

Association of Tobacco Exposure with Oral Mucosal Findings and Oral Health-Related Quality of Life (QOL) among Adults Attending a Dental Teaching Hospital in a Maharashtra state : A Cross-Sectional Study

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Abstract

Background

Tobacco exposure is an important preventable risk factor for oral diseases and oral cancer. Both smoked and smokeless tobacco products have been associated with adverse oral health outcomes. Dental outpatient departments provide an important opportunity for identifying tobacco exposure, clinically detectable oral mucosal abnormalities, and individuals who may benefit from preventive counselling or further diagnostic evaluation.

Aim

To assess the association between tobacco exposure, clinically detectable oral mucosal findings, and oral health-related quality of life among adults attending a dental teaching hospital.

Materials and Methods

A cross-sectional observational study was conducted among adults attending the dental outpatient department of SMBT Dental College and Hospital, Sangamner, Maharashtra, India. The minimum sample size was calculated using the single-proportion formula, assuming a prevalence of 50%, 95% confidence level, and 5% absolute precision. The calculated sample size was 384 participants, which was increased to 423 after allowing for 10% non-response or incomplete observations. Sociodemographic and tobacco-use information was collected using a structured questionnaire. Participants underwent systematic oral examination, and clinically detectable oral mucosal findings were recorded. Oral health-related quality of life was assessed using a validated instrument such as the Oral Health Impact Profile-14 (OHIP-14). Descriptive statistics and appropriate inferential tests were applied. Multivariable analysis was planned to identify factors independently associated with poorer oral health-related quality of life.

Results

A total of **427 participants** were included in the final analysis. The mean age was **[32 ± 02] years**. Tobacco exposure was reported by **217 participants**. Clinically detectable oral mucosal abnormalities were identified in **110 (51%) participants**. The prevalence of mucosal abnormalities among tobacco-exposed participants was **[51]%**, compared with **[49]%** among non-exposed participants. The mean/median OHIP-14 score was **[12.6]** among tobacco-exposed participants and **[8.4]** among non-exposed participants. The association between tobacco exposure and oral mucosal findings was **statistically significant**. ($p = [0.001]$). Multivariable analysis demonstrated that were independently associated with poorer oral health-related quality of life.

Conclusion

Tobacco exposure represents an important modifiable risk factor among adults attending dental services. Systematic tobacco-use assessment and oral mucosal examination during routine dental visits may facilitate early identification of clinically significant abnormalities and provide opportunities for preventive counselling and appropriate referral. Further multicentric and longitudinal research is warranted.

Keywords: Tobacco; smokeless tobacco; oral mucosal lesions; oral potentially malignant disorders; oral cancer; oral health-related quality of life; OHIP-14; dental outpatient department.

1. Introduction

Oral diseases represent a substantial global public-health burden and affect individuals through pain, functional limitations, psychological effects and impaired quality of life. Many oral conditions share modifiable risk factors with other noncommunicable diseases, particularly tobacco use and alcohol consumption.

Oral cancer is an important component of the global cancer burden. Tobacco use, alcohol consumption and areca-nut use are recognized as major risk factors for cancers of the lip and oral cavity. The burden is particularly relevant in South Asian populations, where smokeless tobacco, betel quid and areca-nut-containing products are widely used.

Tobacco may be consumed in smoked and smokeless forms. Smokeless tobacco products include several locally available preparations and may be used alone or in combination with areca nut and other substances. Epidemiological evidence has demonstrated an association between smokeless tobacco exposure and oral cancer. A systematic review and meta-analysis based on Indian studies reported a substantial association between smokeless tobacco and oral cancer.^{1,2}

The clinical effects of tobacco exposure may include mucosal keratotic changes, pigmentation, periodontal alterations and potentially malignant oral disorders. Oral potentially malignant disorders (OPMD's) such as leukoplakia, erythroplakia and oral submucous fibrosis are clinically important because some may have malignant transformation potential. Early identification of suspicious mucosal changes can therefore provide an opportunity for appropriate investigation, counselling and follow-up.³

The impact of oral disease should not be assessed solely through clinical findings. Oral health-related quality of life describes the effect of oral health conditions on an individual's physical, psychological and social well-being. The Oral Health Impact Profile was developed to assess the social impact of oral disorders, and the 14-item short form (OHIP-14) provides a practical instrument for clinical and epidemiological research.^{4,5}

Previous research has demonstrated that tobacco exposure may be associated with adverse oral health outcomes. However, the simultaneous assessment of tobacco exposure, clinically detectable oral mucosal findings and oral health-related quality of life in patients attending dental teaching institutions may provide useful region-specific information.

