

Tobacco as risk factor for periodontal disease in green marble mine laborers of Rajasthan, India

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Abstract

Aim: To determine the effect of tobacco usage on the severity of periodontal disease in green marble mine laborers. **Methods:** Marble mine laborers (n = 585) aged 15–54 years were selected from four geographic zones in green marble mines area using a stratified random sampling procedure. A total of 517 (88%) laborers participated in the study. The sample were classified as tobacco users, non users, occasional users, ex users and the data regarding form, duration and frequency of tobacco consumption was also collected by personal interviews. Periodontal status was assessed by community periodontal index. **Results:** Nearly three fourth (71.9%) of the population was tobacco users. Among the smokers, bleeding and calculus accounted to 33% each whereas the prevalence of these periodontal indicators was 38% and 44% respectively among smokeless tobacco users. Logistic regression analyses revealed that smokeless tobacco users were more liable for presence of periodontal pockets than smokers. Duration had a significant influence with users since more than 20 years being liable for presence of pockets at least twice (OR = 2.625, 95% CI 1.529 – 4.507) than the ≤ 5 years group. The odds ratio for presence of periodontal pockets increased by 2.143 (95 % CI 1.060 – 4.333) and 5.596 (95 % CI 2.901 – 10.639) for users of 6 – 10 units/ day and more than 10 units/day than the 1-2 times/day category. **Conclusions:** Tobacco usage had a significant impact on the severity of periodontal disease with users being more likely to present periodontal pockets than non users. Moreover, the risk of periodontal pockets increased as the duration and frequency of tobacco consumption increased.

Key words: Periodontal disease, risk factors, marble mine laborers, tobacco

Introduction

Multiple cross sectional and longitudinal studies about the association between smoking and periodontal disease have demonstrated that pocket depth, attachment and alveolar bone loss are more prevalent and severe in smoker patients than non smokers¹⁻³. Nevertheless, Sheiham⁴ concluded that smoking has no direct effect on periodontal disease and that differences could be due to higher plaque levels in smokers than non smokers.

Despite the controversial findings, it has been observed that smoking exerts a major effect on the protective elements of immune response, increasing the extent and severity of periodontal destruction. Moreover, this habit

has been associated with alterations in the neutrophil count and function in form of chemotaxis, phagocytosis and oxidative burst. Significant alterations are present in the gingival microvasculature of smokers that can lead to decrease of blood flow and decrease in clinical signs of inflammation⁵.

There is little information concerning tobacco use and periodontitis in developing countries like India^{6,7}, where both oral hygiene levels and the severity of periodontitis may be worse than developed countries⁸. Areca nut, often used with betel quid and chewable tobacco, is the fourth most commonly used psycho-active substance in the world, ranking after caffeine, alcohol and nicotine⁹.

High prevalence of use of these items has been reported in South and South East Asia¹⁰. Having an ancient history, they are an integral part of the culture and sometimes erroneously believed to have medicinal benefits¹¹.

There are fewer studies stating the relationship between smokeless tobacco use and periodontitis than the ones that have examined the association between cigarette smoking and periodontitis^{6,12,13}. The most of them are restricted to tobacco use in form of snuff dipping and

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tobacco chewing¹². The habit of betel chewing with tobacco is a particular form of smokeless tobacco consumption that is predominantly practiced in the Indian subcontinent^{13,14} either in the form of pan or guthka which is an industrially prepared mixture of areca nut, lime, catechu and tobacco⁹.

The association between tobacco consumed in chewing form and oral cancer has been widely documented^{15,16}. Moreover, studies done on athletes^{13,17} and adults^{18,19}, who have smokeless tobacco habit showed a strong relationship with oral white lesions. These lesions were found in regions where tobacco was placed for longer hours, with a prevalence more than 50%^{13,20,21}.

To the best of our knowledge, the effects of tobacco in smoke and smokeless forms, highly prevalent in India, on periodontal disease have not been documented. Hence, the present study aimed to assess the effect of tobacco usage on the severity of periodontal disease in green marble mine laborers in India.

Materials and Methods

The study area is located in Udaipur district of Rajasthan and divided into four geographic zones. Stratified cluster sampling procedure was executed to collect the representative population. The final sample consisted of 513 dentate adult male green marble mine laborers, aged from 15 to 54 years. There were no female subjects among the target group, since mining involves strenuous workload. Intra-oral examinations were performed with adequate illumination by a single examiner (SK), using a mouth mirror and a WHO periodontal probe to record the Community Periodontal Index²² (CPI), comprising the following scores: 0 (healthy); 1 (bleeding); 2 (calculus); 3 (pockets of 4- 5 mm); 4 (pockets of 6 mm or more). Calibration of the investigator for CPI was carried out against an experienced clinician and the Kappa value²³ was 0.91. Ethical clearance for the study was obtained from the Ethical Committee for Research of Darshan Dental College and Hospital, Udaipur, India.

