



## Oral Mucosal Lesions in Type 2 Diabetes Mellitus

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### Abstract

To determine the frequency and types of oral mucosal lesions (OMLs) amongst type 2 diabetes mellitus (DM) patients in Al-Najaf, Iraq. A cross-sectional study was performed with 310 patients (180 females, 130 males; mean age  $51.0 \pm 13.3$  years) diagnosed to have type 2 DM from different specialized centers between September 2024 and March 2025. Ethical approval was granted from the Ethics Committee, College of Dentistry, University of Kufa. The clinical oral examination was performed using WHO diagnostic criteria. The chi-squared test was used as a statistical method with significance set at  $p < 0.05$ . The most frequent lesion was unilateral cheilitis (41.9%), followed by leukoplakia (22.6%), aphthous ulcer (16.1%), lichen planus (9.7%), fibroma (6.5%) and oral candidiasis (3.2%). Lesion type was statistically significant associated with age ( $p=0.040$ ; and sex ( $p=0.02$ ) with further analysis revealing a predominance of females as well in older than 40 years patients suffering the disease more frequently. Oral mucosal lesions are common among individuals with type 2 DM in Iraq; angular cheilitis was the most common.

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### Introduction

Diabetes mellitus (DM) is a cluster of metabolic disorders that has well-established hyperglycemia due to impaired insulin secretion, insulin action, or a combination of both [1]. The global burden of diabetes became extensive and is estimated to have affected around 537 million adults in 2021, a number that is projected to grow to 783 million by 2045 according to the International Diabetes Federation (IDF) [2]. This epidemic is a major public health issue, especially in the region of Middle East and North African countries which has the highest age-adjusted prevalence rate worldwide [3].

The chronic hyperglycemic condition in DM is associated with long-standing damage, dysfunction and even failure of various organs such as the eyes, kidneys, nerves, heart

and blood vessels [4]. The mouth is not an exception, and there is a compilation of evidence that diabetes has a bidirectional relationship with oral health [1]. Poor glycemic regulation can worsen oral pathology and chronic inflammation of the mouth, particularly of periodontal tissue, may impair glycemic control [5,6]. This bidirectional relationship highlights the need for an interdisciplinary approach to diabetes management that includes oral care as a critical component. OMLs are an important, yet unappreciated complication of diabetes within the Social Science Research Network (SSRN) OMLs are reported to be more common with prevalence varying between 45% and 88% in patients of type 2 DM compared to a lower occurrence rate (38–45%) in the general population [7,8]. The pathogenesis of these

lesions in diabetic patients is multifactorial, arising from impaired immune response, especially neutrophil dysfunction and cell-mediated immunity alteration; salivary flow reduction leading to xerostomia; microvascular changes that make tissue perfusion problematic; and oral flora alterations, particularly an increase in Candida colonization [9–11].

Common OMLs reported in diabetic populations include oral candidiasis in its various forms (pseudomembranous, erythematous, angular cheilitis), lichen planus, geographic tongue, fissured tongue, recurrent aphthous stomatitis, and oral potentially malignant disorders such as leukoplakia [12,13]. The clinical significance of these lesions ranges from causing discomfort and impaired quality of life to carrying a risk of malignant

transformation, as in the case of leukoplakia and lichen planus [14,15].

Despite the extensive literature on this topic, there is considerable heterogeneity in the reported prevalence and types of OMLs across different populations. These discrepancies may be attributed to differences in study design, sample size, diagnostic criteria, geographic location, and the metabolic control status of the study participants [16]. In Iraq, where the prevalence of type 2 DM is high and continues to rise, there is a paucity of recent, well-designed studies that systematically evaluate the spectrum of oral mucosal lesions in this population [17]. Furthermore, existing studies from the region often lack standardized diagnostic protocols and adequate statistical analysis.

To fill this gap, the current study aimed to explore the prevalence and distribution of oral mucosal lesions in 310 Iraqi patients with type 2 DM from Al-Najaf using a multi-center cross-sectional design. The objective of the study was to determine the correlation of these lesions with demographic variables (age and sex), by a standardized clinical examination protocol based on WHO diagnostic criteria. To our knowledge, this is the first study that systematically provides oral mucosal health status of well-defined diabetic patients in a modern Iraqi population. It can serve as the basis for preventive and therapeutic intervention strategies somewhere down the line.

