

Prevalence and Determinants of Oral Mucosal Lesions among Tobacco Users

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ABSTRACT

Objective: To find out the rate of oral mucosal lesions in tobacco users and to explore key related factors with the onset of oral lesions.

Methodology: A cross-sectional study was conducted in 110 habitual tobacco users, who had been in a dental outpatient department. Participants were recruited using a non-probability consecutive sampling technique. The structured questionnaire was used to determine demographic characteristics, nature and duration of tobacco exposure, and frequency of consumption. Statistical analyses were performed to assess associations with a significant level of p values less than 0.05 using statistical techniques such as descriptive statistics and chi-square tests.

Results: The mean age of the participants was 42.7 +/- 11.5 years, 70.9 percent were males and 47.3 percent of the sample smoked some form of tobacco who were using smokeless tobacco, and 40.9 percent were smokeless tobacco users consuming a smoked type of tobacco. Oral mucosal lesions were common among this group of people (58.2%), with leukoplakia (19.1%) and oral submucous fibrosis (16.4%) being the most widespread. It was found that the occurrence of lesions was substantially elevated depending on the duration of the use ($p = 0.004$) as well as smokeless tobacco use ($p = 0.03$).

Conclusion: Mucosal lesions of the oral mucosa are of high prevalence among users of tobacco, especially the users who are involved in the prolonged or smokeless consumption of tobacco

Keywords: Tobacco use, Oral mucosal lesions, Leukoplakia, Oral submucous fibrosis, Prevalence

1. INTRODUCTION

There is overwhelming evidence that suggests that tobacco use, regardless of whether it is smoked or smokeless tobacco, is one of the most critical risk factors influencing oral health. (1) The oral mucosa is constantly exposed to carcinogens and irritants found in the smokeless and smoke forms of tobacco, as well as heat produced by tobacco use. These agents can cause damage to the epithelial lining of the oral mucosa, disrupt cellular turnover, and provoke chronic inflammation, resulting in a variety of oral mucosal lesions (OMLs). (2) These can include leukoplakia, erythroplakia, oral submucous fibrosis, smoker's palate, and other ulcerative or pigmented changes. Many of these lesions could be classified as precancerous lesions, and hence, early detection and management of these lesions is essential to ameliorate the potential for oral cancer. (3) The widespread use of tobacco products in many countries, especially in South Asia, only adds to the burden of oral disease and resultant morbidity. (4)

Global statistics indicate a notable increase in tobacco use among all age groups, and particularly among younger and lower socio-economic groups.(5) Research shows that the likelihood of oral mucosal lesions is significantly higher in users of tobacco products compared to non-users.(6, 7) A few local surveys revealed that over one-third of tobacco users had at least one oral lesion.(8, 9) Prevalence can differ between tobacco product types, duration and frequency of use, and cultural factors. Smokeless tobacco products – including items such as paan, gutka, and betel quid- are especially associated with oral submucous fibrosis, while smoking tends to have a greater link to leukoplakia and the smoker's palate. (10, 11) Overall, these data strongly support that oral mucosal conditions related to tobacco use are prevalent public health issue with serious consequences.

While the association of tobacco consumption and oral mucosal lesions is widely established, there continues to be limited local information about the prevalence and contributory factors in many regions. Determining the circumstances that influence the lesions, whether it be the duration of habit, mode of tobacco consumption, socio-demographic factors, oral hygiene, and nutritional habits, is important to develop an early intervention and prevention strategy. Knowing the burden within a community or in a clinical patient population will help to design educational awareness programs, facilitate cessation of tobacco use, and implement regular assessment for oral mucosal lesions. Evidence-based knowledge in this space will also help inform policymakers to strengthen preventive dental care in their community. The objective of this study was to assess the prevalence of oral mucosal lesions among tobacco users and determine the primary factors influencing the development of oral mucosal lesions.

2. METHODOLOGY

This was a cross-sectional analytical study, which was done to determine prevalence and determinants of oral mucosal lesions among tobacco users. The research was conducted in the Outpatient Department of Oral biology, Faryal Dental College, Shaikhpora, Lahore-. The study time was spanning March, 2024 and March, 2025. All participants were told about the nature and goal of the study and verbal or written consent was obtained.

