	<0.001
Very mild xerostomia	n (%)	29 (80.6)	7 (19.4)	<0.001
Mild xerostomia	n (%)	12 (85.7)	2 (14.3)	
Moderate xerostomia	n (%)	6 (13.0)	40 (87.0)	
Severe xerostomia	n (%)	7 (12.3)	50 (87.7)	

Percentages are presented within each manifestation category. Chi-square test or Fisher's exact test, as appropriate.

Duration of diabetes was not significantly associated with the presence of OMLs (p=0.397). However, oral burning sensation and more severe xerostomia were more frequently observed among participants with longer diabetes duration.

Table 8: Oral manifestations according to duration of diabetes among diabetic participants

Outcome	<1 year	2-5 years	6-10 years	>10 years	p-value
OMLs, n (%)	7 (87.5)	23 (88.5)	32 (97.0)	80 (93.0)	0.397
Oral burning sensation, n (%)	0 (0.0)	2 (7.7)	1 (3.0)	18 (20.9)	0.035
Very mild xerostomia, n (%)	4 (50.0)	15 (57.7)	9 (27.3)	8 (9.3)	<0.001
Mild xerostomia, n (%)	2 (25.0)	4 (15.4)	2 (6.1)	6 (7.0)	
Moderate xerostomia, n (%)	0 (0.0)	3 (11.5)	14 (42.4)	29 (33.7)	
Severe xerostomia, n (%)	2 (25.0)	4 (15.4)	8 (24.2)	43 (50.0)	

Percentages are calculated within each diabetes-duration category. Chi-square test or Fisher's exact test, as appropriate.

Note: The manuscript reports absence of OMLs and absence of burning sensation separately. The available aggregate data do not permit calculation of a single combined category for participants free from every selected oral outcome.

4. Discussion

This comparative cross-sectional study demonstrated a substantially greater burden of oral manifestations among diabetic patients than non-diabetic controls in Benghazi. OMLs, subjective xerostomia, and oral burning sensation were all significantly more frequent or more severe in the diabetic group. These findings support the recognized relationship between diabetes and impaired oral health.

Fissured tongue and coated tongue were the most frequently recorded lesions. Similar patterns have been reported in regional and international studies of diabetic populations [16], [18], [20], [26]. The observed association between poor glycemic control and OML burden suggests that metabolic dysregulation may be more clinically relevant than disease duration alone. Nevertheless, oral mucosal changes are multifactorial; age, oral hygiene, denture use, medication exposure, and coexisting conditions may contribute to their occurrence [19], [20].

Subjective xerostomia was more severe among diabetic patients, and moderate or severe symptom categories were observed only in the diabetic group. Poor glycemic control and longer duration of diabetes were associated with more severe xerostomia. Chronic hyperglycemia may contribute to salivary gland dysfunction and altered salivary composition, while medication exposure, dehydration, and psychological factors may also influence subjective dryness [10], [11], [22], [30]. The present study assessed subjective symptoms rather than objective hyposalivation because salivary flow rates were not measured.

Oral burning sensation was significantly more frequent among diabetic patients and was more common in participants with poor glycemic control and longer disease duration. Diabetes-related neuropathic changes may contribute to altered oral sensation. Other potentially relevant factors include xerostomia, candidal infection, nutritional deficiencies, and psychological distress [17], [22], [23].

The findings emphasize the clinical value of routine oral assessment in diabetic care. Dentists may identify oral complications that warrant closer metabolic evaluation or medical referral. Improved collaboration between dental and medical professionals may facilitate earlier intervention, particularly in settings where epidemiological data remain limited.

5. Limitations

The cross-sectional design of the study limits causal inference. Recruitment from a limited number of centers in Benghazi may also reduce the generalizability of the findings. In addition, the diabetic and non-diabetic groups were not age-matched, which may have introduced confounding because some oral manifestations are influenced by age. Subjective xerostomia and burning sensation were self-reported and may therefore be affected by recall or reporting bias. Salivary flow rates were not measured; consequently, the xerostomia findings should not be interpreted as objective evidence of hyposalivation. Furthermore, oral hypoglycemic agents were recorded as a treatment category, but specific drug names and pharmacological classes were not collected.

6. Conclusion

Diabetic patients in Benghazi had a significantly greater burden of oral mucosal lesions, subjective xerostomia, and oral burning sensation than non-diabetic controls. Fissured tongue and coated tongue were the most frequently recorded lesions, and poor glycemic control was associated with a greater burden of oral manifestations. The comparative clinical assessment provides locally relevant evidence for diabetes-associated oral changes; however, the cross-sectional design, lack of age matching, and absence of objective salivary flow measurements limit causal interpretation and the assessment of hyposalivation. Incorporating routine oral examinations into diabetic care pathways and strengthening collaboration between dental and medical professionals may support earlier recognition and improved management of diabetes-related oral complications.

7. Recommendations

Routine oral assessment should be incorporated into diabetes care pathways, and regular dental attendance should be encouraged for diabetic patients. Greater collaboration between dental and medical professionals may strengthen early recognition and prevention strategies. Future studies should use longitudinal designs, include larger and more diverse populations, use age-matched comparison groups, objectively assess salivary flow rates, and document individual antidiabetic medications.

8. Declarations

8.1 Conflict of interest

The authors declare no conflict of interest.

8.2 Funding

This research received no external funding.

8.3 Use of artificial intelligence

Artificial intelligence tools were used only for language editing and formatting. All scientific content remains the responsibility of the authors.

8.4 Informed consent

Written informed consent was obtained from all participants involved in the study.

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