## Subjects and Methods

### Study Design and Setting

This is a cross-sectional study, performed between September 2024 and March 2025 in Al-Najaf/Iraq. A sample of participants was recruited across health sites from different regions to improve participant representativeness. Among these establishments were the Diabetes Division at Al-Sadr Medical City, Intensive Care and Dialysis Departments at Al-Hakim General Hospital, as well as the Martyr Mohammed Al-Sadr Center for Diabetes and Endocrinology.

### Ethical Approval

The protocol and design of the study were evaluated and approved by the Scientific and Ethics Committee, College of Dentistry, University of Kufa (Ref No: UOK-DENT-24-101). The research was undertaken with full adherence to ethical principles embodied in the Declaration of Helsinki (2013 revision). All participants were informed about the aims and procedures of the study, possible risks/benefits. Informed written consent was obtained from each participant before their enrollment.

### Sample Size

The study cohort consisted of 310 patients. An initial pool of 560 screened patients with type 2 DM was examined, but 250 were excluded based on the predefined criteria Figure 1. The final sample consisted of 180 women (58.1%) and 130 men (41.9%), aged between twenty and seventy years. We calculated the sample size using an estimation of a single proportion since we wanted to report prevalence, with established parameters for 95% confidence interval and 5% margin error, based on the reported prevalence of oral mucosal lesions in patients with diabetes varied around 50%, following previous studies [7,8].

### Participant Selection

Participants were selected using a convenience sampling method. The inclusion and exclusion criteria were as follows:

**Inclusion Criteria:** Patients 20 years or older with a confirmed diagnosis of type 2 diabetes mellitus (from medical records and physician confirmation) and the clinical appearance of at least one oral mucosal lesion, were eligible. Written informed consent was also required.

**Exclusion Criteria:** Type 1 diabetes mellitus, co-existing systemic diseases affecting oral mucosal health that are not caused by the presence of DM (e.g. Sjogren's syndrome, HIV/AIDS, other severe immunodeficiency disorders), chemotherapy/radiotherapy at time of diagnosis or taking medications known to cause oral mucosal changes or interfere with lesion healing (e.g., systemic immunosuppressants for conditions unrelated to DM).

### Clinical Examination and Diagnostic Protocol

To minimize variability between examiners, a single, calibrated examiner (M.J.H.) performed all clinical examinations. The examinations took place under standardized settings involving a dental chair together with sufficient artificial lighting. Diagnostic Instruments A sterile dental mouth mirror, periodontal probe and sterile gauze to tissue retraction.

Intraoral examination was conducted systematically around the whole oral cavity with thorough inspection of every area of mucosal surface including labial mucosa, buccal mucosa, tongue (dorsal, ventral and lateral surfaces), floor of mouth: hard palate: soft palate; gingiva and commissures. Oral mucosal lesions were diagnosed based on their clinical features in accordance with the World Health Organization (WHO) criteria [18]. Each lesion identified was recorded for

type, location, size, color and morphologic features. When the clinical diagnosis was equivocal, a specialist in oral medicine (M.M.) was requested for confirmation.

### Data Collection

We registered demographic data (age and sex) medical history (type and duration of diabetes, current medications) and clinical findings (type and characteristics of oral mucosal lesions) using a structured data collection form.

### Statistical Analysis

Data was entered and analyzed using the Statistical Package for Social Sciences (SPSS, Version, 26.0, IBM Corp., Armonk, NY). Demographic and clinical data were summarized by means of descriptive statistics, which included frequencies (%), means ( $\pm$ SD) and standard deviations. The association between type of oral mucosal lesion and the independent variables age (as 20–40 years and >40 years) and sex (male and female) was analyzed by using chi-squared test or Fisher's exact test when expected cell counts were less than 5. A two-tailed p-value of less than 0.050 was considered statistically significant.