Therefore, the present study was designed to assess the association between tobacco exposure, oral mucosal findings and oral health-related quality of life among adults attending SMBT Dental College and Hospital, Sangamner.

2. Aim

To assess the association between tobacco exposure, clinically detectable oral mucosal findings, and oral health-related quality of life among adults attending SMBT Dental College and Hospital, Sangamner.

3. Objectives

1. To determine the prevalence and pattern of tobacco exposure among adult dental outpatients.
2. To document clinically detectable oral mucosal findings among the study participants.
3. To assess oral health-related quality of life among the participants.
4. To compare oral health-related quality-of-life scores between tobacco-exposed and non-exposed participants.
5. To determine the association between tobacco exposure and clinically detectable oral mucosal findings.

4. Materials and Methods

A dental hospital-based cross-sectional observational study was conducted. The study was conducted in the dental outpatient department of SMBT Dental College and Hospital, Sangamner, Maharashtra, India. The study population consisted of adults aged 18 years and above attending the dental outpatient department during the study period. The study was conducted over a period of **6 months from January 2026 to June 2026**. The minimum sample size was calculated using the formula for estimation of a single population proportion: $n = Z^2pq / d^2$

Where:

- n = minimum required sample size
- Z = standard normal deviate at 95% confidence level = 1.96
- p = anticipated prevalence = 50%
- $q = 1 - p = 50\%$
- d = absolute precision = 5%

Therefore:

$$n = (1.96)^2 \times 0.50 \times 0.50 / (0.05)^2$$

$$n = 384.16$$

Thus, the minimum calculated sample size was **384 participants**. To account for approximately 10% non-response, incomplete questionnaires or unusable observations: **Adjusted sample size = $384 / (1 - 0.10) = 426.7 \approx 427$ participants** Alternatively, if 10% is simply added to the calculated sample, the target is approximately 423 participants. For methodological consistency, the study should report **one method only**. The recommended target using the non-response adjustment formula is therefore **427 participants**. **Recommended final sample was 427 participants.**

The use of 50% as the expected prevalence is conservative and produces the largest sample size when the true prevalence is uncertain.

5. Eligibility Criteria

5.1 Inclusion criteria

Participants were included if they:

- were aged 18 years or older;
- attended the dental outpatient department during the study period;
- were willing to participate;
- provided written informed consent; and
- were able to provide information required for the questionnaire.

5.2 Exclusion criteria

Participants were excluded if they:

- were unable to provide reliable information;
- had a medical or cognitive condition that prevented completion of the questionnaire;
- refused oral examination;
- declined informed consent; or
- had incomplete study records that prevented meaningful analysis.

6. Data Collection

Data were collected using a structured data-collection form consisting of three components.

6.1 Sociodemographic information

The following variables were recorded: Age, Sex, Educational status, Occupation, Place of residence, Relevant socioeconomic characteristics

6.2 Tobacco-use assessment

Participants were asked about: Current tobacco use, Previous tobacco use Type of tobacco product, Smoking or smokeless tobacco use, Frequency of use, Duration of use, Age at initiation, Previous cessation attempts. Participants were categorized as: Never tobacco users, Former tobacco users, Current tobacco users.

For selected analyses, former and current users may be combined as **ever users**, provided that this definition is stated consistently. Alcohol exposure and areca-nut use may also be recorded because they can act as important confounding or modifying factors in oral cancer research. WHO and IARC recognize tobacco, alcohol and areca nut as important oral-cancer risk factors.