For assessment of tobacco habits, the sample was classified as non users, regular users, occasional users and ex-users²⁴. The form of tobacco use (smoking, chewing and snuff), the number of years of consumption (duration) and the number of units used per day were recorded according to a pre formulated scale by subject interview.

Subjects were then classified based on duration of tobacco usage into less than 5 years, 6- 10 years, 11-20 years and more than 20 years. Number of units was measured under four categories, namely 1-2/day, 3-5/day, 6-10/day and more than 10/day.

Regular users constituted of individuals who are currently consuming tobacco at least once a day, non users are those who had never used tobacco. Occasional users were those people who did not use tobacco at least for three consecutive days and ex users were subjects who had not

used tobacco in any form since a year or more.

Smoking category included cigarettes, bidi and combination of both. Bidi is the most popular smoking form of tobacco used in India because of the less cost, while chewable forms of tobacco comprised of pan, guthka, mawa, zarda and khaini.

Mawa is a mixture of areca nut, tobacco and slaked lime, while Khaini comprises of powdered sun-dried tobacco mixed with slaked lime and is occasionally used with areca nut. Zarda is prepared by boiling tobacco leaf in water along with lime and spices²⁵.

Snuff dipping was recorded separately. There were many subjects in the study sample who used snuff orally though it can also be used through nasal route.

To eliminate the bias, 25 subjects with systemic illness like diabetes and heart disease were excluded from study in addition to 47 subjects who were in the habit of using both smoke as well as smokeless forms of tobacco. Therefore, a final sample of 513 individuals were included in the study

Statistical analysis

The data collected was entered into the spreadsheets. SPSS (version 11.0) software package was used for statistical analysis. The Pearson Chi-square test was used to compare different percentages at the 1% level of significance²⁶. In order to facilitate Chi-square analysis, all the tobacco categories were dichotomized, users (regular, ex and occasional) and non users, smokers and smokeless users (chewers and snuff users), short (1 - 10 years) and long duration (more than 11 years) in addition to moderate (1 - 5 units/day) and heavy users (more than 5 units/day).

Logistic regression analysis was performed to determine the influence of tobacco on the severity of periodontal status. Independent variables constituted age, use, form, duration and frequency of tobacco consumption.

Dependent variable for multiple logistic regression analysis constituted Absence (scores 0, 1 and 2 of CPI) Vs Presence of periodontal pockets (scores 3 and 4 of CPI). Odds ratio was calculated for the influence of age and the tobacco variables with 95% confidence intervals. The effect of each independent variable was assessed adjusting for all other variables in the model.

Results

Table 1 illustrates the general characteristics of the study population. The youngest and the oldest age groups constituted for a major and minor proportion of the final sample size with 33.3% and 8.8% respectively. The sample size in each age group was proportional to elementary units in each age group (optimal allocation). Nearly three fourth (71.9%) of the population was tobacco users. Chewers formed a major proportion of tobacco users and there were few subjects (5.3%) who were using tobacco since 20 years. For a majority of the sample, duration of

Table 1- Background and general sample characteristics

		Frequency	Percentage (%)
Age	15 – 24	171	33.3
	25 – 34	162	31.6
	35 – 44	135	26.3
	45 – 54	45	8.8
Periodontal status	Healthy	9	1.7
	Bleeding on probing	234	45.6
	Calculus	189	36.9
	Shallow pockets	72	14.1
	Deep pockets	9	1.7
Tobacco usage	Non users	81	15.8
	Regular users	315	61.4
	Occasional users	54	10.5
	Ex users	63	12.3
Tobacco form	Smokers	81	15.8
	Chewers	315	61.4
	Snuff users	36	7.1
Duration of tobacco use	> 5 years	81	15.8
	6 – 10 years	189	36.8
	11 – 20 years	135	26.3
	> 20 years	27	5.3
Frequency of tobacco consumption	1 – 2 units/day	90	17.5
	3 – 5 units/day	126	24.6
	6 – 10 units/day	135	26.3
	> 10 units/day	81	15.8

tobacco consumption was in the range of 6 – 20 years whereas frequency ranged between 3 – 10 units per day. Table 2 presents the sample distribution in accordance with CPI scores for users and non users of tobacco in different age groups. The majority of regular users belonged to the youngest age group. All the periodontal disease indicators were more predominant in tobacco users when compared to non users. There were no periodontal pockets observed in non users whereas they were evident among tobacco users. Furthermore, there was a statistically significant proportion ($\chi^2 = 13.965$, $p = 0.003$) between the users and non users for all the indicators of periodontal disease.