### Results

A total of 310 patients with type 2 diabetes mellitus and oral mucosal lesions were enrolled in the study. The demographic characteristics of the study sample are summarized in Table 1. The mean age of the participants was  $51.0 \pm 13.3$  years, with a range of 20 to 70 years. Most patients ( $n = 240$ , 77.4%) were in the older age group (>40 years), while 70 patients (22.6%) were in the 20–40 years age group (Figure 2). The sample comprised 180 females (58.1%) and 130 males (41.9%), yielding a female-to-male ratio of 1.38:1 (Figure 3).

### Prevalence and Distribution of Oral Mucosal Lesions

All 310 patients (100%) presented with at least one type of oral mucosal lesion. The distribution of the six types of lesions identified is presented in Table 2 and Figure 4. Angular cheilitis was the most frequently observed lesion, present in 130 patients (41.9%). This was followed by leukoplakia in 70 patients (22.6%), recurrent aphthous stomatitis in 50 patients (16.1%), oral lichen planus in 30 patients (9.7%), fibroma in 20 patients (6.5%), and pseudomembranous oral candidiasis in 10 patients (3.2%).

### Association Between Oral Mucosal Lesions and Age

The association between the type of oral mucosal lesion and age group is presented in

Table 3 and Figure 5. A statistically significant association was observed between the type of oral lesion and age ( $p = 0.04$ ). In the >40 years age group, angular cheilitis was the dominant lesion, accounting for 50.0% ( $n = 120$ ) of all lesions in this group. In the 20–40 years age group, leukoplakia was the most common lesion at 42.9% ( $n = 30$ ). Fibroma was exclusively found in the older age group, while oral candidiasis was only observed in the younger age group.

### Association Between Oral Mucosal Lesions and Sex

The association between the type of oral mucosal lesion and sex is presented in Table 4 and Figure 6. A statistically significant association was found between the type of oral lesion and sex ( $p = 0.02$ ). Angular cheilitis was predominantly observed in females (61.1%,  $n = 110$ ) compared to males (15.4%,  $n = 20$ ). Conversely, leukoplakia was more prevalent in males (38.5%,  $n = 50$ ) than in females (11.1%,  $n = 20$ ). Oral candidiasis was exclusively found in males in this cohort.

### Discussion

This study was aimed to evaluate the prevalence and patterns of oral mucosal lesions among 310 diabetic patients with type 2 diabetes mellitus in Al-Najaf, Iraq. This finding that all 310 participants had at least one oral mucosal lesion highlights the high incidence of oral complications amongst this cohort. Although this prevalence of 100% is higher than that reported in many studies, it should be noted that we specifically included only patients with oral lesions as part of the eligibility criteria, which obviously selects for affected individuals. However, this high prevalence fits with a more generic literature which demonstrates that patients with diabetes are significantly more likely to have oral mucosal disease than the general population [7,8,19].

The highlight of this study is that angular cheilitis was the most common category of oral mucosal lesions in our cohort (41.9%). Our observation corroborated with the study conducted by Al-Maweri et al. (2013) which reported an exceptionally high prevalence of angular cheilitis amongst type 2 diabetic patients in Malaysia [20]. Similarly, Saini et al. found that the prevalence of angular cheilitis was significantly greater in diabetic patients than in those without diabetes [21]. Angular cheilitis is a multifactorial disease most related to Superficial Superinfection with *Candida albicans*, often combined with *Staphylococcus aureus*. In patients with diabetes, many factors predispose to this such as xerostomia due to salivary gland dysfunction, immunosuppression and hyperglycemia that facilitate the colonization

and growth of fungi [10,23]. The observed high prevalence in our study may, however as aforementioned effectively mirror the role of nutritional deficiency with iron and the B vitamin complex being common deficiencies in diabetic populations which are well-established epidemiologic risk factors for angular cheilitis [24].

Leukoplakia was the second most common lesion in this study (22.6%), with a considerable male predominance (38.5% of males). The clinical importance of this finding is that leukoplakia is an oral potentially malignant disorder (OPMD) reported to have a malignant transformation rate of 0.7% to 2.9% per year [25]. The possible link between diabetes and OPMDs has recently been investigated by Chen et al. Moving forward, diabetes may also play a dual role involving oral potentially malignant disorders by inducing chronic inflammation, oxidative stress and impairing DNA repair [26]. This higher prevalence among males in our study may be related to the increased frequency of tobacco use among males in the Iraqi population, which is an independent risk factor for leukoplakia [27].

