Research Square

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Self-Rated Oral Health and Perceived Needs among Smokers, Non-Smokers, and Dual Tobacco Users in Mysuru City: A Comparative Study

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Abstract

Background: Tobacco use, in smoked and smokeless forms, is a significant public health concern closely associated with adverse oral health outcomes. Comparative evidence on self-rated oral health, perceived treatment needs, oral hygiene practices, and clinical dental status across tobacco use categories remains limited in the urban Indian context.

Objective:

To assess and compare the parameters among smokers, dual tobacco users, and non-smokers attending a dental outpatient department in Mysuru, India.

Methods: A hospital-based comparative cross -sectional study was conducted among 135 adults (>18 years), equally allocated into non-smokers, smokers and dual tobacco user groups (n=45 each). A structured, pre-validated questionnaire captured sociodemographic, behavioural, and self-reported oral health data. Clinical examination followed WHO Oral Health Assessment Criteria (2013), with caries experience recorded using the DMFT index. Data were analysed using chi-square test and one-way ANOVA ($p<0.05$).

Results: Tobacco users reported significantly poorer self-rated oral health and greater perceived treatment needs than non-smokers($p<0.001$). Dual tobacco users demonstrated the highest prevalence of toothache (66.7%), eating avoidance due to oral problems (46.7%), and dental appearance dissatisfaction. Oral hygiene practices were notably suboptimal among smokers and dual users. Clinically, dual users exhibited the highest mean decayed teeth score (2.7±2.04), while both tobacco-using groups showed significantly greater missing teeth scores($p<0.001$).

Conclusion: Dual tobacco use was associated with oral disease burden. Regular dental visits should incorporate tobacco screening, cessation counselling, and targeted preventive interventions, particularly for dual users.

1. Introduction

Tobacco use continues to cast a long shadow over the lives, health, and well-being of millions across the globe, bearing down hardest on the most vulnerable populations. The World Health Organisation (WHO) estimates that tobacco claims more than 8 million lives each year, over 1.2 million of which are non-smokers exposed to second hand smoke with low and middle income countries shouldering the greatest burdern.[1]The scale of devastation is further underscored by the global burden of disease (GBD) 2023 analysis which attributes approximately 7.36 million deaths and 188 million Disability-adjusted life years(DALYs) to tobacco use, cementing its status as one of the most pressing public health challenges of our time.[2] Cigarette smoke contains over 7,000 chemicals, at least 69 of which are carcinogenic. Prolonged exposure to these toxins leads to chronic illnesses such as lung cancer, chronic obstructive pulmonary disease, cardiovascular disease, stroke, and systemic inflammatory disease.[1,3]

Tobacco consumption varies greatly by sociodemographic group. According to WHO surveillance data, males, those with lower socioeconomic level, and people with lower educational attainment all have a higher prevalence of tobacco use.[1,3] However, growing global trends indicate that the prevalence of tobacco use among females is increasing in various regions, driven by social normalisation, focused marketing efforts, and evolving cultural values. Furthermore, both smoked and smokeless tobacco continue to have a negative impact on younger populations in low- and middle-income nations, including adolescents and young adults.[1]

In addition to smoking, many people in South Asian countries such as India use smokeless tobacco (SLT) products, which also carry significant health risks. The Centers for Disease Control and Prevention reported in 2024 that smokeless tobacco use increases the risk of periodontal disease, pancreatic cancer, oesophageal cancer, oral cancer, and nicotine addiction.5. Long-term SLT users often experience altered salivary pH, gingival recession, and oral mucosal lesions, which may increase their susceptibility to potentially malignant disorders.[5]

People's understanding and awareness of health issues differ dramatically across smokers, users of smokeless tobacco, and non-tobacco users. Evidence reveals that smokers frequently report lower self-rated health while underestimating symptom intensity, a condition linked to cognitive dissonance and nicotine dependence.[6] Despite considerable scientific data contradicting this assumption, dual tobacco users frequently perceive smokeless tobacco products as a "safer" alternative to cigarettes.[5] Nonsmokers, particularly those exposed to ambient tobacco smoke, are more likely to be aware of and concerned about tobacco-related health concerns as a result of recurrent public health messaging and perceived susceptibility.[1,6]

Tobacco control efforts have expanded significantly over the past decade. According to the 2025 WHO report on the global tobacco epidemic, at least one strong tobacco control policy, such as smoke-free laws, higher taxes, advertising restrictions, or graphic health warnings, now protects 6.1 billion people worldwide.[7] However, compliance remains uneven in developing regions, where enforcement is weak and exposure to both active and passive smoking remains high.[1,7]

Despite extensive global evidence on the adverse health effects of smoking and smokeless tobacco use, data comparing self-rated oral health, perceived treatment needs, and health-seeking behaviour among smokers, dual tobacco users, and non-smokers remain limited, particularly in urban India. Understanding these perceptions is important because they influence healthcare utilisation, treatment compliance, and motivation for tobacco cessation. Therefore, this study aimed to assess and compare self-rated oral health, perceived treatment needs, oral health practices, and dental experiences among smokers, dual tobacco users, and non-smokers in Mysuru City, India.