Occurrence of periodontal disease among smokers and smokeless tobacco users in different age groups is presented in Table 3. Of the 432 tobacco users, 81 (18.7%) were smokers, whereas 351 (81.3%) were smokeless tobacco

users. Among the smokers, bleeding and calculus accounted to 33% each whereas the prevalence of these periodontal indicators was 38% and 44% respectively among smokeless tobacco users. Chi square analysis revealed significant results ($p=0.001$) for presenting bleeding and calculus between smokers and smokeless tobacco users.

Table 4 illustrates the sample distribution according to CPI scores in each age group, considering the duration of tobacco use irrespective of the form consumed. Long time users constituted 38% of the users and the respective proportion increased with the age, whereas among the short time users the trend was opposite. The proportions of subjects with bleeding, calculus and pockets for long time users were, respectively, 33%, 39% and 28%. The respective values for the short time users were 40%, 44% and 13%. There were significant differences ($p = 0.001$) for the presence of pockets between short time and long time users.

Table 2 - Distribution of Tobacco Users (U) and Non – Users (NU) in accordance with CPI scores in different age groups

Age	Healthy		Bleeding		Calculus		Pockets 4 – 5 mm		Pockets ≥6mm		Total	
	NU	U	NU	U	NU	U	NU	U	NU	U	NU	U
15 – 24	9	9	18	72	9	36	0	18	0	0	36	135
25 – 34	0	0	18	36	18	72	0	18	0	0	36	126
35 – 44	0	0	9	27	0	63	0	27	0	9	9	126
45 – 54	0	0	0	27	0	9	0	9	0	0	0	45
Total	9	9	45	162	27	180	0	72	0	9	81	432

$\chi^2 = 13.965, p = 0.003$

Table 3 - Distribution of smokers (S) and smokeless (SL) tobacco users in accordance with CPI scores in different age groups

Age	Healthy		Bleeding		Calculus		Pockets 4 – 5 mm		Pocket ≥ 6mm		Total	
	S	SL	S	SL	S	SL	S	SL	S	SL	S	SL
15 – 24	9	0	9	63	0	36	0	18	0	0	18	117
25 – 34	0	0	9	27	0	72	0	18	0	0	9	117
35 – 44	0	0	0	27	18	45	9	18	0	9	27	99
45 – 54	0	0	9	18	9	0	9	0	0	0	27	18
Total	9	0	27	135	27	153	18	54	0	9	81	351

$\chi^2 = 66.851, p = 0.001$

Table 4 - Distribution of short time (ST – 1 to 10 years) and long time (LT – greater than 10 years) tobacco users in accordance with CPI scores in different age groups

Age	Healthy		Bleeding		Calculus		Pockets 4 – 5 mm		Pocket ≥6mm		Total	
	ST	LT	ST	LT	ST	LT	ST	LT	ST	LT	ST	LT
15 – 24	0	0	9	18	9	0	0	9	0	0	18	27
25 – 34	9	0	54	18	36	0	18	0	0	0	117	18
35 – 44	0	0	36	0	27	45	9	9	0	0	72	54
45 – 54	0	0	9	18	45	18	9	18	0	9	63	63
Total	9	0	108	54	117	63	36	36	0	9	270	162

$\chi^2 = 18.173, p = 0.001$

Sample distribution in accordance with periodontal disease levels in various age groups based on frequency of tobacco consumption is presented in Table 5. The highest proportion of heavy users of tobacco was found in 15-24

years old age group (53%), followed by the oldest age group (40%). Thirty-three percent of heavy users presented periodontal pockets where as only 4% among the moderate users had pockets ($p = 0.001$).

Table 5 - Sample distribution based on frequency of tobacco consumption in accordance with CPI scores in different age groups

Age	Healthy		Bleeding		Calculus		Pockets 4 – 5 mm		Pocket ≥ 6mm		Total	
	Mod	Heavy	Mod	Heavy	Mod	Heavy	Mod	Heavy	Mod	Heavy	Mod	Heavy
15-24	0	9	36	36	9	27	0	18	0	0	45	90
25-34	0	0	27	9	45	27	0	18	0	0	72	54
35-44	0	0	18	9	45	18	9	18	0	9	72	54
45-54	0	0	18	9	9	0	0	9	0	0	27	18
Total	0	9	99	63	108	72	9	63	0	9	216	216

$\chi^2 = 23.625$, $p = 0.001$

Mod – Moderate (1 – 5 units/day)

Heavy (more than 5 units/day)

Table 6 - Logistic Regression analysis with CPI as dependent variable (absence Vs Presence periodontal pockets) and age, users of tobacco, form, duration and frequency of tobacco use as independent variables

