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Original Article

Smokeless tobacco use and its association with oral potentially malignant lesions among patients seeking dental care during 2020-2022 in Dakshina Kannada, Karnataka, India

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Abstract

Background: This study aimed to investigate the association between oral potentially malignant lesions (OPML) and the consumption of areca nut and tobacco among individuals in the Dakshina Kannada district of Karnataka, India.

Methods: This observational, cross-sectional analysis was conducted as part of the various outreach programs organized by the institution. Dental patients from the dental college, camps, and rural centers were screened for OPMLs. Participants with smokeless tobacco (SLT) habits were included. A validated questionnaire, administered in the local language, was used to gather demographic data and habit details. Subsequent oral examinations recorded OPML characteristics. Descriptive statistics and chi-square tests were utilized for analysis using IBM SPSS software.

Results: Of the 4847 screened individuals seeking dental care, 330 SLT users were included. The majority (25.2%) were aged 51–60 years, predominantly male (69.4%), and from lower socioeconomic backgrounds (69.7%). Most resided in rural areas (95.2%), with some reporting a family history of cancer. Among SLT users, 37 also smoked, and 40 consumed alcohol. Various SLT forms were reported, with betel quid, areca nut, lime, and tobacco being the most common (63.6%). Of the participants, 38.8% had OPMLs, primarily oral submucous fibrosis (39.06%) and leukoplakia (14.8%). OPMLs were predominantly found on the buccal mucosa (76.5%). Significant associations were found between the type of tobacco products, method of consumption, duration of SLT use, and the presence of OPMLs.

Conclusion: This study highlights a significant association between SLT habits and the presence of OPMLs among individuals in Dakshina Kannada. Understanding these associations can inform preventive strategies and oral health interventions to reduce the burden of potentially malignant lesions in this population.

Keywords: Substance abuse, Oral health, Oral submucous fibrosis, Leukoplakia

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Introduction

Oral cancer is ranked as the 16th most prevalent cancer globally, with an estimated global incidence of 389,846 and mortality of 188,438, as reported by GLOBOCAN 2022.[1] It is among the most common malignancies in the Pacific regions and Southeast Asia, primarily due to the increase in betel nut and tobacco consumption.[2] In India, a staggering 28.6% of the population consumes tobacco products, leading to 800,000 annual deaths from tobacco-related ailments.[3] Oral cancer has been firmly linked to several established risk factors such as consumption of alcohol, tobacco, and betel nut derivatives, human papillomavirus infection, genetic predisposition, mucosal inflammation, and chronic mucosal trauma.[4] These risk factors are also known to induce a diverse set of morphological changes in the oral mucosa that have the potential to convert into malignancy; these changes are termed oral potentially malignant lesions (OPMLs).[5] Within the diverse spectrum of OPMLs, the most prevalent lesions include oral leukoplakia, oral submucous fibrosis, and oral erythroplakia.[6] Some other OPMLs are lichen planus, candidiasis, oral ulceration, hairy tongue, and more.

The high incidence and mortality rate of oral cancer makes its prompt and early diagnosis of prime significance. Consequently, the early detection of OPMLs and habit cessation counseling are pivotal in preventing their

transformation and progression into oral malignancy. The present study aimed to determine the association of OPMLs with the consumption of areca nuts and tobacco in the Dakshina Kannada district of Karnataka, India.

Methods

Dakshina Kannada is a southern coastal district of Karnataka State with an area of 4866 sq. km, comprising nine taluks, and an estimated population of 2,089,649[7]. The current observational and cross-sectional study was conducted through various outreach programs organized by the institution from 2020 to 2022. An ethical clearance (NU/CEC/2020/0297), dated 10 July 2020, was obtained from the Institutional Ethical Committee, and written informed consent was obtained from all participants. Patients seeking dental treatments at the dental college, dental camps, and rural dental centers affiliated with the institution were informed about the study and screened for OPMLs and malignant lesions.

Participants with smokeless tobacco (SLT) habits were included in the study. A self-administered 18-item questionnaire was used to collect data on patients' age, sex, education, occupation, income, and history of adverse habits (type, frequency, and duration). The questionnaire was validated by five subject experts, yielding a content validity of 0.86. The internal consistency of the questionnaire was found to be 0.92, and the test-retest reliability was 0.88. A pilot study of the questionnaire was conducted among 30 participants, and modifications were made accordingly. The questionnaire was administered to the participants in their local language, followed by an oral examination using a sterile mouth mirror following standard operating protocols. In cases where an OPML was detected, its site, size, appearance, and extent were recorded.