2. Methods

i) Study Design

A hospital-based, comparative cross-sectional study was conducted to assess and compare self-rated oral health, perceived dental treatment needs, oral hygiene practices, and clinical dental status among three distinct groups of adults based on their tobacco use behaviour. The cross-sectional design was considered appropriate for the study objectives, as it permitted simultaneous assessment of exposure status (tobacco use) and health outcomes (self-rated oral health, perceived needs, and clinical dental indices) within a single time frame.

ii) Study Setting

The study was conducted in the outpatient department (OPD) of a dental teaching hospital affiliated with JSS Dental College and Hospital, Mysuru, Karnataka, India. Mysuru is a Tier II urban centre and presents a demographically heterogeneous population with a well-established burden of tobacco consumption, rendering it an ideal site for conducting this investigation. The dental outpatient department serves individuals spanning a broad spectrum of socioeconomic strata and occupational categories, thereby facilitating the recruitment of a sample with considerable diversity.

iii)Study Duration

Data collection was carried out over a period of 10 months, from June 2025 to March 2026. Participants' enrolment was continued until the required sample size was achieved in each study group.

iv) Study Population and Eligibility Criteria

Participants were classified into three mutually exclusive groups based on their current tobacco use behaviour:

a) Group I: Non-smokers: Adults with no history of smoked or smokeless tobacco products.

b) Group II: Smokers: Adults currently engaged in regular use of smoked tobacco products (cigarettes, beedis, or cigars).

c) Group III: Dual tobacco users: Adults who concurrently used both smoked tobacco products and smokeless tobacco (SLT) products (chewing tobacco, khaini, gutkha, pan masala with tobacco, or snuff) at the time of recruitment.

Inclusion criteria:

d) Adults aged 18 years and above

e) Current smokers, current dual tobacco users, or lifetime non-users of tobacco

f) Willingness to provide written informed consent.

g) Ability to understand and respond to questionnaire items in Kannada or English

Exclusion criteria:

h) Presence of systemic illnesses known to independently affect oral health (e.g., uncontrolled diabetes mellitus, autoimmune disorders, and haematological malignancies)

i) Participants who were hospitalised or receiving inpatient treatment at the time of recruitment

j) Former tobacco users who had ceased using tobacco within the six months preceding the study

k) Individuals with cognitive or communication impairments that prevented valid questionnaire completion.

v) Sample Size Calculation

The sample size was calculated a priori using G*Power software (version 3.1). Based on a previously published estimate that approximately 60% of smokers self-rate their oral health as poor or fair compared with approximately 30% of non-smokers (effect size h ≈ 0.63), a minimum of 40 participants per group was required to achieve 80% statistical power at a two-tailed significance level of α = 0.05. To enable a robust three-group comparison, enhance statistical precision, and account for potential non-response or incomplete data, the final sample size was 45 participants per group, for a total of 135 participants.

vi) Sampling Method

Consecutive sampling was employed whereby all patients attending the dental OPD during the study period were systematically screened for eligibility. Participants were enrolled sequentially into the respective group until the target of 45 per group was met. This method eased systematic participant selection, reduced the potential for selection bias, and was well suited to the operational requirements of the hospital study. effectively minimised selection bias by reducing the likelihood of excluding eligible individuals, while remaining practical and possible within the constraints of a hospital-based setting.

vii) Data Collection Tool

A structured, pre-validated, interviewer-administered questionnaire was developed in English and subsequently translated into Kannada, the regional language. The questionnaire comprised five domains: (i) sociodemographic characteristics (age, sex, education, occupation, and dietary habits); (ii) tobacco use patterns (type of tobacco product, frequency of use, and duration of use); (iii) oral hygiene practices (brushing frequency, oral hygiene aids, dental visit history, and mouth-rinsing habits); (iv) self-rated oral health, assessed using a validated five-point Likert scale ranging from “Excellent” (1) to “Poor” (5); and (v) perceived dental treatment needs and oral complaints, including pain duration, avoidance of eating, bleeding gums, tooth sensitivity, and satisfaction with dental appearance. In total, the questionnaire comprised 35 items across these five domains.

viii) Validation and Reliability

Content validity of the questionnaire was established through a panel review conducted by three subject matter experts in public health dentistry. Expert feedback was incorporated, and a revised instrument was

then subjected to a pilot study involving 15 participants (five per group) who were not included in the main study. Pilot data were collected to assess questionnaire clarity, participant comprehension, and the overall feasibility of questionnaire administration. Internal consistency of the instrument was assessed using Cronbach's alpha coefficient (α = 0.79), reflecting acceptable reliability. Test-retest reliability was evaluated among ten participants over a two-week interval, demonstrating good temporal stability of responses (Spearman's r= 0.82).

ix) Study Variables

Primary outcome variables: Self-rated oral health (five-point Likert scale: Excellent, Very Good, Good, Fair, Poor) and perceived dental treatment need (binary: yes/no)

Primary exposure variable was tobacco use status,(categorical: non-smoker, smoker, dual tobacco user)

Covariates: Sociodemographic factors: age, sex, educational attainment, and occupation; behavioural factors(Oral hygiene practices, frequency of dental visits, alcohol Consumption, pan or gutkha chewing) and Clinical dental status measured using the Decayed, Missing, and Filled Teeth DMFT index.

x) Data Collection Procedure

Data collection was conducted in two phases. Initially, participants completed an interviewer-administered questionnaire in a private area of the outpatient department to ensure confidentiality. Subsequently, a calibrated examiner performed a standardised oral examination using sterile mouth mirrors and explorers under adequate illumination, in accordance with the WHO Oral assessment criteria (2013). Dental caries experience was assessed using the DMFT index, where D represents decayed teeth, M represents missing teeth due to caries, and F represents filled teeth. Third molars were excluded from the assessment. All clinical examinations were conducted by a single examiner to maintain consistency.