In our patients, recurrent aphthous stomatitis (RAS) occurred in 16.1%. Although RAS occurs in about 20% of the general population, its frequency may be aggravated by immunological dysregulation owing to a diabetic process and dietary deficiencies in effector molecules [28, 29]. Manoj et al. A recent large-sized study by Liamis et al. (2023) found a strong correlation between RAS and diabetes, which reinforced the concept that metabolic disorders may represent major contributors to the pathogenesis of this disease [30].

The clinical characteristics of all patients are summarized in Table 1. OLP was diagnosed in 9.7% of our patients, with a slight female predominance. Data regarding the relation of OLP with diabetes mellitus is well documented in literature [31,32]. Example 3: Ferrel et al, recently performed a study Diabetes mellitus has a significant effect on clinical presentation in and severity of OLP; diabetic patients showed more severe erosive forms, this was also shown by (2025) [33]. The potential mechanisms could be due to immunopathological pathways in common including T-cell mediated autoimmune responses and chronic inflammatory signaling [34].

The very low prevalence of pseudomembranous oral candidiasis (3.2%) demonstrated in this study is noteworthy and opposes some studies which identified oral candidiasis as one of the most common oral infections found in diabetic patients [35]. Well, this observation correlates with Rashmi et al. (2018), who also found a low percentage of candidiasis among patients with diabetes

[36]. This inconsistency might be attributed to multiple reasons. Finally, the high prevalence of angular cheilitis in our cohort might reflect the most common clinical form of oral Candida infection because angular cheilitis is mostly caused by different species of *Candida* [22]. Second, patients may have had antifungal treatment or good oral hygiene that could have inhibited the advent of obvious pseudomembranous candidiasis. Third, the clinical picture of erythematous candidiasis may have been underestimated because its presentation is not as striking.

In relation to the impact of age, our study found a significant relationship between oral lesion type and age group ( $p = 0.04$ ). The prevalence of angular cheilitis and fibroma was much higher among patients aged >40 years. So perhaps this confirms what Radwan-Oczko et al. (2022) reported that older patients showed a wider variety and frequency of oral mucosal lesions [37]. Cumulative effects of chronic hyperglycemia, age-related declines in immune function (immunosenescence), hypofunctioning salivary glands, and presence of comorbidities [38,39] contribute to risks for oral lesions with increasing age.

Our study revealed a strong association between lesion type and gender ( $p = 0.02$ ) in which females were more affected than males in angular cheilitis and lichen planus, like most of the previous studies [18,20]. The decrease of estrogens for more often the cause be believed hormonal factors, especially after menopause. Mauvais-Jarvis et al. Three mechanisms through which estrogen deficiency may contribute to the pathogenesis of type 2 diabetes are altered insulin secretion, diminished insulin sensitivity, and increased susceptibility to glucose-mediated organ damage (2017) [40]. Hormonal changes can also affect oral mucosal immunity and integrity, which may render postmenopausal women more susceptible to oral lesions [41].

This is the first multi-center study investigating this issue in Iraq on patients sampled in a relatively large sample (310 patients), using a WHO-based diagnostic protocol, and systematically exploring any associations between each specific lesion-type and demographic variables. These observations further increase the evidence base for integrating routine oral health assessment as a part of diabetic patients care especially among high diabetes burden populations.

### Conclusion

This study demonstrates that oral mucosal lesions are highly prevalent among Iraqi patients with type 2 diabetes mellitus. Angular cheilitis was identified as the most common lesion, followed by leukoplakia, recurrent

aphthous stomatitis, lichen planus, fibroma, and oral candidiasis. Statistically significant associations were observed between the patterns of oral lesions and both age and sex, with patients over 40 years and females demonstrating a higher susceptibility. These findings emphasize the critical importance of integrating comprehensive oral health screening into the routine management of diabetic patients to facilitate early diagnosis, timely intervention, and improved quality of life.

