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Burden and clinical spectrum of tobacco-related oral lesions: A cross-sectional study in India

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Abstract:
Tobacco use is a major risk factor for oral mucosal lesions and other oral diseases. Therefore, it is of interest to assess the tobacco use and associated oral mucosal lesions among 2725 dental outpatients in Chhattisgarh. Smokeless tobacco was the most common form and about 56% of participants reported tobacco use. Among tobacco users, 42.39% had oral mucosal lesions, with tobacco pouch keratosis and oral submucous fibrosis being the most frequent. Thus, data shows the burden of tobacco-related oral lesions supporting targeted tobacco cessation and early screening programs.

Keywords: Tobacco use, oral mucosal lesions, Chhattisgarh, cross-sectional study, smokeless tobacco, fagerstrom test

Background:
The tobacco epidemic remains one of the most important global public health challenges, accounting for more than 8 million deaths annually, including approximately 7 million among tobacco users and 1.2 million among individuals exposed to second-hand smoke **[1]**. Tobacco use is a leading preventable cause of mortality and is strongly associated with cancers, cardiovascular diseases, chronic respiratory disorders and several other non-communicable diseases, with the greatest burden occurring in low- and middle-income countries **[2]**. More than 80% of the world's tobacco users reside in these regions, where limited access to preventive healthcare and cessation services further increases tobacco-related morbidity and mortality **[3].** India is the world's second-largest consumer and third-largest producer of tobacco, contributing nearly one million tobacco-related deaths each year and representing a major public health concern **[4]**. According to the Global Adult Tobacco Survey (GATS-2), tobacco use affects more than one-quarter of Indian adults, with higher prevalence reported in rural populations than in urban populations **[5]**. Tobacco is consumed in both smoked and smokeless forms, including cigarettes, bidi, gutka, khaini, betel quid with tobacco and other locally available products, with considerable regional and sociocultural variation in usage patterns **[5].** Tobacco consumption has profound effects on oral health and is a well-established risk factor for oral cancer, periodontal disease, delayed wound healing, halitosis, gingival recession, tooth discoloration and a wide spectrum of oral mucosal lesions **[6]**. Both smoked and smokeless tobacco exposes the oral mucosa to numerous toxic and carcinogenic compounds that induce chronic irritation, epithelial alterations and potentially malignant disorders. Early recognition of these lesions during routine dental examination provides an opportunity for timely intervention, tobacco cessation counselling and prevention of disease progression **[7].** Therefore, it is of interest to evaluate the prevalence of tobacco use, associated oral mucosal lesions and tobacco dependence among patients attending the Dental Outpatient Department of Maitri College of Dentistry and Research Centre, Anjora (Durg), Chhattisgarh.

Materials and Methods:
This single-centered, descriptive, cross-sectional study was conducted in the Dental Outpatient Department, Maitri College of Dentistry and Research Centre, Anjora (Durg), Chhattisgarh, between August 2019 and November 2019, after obtaining approval from the Institutional Review Board and written informed consent from all participants. A total of 2725 patients aged over 15 years (1848 males, 877 females) were enrolled through a convenience sampling technique. Patients with a medical history of prolonged systemic or mental illness and those undergoing radiotherapy, were excluded. Patient confidentiality and anonymity were maintained throughout the study and all participants were informed of the study's purpose, procedures and expected outcomes prior to enrolment. Examinations were performed using standard armamentarium comprising a sterilized mouth mirror, explorer and dental probe, hand gloves, mouth mask, sterilizing solution, toluidine blue, 1% acetic acid, ice-cream (Popsicle) sticks, gauze pieces and cotton rolls. Each participant was interviewed using a structured, pre-validated questionnaire recording demographic characteristics, form of tobacco use (smoked or smokeless) and pattern, frequency and duration of use. Tobacco dependence was assessed using the Fagerstrom Test for Nicotine Dependence (FTND) for smokers and the modified Fagerstrom Test for Nicotine Dependence - Smokeless Tobacco (FTND-ST) for smokeless tobacco users, with the resulting Tobacco Dependence Score categorized as low (0–3), medium (4–6), or high (7–10)**.** This was followed by a type-III clinical oral mucosal examination performed by trained clinicians to identify and localize oral mucosal lesions, applying the WHO criteria for the

assessment of oral mucosal diseases and conditions; diagnoses were confirmed through clinical assessment, toluidine blue staining and where indicated, histopathological evaluation**.**

