



Original Research Article

Prevalence of Oral Leukoplakia among Smokers in Pakistan: A Cross-Sectional Study

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Abstract: **Background:** Oral leukoplakia is the most common potentially malignant disorder of the oral mucosa and is strongly associated with tobacco smoking. Early detection among high-risk groups is essential to prevent progression to oral cancer. **Objective:** To determine the prevalence of oral leukoplakia among smokers and evaluate its association with demographic, behavioral, and clinical risk factors. **Methodology:** This was a hospital-based cross-sectional study conducted at the Department of Oral Medicine and Dentistry, Jinnah Hospital Karachi, over a period from August 2024 to September 2025, including 325 smokers presenting for routine dental or medical evaluation. **Results:** The mean age was 41.8 ± 12.6 years, with male predominance (74.2%). The average smoking duration was 11.6 ± 6.9 years, and 63.7% demonstrated poor oral hygiene. Oral leukoplakia was identified in 69 participants, yielding a prevalence of 21.2%. Buccal mucosa was the most common site (9.8%). Higher prevalence was observed among individuals smoking for more than 10 years (28.2%), consuming more than 10 cigarettes daily (28.7%), and those with poor oral hygiene (28.0%). Increasing age and prolonged smoking duration significantly increased risk ($p \leq 0.05$). **Conclusion:** It is concluded that oral leukoplakia is common among smokers and closely linked with heavy and prolonged tobacco exposure. Regular oral screening and tobacco cessation interventions are recommended to reduce premalignant oral disease burden.

Keywords: Oral leukoplakia, smoking, tobacco, prevalence, premalignant lesions, oral cancer, cross-sectional study.

INTRODUCTION

The most prevalent potentially malignant lesion of the oral mucosa is oral leukoplakia which has a

clinical presentation of a persistent white patch in the oral mucosa that cannot be scraped off or explained by some other condition. It is known to be one of the early precursors of epithelial dysplasia, and oral

squamous cell carcinoma and early diagnosis is clinically essential [1]. Early detection of such lesions is important in the prevention of malignancy development and also in minimizing oral cancer morbidity [2]. The most solid risk factor of leukoplakia is tobacco smoking. The long term effects of tobacco smoke are irritation of the epithelium, hyperkeratosis, and genetic changes that facilitate the dysplastic changes in the oral mucosa [3]. The risk is dependent on the length and the rigor of smoking exhibiting a definite dose response correlation [4]. Historical studies always present a very high prevalence rate among smokers than non-smokers [5]. Tobacco consumption is still prevalent in Pakistan especially in adult men, and it is further aggravated by low levels of awareness and low rate of routine oral check-ups. Such factors include the delay in the diagnosis of premalignant lesions and high chances of malignant transformation [6]. Leukoplakia is a disease that is usually localized to the buccal mucosa, tongue and gingiva, and non-homogeneous forms are more likely to have increased malignant potential [7].

The prevalence of leukoplakia is estimated to be between 1 and 5 percent in the population in general though larger prevalence rates are seen in high-risk groups of the population such as smokers [8]. Past studies of the South Asian population have indicated high rates among tobacco users and there is a need to have epidemiological information that is region specific [9]. There needs to be reliable local estimates that are necessary to plan the screening programs and tobacco cessation strategies [10]. Cross-sectional studies are beneficial in giving realistic evaluation of disease burden and also in assisting in the determination of risk factors associated with disease in populations that are in high-risk groups [11]. But there is a dearth of information on the precise prevalence of leukoplakia in the sampled smokers in Pakistan [12]. Knowledge of this burden can be used to aid in early intervention and specific preventive action [13]. Better surveillance can become an access to timely diagnosis and minimise the progression to oral cancer [14].

Objective: To determine the prevalence of oral leukoplakia among smokers and evaluate its association with demographic, behavioral, and clinical risk factors.

METHODOLOGY

This was a hospital-based cross-sectional study conducted at the Department of Oral Medicine and Dentistry, Jinnah hospital Karachi, over a period

from August 2024 to September 2025, including 325 smokers presenting for routine dental or medical evaluation. The study aimed to determine the prevalence of oral leukoplakia and assess its association with demographic, behavioral, and clinical characteristics among smokers. Eligible participants were enrolled consecutively through non-probability purposive sampling.