Descriptive statistics were obtained as percentages, and the chi-square test was used to analyze differences in proportions. A *p*-value of less than 0.05 was considered statistically significant. Logistic regression was done to analyze the impact of various covariates on the occurrence of OPMLs. Data analysis was conducted using IBM SPSS Statistics for Windows, Version 23.0 (Armonk, NY: IBM Corp).

Results

Oral screening was conducted on 4847 individuals seeking dental treatment, of whom 330 participants were included in the study based on their history of SLT use. The majority of the participants (25.2%) were in the 51–60 years age group. Among the SLT consumers, 69.4% were male, and 30.6% were female. They predominantly (69.7%) belonged to the lower socioeconomic group, with 95.2% residing in rural areas of Dakshina Kannada. Seven participants reported a family history of cancer. Table 1 presents the association of sociodemographic factors, systemic diseases, and family history of cancer with the presence of OPML. None of the variables showed a statistically significant association with OPML.

Table 2 shows the distribution of study participants according to patterns of tobacco and alcohol consumption, along with the frequency of OPML among SLT users. Among the 330 participants who used SLT, 37 had a history of smoking tobacco, and 40 reported alcohol consumption. Various forms of SLT use included consumption of betel quid with areca nut, lime, and tobacco (63.6%), paan masala (10%), snuff (6.4%), hans (3.6%), betel quid with areca nut and lime (3.3%), gutka (3%), betel quid with areca nut only (2.7%), betel leaf (2.7%), areca nut (2.4%), tobacco flakes (1.2%), and areca nut with tobacco (0.9%). The majority of participants (64.8%) consumed these products at least 3–5 times daily, with a significant proportion (33.3%) reporting consumption for over 15 years. About 30.9% of the participants reported chewing these products, while others mentioned placing them in the buccal or labial vestibules for extended periods. Among the 330 study participants who were SLT consumers, 128 (38.8%) were diagnosed with OPMLs. Oral submucous fibrosis (OSMF) was identified in the majority of the participants (39.06%), followed by leukoplakia (14.8%). Other oral lesions, albeit infrequently observed, included angular cheilitis, smokers' palate, erosive paan stains, tobacco pouch keratosis, and leucoedema.

A combination (present either at the same site or different sites) of two lesions was observed in 29 participants, and three lesions were observed among 3 participants (Table 3). A total of five participants had a combination of erythroplakia and other OPMLs. Among the participants with OPMLs, the buccal mucosa was the most commonly affected site (76.5%). A total of 19 participants (14.8%) with OPMLs were affected at two or more intraoral sites.

Table 4 depicts the association between the behavioral pattern of SLT consumption and the presence of OPMLs. There was no statistically significant association between the habitual use of SLT, either alone or in combination with smoking and/or alcohol consumption, and the presence of OPMLs. A statistically significant association was found between the type and duration of SLT consumed and the presence of OPMLs, as well as between whether the participants spat or swallowed the residue of SLT and the presence of OPMLs.

Table 5 presents the results of logistic regression analysis to determine the relationship between various SLT products, duration of chewing, and whether the participant spits or swallows the tobacco product after consumption. The consumption of betel leaf was associated with a 0.04 times chance of developing an OPML compared to tobacco flakes.

Discussion

The results of the present study showed that the overall

Table 1. Association of sociodemographic factors, systemic diseases, and family history of OPMLs