The sample size for this study was calculated using **OpenEpi, Version 3**, based on the prevalence of oral mucosal lesions among tobacco users reported in a previous similar study, where approximately 26.8% of tobacco users were found to have clinically detectable lesions.(12) Using a 95% confidence interval and 80% power, the minimum required sample size was calculated to be **110 participants**. A **non-probability consecutive sampling technique** was employed, whereby all eligible and consenting tobacco users who attended the dental outpatient department during the study period were included until the desired sample size was reached.

Inclusion criteria consisted of: adults aged 18 years and above, current users of smoked or smokeless tobacco for at least the past one year, and those who provided informed consent willingly. **Exclusion criteria** included patients with diagnosed systemic or autoimmune conditions known to cause oral mucosal alterations (e.g., lichen planus, pemphigus), individuals currently receiving treatment for oral precancerous or cancerous lesions, ex-tobacco users who had quit for more than one year, and participants who were unable or unwilling to undergo oral examination.

There were two significant aspects of data collection: a questionnaire that was conducted by an interviewer and a thorough clinical oral examination. Demographic factors like age, gender, occupation, as well as socioeconomic status were noted in the questionnaire, and other specific tobacco related factors like the type of tobacco used (whether smoked or smokeless), years in which the habit started, frequency of use on a day to day basis, and other related habits (like alcohol drinking or betel nut chewing). Oral examination was conducted under natural day lighting or clinical examination lighting, through the application of mouth mirror and probe when the participant was sitting in a dental chair. The systemic examination of the mucosa of the lips, buccal mucosa, gingiva, tongue, floor of the mouth, palate, and oropharynx is done. In case of any lesion identified, it was recorded in terms of type, color, location, surface appearances, and symptoms. Lesions were clinically categorized using standard diagnostic criteria for leukoplakia, erythroplakia, oral submucous fibrosis, smoker's palate, aphthous ulcers, and tobacco pouch keratosis.

All data collected were analyzed and fed into SPSS software 26. Data was summarized with descriptive statistics; percentages and frequencies were utilized in data that was categorical and mean and standard deviation were used on continuous data. Chi-square test was used to determine whether there is an association between independent variables (type, duration and frequency of tobacco use, demographic factors) and the occurrence of oral mucosal lesions. A p-value ≤ 0.05 was considered a statistically significant value. The results were provided in tables and charts to make the presentation clear and easy to interpret.

3. RESULTS

The participants in the study were mostly of middle adulthood as the mean age of the participants was 42.7 $\pm$ 11.5 years. The sample was predominantly male with a representation of about two-thirds of the study population with females constituting the minor percentage. More of the participants lived in rural as opposed to urban environment. In terms of educational status, nearly half of the participants had completed schooling up to the primary or matric level, whereas a smaller

proportion were illiterate and an even smaller percentage had attained higher secondary or college education. Socioeconomic assessment showed that more than half of the participants belonged to lower income groups, with fewer individuals categorized in the middle and high socioeconomic strata.(Table 1).

Table 1: Socio-Demographic Characteristics of Study Participants (n = 110)

Variable	Category	n(%)/Mean ± SD
Age (years)	—	42.7 ± 11.5
Gender	Male	78 (70.9%)
	Female	32 (29.1%)
Residence	Urban	45 (40.9%)
	Rural	65 (59.1%)
Education Level	Illiterate	31 (28.2%)
	Primary to Matric	56 (50.9%)
	Intermediate & Above	23 (20.9%)
Socioeconomic Status	Low	63 (57.3%)
	Middle	39 (35.5%)
	High	8 (7.2%)

Nearly half of the participants reported the use of smokeless tobacco products such as paan, gutka, or betel quid, while a slightly smaller proportion were smokers, and a small minority used both forms of tobacco. Regarding the duration of tobacco consumption, a considerable number of individuals had been using tobacco for five to ten years, with almost an equal proportion having continued the habit for over ten years, indicating a long-term pattern of use among many participants. The frequency of daily tobacco use varied, with a notable portion consuming tobacco six to ten times per day, followed by those using it more than ten times daily and a smaller group using it five times or less.(Table 2).