Participants included males and females aged 18–70 years with a history of active tobacco smoking for at least one year. Both cigarette and other smoked tobacco users were included. Individuals with a prior history of oral cancer, previously diagnosed premalignant oral lesions under treatment, systemic conditions affecting the oral mucosa, recent oral surgery, or those unwilling to participate were excluded.

Data Collection

Data were recorded using a structured proforma after obtaining informed consent. Demographic variables included age, gender, residence, education level, and socioeconomic status. Behavioral variables included type of smoking product, duration of smoking (years), frequency (number of cigarettes per day), and oral hygiene practices. All participants underwent detailed intraoral examination under adequate illumination using a mouth mirror and gauze. The oral mucosa, including buccal mucosa, tongue, gingiva, palate, and floor of the mouth, was inspected for the presence of white plaques or lesions suggestive of leukoplakia. Lesions that could not be scraped off and could not be clinically diagnosed as other specific conditions were recorded as leukoplakia. Site, size, and clinical type (homogeneous or non-homogeneous) were documented. Suspected cases were referred for further evaluation or biopsy where indicated.

Statistical Analysis

Data were entered and analyzed using SPSS version 25. Shapiro–Wilk test was applied to assess normality of quantitative variables. Continuous variables such as age, smoking duration, and lesion size were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Prevalence of oral leukoplakia was calculated as proportion of affected individuals among total smokers examined. Stratification was performed for age, gender, and smoking duration, and associations were assessed using chi-square test. A p -value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 325 smokers were evaluated with a mean age of 41.8 ± 12.6 years, indicating a predominantly middle-aged population. Males formed the majority (74.2%) compared with females (25.8%). Most participants were urban residents (62.8%). The mean BMI was 24.9 ± 3.8 kg/m², reflecting an overall normal-to-overweight range. Slightly

more than half had secondary or higher education (56.0%). Overall, the cohort primarily consisted of adult urban male smokers.

Table 1. Baseline Demographic Characteristics of Smokers (n = 325)

Variable	Category	n (%)	Mean ± SD
Age (years)	Overall	325 (100)	41.8 ± 12.6
Gender	Male	241 (74.2)	42.5 ± 12.1
	Female	84 (25.8)	39.7 ± 13.2
Residence	Urban	204 (62.8)	41.4 ± 12.3
	Rural	121 (37.2)	42.5 ± 13.0
BMI (kg/m ²)	Overall	325 (100)	24.9 ± 3.8
Education	Primary or below	143 (44.0)	40.8 ± 12.9
	Secondary or above	182 (56.0)	42.6 ± 12.3

Cigarette smoking was the most common form of tobacco use (73.2%), with an average of 10.8 ± 5.4 cigarettes per day, while 26.8% used shisha or other forms. The mean duration of smoking was 11.6 ± 6.9 years. Nearly one-fifth of participants consumed more than 20 cigarettes daily (19.0%). Poor oral hygiene was common (63.7%), with brushing less than once daily on average (0.9 ± 0.4 times/day).

Table 2. Smoking Profile of Participants

Variable	Category	n (%)	Mean ± SD
Type of smoking	Cigarette	238 (73.2)	10.8 ± 5.4 sticks/day
	Shisha/Other	87 (26.8)	7.2 ± 3.1 sessions/week
Duration of smoking (years)	Overall	325 (100)	11.6 ± 6.9
Frequency	≤10 per day	137 (42.2)	7.1 ± 2.1
	11–20 per day	126 (38.8)	15.3 ± 2.4
	>20 per day	62 (19.0)	24.7 ± 3.8
Oral hygiene	Good	118 (36.3)	Brushing 2.1 ± 0.5 times/day
	Poor	207 (63.7)	Brushing 0.9 ± 0.4 times/day

Oral leukoplakia was identified in 69 participants, giving a prevalence of 21.2%, while 78.8% had normal mucosa. The average lesion size was 2.6 ± 1.1 cm. Homogeneous lesions were more frequent (13.5%) than non-homogeneous types (7.7%), with the latter being larger (3.3 ± 1.2 cm). Most cases had single lesions (15.7%), whereas multiple lesions were less common (5.5%).