Statistical analysis:

Data were analysed using Statistical Package for the Social Sciences (SPSS) software, version 19.0 (IBM, Chicago, IL, USA). Descriptive statistics were used to compute frequencies, percentages and mean values and the chi-square test was applied to assess associations between tobacco use and oral mucosal lesion status, with statistical significance set at $p \leq 0.05$ and a 95% confidence interval.

Results:

The study included 2725 patients - 1848 (67.8%) males and 877 (32.2%) females, mean age 47.34 ± 11.42 years - of whom 1526 (56%) were tobacco users (smoked or smokeless form) and 1199 (44%) were non-users. Tobacco use was more common among males (1249, 67.6%) than females (277, 31.6%) **(Table 1).** Of the 1526 tobacco users, 975 (35.8%) used smokeless tobacco (746 males, 229 females), 387 (14.2%) used smoked tobacco (354 males, 33 females) and 164 (6.01%) used both forms (149 males, 15 females) **(Table 2).** Among the 387 smokers, 93 (24%) smoked 1–10 cigarettes/day, 159 (41%) smoked 10–20/day, 65 (16.79%) smoked 21–30/day and 70 (18%) smoked 31 or more cigarettes/day **(Table 3).** Among the 975 smokeless tobacco users, 809 (83%) used tobacco more than 3 times/day, 151 (15.5%) 2–3 times/day and 15 (1.5%) once daily **(Table 4).** Tobacco dependence in relation to cigarettes smoked per day is shown in **(Table 5).** Overall, 100 (25.84%), 205 (52.97%) and 82 (21.18%) smokers scored low, medium and high tobacco dependence, respectively; dependence increased with the number of cigarettes smoked per day. Tobacco dependence in relation to smoking duration is shown in **(Table 6).** Low and medium dependence predominated among participants smoking for less than 5 years (20.1% and 9.3%, respectively), while medium and high dependence predominated among those smoking for 5–10 years (26% and 11.37%) and more than 10 years (17.57% and 8.52%). Tobacco dependence in relation to smokeless tobacco usage duration is shown in **(Table 7).** Overall, 234 (24%), 555 (56.9%) and 186 (19%) smokeless tobacco users scored low, medium and high dependence, respectively. **(Table 8)** summarizes oral mucosal lesions among tobacco users: 647 (42.39%) participants exhibited at least one lesion - tobacco pouch keratosis (207, 13.56%), oral submucous fibrosis (102, 6.68%), recurrent aphthous ulcer (95, 6.2%), leukoplakia (81, 5.3%) and lichen planus (50, 3.27%) being the most frequent. Lesion prevalence was 45.2% among smokeless tobacco users, 35.1% among smokers and 42.7% among users of both forms. Among non-tobacco users, 156 (13.01%) presented with at least one oral mucosal lesion, most commonly recurrent aphthous ulcer (107, 8.9%) and candidiasis (18, 1.5%) **(Table 9).** Across the entire cohort, 803 (29.46%) participants exhibited an oral mucosal lesion, most frequently tobacco pouch keratosis (7.7%) and recurrent aphthous ulcer (7.41%) (**Table 10).** On chi-square comparison, tobacco users showed a significantly higher prevalence of oral mucosal lesions than non-users across all lesion types (**Table 11),** most markedly for leukoplakia, oral submucous fibrosis, tobacco pouch keratosis, smoker's palate and erythroplakia.