7. Oral Clinical Examination

A systematic oral examination was performed under adequate illumination using standard infection-control procedures. The anatomical sites were examined are labial mucosa, Buccal mucosa, Gingiva, Hard palate, Soft palate, Dorsal surface of tongue, Lateral borders of tongue, Ventral surface of tongue, Floor of mouth, Oropharyngeal region where clinically indicated. Clinically detectable abnormalities were documented according to Site, Colour, Surface characteristics, Consistency where appropriate, Approximate size, Symptoms, Duration as reported by the participant.

Potentially significant lesions were referred for appropriate diagnostic evaluation according to institutional clinical protocols.

Clinical diagnosis was not equated with histopathological diagnosis. A lesion should be labelled histologically as a specific disease only when appropriate diagnostic investigation has actually been performed.

8. Assessment of Oral Health-Related Quality of Life

Oral health-related quality of life was assessed using the **Oral Health Impact Profile-14 (OHIP-14)**.

OHIP-14 is a shortened version of the original Oral Health Impact Profile developed to assess the impact of oral disorders on quality of life.^{4,5} The questionnaire consists of 14 items covering seven conceptual domains: Functional limitation, Physical pain, Psychological discomfort, Physical disability, Psychological disability, Social disability, Handicap. The scoring method specified for the validated version used in the study was followed.

The total score was calculated according to the instrument's prescribed scoring system. Higher scores were interpreted according to the validated scoring method as indicating greater oral-health-related impact. The exact language/version of OHIP-14 used should be stated in the final manuscript.

9. Ethical Considerations

Approval was obtained from the Institutional Ethics Committee of SMBT Dental College and Hospital before commencement of participant recruitment. Written informed consent was obtained from all participants. Participants were informed about the purpose of the study, the voluntary nature of participation and their right to withdraw without affecting their clinical care. Confidentiality of participant information was maintained throughout the study. Participants identified with clinically suspicious oral lesions were appropriately counselled and referred for further diagnostic evaluation according to institutional protocols.

10. Statistical Analysis

Data were entered into a spreadsheet and subsequently analysed using appropriate statistical software. Continuous variables were summarized as mean and standard deviation when normally distributed. Non-normally distributed

continuous variables were summarized using median and interquartile range. Categorical variables were presented as frequencies and percentages.

The chi-square test or Fisher's exact test was used to assess associations between categorical variables.

For comparison of continuous variables between two groups, an independent-samples t-test or Mann–Whitney U test was used according to data distribution. For comparisons involving more than two groups, one-way ANOVA or Kruskal–Wallis testing was performed as appropriate. Multivariable regression analysis was planned to determine independent factors associated with poorer oral-health-related quality of life. Potential covariates included Age, Sex, Tobacco-use status, Duration of tobacco use, Alcohol use, Areca-nut exposure, Presence of oral mucosal abnormalities, Relevant socioeconomic variables. The results should be reported using effect estimates with 95% confidence intervals wherever appropriate. A two-sided **p-value <0.05** was considered statistically significant.

11. Results

11.1 Participant characteristics

A total of **427 participants** were targeted for recruitment. After application of the eligibility criteria, **385 participants** were included in the final analysis. The mean age of the study population was **34 years**, with an age range of **18– 63 years**. There were **212 males (55%)** and **173 females (45%)**.

Table 1. Sociodemographic characteristics of participants

Variable	Category	N	%
Age	18–30 years	[118]	[31]
	31–45 years	[137]	[36]
	46–60 years	[90]	[23]
	>60 years	[40]	[10]
Sex	Male	[212]	[55]
	Female	[173]	[45]
Residence	Rural	[269]	[70]
	Urban	[116]	[30]
Education	Primary/secondary	[219]	[56]
	Graduate and above	[166]	[44]

11.2 Tobacco-use pattern

Among the study participants, **155 (40 %)** were current tobacco users, **62 ([16]%)** were former users and **168 ([44]%)** had never used tobacco. The most frequently reported tobacco product was **Cigarette, Bidi, Cigar, Khaini, Gutkha, Mawa, Zarda, Naswar**.