xi) Ethical Considerations

The study adhered to the ethical principles outlined in the Declaration of Helsinki (revised 2013). Ethical clearance was obtained from the Institutional Ethics Committee of JSS Dental College and Hospital (Reference No.: 27/2025). Written informed consent was obtained from all participants before enrolment. Participation was voluntary, and participants were assured that refusal or withdrawal would not affect their access to treatment or clinical care. All data were anonymised and stored securely; only the principal investigator had access to identifiable data.

xii) Clinical Trial Number

Clinical Trial Number: Not Applicable.

xiii) Statistical Analysis

Data were coded and entered into IBM SPSS Statistics (Version 27.0; IBM Corp., Armonk, NY, USA) for analysis. Normality of the distribution of continuous variables was assessed using the Kolmogorov-

Smirnov and Shapiro-Wilk tests. Descriptive statistics were reported as mean ± standard deviation (SD) for continuous variables and as frequency and proportion (%) for categorical variables.

One-way analysis of variance (ANOVA) was applied to evaluate intergroup differences in continuous variables, including DT, MT and FT scores, with Tukey's Honest Significant Difference (HSD) post hoc test employed for pairwise comparison. Associations between categorical variables and group membership were assessed using the Pearson chi-square test. A significance threshold of $p<0.05$ was adopted for all statistical analyses.

3. Results

The study included 135 participants, with 45 each in the non-smoker, smoker, and dual tobacco user groups.

The mean age of the study population was 38.7 ± 15.1 years, with no statistically significant difference among non-smokers (37.9 ± 16.4 years), smokers (42.4 ± 16.0 years), and dual tobacco users (35.9 ± 12.1 years). Males constituted the majority of the overall study population and were significantly overrepresented among smokers and dual tobacco users, while females predominated in non-smokers, with a statistically significant difference ($p < 0.001$).

Educational attainment, occupational status and dietary habits varied significantly across the three study groups. Graduate-level education was more common among non-smokers, whereas primary and secondary education were more frequent among tobacco users ($p = 0.05$). Occupational distribution also differed significantly ($p < 0.01$), with the 'others' category most common among dual tobacco users. A mixed diet was reported more often by smokers and dual tobacco users, while vegetarian diets were more common among non-smokers ($p < 0.01$). Detailed sociodemographic characteristics are presented in Table 1.

Table 1
Sociodemographic characteristics of the study population (n = 135).

Variable	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
Age group (years) ≥ 18 (mean ± SD)		37.9 ± 16.4	42.4 ± 16.0	35.9 ± 12.1	38.7 ± 15.1	9.85	0.260
Gender	Male	16 (35.6%)	39 (86.7%)	37 (82.2%)	92 (68.1%)	33.3	< 0.001
	Female	29 (64.4%)	6 (13.3%)	8 (17.8%)	43 (31.9%)		
Education level	Illiterate	1 (2.2%)	1 (2.2%)	0 (0%)	2 (1.5%)	20.6	0.05
	Primary	0 (0%)	5 (11.1%)	7 (15.6%)	12 (8.9%)		
	Secondary	2 (4.4%)	6 (13.3%)	9 (20.0%)	17 (12.6%)		
	Graduate/Above	42 (93.4%)	33 (73.4%)	29 (64.4%)	104 (77.0%)		
Occupation	Skilled	4 (8.9%)	3 (6.7%)	1 (2.2%)	8 (5.9%)	23.2	< 0.01
	Unskilled	13 (28.9%)	5 (11.1%)	0 (0%)	18 (13.3%)		
	Student/Unemployed	11 (24.4%)	16 (35.6%)	11 (24.4%)	38 (28.1%)		
	Others	17 (37.8%)	21 (46.6%)	33 (73.4%)	71 (52.6%)		
Food habits	Veg	23 (51.1%)	4 (8.9%)	3 (6.7%)	30 (22.2%)	32.6	< 0.01
	Mixed	22 (48.9%)	41 (91.1%)	42 (93.3%)	105 (77.8%)		

Data are presented as mean ± SD for continuous variables and n (%) for categorical variables. Chi-square test was used for categorical comparisons and ANOVA for age comparison. $p < 0.05$ was considered statistically significant.

Personal habits are summarised in Table 2. As expected from the group definitions, smoking was reported by all smokers and dual tobacco users, while smokeless tobacco use was reported by all dual users and by one-third of smokers. Alcohol consumption, pan chewing, and gutkha chewing were significantly more common among tobacco users, particularly dual tobacco users, than among non-smokers ($p < 0.01$).

Table 2
Distribution of personal habits among non-smokers, smokers, and dual tobacco users.