Table 1: Participant distribution based on gender

Sex	Tobacco Users, N (%)	Non-Users, N (%)	Total, N (%)
Male	1249 (67.6%)	599 (32.4%)	1848 (100%)
Female	277 (31.6%)	600 (68.4%)	877 (100%)
Total	1526 (56%)	1199 (44%)	2725 (100%)

Table 2: Participant distribution based on form of tobacco use

Form of Tobacco Use	Males, N (%)	Females, N (%)	Total, N (%)
Smokeless	746 (40.4%)	229 (26.1%)	975 (35.8%)
Smokers	354 (19.15%)	33 (3.76%)	387 (14.2%)
Both	149 (8.0%)	15 (1.7%)	164 (6.01%)

Table 3: Cigarettes smoked/day by smokers

Cigarettes	N (%)	Females, N (%)	Total, N (%)
0–10	93 (24%)	229 (26.1%)	975 (35.8%)
More than 10–20	159 (41%)	33 (3.76%)	387 (14.2%)
21–30	65 (16.79%)	15 (1.7%)	164 (6.01%)

Table 4: Frequency of smokeless tobacco usage/day

Smokeless Tobacco Usage Frequency/day	N (%)
More than 3	809 (83%)
2–3	151 (15.5%)
1	15 (1.5%)
Total	975 (100%)

Table 5: Tobacco dependence with respect to cigarettes smoked/day by smokers

Cigarettes	Dependence Score 0–3, N (%)
0–10	85 (21.96%)
11–20	12 (3.1%)
21–30	3 (0.77%)
31+	0 (0%)

Table 6: Tobacco dependence with respect to smoking duration

Duration of Smoking	Dependence Score 0–3, N (%)
< 5 years	78 (20.15%)
5–10 years	21 (5.42%)
> 10 years	01 (0.25%)
Total	100 (25.84%)

Table 7: Tobacco dependence with respect to smokeless tobacco usage duration

Duration	Dependence Score 0–3, N (%)
< 5 years	177 (18.15%)
5–10 years	42 (4.3%)
> 10 years	15 (1.53%)
Total	234 (24%)

Table 8: Status of oral mucosal lesions among tobacco users

Name of Lesion	Total, N (%)	Smokeless Tobacco, N (%)	Smoked Tobacco, N (%)	Both Forms, N (%)
Leukoplakia	81 (5.3%)	52 (5.3%)	19 (4.9%)	10 (6.09%)
Lichen Planus	50 (3.27%)	33 (3.38%)	12 (3.1%)	5 (3.04%)
Oral Submucous Fibrosis	102 (6.68%)	76 (7.8%)	15 (3.87%)	11 (6.7%)
Erythroplakia	39 (2.55%)	22 (2.26%)	13 (3.35%)	4 (2.43%)
Smoker's Palate	40 (2.62%)	0 (0%)	35 (9.04%)	5 (3.04%)

Tobacco Pouch Keratosis	207 (13.56%)	175 (17.94%)	10 (2.58%)	22 (13.41%)
Candidiasis	12 (0.78%)	6 (0.62%)	4 (1.03%)	2 (1.21%)
Recurrent Aphthous Ulcer	95 (6.2%)	64 (6.56%)	23 (5.94%)	8 (4.87%)
Leukoderma	11 (0.72%)	6 (0.62%)	3 (0.77%)	2 (1.21%)
Oral Cancer	10 (0.65%)	7 (0.71%)	2 (0.52%)	1 (0.6%)
Total	647 (42.39%)	441 (45.2%)	136 (35.1%)	70 (42.7%)

Table 9: Status of oral mucosal lesions among non-tobacco users

Name of Lesion	N (%)
Leukoplakia	3 (0.25%)
Lichen Planus	8 (0.67%)
Oral Submucous Fibrosis	1 (0.08%)
Erythroplakia	2 (0.17%)
Smoker's Palate	0 (0%)
Tobacco Pouch Keratosis	3 (0.25%)
Candidiasis	18 (1.5%)
Recurrent Aphthous Ulcer	107 (8.9%)
Leukoderma	13 (0.01%)
Oral Cancer	1 (0.08%)
Total	156 (13.01%)