### Limitations

This study has several limitations that should be considered when interpreting the results. The cross-sectional design precludes the establishment of causal relationships between diabetes and the observed oral lesions. The convenience sampling method may have introduced selection bias. Additionally, glycemic control parameters such as HbA1c levels and the duration of diabetes were not systematically analyzed in relation to the specific types of oral lesions, which would have provided more nuanced insights into the role of metabolic control. Furthermore, diagnoses were based solely on clinical examination without histopathological confirmation, which is the gold standard for definitive diagnosis of many oral mucosal lesions, particularly leukoplakia and lichen planus. Future studies with prospective designs and the inclusion of glycemic control parameters and histopathological confirmation are recommended.

### Conflict of Interest

The authors declare no conflict of interest.

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Table 1. Demographic characteristics of the studied population (N = 310).

Variable	Category	n (%)
Age (years)	Mean ± SD	51.0 ± 13.3
	Range	20–70
	20–40 years	70 (22.6%)
	>40 years	240 (77.4%)
Sex	Female	180 (58.1%)
	Male	130 (41.9%)
	Female:Male ratio	1.38:1

Table 2. Prevalence of oral mucosal lesions among studied patients (N = 310).

Oral Mucosal Lesion	n	Prevalence (%)
Angular cheilitis	130	41.9
Leukoplakia	70	22.6
Recurrent aphthous stomatitis	50	16.1
Oral lichen planus	30	9.7
Fibroma	20	6.5
Pseudomembranous oral candidiasis	10	3.2
Total	310	100.0

Table 3. Association between oral mucosal lesions and age (N = 310).

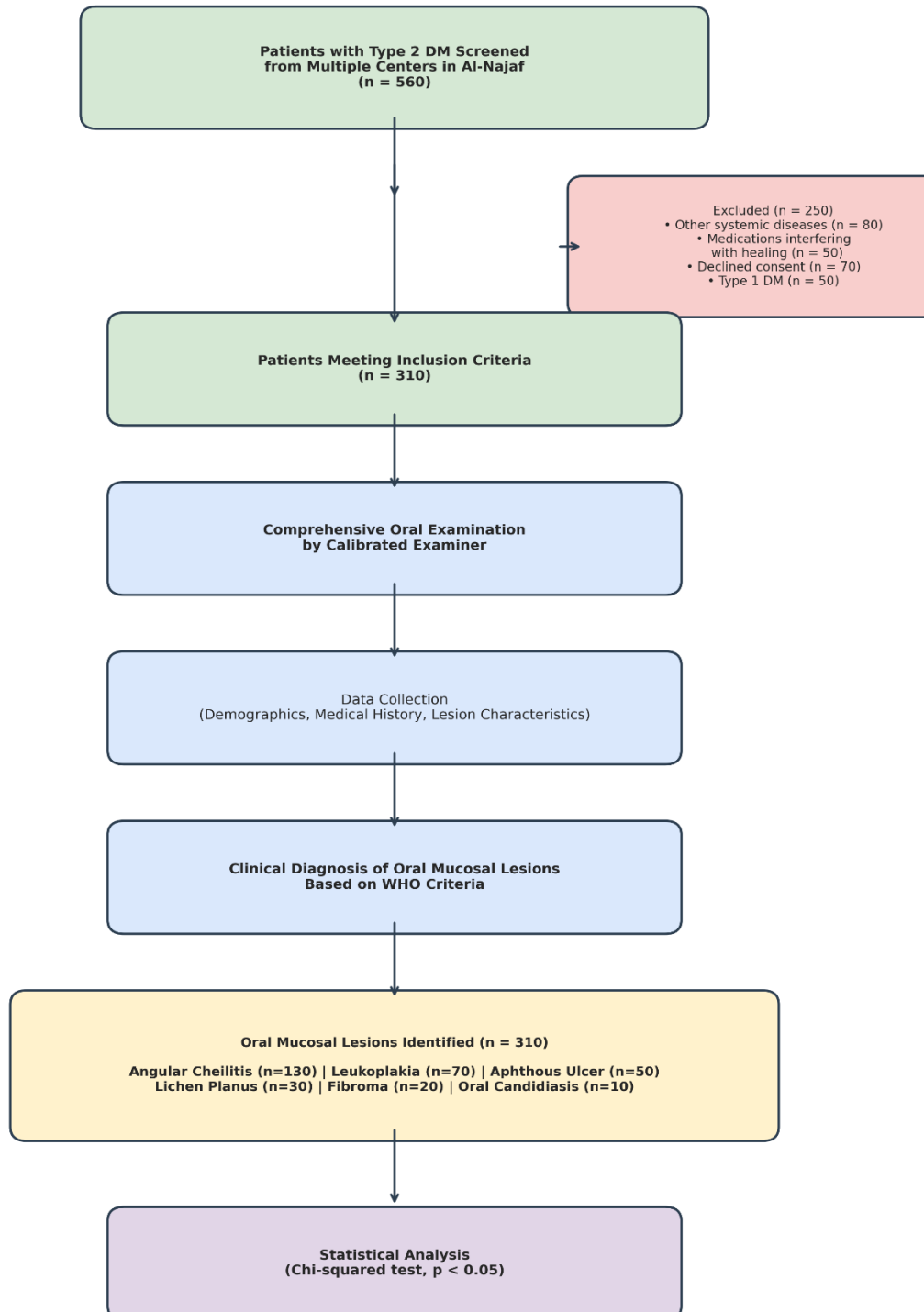
Oral Mucosal Lesion	20–40 years (n = 70)	>40 years (n = 240)	p-value
Angular cheilitis	10 (14.3%)	120 (50.0%)	
Leukoplakia	30 (42.9%)	40 (16.7%)	
Recurrent aphthous stomatitis	10 (14.3%)	40 (16.7%)	0.04*
Oral lichen planus	10 (14.3%)	20 (8.3%)	
Fibroma	0 (0.0%)	20 (8.3%)	
Pseudomembranous oral candidiasis	10 (14.3%)	0 (0.0%)	