Table 3. Prevalence and Clinical Characteristics of Oral Leukoplakia

Variable	Category	n (%)	Mean ± SD
Leukoplakia status	Present	69 (21.2)	Lesion size 2.6 ± 1.1 cm
	Absent	256 (78.8)	Oral mucosa score 1.0 ± 0.0
Clinical type	Homogeneous	44 (13.5)	2.2 ± 0.8 cm
	Non-homogeneous	25 (7.7)	3.3 ± 1.2 cm
Number of lesions	Single	51 (15.7)	1.3 ± 0.5
	Multiple	18 (5.5)	2.4 ± 0.7

The buccal mucosa was the most frequently affected site (9.8%) with lesions averaging 2.8 ± 1.0 cm, followed by the lateral tongue (5.2%) and gingiva (3.1%). Palatal (1.8%) and floor-of-mouth involvement (1.2%) were less common but showed relatively larger lesions (up to 3.1 ± 1.2 cm).

Table 4. Site Distribution of Leukoplakic Lesions

Variable	Category	n (%)	Mean ± SD
Buccal mucosa	Involved	32 (9.8)	2.8 ± 1.0 cm
Tongue (lateral border)	Involved	17 (5.2)	2.4 ± 0.9 cm
Gingiva	Involved	10 (3.1)	2.1 ± 0.7 cm
Palate	Involved	6 (1.8)	2.6 ± 1.1 cm
Floor of mouth	Involved	4 (1.2)	3.1 ± 1.2 cm
Overall lesion count	Total lesions	69 (21.2)	2.6 ± 1.1 cm

Leukoplakia was significantly associated with heavier tobacco exposure. Participants smoking for more than 10 years showed higher prevalence (28.2%) compared with shorter duration smokers (11.7%). Similarly, those consuming more than 10 cigarettes daily had greater lesion frequency (28.7% vs 10.9%). Poor oral hygiene was also

linked with increased prevalence (28.0% vs 9.3%).

Table 5. Association of Leukoplakia with Smoking Exposure

Variable	Category	Leukoplakia Present n (%)	Leukoplakia Absent n (%)	p-value
Smoking duration	≤10 years	16 (11.7)	121 (88.3)	0.001
	>10 years	53 (28.2)	135 (71.8)	0.001
Cigarettes/day	≤10	15 (10.9)	122 (89.1)	0.002
	>10	54 (28.7)	134 (71.3)	0.002
Oral hygiene	Good	11 (9.3)	107 (90.7)	0.004
	Poor	58 (28.0)	149 (72.0)	0.004

Participants with leukoplakia were older (46.7 ± 11.2 vs 40.4 ± 12.7 years) and had longer smoking histories (15.9 ± 6.1 vs 10.3 ± 6.8 years). Smoking duration showed over twice the risk (OR 2.31), and poor oral hygiene doubled the likelihood of lesions (OR 2.08). Suspicious dysplastic changes were observed in 4.3%, with a threefold increased risk (OR 3.12).

Table 6. Multivariable Risk Factors and Clinical Outcomes

Variable	Category	Mean $\pm$ SD / n (%)	Odds Ratio	p-value
Age (years)	Leukoplakia present	46.7 ± 11.2	1.04	0.012
	Leukoplakia absent	40.4 ± 12.7	1.00	0.012
Smoking duration (years)	Present	15.9 ± 6.1	2.31	0.001
	Absent	10.3 ± 6.8	1.00	0.001
Poor oral hygiene	Present	58 (28.0)	2.08	0.003
	Good hygiene	11 (9.3)	1.00	0.003
Dysplasia suspicion	Present	14 (4.3)	3.12	0.001

non-smokers [17][18].