Personal Habit	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
Smoking	Yes	0 (0.0%)	45 (100%)	45 (100%)	90 (66.7%)	135.0	< 0.01
	No	45 (100%)	0 (0.0%)	0 (0.0%)	45 (33.3%)		
Smokeless Tobacco	Yes	0 (0%)	15 (33.3%)	45 (100.0%)	60 (44.4%)	94.5	< 0.01
	No	45 (100.0%)	30 (66.7%)	0 (0%)	75 (55.6%)		
Alcohol	Yes	0 (0.0%)	27 (60.0%)	34 (75.6%)	61 (45.2%)	68.3	< 0.01
	No	45 (100.0%)	18 (40.0%)	11 (24.4%)	74 (54.8%)		
Pan Chewing	Yes	0 (0%)	13 (28.9%)	29 (64.4%)	42 (31.1%)	43.7	< 0.01
	No	45 (100.0%)	32 (71.1%)	16 (35.6%)	93 (68.9%)		
Gutkha chewing	Yes	0 (0%)	14 (31.1%)	32 (71.1%)	46 (34.1%)	50.9	< 0.01
	No	45 (100.0%)	31 (68.9%)	13 (28.9%)	89 (65.9%)		

Data are presented as n (%). Chi-square test was used for comparison. $p < 0.05$ was considered statistically significant.

Oral hygiene practices are shown in Table 3. Brushing once daily was more common among smokers and dual tobacco users, whereas twice-daily brushing was more frequent among non-smokers ($p < 0.01$). Toothbrushes and toothpaste were the most commonly used oral hygiene aids overall, although non-standard cleaning materials were reported more often by tobacco users. Dental service utilisation was significantly lower among dual tobacco users than among non-smokers ($p = 0.015$), and post-meal mouth-rinsing also differed significantly across groups ($p = 0.008$).

Table 3
Oral hygiene practices of participants across the three study groups.

Practice	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
Brushing frequency	Once	19 (42.2%)	35 (77.8%)	42 (93.3%)	96 (71.1%)	30.6	< 0.01
	Twice	23 (51.1%)	8 (17.8%)	3 (6.7%)	34 (25.2%)		
	≥ 2 times/day	3 (6.7%)	2 (4.4%)	0 (0%)	5 (3.7%)		
Use of a brushing aid	Toothbrush	43 (95.6%)	37 (82.2%)	36 (80.0%)	116 (85.9%)	12.9	0.227
	Finger	2 (4.4%)	2 (4.4%)	6 (13.3%)	10 (7.4%)		
	Neem Sticks	0 (0%)	1 (2.2%)	0 (0%)	1 (0.7%)		
	Others/Both	0 (0%)	5 (11.2%)	3 (6.7%)	8 (5.9%)		
Material used	Toothpaste	41 (91.1%)	37 (82.2%)	30 (66.7%)	108 (80.0%)	19.9	0.029
	Toothpowder	1 (2.2%)	0 (0%)	0 (0%)	1 (0.7%)		
	Mud	0 (0%)	4 (8.9%)	7 (15.6%)	11 (8.1%)		
	Others	3 (6.7%)	4 (8.9%)	8 (17.8%)	15 (11.1%)		
Method of cleaning	Horizontal	8 (17.8%)	21 (46.7%)	26 (57.8%)	55 (40.7%)	16.8	0.002
	Vertical	1 (2.2%)	0 (0%)	1 (2.2%)	2 (1.5%)		
	Both	36 (80.0%)	24 (53.3%)	18 (40.0%)	78 (57.8%)		
Dental visit	Yes	30 (66.7%)	24 (53.3%)	15 (33.3%)	69 (51.1%)	12.2	0.015
	No	15 (33.3%)	21 (46.6%)	30 (66.7%)	66 (48.9%)		
Mouthrinse after eating	Yes	35 (77.8%)	20 (44.4%)	27 (60.0%)	82 (60.7%)	13.7	0.008

Data are presented as n (%). Chi-square test was used for comparison. $p < 0.05$ was considered statistically significant.

Practice	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
	No	10 (22.2%)	25 (55.5%)	18 (40.0%)	53 (39.3%)		

Data are presented as n (%). Chi-square test was used for comparison. p < 0.05 was considered statistically significant.

Self-rated oral health status and dental experience are presented in Table 4. Toothache was reported more often by dual tobacco users and smokers than by non-smokers (p = 0.002). Dental care-seeking for toothache differed significantly across groups (p < 0.001). Perception of having an untreated medical condition also differed significantly across groups, with the highest proportion among dual tobacco users (p < 0.001).

Table 4
Self-rated oral health status and dental experience among participants.

Question	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
Ever had any teeth extracted?	Yes	21 (46.7%)	20 (44.4%)	24 (53.3%)	65 (48.1%)	0.771	0.680
	No	24 (53.3%)	25 (55.6%)	21 (46.7%)	70 (51.9%)		
Have any fillings or extractions?	Yes	23 (51.1%)	22 (48.9%)	27 (60.0%)	72 (53.3%)	29.3	< 0.001
	No	22 (48.9%)	9 (20.0%)	4 (8.9%)	35 (25.9%)		
	Do not know	0 (0%)	14 (31.1%)	14 (31.1%)	28 (20.8%)		
Do you think you have any untreated medical conditions?	Yes	17 (37.8%)	13 (28.9%)	24 (53.3%)	54 (40.0%)	52.9	< 0.001
	No	27 (57.8%)	9 (20%)	0 (0%)	35 (25.9%)		
	Do not know	1 (2.2%)	23 (51.1%)	21 (46.7%)	45 (33.3%)		
Toothache in the past?	Yes	21 (46.7%)	26 (57.8%)	30 (66.7%)	77 (57.0%)	17.1	0.002
	No	24 (53.3%)	19 (42.2%)	15 (33.3%)	58 (43.0%)		
Did you seek care for a toothache?	Yes	19 (42.2%)	15 (33.3%)	17 (37.8%)	51 (37.8%)	21.008	< 0.001
	No	26 (57.8%)	30 (66.7%)	28 (62.2%)	84 (62.2%)		

Data are presented as n (%). Chi-square test was used for comparison. $p < 0.05$ was considered statistically significant.