Study variable		*n* (%)	Lesions		Significance
			Present	Absent	
Age (years)	18–30	21 (6.4%)	10	11	*P*=0.675
	31–40	68 (20.6%)	25	43	
	41–50	75 (22.7%)	34	41	
	51–60	83 (25.2%)	31	52	
	61–70	63 (19.1%)	22	41	
	70 and above	20 (6.1%)	6	14	
Gender	Male	229 (69.4%)	90	139	*P*=0.824
	Female	101 (30.6%)	38	63	
Education	Illiterate	85 (25.8 %)	36	49	*P*=0.865
	Primary school	140 (42.4%)	52	88	
	High school	79 (23.9%)	31	48	
	Secondary school	16 (4.8%)	5	11	
	Graduation	9 (2.7%)	4	5	
	Post-graduation	1 (0.3%)	0	1	
Occupation	Unemployed	101 (30.6%)	31	70	*P*=0.268
	Elementary occupations	160 (48.5%)	72	88	
	Plant and machine operators	14 (4.2%)	5	9	
	Skilled agricultural and fishery workers	20 (6.1%)	8	12	
	Skilled shop and market sales workers	28 (8.5%)	9	19	
	Clerks	1 (0.3%)	1	0	
	Technicians and associate professionals	4 (1.2%)	2	2	
	Other professionals	2 (0.6%)	0	2	
Income (Rs/month)	<6,174	45 (13.6%)	13	32	*P*=0.330
	6,175-18,496	248 (75.2%)	103	145	
	18,497–30,830	26 (7.9%)	8	18	
	30,831–46,128	8 (2.4%)	4	4	
	46,129–61,662	2 (0.6%)	0	2	
	61,663–1,23,321	1 (0.3%)	0	1	
	>1,23,322	0 (0.0%)	0	0	
Location	Urban	16 (4.8%)	5	11	*P*=0.520
	Rural	314 (95.2%)	123	191	
Presence of systemic diseases	None	226 (68.5%)	88	138	*P*=0.562
	Diabetes	61 (18.5%)	21	40	
	Hypertension	38 (11.5%)	18	20	
	Lung diseases	2 (0.6%)	0	2	
	Cancer	3 (0.9%)	1	2	
History of cancer in the family	No	323 (97.9%)	125	198	0.577
	Yes	7 (2.1%)	2	5	

prevalence of SLT use among dental patients was 6.8%, with the majority of users residing in rural areas and belonging to lower socioeconomic groups. It was also found that 38.8% of smokeless tobacco (SLT) users had oral potentially malignant lesions (OPMLs), with oral submucous fibrosis (OSMF) being the most prevalent lesion (39.06%), followed by leukoplakia (14.8%).

Oral inflammatory/reactive lesions and intraosseous lesions are prevalent among children, adolescents, and adults in Iran.[8,9] Substance abuse has been linked to the occurrence of oral diseases.[10,11] Tobacco use is a pervasive global health concern, with significant adverse effects on various organ systems. The diverse array of oral lesions associated with tobacco use encompasses a spectrum of conditions, ranging from benign lesions to potentially malignant lesions and malignant entities such as oral

Table 2. Distribution of study participants by patterns of tobacco and alcohol consumption and the presence of OPMLs

Variable			*n* (%)
Smokeless Tobacco (*n* = 330)	Type	Betel leaf only	9 (2.7%)
		Arecanut and tobacco	3 (0.9%)
		Arecanut only	8 (2.4%)
		Betel quid with areca nut, lime, and tobacco	210 (63.6%)
		Betel quid with areca nut and lime only	11 (3.3%)
		Betel quid with areca nut only	9 (2.7%)
		Hans	12 (3.6%)
		Paan masala	33 (10.0%)
		Zarda	0 (0.0%)
		Ghutka	10 (3.0%)
		Tobacco flakes	4 (1.2%)
		Snuff	21 (6.4%)
	Frequency (per day)	Once	14 (4.2%)
		Twice	42 (12.7%)
		3-5 times	214 (64.8%)
		6 or more	37 (11.2%)
		Others	23 (7.0%)
	Onset (years)	<1	7 (2.1%)
		1–5	79 (23.9%)
		6–10	81 (24.5%)
		11–15	53 (16.1%)
		>16	110 (33.3%)
Smoking (*n* = 37)	Type	Beedi	24 (64.86%)
		Cigarette	13 (35.14%)
	Frequency (per day)	Once	2 (5.4%)
		Twice	4 (10.8 %)
		3–5 times	20 (54.05%)
		6 or more	2 (5.4%)
		Others	9 (24.3%)
	Onset (in years)	<1	1 (2.7%)
		1–5	4 (10.8%)
		6–10	8 (21.6%)
		11–15	0 (0.0%)
		>16	24 (64.8%)
Alcohol (*n* = 40)	Frequency (per day)	Once	15 (37.5%)
		Twice	5 (12.5%)
		3–5 times	3 (7.5%)
		6 or more	1 (2.5%)
		Occasionally	16 (40.0%)
	Onset (in years)	<1	0 (0.0%)
		1–5	9 (22.5%)
		6–10	7 (17.5%)
		11–15	7 (17.5%)
		>16	17 (42.5%)

Table 2. Continued.