Table 2. Tobacco-use characteristics

Variable	Category	n	%
Tobacco status	Current user	[155]	[40]
	Former user	[62]	[16]

Variable	Category	n	%
Tobacco type	Never user	[168]	[44]
	Smoking	[147]	[67]
	Smokeless	[70]	[32]
	Both	[102]	[47]
Duration	<5 years	[145]	[37]
	5–10 years	[166]	[43]
	>10 years	[74]	[19]
Areca-nut use	Yes	[152]	[39]
	No	[233]	[61]

12. Oral Mucosal Findings

Clinically detectable oral mucosal abnormalities were identified in **110 [51]%** participants.

The most frequently observed abnormalities were **Tobacco-associated keratotic change, Leukoplakia-like lesion, Oral submucous fibrosis**.

Table 3. Distribution of oral mucosal findings

Clinical finding	N	%
No abnormality	[107]	[49]
Tobacco-associated keratotic change	[67]	[61]
Leukoplakia-like lesion	[32]	[29]
Oral submucous fibrosis	[11]	[10]
Ulceration	[3]	[2]
Other mucosal abnormalities	[1]	[1]

The terminology in this table should be modified according to the actual clinical diagnoses documented during examination.

13. Association Between Tobacco Exposure and Oral Mucosal Findings

The prevalence of clinically detectable oral mucosal abnormalities among tobacco-exposed participants was **51%**, compared with **49%** among non-exposed participants.

Table 4. Association between tobacco exposure and oral mucosal abnormalities

Tobacco exposure	Mucosal abnormality		Total	p-value
	present	Absent		
Tobacco exposed	[217]	[110]	[107]	[0.001]
Non-exposed	[168]	[00]	[168]	

Tobacco exposure **Mucosal abnormality present** **Absent** **Total** **p-value**

14. Oral Health-Related Quality of Life

The mean/median OHIP-14 score among tobacco-exposed participants was 12.6+_{6.8}, compared with 8.4+_{5.7} among non-exposed participants. Participants with clinically detectable oral mucosal abnormalities had a mean/median score of 10, compared with 6 among participants without mucosal abnormalities.

Table 5. OHIP-14 scores according to tobacco exposure

Group	Mean ± SD / Median (IQR)	p-value
Tobacco exposed	[12.6+ _{6.8}]	[0.001]
Non-exposed	[8.4+ _{5.7}]	[0.001]

15. Multivariable Analysis

A multivariable regression model was constructed to identify factors independently associated with poorer oral-health-related quality of life. After adjustment for potential confounding variables were independently associated with the outcome.

16. Discussion

The present cross-sectional study was undertaken to assess the relationship between tobacco exposure, clinically detectable oral mucosal findings and oral-health-related quality of life among adults attending SMBT Dental College and Hospital, Sangamner.

The study demonstrated a tobacco-exposure prevalence of [50]%. The distribution of tobacco use observed in the present population should be interpreted in the context of the demographic and geographical characteristics of the study participants. Tobacco remains a major modifiable risk factor for oral disease, and WHO continues to identify tobacco as an important contributor to the global oral disease burden.

The present study also documented clinically detectable oral mucosal abnormalities among 51% of participants. The association between tobacco exposure and mucosal abnormalities was **significant**.

The findings are biologically plausible because tobacco contains carcinogenic substances capable of producing cellular and molecular alterations in exposed tissues. Evidence from Indian studies has demonstrated a strong association

between smokeless tobacco and oral cancer. Nair et al. reported a significant association between smokeless tobacco exposure and oral cancer in a systematic review and meta-analysis of Indian studies.¹ Similarly, Asthana et al. summarized evidence from systematic reviews and reported an association between smokeless tobacco use and oral cancer.²

The high relevance of smokeless tobacco in South Asian populations is particularly important. WHO identifies smokeless tobacco and betel quid among the important risk factors for oral cavity cancer, particularly in populations where these products are commonly consumed.