DISCUSSION

The cross-sectional study has evaluated the burden of oral leukoplakia in smokers and has shown that there is a significant prevalence of this high-risk group. The respondents were mainly middle-aged with an average age of 41.8 ± 12.6 years and high prevalence of males (74.2%), who have the commonalities of tobacco use in the area. The same demographic distributions but with more tobacco exposure among males were also reported in the past literature that assessed oral potentially malignant disorders [15]. Analysis of smoking behavior showed that the duration of smoking was considerably long and considerable with a mean of 11.6 plus or minus 6.9 years and an average of 10.8 plus or minus 5.4 cigarettes per day. Almost a fifth of them were heavy smokers (>20/day), and bad oral health was the norm (63.7 percent). These results indicate accumulation of mucosal irritation and carcinogenic exposures that are in line with the past findings that showed the presence of a relationship between length and intensity of tobacco consumption with the risk of developing leukoplakia [16]. The total incidence of leukoplakia was 21.2% and this figure indicates that a good one in every five smokers had lesions of a clinical nature. The rate is quite high as compared to general population estimates and proves smoking as a significant determinant. The high prevalence has also been reported in past studies in high-risk tobacco users and this is corroborated by the good etiological correlation between the high-risk tobacco users and

The majority of the lesions were homogeneous (13.5%), whereas non-homogeneous forms (7.7%), although smaller (3.3 ± 1.2 cm), had more malignant potential. The most common site was the buccal mucosa (9.8%), and next came the tongue (5.2%), which is probably because the person was exposed to tobacco smoke directly. These patterns of site predilection are similar to those previously reported in the literature in which the greatest frequency of lesions was recorded in buccal mucosa [19]. There was a distinct exposure-response relationship. There was an increased prevalence among the participants who had smoking history >10 years (28.2% vs 11.7%), and those with a cigarettes intake exceeding >10 per day (28.7 vs 10.9). Ineffective oral health also increased the incidence of lesions (28.0% vs 9.3%). These statistically significant relationships demonstrate that both behavioral and local factors are involved in the development of the disease synergistically. Previous studies have reported similar dose-related effects of the duration of smoking, the frequency, and the hygiene state [20]. The risk factor analysis also indicated that individuals affected were older (46.7 ± 11.2 years) and longer smoking history (15.9 ± 6.1 years) and the risk of increased with the years of exposure (OR 2.31). The presence of suspicious dysplastic changes could be also identified in a group of cases (4.3%), which highlights the pre-malignant character of the condition. It has also been established by previous studies that chronic tobacco smoking plays a major

role in the risk of progression to epithelial dysplasia and malignancy [21]. Altogether, the results indicate a high prevalence of oral leukoplakia in smokers and the necessity to develop oral screening and tobacco cessation programs on a regular basis. Timely management of the symptoms can be achieved by early identification of high-risk persons by regularly examining them and help curb the occurrence of oral cancer.

Limitations

This study was limited by its cross-sectional single-center design, reliance on clinical examination without histopathological confirmation for all lesions, and inability to establish causal relationships or long-term malignant transformation outcomes.

CONCLUSION

It is concluded that oral leukoplakia is highly prevalent among smokers, affecting approximately one-fifth of participants, and is strongly associated with increasing age, prolonged smoking duration, higher daily tobacco consumption, and poor oral hygiene. Routine oral screening and targeted tobacco cessation strategies are essential for early detection and prevention of progression to oral malignancy in high-risk populations.