Table 10: Status of oral mucosal lesions among all individuals

Name of Lesion	N (%)
Leukoplakia	84 (3.08%)
Lichen Planus	58 (2.12%)
Oral Submucous Fibrosis	103 (3.78%)
Erythroplakia	41 (1.5%)
Smoker's Palate	40 (1.47%)
Tobacco Pouch Keratosis	210 (7.7%)
Candidiasis	30 (1.1%)
Recurrent Aphthous Ulcer	202 (7.41%)
Leukoderma	24 (0.9%)
Oral Cancer	11 (0.4%)
Total	803 (29.46%)

Table 11: Comparison of oral mucosal lesions between tobacco users and non-users (chi-square test)

Name of Lesion	Tobacco Users, N (%)	Non-Users, N (%)	Total
Leukoplakia	81 (96.4%)	3 (3.6%)	84 (100%)
Lichen Planus	50 (86.2%)	8 (13.8%)	58 (100%)
Oral Submucous Fibrosis	102 (99.0%)	1 (1.0%)	103 (100%)
Erythroplakia	39 (95.1%)	2 (4.9%)	41 (100%)
Smoker's Palate	40 (100%)	0 (0%)	40 (100%)
Tobacco Pouch Keratosis	207 (98.6%)	3 (1.4%)	210 (100%)
Candidiasis	12 (40%)	18 (60%)	30 (100%)
Recurrent Aphthous Ulcer	95 (47%)	107 (53%)	202 (100%)
Leukoderma	11 (45.8%)	13 (54.2%)	24 (100%)
Oral Cancer	10 (90.9%)	1 (9.1%)	11 (100%)
Total	647 (80.6%)	156 (19.4%)	803 (100%)

N, number; %, percentage. $p < 0.0001$ for the overall comparison (chi-square test).

Discussion:

This cross-sectional study evaluated tobacco use and associated oral mucosal lesions (OMLs) among 2725 patients attending a dental outpatient department in Durg, Chhattisgarh. Overall, 56% of participants reported tobacco use, prevalence comparable with findings reported in previous hospital- and community-based studies. Tobacco use was more common among males than females and smokeless tobacco was the predominant form, consistent with reports demonstrating the widespread use of smokeless tobacco products in India and their strong association with oral disease **[8].** Among tobacco users, 42.39% presented with at least one OML, prevalence comparable to previous studies reporting a high burden of tobacco-related oral lesions. Tobacco pouch keratosis and oral submucous fibrosis were predominantly associated with smokeless tobacco use, whereas smoker's palate and leukoplakia were more frequently observed among smokers. Individuals using both smoked and smokeless tobacco exhibited the greatest burden of oral lesions, supporting the cumulative adverse effects of multiple tobacco habits **[9].** The lesion profile observed in the present study was broadly consistent with previous reports, although variations in lesion frequency may reflect regional differences in tobacco products, duration and frequency of use, cultural practices and study populations **[10]**. Among non-tobacco users, recurrent aphthous ulcers and candidiasis were the most common lesions, indicating that factors other than tobacco, including local irritation, nutritional deficiencies and microbial infections, also contribute to oral mucosal pathology **[11].** The high prevalence of tobacco use and OMLs observed in this study emphasizes the need for routine oral screening, early detection of potentially malignant disorders and effective tobacco cessation counseling. These findings reinforce previous evidence supporting the integration of tobacco control strategies with oral healthcare services to reduce the burden of tobacco-related oral diseases **[12, 13].**

Conclusion:

We show a high prevalence of tobacco use and associated oral mucosal lesions among dental outpatients in Durg, Chhattisgarh. Routine oral screening and tobacco cessation counseling are essential for early detection and, India prevention of potentially malignant lesions. Strengthening public awareness and tobacco control programs may help reduce the burden of tobacco-related oral diseases.

Limitations:

This study is limited by its reliance on self-reported tobacco use, which introduces the possibility of recall or information bias. Its single-center design and use of convenience sampling may have led to an over-representation of tobacco users and oral mucosal lesion prevalence relative to the general population, limiting the generalizability and reproducibility of these findings across other settings.

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