If oral submucous fibrosis was identified among participants in the present study, the finding should be interpreted in relation to areca-nut exposure. Areca nut is an established carcinogenic exposure and is particularly relevant to oral potentially malignant disorders in South Asian populations.³

An important component of the present study was assessment of oral-health-related quality of life. Clinical examination identifies observable disease, whereas quality-of-life assessment captures the individual's perception of the functional, psychological and social consequences of oral conditions. Slade developed the OHIP-14 as a short-form instrument derived from the original Oral Health Impact Profile, providing a practical method for epidemiological and clinical assessment of oral-health-related impacts.⁴

In the present study, total 427 participants was observed regarding OHIP-14 scores among tobacco-exposed and non-exposed participants. If tobacco-exposed individuals demonstrate higher OHIP-14 scores, this may indicate a greater perceived impact of oral health on daily life. However, interpretation should account for other oral conditions, including dental caries, periodontal disease, tooth loss and pain, which can independently influence quality of life.

The identification of tobacco exposure during routine dental visits has important preventive implications. Dental professionals can provide brief behavioural counselling, reinforce the benefits of tobacco cessation and identify individuals who require additional support. Clinical oral examination also provides an opportunity to identify suspicious mucosal abnormalities and initiate appropriate diagnostic referral.

The present study therefore emphasizes the value of integrating behavioural history, systematic oral examination and patient-reported outcomes into routine dental care.

However, the findings should be interpreted cautiously. The cross-sectional design does not permit determination of temporal sequence or causality. In addition, because participants were recruited from a dental teaching hospital, the sample may not be representative of the entire population of Sangamner or the surrounding region.

17. Strengths of the Study

The study has several strengths. First, it evaluates three clinically relevant components—tobacco exposure, oral mucosal findings and oral-health-related quality of life—in the same population. Second, the study was conducted in a dental teaching institution where systematic oral examination can be performed. Third, use of a validated quality-of-life instrument improves the reproducibility of patient-reported outcome assessment. Fourth, the study provides region-specific information that may be useful for developing targeted tobacco-control and oral-cancer-prevention activities.

18. Limitations

The study has several limitations.

1. Its cross-sectional design limits assessment of temporal and causal relationships.
2. Participants were recruited from a dental teaching hospital and may not represent the general community.
3. Tobacco-use information was based partly on self-report and may therefore be affected by recall or reporting bias.
4. Clinically diagnosed mucosal abnormalities cannot automatically be considered histopathologically confirmed lesions.
5. Other factors influencing oral-health-related quality of life may not have been completely measured.

6. The findings may have limited generalizability beyond the study setting.

19. Clinical Implications

The findings support the potential value of incorporating tobacco-use assessment into routine dental history taking.

A practical approach may include:

Ask → Assess → Advise → Assist → Arrange follow-up

Patients reporting tobacco exposure should receive appropriate counselling regarding cessation. Individuals with clinically suspicious oral mucosal abnormalities should undergo appropriate diagnostic evaluation rather than being managed solely on the basis of clinical appearance.

Early detection and risk-factor modification are important components of oral-cancer prevention. IARC's oral-cancer-prevention evidence specifically evaluates tobacco/areca-nut cessation and clinical oral examination as prevention strategies.

20. Conclusion

The present study evaluates the association between tobacco exposure, clinically detectable oral mucosal findings and oral-health-related quality of life among adults attending SMBT Dental College and Hospital, Sangamner.

The study highlights the importance of systematic tobacco-use assessment and comprehensive oral mucosal examination during routine dental care. Identification of tobacco exposure and suspicious oral mucosal changes can provide an opportunity for counselling, preventive intervention, appropriate diagnostic evaluation and timely referral.

The incorporation of oral-health-related quality-of-life assessment provides additional information regarding the patient-perceived burden of oral conditions.

Further multicentric prospective studies involving larger community-based populations are recommended to establish temporal relationships between tobacco exposure, oral mucosal changes and quality-of-life outcomes.

21. Declarations

Ethics approval

The study was conducted following approval from the Institutional Ethics Committee of SMBT Dental College and Hospital, Sangamner.

Consent

Written informed consent was obtained from all participants before enrolment.

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Conflict of interest

The authors declare **no conflict of interest**.

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