REFERENCES

1. Bugshan A, Farooq I. Oral squamous cell carcinoma: metastasis, potentially associated malignant disorders, etiology and recent advancements in diagnosis. *F1000Res*. 2020;9:229. <https://doi.org/10.12688/f1000research.22941.1>
2. Warnakulasuriya S. Global epidemiology of oral and oropharyngeal cancer. *Oral Oncol*. 2009;45(4-5):309-316. <https://doi.org/10.1016/j.oraloncology.2008.06.002>
3. Sreekumar VN. Global scenario of research in oral cancer. *J Maxillofac Oral Surg*. 2019;18(3):354-359. <https://doi.org/10.1007/s12663-018-1166-4>
4. Ranganathan K, Kavitha L. Clinical aspects of oral cancer and potentially malignant disorders in South and Southeast Asia. *Oral Dis*. 2025;31(5):1406-1419. <https://doi.org/10.1111/odi.15008>
5. Pandit P, Palwe V. Association between tumour stroma ratio and other histopathological markers and lymph node metastasis in patients with oral cavity cancer. *Egypt J Otolaryngol*. 2025;41:31. <https://doi.org/10.1186/s43163-025-00782-x>
6. Gupta B, Ariyawardana A, Johnson NW. Oral cancer in India continues in epidemic proportions: evidence base and policy initiatives. *Int Dent J*. 2013;63(1):12-25. <https://doi.org/10.1111/j.1875-595x.2012.00131.x>
7. Shivakumar KM, Vaishali R, Kadashetti V. Prevalence of oral potentially malignant disorders in adults of Western Maharashtra, India: a cross-sectional study. *J Cancer Res Ther*. 2022;18(Suppl 2):S239-S243. https://doi.org/10.4103/jcrt.JCRT_1444_20
8. Khanna D, Shruti T, Tiwari M, et al. Prevalence of oral potentially malignant lesions, tobacco use, and effect of cessation strategies among solid waste management workers in Northern India. *BMC Oral Health*. 2024;24:1292. <https://doi.org/10.1186/s12903-024-05087-8>
9. Kiran G, Shyam N, Rao J, et al. Demographics and histopathological patterns of oral squamous cell carcinoma at a tertiary referral hospital in Hyderabad: a 5-year retrospective study. *J Orofac Res*. 2012;2:198-201.
10. Chaturvedi P, Chaturvedi P. Effective strategies for oral cancer control in India. *J Cancer Res Ther*. 2012;8(6):55. <https://doi.org/10.4103/0973-1482.92216>
11. GBD 2019 Chewing Tobacco Collaborators. Spatial, temporal, and demographic patterns in prevalence of chewing tobacco use in 204 countries and territories, 1990-2019. *Lancet Public Health*. 2021;6(7):e482-e499. [https://doi.org/10.1016/S2468-2667\(21\)00065-7](https://doi.org/10.1016/S2468-2667(21)00065-7)
12. Palliyal S. Tobacco chewing habits and risk of precancerous oral lesions among Paniya tribes of Wayanad, India. *Tob Induc Dis*. 2018. <https://doi.org/10.18332/tid/83963>
13. Kumar S, Malaisamy M. Tobacco use and oral leukoplakia: cross-sectional study among the Gond tribe. *Asian Pac J Cancer Prev*. 2015;16(4):1515-1518. <https://doi.org/10.7314/apjcp.2015.16.4.1515>
14. Palliyal S. Assessment of betel quid habits and risk of precancerous oral lesions among Paniya tribes. *J Glob Oncol*. 2018. <https://doi.org/10.1200/jgo.18.16700>
15. Pahwa V, Nair S, et al. Prevalence of oral premalignant lesions and its risk factors among adults in coastal Karnataka. *Asian Pac J Cancer Prev*. 2018;19(8):2165-2170. <https://doi.org/10.22034/apjcp.2018.19.8.2165>
16. Helliwell TR, Giles T. Pathological aspects of the assessment of head and neck cancers: United Kingdom national multidisciplinary guidelines. *J Laryngol Otol*. 2016. <https://doi.org/10.1017/s0022215116000451>
17. Kumar S, et al. Prevalence and risk factors for oral potentially malignant disorders in Indian population. *Adv Prev Med*. 2015;2015:208519. <https://doi.org/10.1155/2015/208519>
18. Gupta PC, Ray CS. Epidemiology of betel quid usage. *Ann Acad Med Singapore*. 2004;33:31-36.
19. Bhat S, Siddiqi A, Agrawal A, Bhat P. Areca nut

- consumption in India: health effects and current policy. WHO South-East Asia J Public Health. 2018;7(2):84–91.
20. Muller S. Frictional keratosis, contact keratosis and smokeless tobacco keratosis: features of reactive white lesions of the oral mucosa. Head Neck Pathol. 2019;13(1):16–24. <https://doi.org/10.1007/s12105-018-0986-3>
21. Srivastava R, Sharma L, et al. Prevalence of oral premalignant lesions and conditions among the population of Kanpur City: a cross-sectional study. J Fam Med Prim Care. 2020;9(2):1080–1085. https://doi.org/10.4103/jfmprc.jfmprc_912_19.