Table 2: Tobacco Use Characteristics of Participants (n = 110)

Variable	Category	n (%)
Type of Tobacco Used	Smokeless (paan/gutka/betel quid)	52 (47.3%)
	Smoked (cigarette/huqqa)	45 (40.9%)
	Both Forms	13 (11.8%)
Duration of Habit	< 5 years	29 (26.4%)
	5–10 years	41 (37.3%)
	> 10 years	40 (36.3%)
Frequency of Use/Day	≤ 5 times/day	33 (30.0%)
	6–10 times/day	48 (43.6%)
	> 10 times/day	29 (26.4%)

Over 50% of the subjects had one or more oral mucosal lesions, and the prevalence of oral mucosal lesions was found to be 58.2% by the study population. Leukoplakia was the most common lesion that was detected, and then oral submucous fibrosis

(OSMF), which shows that there is a significant association between chronic tobacco exposure and the occurrence of potentially malignant disorders. Another palate that was reported in a significant number of participants was that of Smoker and more especially those who reported of having regular habits of smoking. Tobacco pouch keratosis was observed in those who mostly used smokeless tobacco that was fixed habitually in the buccal vestibule. Only a minor percentage of the participants were given recurrent ulcerative lesions. In the meantime, a significant portion of the sample had no observable lesions clinically. (Table 3).

Table 3: Prevalence and Types of Oral Mucosal Lesions (n = 110)

Type of Lesion	n (%)
No Visible Lesion	46 (41.8%)
Leukoplakia	21 (19.1%)
Oral Submucous Fibrosis (OSMF)	18 (16.4%)
Smoker's Palate	14 (12.7%)
Tobacco Pouch Keratosis	7 (6.4%)
Recurrent Ulcerative Lesions	4 (3.6%)

It was also shown that there was a significant relationship between the time period and the existence of the oral mucosal lesions. People with a shorter history of tobacco use exhibited a relatively lower prevalence of lesions, but again, those with a longer history of use, especially those who had used it for over ten years, proved to have a significantly higher percentage of lesions that could be clinically detected. The statistical significance of the difference between lesion occurrence under various lengths of the use period was statistically significant, which results in the fact that with the increase in the length of tobacco exposure, the probability of the appearance of the oral mucosal abnormalities is also increased. (Table 4)

Table 4: Association between Duration of Tobacco Use and Presence of Oral Mucosal Lesions

Duration of Habit	Lesions Present n (%)	No Lesions n (%)	p-value
< 5 years (n=29)	9 (31.0%)	20 (69.0%)	
5–10 years (n=41)	25 (61.0%)	16 (39.0%)	0.004
> 10 years (n=40)	30 (75.0%)	10 (25.0%)	
<i>Chi-square test applied; $p \leq 0.05$ considered statistically significant.</i>			

On the same note, in making a comparison of the type of tobacco used, oral lesions were more common in those who had smokeless tobacco. Individuals who smoked smokeless tobacco like paan, gutka or betel quid had a higher incidence of the development of lesions than smokers. The population that smoked and smokeless obtained a relatively lower prevalence of lesions, though this could be explained by the fact that the sample population in the category is smaller. The association between the type of tobacco used and the presence of lesions was statistically significant, highlighting smokeless tobacco as a particularly high-risk habit for the development of oral mucosal disorders. (Table 5)

Table 5: Association between Type of Tobacco and Lesion Occurrence

Type of Tobacco	Lesions Present n (%)	No Lesions n (%)	p-value
Smokeless (n=52)	35 (67.3%)	17 (32.7%)	
Smoked (n=45)	23 (51.1%)	22 (48.9%)	0.032
Both Forms (n=13)	6 (46.2%)	7 (53.8%)	

4. DISCUSSION

Our study found a high overall prevalence of oral mucosal lesions (58.2%) among tobacco users, which was broadly consistent with several recent clinic-based reports that documented elevated OML burdens in tobacco-exposed populations. Studies that examined tobacco-associated oral lesions reported similarly high rates of OMLs among users, reflecting the concentrated burden seen in clinical samples.(13, 14)