\*Chi-squared test; \*p < 0.05 indicates statistical significance.

Table 4. Association between oral mucosal lesions and sex (N = 310).

Oral Mucosal Lesion	Female (n = 180)	Male (n = 130)	p-value
Angular cheilitis	110 (61.1%)	20 (15.4%)	
Leukoplakia	20 (11.1%)	50 (38.5%)	
Recurrent aphthous stomatitis	20 (11.1%)	30 (23.1%)	0.02*
Oral lichen planus	20 (11.1%)	10 (7.7%)	
Fibroma	10 (5.6%)	10 (7.7%)	
Pseudomembranous oral candidiasis	0 (0.0%)	10 (7.7%)	

\*Chi-squared test; \*p < 0 indicates statistical significance.

**Figure 1. Study Flowchart****Figure 1.** Study flowchart illustrating the patient selection process.

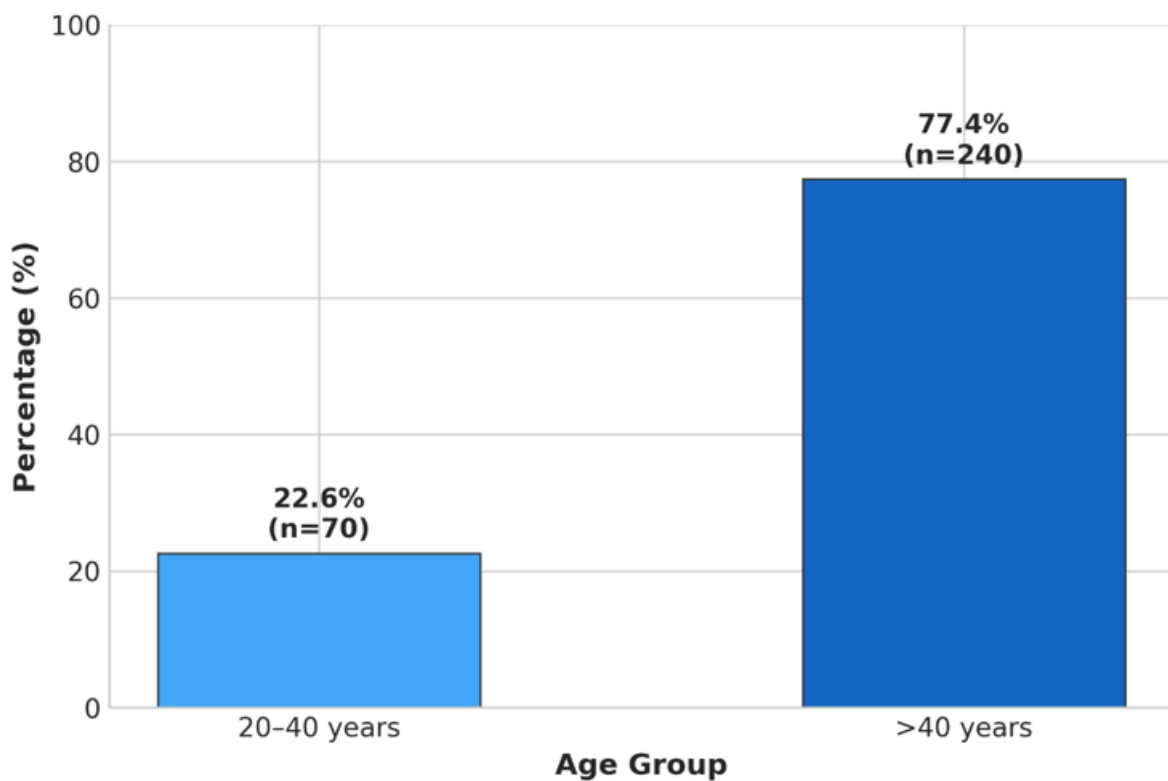


Figure 2. Distribution of study patients by age group (N = 310).



Figure 3. Distribution of study patients by sex (N = 310).

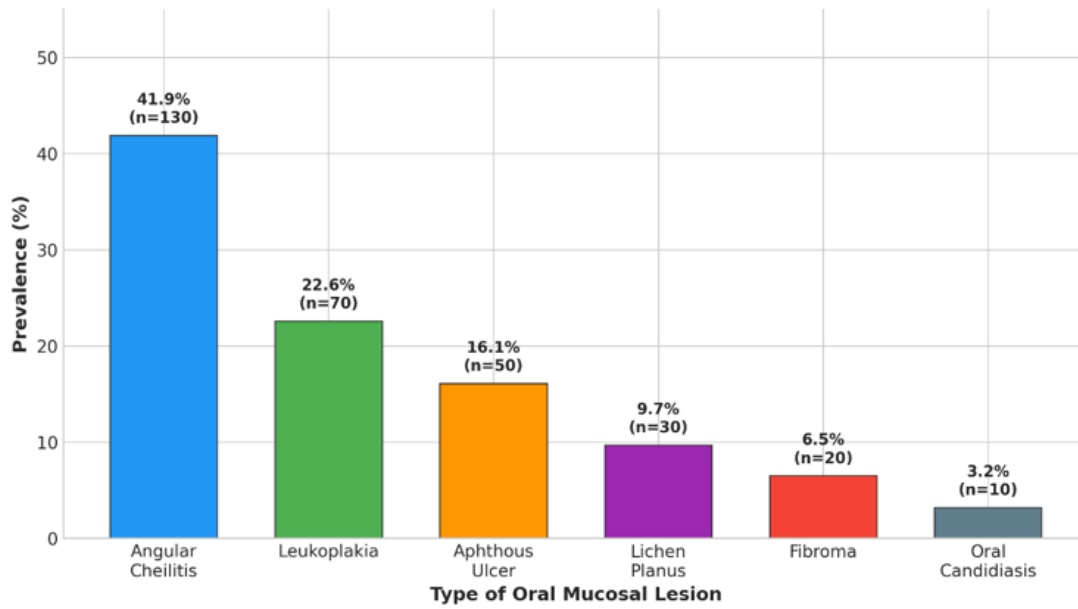


Figure 4. Distribution of oral mucosal lesions among study patients (N = 310).