Variable			*n* (%)
OPML	Presence (*n* = 330)	Yes	128 (38.8%)
		No	202 (61.2%)
	Site (*n* = 128)	Lip	1 (0.8%)
		Labial mucosa	6 (4.7%)
		Buccal mucosa	98 (76.5%)
		Gingiva	3 (2.4%)
		Tongue	1 (0.8%)
		Combination of two or more sites	19 (14.8%)
	Type (*n* = 128)	Leukoplakia	19 (14.8%)
		Erythroplakia	0 (0.0%)
		Lichen planus	9 (7.03%)
		Ulceration	11 (8.59%)
		Candidiasis	0 (0.0%)
		Oral submucous fibrosis	50 (39.06%)
		Others	7 (5.46%)
		Combination of two or more lesions	32 (25%)

Table 3. Various combinations of two or more oral lesions

Type of lesion	*n*
Leukoplakia + OSMF	6
Leukoplakia + tobacco pouch keratosis	1
Leukoplakia + lichen planus	1
Leukoplakia + erosive paan stain	1
OSMF + ulceration	4
OSMF + erythroplakia	3
OSMF + angular cheilitis	2
OSMF + tobacco pouch keratosis	2
OSMF + leukoedema	1
OSMF + erosive paan stain	1
OSMF + smokers' palate	1
OSMF + candidiasis	1
Lichen planus + OSMF	2
Lichen planus + smokers' palate	1
Lichen planus + vesicular lesion on hard palate	1
Ulceration + erythroplakia	1
Lichen planus + OSMF + ulceration	1
Lichen planus + OSMF + erythroplakia	1
Lichen planus + candidiasis + ulceration	1
Total number of combined lesions	32

squamous cell carcinoma.

SLT consists of a mixture of tobacco, slaked lime, areca nut, and other spices, which are commercially available.[12] More than 40 varieties of SLT are used and popular globally.[13] Among global SLT users, an appalling 67.5% reside in India.[14] SLTs are widely used by both men and women in India, with common forms including khaini and gutka for men and betel quid with tobacco and oral application of tobacco for women.[15] In the present study, betel quid with areca nut, lime, and tobacco was the most commonly used form among both men and women. This trend could be attributed to widespread areca nut cultivation, which accounts for the easy access and affordability of the product in the Dakshina Kannada district of Karnataka.

The association between SLT consumption and the development of OPMLs has been extensively documented in previous studies. A study by Al-Maweri et al in Yemen (2014) reported that 239 out of 409 participants (58.4%) exhibited oral lesions associated with chewing tobacco.[16] Similarly, a study by Hallikeri et al[17] in India reported that 54.17% of individuals (*n* = 1438) developed oral lesions due to regular SLT consumption. In the present study, the prevalence of OPMLs was found to be 38.8%. In addition, no statistically significant difference was found in the occurrence of OPMLs with the use of SLT alone or in combination with other adverse habits. This means that even without the additional risk factors such as smoking and alcohol, exposure to SLT alone can initiate the occurrence of OPMLs. The findings are noteworthy and underscore the impact of SLT on oral health.

Similar to the findings of the present study, a study by Aishwarya et al conducted among 280 tobacco users found that OSMF was the most common lesion among chewers, followed by Leukoplakia.[18] Similar findings were also reported by Gupta et al and Reddy et al.[19,20] The oral cavity serves as a primary portal for tobacco exposure, providing direct contact between the mucosal tissues and the myriad of harmful constituents present in tobacco products. These constituents lead to the initiation and progression of the OPMLs at the site of SLT placement. In the present study, the buccal mucosa was the most commonly affected

Table 4. Association of behavioral patterns of SLT consumption and the presence of OPMLs

Study variable		Soft tissue lesions			Significance
		Present	Absent		
Adverse habits	SLT	165	96	261	Fisher's Exact $X^2=2.633$, $P=0.453$
	SLT + smoking	16	13	29	
	SLT + alcohol	16	16	32	
	SLT + smoking + alcohol	5	3	8	
	Total	202	128	330	
Smokeless type	Betel leaf only	8	1	9	Fisher's Exact $X^2=20.460$, $P<0.05$*
	Arecanut and tobacco	3	0	3	
	Arecanut only	4	4	8	
	Betel quid with areca nut, lime, and tobacco	127	83	210	
	Betel quid with areca nut and lime only	6	5	11	
	Betel quid with areca nut only	6	3	9	
	Hans	6	6	12	
	Paan masala	19	14	33	
	Ghutka	3	7	10	
	Tobacco flakes	1	3	4	
	Snuff	19	2	21	
	Total	202	128	330	
Duration (minutes)	0–5 (Snuff)	19	2	21	Fisher's Exact $X^2=11.374$, $P<0.05$*
	5–10	148	106	254	
	11–20	24	17	41	
	21–30	9	2	11	
	31 and above	2	1	3	
	Total	202	128	330	
Type of consumption after use	Snuff	19	2	21	$X^2=8.381$, $P<0.05$*
	Spit	175	122	297	
	Swallow	8	4	12	
	Total	202	128	330	