Perceived treatment needs and oral problems are summarised in Table 5. Prolonged toothache, avoidance of eating due to oral problems, bleeding gums, bad breath, and dissatisfaction with dental appearance were significantly more frequent among tobacco users, especially dual tobacco users, than among non-smokers.

Table 5
Perceived treatment needs and oral problems reported by participants.

Question	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
How long did the toothache last?	1 week	16 (35.6%)	9 (20.0%)	14 (31.1%)	39 (28.9%)	19.33	0.014
	> 1 week	3 (6.7%)	12 (26.7%)	15 (33.3%)	30 (22.2%)		
	1 month	4 (8.9%)	8 (17.8%)	6 (13.3%)	18 (13.3%)		
	> 1 month	5 (11.1%)	2 (4.4%)	5 (11.1%)	12 (8.9%)		
	> 7 months	17 (37.8%)	14 (31.1%)	5 (11.1%)	36 (26.7%)		
Avoid eating due to mouth problems?	Often	2 (4.4%)	6 (13.3%)	12 (26.7%)	20 (14.8%)	24.014	0.002
	Sometimes	10 (22.2%)	10 (22.2%)	9 (20.0%)	29 (21.5%)		
	Rarely	6 (13.3%)	8 (17.8%)	9 (20.0%)	23 (17.0%)		
	Never	22 (48.9%)	11 (24.4%)	4 (8.9%)	37 (27.4%)		
	Both/either	5 (11.1%)	10 (22.2%)	11 (24.4%)	26 (19.3%)		
Reasons for avoiding eating	Mouth ulcer	2 (4.4%)	0 (0%)	0 (0%)	2 (1.5%)	14.471	0.025
	Pain	14 (31.1%)	15 (33.3%)	26 (57.8%)	55 (40.7%)		
	Others	3 (6.7%)	1 (2.2%)	0 (0%)	4 (3.0%)		
	Both ulcer and pain	26 (57.8%)	29 (64.4%)	19 (42.2%)	74 (54.8%)		
In the past month, did you notice	Bleeding gums	9 (20.0%)	4 (8.9%)	8 (17.8%)	21 (15.6%)	33.831	0.002
	Bad breath	4 (8.9%)	7 (15.6%)	7 (15.6%)	18 (13.3%)		

Data are presented as n (%). Chi-square test was used for comparison. $p < 0.05$ was considered statistically significant.

Question	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
	Dry mouth	0 (0.0%)	2 (4.4%)	0 (0.0%)	2 (1.5%)		
	Any other	22 (48.9%)	5 (11.1%)	12 (26.7%)	39 (28.9%)		
	Both bleeding gums & bad breath	10 (22.2%)	19 (42.2%)	16 (35.6%)	45 (33.3%)		
How satisfied are you with the appearance of your teeth?	Satisfied	24 (53.3%)	12 (26.7%)	0 (0.0%)	36 (26.7%)	55.773	< 0.001
	Neither satisfied nor dissatisfied	11 (24.4%)	23 (51.1%)	32 (71.1%)	66 (48.9%)		
	Dissatisfied	10 (22.2%)	11 (24.4%)	13 (28.9%)	34 (25.2%)		

Data are presented as n (%). Chi-square test was used for comparison. p < 0.05 was considered statistically significant.

Table 6 shows the presence of oral conditions and satisfaction with dental appearance. Most participants (88.9%) considered their teeth important, with a significant difference among groups (p = 0.009). Discoloured or stained teeth were reported by 45.2% of participants overall, with the highest prevalence among smokers (64.4%) (p < 0.001). Loose teeth (41.5% overall), sensitive teeth (29.6% overall), and broken teeth or fillings (37.8% overall) were most reported by dual tobacco users, with statistically significant differences for loose teeth and sensitive teeth (p < 0.001 and p = 0.004, respectively). Dental fears, tooth abscess, and the presence of an ill-fitting prosthesis did not differ significantly between groups.

Table 6
Presence of oral conditions and satisfaction with dental appearance among participants.