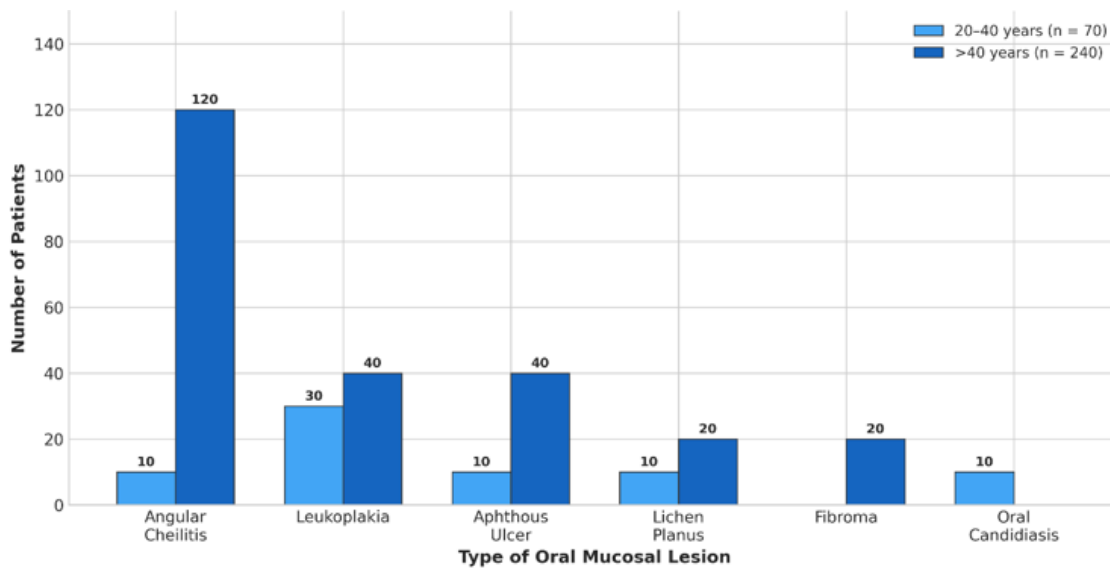
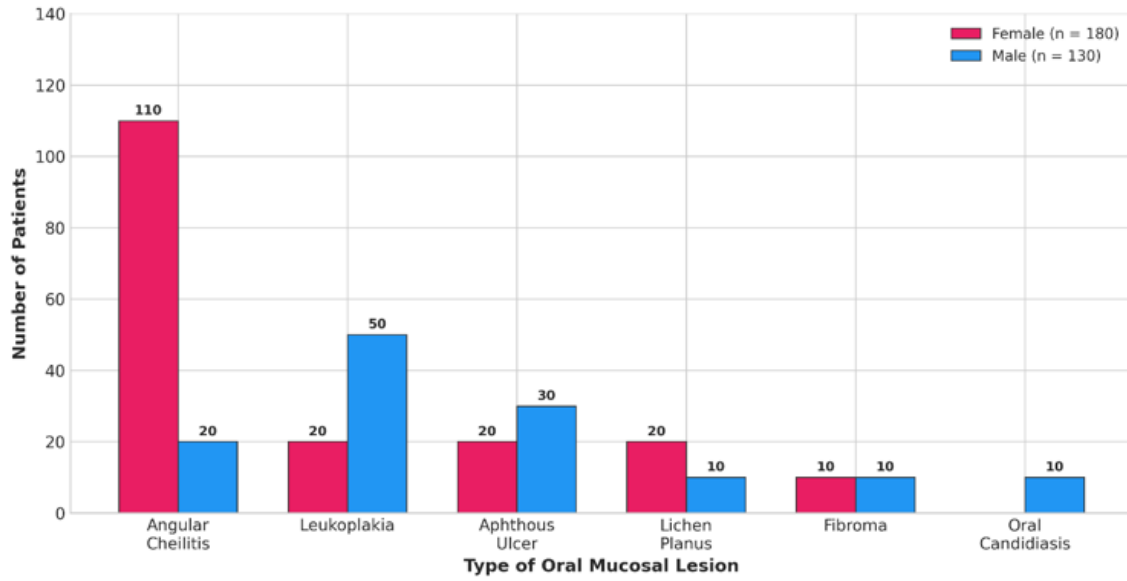


Figure 5. Distribution of oral mucosal lesions by age group (N = 310).



**Figure 6.** Distribution of oral mucosal lesions by sex (N = 310).