site. Even among the lesions with a combination of multiple sites, at least one site included either the labial or buccal mucosa. These findings are consistent with those of Jagtap et al, who reported that 55.26% of the OPMLs were located in the buccal mucosa.[21] Similarly, Gabhane et al reported that 51.11% of study participants were affected by an OPML in the buccal mucosa.[22]

Our results demonstrate a clear correlation between SLT use and the presence of OPMLs. This finding corroborates previous research indicating that the carcinogenic compounds present in these products can initiate and promote cellular changes in oral tissues, leading to the development of OPMLs. The findings provide valuable insights into the complex relationship between smokeless tobacco use and oral health, underscoring the need for targeted interventions and awareness programs to mitigate associated risks and enhance public health outcomes in this population. However, this study had a few limitations. The data collected were self-reported, which may introduce recall bias. The findings of the present study may be under-represented and not fully generalizable, as data were collected only from dental patients. Further large-scale, population-based research and longitudinal studies are necessary to explore the causative mechanisms and long-term effects of SLT use on oral and systemic health.

Conclusion

This study comprehensively examined 330 smokeless tobacco users, shedding light on their sociodemographic characteristics, tobacco consumption patterns, and oral health conditions. Patients who use SLT should be informed about the heightened risk of OPMLs and oral cancer and encouraged to undergo regular screenings for early detection. Healthcare providers play a critical role in educating individuals about the detrimental effects of SLT on oral health and in promoting tobacco cessation interventions as part of comprehensive cancer

Table 5. Binomial logistic regression analysis of the association of smokeless tobacco use and OPMLs

Variables in the equation									
		B	Standard error	Wald	df	Significance	Exp (B)	95% confidence interval for Exp (B)	
								Lower	Upper
Step 1[a]	31 minutes and more			8.123	4	0.087			
	>5 minutes	-2.741	2.027	1.829	1	0.176	0.065	0.001	3.426
	5–10 minutes	0.678	1.283	0.279	1	0.597	1.970	0.159	24.344
	11–20 minutes	0.641	1.323	0.235	1	0.628	1.898	0.142	25.353
	21–30 minutes	-0.695	1.500	0.215	1	0.643	0.499	0.026	9.445
	Tobacco flakes			9.053	9	0.432			
	Betel leaf only	-3.197	1.586	4.061	1	0.044	0.041	0.002	0.916
	Arecanut and tobacco	-22.33	23203.03	0.000	1	0.999	0.000	0.000	
	Arecanut only	-0.864	1.379	0.393	1	0.531	0.421	0.028	6.291
	Betel quid with areca nut, lime, and tobacco	-1.464	1.165	1.579	1	0.209	0.231	0.024	2.269
	Betel quid with areca nut and lime only	-1.278	1.304	0.960	1	0.327	0.279	0.022	3.592
	Betel quid with areca nut only	-1.788	1.355	1.742	1	0.187	0.167	0.012	2.380
	Hans	-1.046	1.298	0.650	1	0.420	0.351	0.028	4.468
	Paan masala	-1.396	1.209	1.332	1	0.248	0.248	0.023	2.650
	Ghutka	-0.085	1.359	0.004	1	0.950	0.919	0.064	13.179
	Swallow			0.010	1	0.921			
	Spit	-0.069	0.697	0.010	1	0.921	0.933	0.238	3.662
	Constant	0.490	1.885	0.067	1	0.795	1.632		

a. Variable(s) entered on step 1: Duration_P, Smokeless_type, Spit_swallow.

prevention strategies.

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Competing Interests
Nil

Data Availability Statement
The available data will be shared on request.

Ethical Approval
The study was approved by the University Ethics Committee on 10/07/2020 with reference number NU/CEC/2020/0297.

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