Question	Category	Non-smokers n (%)	Smokers n (%)	Dual tobacco users n (%)	Total n (%)	Chi-square	p value
Are teeth important to you?	Yes	45 (100%)	39 (86.7%)	36 (80.0%)	120 (88.9%)	9.450	0.009
	No	0 (0.0%)	6 (13.3%)	9 (20.0%)	15 (11.1%)		
Dental fears	Yes	13 (28.9%)	10 (22.2%)	16 (35.6%)	39 (28.9%)	1.947	0.378
	No	32 (71.1%)	35 (77.8%)	29 (64.4%)	96 (71.1%)		
Broken tooth or filling?	Yes	18 (40.0%)	11 (24.4%)	22 (48.9%)	51 (37.8%)	5.861	0.053
	No	27 (60.0%)	34 (75.6%)	23 (51.1%)	84 (62.2%)		
Discoloured/stained teeth?	Yes	11 (24.4%)	29 (64.4%)	21 (46.7%)	61 (45.2%)	28.659	< 0.001
	No	34 (75.6%)	16 (35.6%)	24 (53.3%)	74 (54.8%)		
Tooth abscess	Yes	3 (6.7%)	3 (6.7%)	8 (17.8%)	14 (10.4%)	3.985	0.136
	No	42 (93.3%)	42 (93.3%)	37 (82.2%)	121 (89.6%)		
Loose teeth	Yes	1 (2.2%)	18 (40.0%)	37 (82.2%)	56 (41.5%)	59.3	< 0.001
	No	44 (97.8%)	27 (60.0%)	8 (17.8%)	79 (58.5%)		
Sensitive teeth	Yes	5 (11.1%)	17 (37.8%)	18 (40.0%)	40 (29.6%)	11.155	0.004
	No	40 (88.9%)	28 (62.2%)	27 (60.0%)	95 (70.4%)		
Have any crown, bridge, or partial denture that does not fit?	Yes	3 (6.7%)	2 (4.4%)	2 (4.4%)	7 (5.2%)	0.301	0.860
	No	42 (93.3%)	43 (95.6%)	43 (95.6%)	128 (94.8%)		

Data are presented as n (%). Chi-square test was used for comparison. $p < 0.05$ was considered statistically significant.

Table 7 compares the Decayed (DT), Missing (MT), and Filled Teeth (FT) scores among the three study groups. Dual tobacco users had the highest mean DT score (2.71 ± 2.04), followed by smokers (2.49 ± 2.86) and non-smokers (1.09 ± 1.41); this difference was statistically significant (F = 7.268, p = 0.001). Similarly, the mean MT score was significantly higher among smokers (2.49 ± 2.75) and dual tobacco users (2.42 ± 2.14) than among non-smokers (0.80 ± 1.47) (F = 8.633, p < 0.001). No statistically significant difference was observed in the mean FT scores among the three groups (F = 2.379, p = 0.097).

Table 7
Comparison of mean Decayed (DT), Missing (MT), and Filled Teeth (FT) scores among the three study groups.

Variable	Group	N	Mean	SD	F-value	p value
Decayed Teeth (DT)	Group 1 (non-smokers)	45	1.09	1.411	7.268	0.001
	Group 2 (smokers)	45	2.49	2.865		
	Group 3 (dual tobacco users)	45	2.71	2.041		
	Total	135	2.10	2.288		
Missing Teeth (MT)	Group 1 (non-smokers)	45	0.80	1.471	8.633	< 0.001
	Group 2 (smokers)	45	2.49	2.752		
	Group 3 (dual tobacco users)	45	2.42	2.137		
	Total	135	1.90	2.305		
Filled Teeth (FT)	Group 1 (non-smokers)	45	0.96	2.236	2.379	0.097
	Group 2 (smokers)	45	1.78	2.173		
	Group 3 (dual tobacco users)	45	1.02	1.454		
	Total	135	1.25	2.006		

Group 1 = non-smokers; Group 2 = smokers; Group 3 = dual tobacco users. One-way ANOVA was used for comparison. Post-hoc Tukey test was applied for pairwise comparisons. p < 0.05 was considered statistically significant.

4. Discussion

The present study compared how adults with different tobacco-use patterns perceived their oral health and how these perceptions corresponded with clinical dental findings. A clear and consistent gradient emerged across the three study groups. Non-smokers generally reported and demonstrated better oral health; smokers showed intermediate findings; and dual tobacco users had the poorest profile on most indicators. This pattern is particularly noteworthy as dual users were not simply exposed to two tobacco

products; they also appeared to represent a distinct subgroup with overlapping behavioural risks, lower dental attendance, and a higher burden of untreated disease.

4.1 Sociodemographic Profile

The three groups were comparable in age, which strengthens the interpretation that the observed oral health differences were more attributable to tobacco-use behaviour than to age-related variation. Sex distribution, however, differed markedly. Most smokers and dual tobacco users were male, whereas most non-smokers were female. This reflects the well-established pattern documented in GATS-2, where tobacco use in India remains substantially more prevalent among men than women.[8] Within the Mysuru OPD setting, this finding may also reflect social acceptability, occupational exposure, peer influence, and easier access to tobacco products among men. However, emerging global cancer surveillance data reporting a rise in tobacco use among younger urban women underscores the need for future studies to closely monitor sex specific shifts in tobacco behaviour.[4]

Educational attainment differed across the study groups, with lower levels of education being more prevalent among smokers and dual users, whereas non-smokers were more likely to have graduate-level qualifications.

Education is an important determinant of health literacy and may influence awareness of oral health problems, understanding of tobacco related risk and utilisation of dental services to seek timely dental care. The poorer brushing practices and reduced attendance observed among tobacco users may therefore be partially attributable to differences in health literacy. These findings are consistent with previous reports indicating a higher tobacco prevalence among individuals with lower educational attainment.[1]

4.2 Tobacco Use Patterns, Alcohol, and Dietary Habits

Alcohol consumption was more prevalent among tobacco users, indicating a clustering of risk behaviours. Alcohol use was absent among non-smokers yet commonly reported among smokers and dual users, especially the latter. This co-occurrence mirrors national survey findings where tobacco and alcohol frequently converge.[8] From a dental public health standpoint, this clustering carries important clinical implications as alcohol can worsen oral dryness, influence oral hygiene behaviour, and add to the mucosal risk already posed by tobacco. Therefore, a patient who reports tobacco use in the dental OPD should not be counselled for tobacco alone; alcohol use must equally be screened and addressed where relevant.