Leukoplakia was the single most frequent lesion in our sample (19.1%). This proportion exceeded the pooled population-level prevalence estimates for oral leukoplakia reported in a 2023 systematic review, which estimated lower prevalence in general population samples but higher figures in high-risk and clinic populations. Our higher clinic-based leukoplakia frequency therefore, aligned with the expectation that targeted, tobacco-using cohorts show greater leukoplakia rates than community surveys.(13, 15)

Oral submucous fibrosis (OSMF) accounted for 16.4% of lesions in our data, an observation that agreed with regional studies from South Asia that continued to report substantial OSMF burdens where areca nut and smokeless tobacco are widely used. A recent prevalence synthesis of OSMF noted substantial geographic variation but similarly elevated estimates in populations with high areca/tobacco chewing habits, supporting the plausibility of our OSMF proportion.(16, 17)

Smoker's palate (12.7%) and tobacco pouch keratosis (6.4%) were also common in our cohort; these lesion patterns mirrored findings from earlier clinical series that described palatal hyperkeratosis as predominating among smokers and pouch keratosis among chewers. A study documented palatal keratosis and chewers' mucosa as frequent tobacco-related changes, which were concordant with our distribution by lesion type.(18)

We observed a clear, graded relationship between duration of tobacco use and lesion prevalence (31.0% for <5 years; 61.0% for 5–10 years; 75.0% for >10 years), and this temporal trend agreed with mechanistic expectations and empirical data showing cumulative exposure effects. Longitudinal and cross-sectional cytological and histological investigations demonstrated progressive epithelial and cellular changes with increasing exposure to smokeless tobacco and smoking, which supported our finding that prolonged use markedly increased lesion risk.(10, 19, 20)

When lesions were compared by tobacco form, smokeless tobacco users in our sample had a higher lesion prevalence (67.3%) than smokers (51.1%), and the association reached statistical significance. This was in line with multiple recent studies and reviews that identified chewing/tobacco quid use as a particularly strong driver of OSMF, pouch keratosis and leukoplakia; reviews emphasized that smokeless products often produce focal, high-concentration mucosal exposure to nitrosamines and areca nut alkaloids, which explain the stronger local lesion burden.(10, 21)

Several recent Pakistani and regional studies had findings consonant with ours in that they emphasized the combined effects of lower socio-economic status, male gender predominance, and low education on higher tobacco exposure and lesion frequency. Those contextual factors likely explained the demographic distribution in our sample and suggested that socio-behavioral determinants were important targets for intervention in similar populations.(22)

Overall, our results were largely consistent with the recent 2020–2025 literature: clinic-based samples showed high OML prevalence; smokeless tobacco and longer duration were repeatedly associated with greater lesion frequency; and lesion spectra (leukoplakia, OSMF, palatal keratosis, pouch keratosis) matched patterns reported in regional and systematic studies. Sampling frames and clinic settings in our study were possible explanations for the differences with several population-based surveys. These comparisons not only assisted in the fairness of our results to the external world but also highlighted the ongoing public-health issue of tobacco use in the region under study.

5. CONCLUSION

The study revealed that oral mucosal lesions were very high in the tobacco users which can be attributed to high oral health challenge in the community. The most common lesions known to be precancerous lesions include leukoplakia, oral submucous fibrosis and smoker palate hence depicting the dangers of oral cancer developing in the absence of the knowledge of these lesions. The findings clearly show that the risk of development of oral lesions is an increasing concern with long-term use of tobacco particularly after ten years and that such a risk is more imminent among the users of smokeless tobacco such as paan, gutka, and betel quid. These trends show that behavioral exposure also plays a major role in the variation of the changes induced in the oral mucosa in addition to the type of tobacco habit. Based on these results, this factor requires screenings of those individuals who use tobacco actively, at a tender age in order to prevent the onset and development of potentially dangerous diseases. Community and primary care-based prevention can play a significant role in the future burden of oral cancer reduction and contribute to a better oral health status of at-risk individuals

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