Dietary pattern represented another meaningful behavioural distinction between the groups, with mixed diet being more prevalent among smokers and dual users. While the present study did not capture the sugar intake, meal frequency, or nutritional quality, diet cannot be interpreted as an independent causal factor. Association with tobacco and alcohol indicates that tobacco users may carry a broader and more complex lifestyle-risk profile. In clinical practice, this reinforces the need to pair brief tobacco cessation advice with simple oral hygiene and diet-related counselling, particularly for patients who are already presenting with untreated caries or periodontal symptoms.

4.3 Oral Hygiene Practices

Oral hygiene practices differed significantly across the study groups. Once daily brushing was the norm among most smokers and nearly all dual tobacco users, while twice-daily brushing was considerably more common among non-smokers. This disparity carries direct clinical relevance because tobacco-related plaque retention, staining, gingival inflammation, and halitosis may worsen when brushing frequency and technique are inadequate. These observations are consistent with a recent dental OPD-based comparison, reporting that tobacco users had poorer oral hygiene scores than non-users.[9] Furthermore, the use of unconventional cleaning agents such as mud and ash by some tobacco users further suggests that oral health education should address local practices directly, rather than relying solely on generic toothbrushing messages recommended.

Dental service utilisation was lowest among dual tobacco users, despite their higher burden of oral symptoms and perceived treatment needs. This mismatch between need and care-seeking is one of the most important findings of the study. A national dataset analysis also reported lower dental-care utilisation among smokeless tobacco users.[10] In the present setting, possible reasons include cost concerns, delayed care-seeking until pain becomes severe, low perceived benefit of preventive visits, and fear of being advised to stop tobacco. The finding indicates that dental OPDs should actively identify tobacco users and invite them into care, rather than waiting for them to present only when symptoms become advanced.

4.4 Self-Rated Oral Health and Perceived Treatment Needs

Self-rated oral health provides insight into how participants understand their own oral condition. In this study, tobacco users, particularly dual users, perceived their oral health more poorly and reported greater treatment needs than non-smokers. These perceptions were not isolated complaints; they were supported by clinical findings such as higher decayed and missing teeth scores. Similar hospital-based evidence from India has reported poorer self-perceived oral health among tobacco users.[9] The agreement between subjective perception and clinical findings in the present study strengthens the relevance of using simple self-rated oral health questions as a screening tool in busy outpatient settings.

Toothache was common in all groups but was highest among dual tobacco users. Dental care-seeking for toothache remained lower than expected despite the high prevalence of toothache, indicating unmet treatment need. In tobacco users, pain may arise from untreated caries, periodontal involvement, exposed root surfaces, or mucosal irritation. Dependence on tobacco may also delay care because symptoms are normalised or ignored until they interfere with eating or daily activity. The present findings therefore highlight the need to move from symptom-based treatment to earlier risk-based screening among tobacco users.

Dual tobacco users also more frequently perceived that they had untreated medical conditions. Although this item was self-reported and cannot be taken as a clinical diagnosis, it suggests that this group may experience a broader sense of poor health. Self-rated health is known to predict morbidity, mortality, and

later health-seeking behaviour.[6] In the context of this study, poorer self-rated oral health may therefore be a useful warning sign for clinicians, especially when it appears alongside tobacco use, pain, and low dental attendance.

4.5 Aesthetic Concerns and Functional Limitations

Aesthetic concerns were prominent among tobacco users. Smokers most often reported stained or discoloured teeth, which is expected because tobacco smoke deposits extrinsic stains on enamel and restorations. A national cross-sectional study also reported a strong association between smoking and tooth discolouration.[13] In the present study, dissatisfaction with dental appearance was especially striking among dual users, none of whom reported being satisfied. This finding is clinically useful because appearance-related concerns may motivate patients who are otherwise reluctant to seek care or discuss tobacco cessation.

Loose teeth and sensitivity were reported much more frequently by dual tobacco users. These complaints are compatible with periodontal attachment loss, gingival recession, exposed root surfaces, and untreated caries. Smokeless tobacco may also produce local irritation at the placement site, while smoking can impair vascular response and periodontal healing. A comparative study among young adults reported worse periodontal status among individuals with dual habits than among non-users, supporting the possibility of additive periodontal damage.[11] The very high reporting of loose teeth among dual users in this study should therefore be interpreted as a signal for early periodontal assessment and follow-up.

Avoidance of eating because of oral problems was also more common among smokers and dual users. Pain emerged as the most frequently reported trigger for dental visit, a finding that extends the interpretation beyond clinical indices alone, because it signals that oral disease was affecting daily function. Difficulty eating may compel patients to avoid certain foods, delay meals, or rely on softer and often more cariogenic foods. For tobacco users already burdened with existing caries and periodontal problems, this dynamic can give rise to a self-reinforcing cycle in which pain, poor diet, and delayed dental care reinforce one another.

4.6 Clinical Dental Status (DMFT)

The clinical examination findings were consistent with the self-reported oral health findings. Dual tobacco users had the highest mean decayed teeth score, followed by smokers and then non-smokers. This pattern may be explained by reduced salivary protection, altered oral microbial balance, poor plaque control, lower dental attendance, and delayed treatment. Recent evidence among smokeless tobacco users has shown reductions in salivary flow, pH, and antioxidant capacity, which may increase caries susceptibility.[14] The present findings therefore suggest that dual use may increase caries risk through both biological pathways and care-seeking barriers.

Missing teeth scores were significantly higher among smokers and dual users than among non-smokers. Tooth loss is usually the final outcome of long-standing untreated disease rather than an isolated event. In tobacco users, it may reflect both advanced caries and periodontal destruction. Tobacco exposure can

impair periodontal healing and host defence, and longitudinal evidence has linked tobacco use with incident tooth loss over time.[12] The present study adds to this evidence by showing that higher missing teeth scores were already evident in a relatively small dental OPD sample.

Filled teeth scores did not differ significantly among the three groups, even though tobacco users had more decayed and missing teeth. The absence of significant associations is itself a clinically meaningful observation. It suggests that dental treatment rendered to tobacco users may be disproportionate to their actual disease burden. These patients may be entering the dental-care system late, when extraction becomes more likely than restoration. A recent South Asian study reported a significant association between dual tobacco use and severe dental caries.[15]Collectively, these findings highlight's that dual tobacco users need earlier restorative assessment, not only emergency care after pain develops.

4.7 Implications for Clinical Practice and Public Health

From a clinical practice perspective, these findings advocate for a straightforward yet meaningful modification in routine dental outpatient workflow. Systematic screening for both smoked and smokeless tobacco use should be incorporated for every adult patient, with dual use documented as a distinct category rather than subsumed under smoking alone. Brief risk-based counselling anchored to the patient's presenting complaint, such as staining, sensitivity, tooth mobility, pain, or difficulty eating. This approach may make counselling more acceptable because it connects tobacco use with problems the patient already recognises.

From a public health perspective, dual tobacco users should be recognised as a high-risk subgroup due to their poorer oral hygiene, lower dental attendance, greater symptom burden, and worse clinical findings than the other groups. These findings highlight the need for integrated preventive strategies with dental colleges and community health care settings, including oral cancer awareness, periodontal screening, caries prevention, and tobacco-cessation counselling. Public health interventions should also address misconceptions regarding the relative safety of smokeless tobacco products and emphasise the adverse oral health consequences associated with all forms of tobacco use.

4.8 Limitations

The findings of this study should be interpreted considering certain limitations. The cross-sectional design precludes causal inference, and the hospital-based sample may limit the generalisability of the results to the wider population. In addition, Self-reported information on tobacco use and alcohol consumption, oral hygiene practices, and oral symptoms is subject to recall and reporting bias. Biochemical verification of tobacco exposure was not performed, and inadequate characterisation of exposure intensity precluded dose-response evaluation. Future longitudinal community-based studies incorporating objective measures of tobacco exposure and comprehensive exposure metrics, including pack-years, smokeless tobacco frequency, dependence assessment and comprehensive periodontal evaluation are warranted to further clarify the relationship between tobacco use patterns and oral health outcomes.

5. Conclusion

This comparative cross-sectional study found that tobacco use, particularly dual use of smoked and smokeless tobacco, was associated with poorer self-rated oral health, greater perceived treatment needs, suboptimal oral hygiene practices, and higher burden of dental diseases. Dual tobacco users exhibited the poorest oral health profile, characterised by greater symptom burden and lower dental service utilisation, highest mean decayed and missing teeth scores. The lack of significant differences in filled teeth scores across groups suggests inadequate restorative care relative to actual disease burden among tobacco users. These findings highlight the importance of integrating tobacco cessation counselling, preventive oral health intervention and early dental care into routine clinical practice with particular emphasis on dual tobacco users. Further longitudinal studies are needed to better understand the long-term impact of different tobacco use pattern on oral health outcomes.

Declarations

6. Clinical Relevance

These findings underscore the importance of routine shows that tobacco use should be assessed routinely during dental outpatient visits, with specific attention to patients who use both smoked and smokeless tobacco. Dual tobacco users demonstrated notably poorer oral hygiene, lower dental attendance, more untreated dental disease, and higher decayed and missing teeth scores than the other groups. These patients may benefit from earlier caries detection, periodontal assessment, tobacco cessation advice, and shorter recall intervals. Linking counselling to the patient's presenting complaint, such as toothache, staining, sensitivity, loose teeth, or difficulty eating, may make the advice more relevant and acceptable in routine dental practice.

Consent to publish

Consent to publish declaration: Not applicable

Data Availability:

The datasets generated or analysed during the current study are available from the corresponding author on reasonable request.

Ethical approval and consent of participants

This study was conducted in accordance with the ethical principles stipulated in the Declaration of Helsinki, with institutional ethical clearance obtained from the Ethics Committee of JSS Dental College and Hospital (ref. No:27/2025). Written informed consent was obtained from all participants before their inclusion in the study. Confidentiality and anonymity of the participants were strictly maintained throughout the study.

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9. Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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11. Author contributions

M.S conceived and designed the study, collected the data, performed the statistical analysis, interpreted the findings, and drafted the manuscript. T.H.M. conceptualised and supervised the study, contributed to the methodology, interpretations of data and critically revised the manuscript. M.M. contributed to the study design, data interpretation and manuscript review. V.G. assisted with data collection, literature review and critical revision of the manuscript. M.B. contributed to methodology, statistical guidance and manuscript revision. D.H. contributed to data interpretation, manuscript review and critical revision of the manuscript. All authors read and approved the final manuscript.

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