Independent variables		Odds ration (95% CI)	P value
Age (years)	15 – 24	1.00	<0.0001
	25 – 34	1.059 (0.573 – 1.558)	
	35 – 44	1.203 (1.070 – 1.353)	
	45 – 54	1.875 (1.277 – 4.523)	
Tobacco usage	Non users	1.00	<0.0001
	Regular users	1.250 (1.183 – 1.321)	
	Occasional users	1.250 (1.080 – 1.447)	
	Ex users	1.200 (1.065 – 1.352)	
Tobacco form	Smokers	1.00	<0.0001
	Chewers	1.250 (1.191 – 1.974)	
	Snuff users	1.333 (1.167 – 1.524)	
Duration of tobacco use	≤ 5 years	1.00	<0.0001
	6 – 10 years	1.167 (1.120 – 3.611)	
	11 – 20 years	1.175 (1.174 – 3.957)	
	> 20 years	2.625 (1.529 – 4.507)	
Frequency of tobacco consumption	1 – 2 units/ day	1.00	<0.0001
	3 – 5 units/ day	1.111 (1.037 – 1.190)	
	6 – 10 units/ day	2.143 (1.060 – 4.333)	
	> 10 units /day	5.596 (2.901 – 10.639)	

Logistic regression analysis was employed to determine the effect of the age and tobacco practices on periodontal status. The results showed that all the independent variables were statistically significantly related to periodontal disease. The relationship between age of the subjects and their periodontal status was evident (Table 6) and the odds ratio of presenting shallow and deep pockets increased gradually as the age increased with oldest population being 1.875 times more likely to have pockets than the youngest age group. When form of tobacco consumed was taken into consideration, it was clear that chewers (OR = 1.250; $p = 0.0001$) and snuff users (OR = 1.333; $p = 0.0001$) were more liable to present periodontal pockets than smokers. Duration had a significant influence on the periodontal disease, since more than 20 years tobacco users were liable to have periodontal pockets at least twice (OR = 2.625; $p = 0.0001$) than the ≤ 5 years group.

The odds for presence of periodontal pockets increased by 2.143 and 5.596 times for users of 6 – 10 units/ day and more than 10 units /day than the 1-2 times/day category.

Discussion

In the most of the population studies the sample belongs to lower socio economic level. Moreover, the population of the present study had Government provided below poverty line (BPL) cards with them. They have poor access to formal health care services and particularly to oral health; about 90% of the subjects had stated that they have never been to a dentist and they completely rely on local quacks for their treatment. Our study also revealed poor oral hygiene habits in the subjects, since none of them brushed their teeth twice or more a day, being the most common oral hygiene aids restricted to finger with tooth powder and neem sticks.

The nature of this study was cross-sectional, thus precluding the ability to draw inferences about causal relationships. A limitation that can be considered is that periodontal status was assessed using CPI, which measures probing depth in selected index teeth without any measurement of clinical attachment loss.

Adjusted OR of regular users of tobacco for the presence of periodontal pockets was 1.25 which is in accordance with a study among Japanese adult population where the respective value was 1.38 among current smokers²⁷.

Furthermore, a very small difference for the presence of periodontal pockets was noticed between regular users, ex-users and occasional users which lead to a conclusion that former and occasional use of tobacco play analogous role in the causation of pockets as that of regular use.

The association between age of the subjects and their periodontal status was evident and the risk of presenting periodontal pockets increased gradually as the age increased, similarly to previous study²⁸ with higher levels

of periodontal disease in older age group compared to younger ones.

Several studies have shown a relationship between the smoking amount and the prevalence and severity of periodontitis. A relationship has been demonstrated between the prevalence of moderate to severe periodontal disease and the number of cigarettes smoked per day²⁹⁻³³ and number of years that the patient has smoked^{30-32,34,35}. Similar relationship was observed in the present study, since long time and heavy tobacco users were more liable for presenting periodontal pockets.

We could not find any study that assessed the effect of quantity and duration of smokeless tobacco usage for the occurrence of periodontal pockets. Smokeless forms of tobacco users presented pockets more frequently than smokers. Chewers and snuff users presented, respectively, 1.250 and 1.333 more chance to present pockets in reference to smokers. Nevertheless, previous studies have failed to demonstrate an association of these forms with periodontal disease³⁶.

It was difficult to compare the results of the present study with previous ones^{30,32} regarding the quantity, form of tobacco used and associated periodontitis because they have included only cigarette smokers, whereas the present study dealt with cigarette, bidi smokers, chewers of various forms of tobacco and snuff users. Moreover, the quantity of tobacco used by the subjects³² was greater than the subjects of the present study.

In this way it was observed that tobacco usage had a significant impact on the severity of periodontal disease, with users being more likely to present periodontal pockets than non users. Moreover, the risk of periodontal pockets increased as the duration and frequency of tobacco consumption increased.

Extensive health education should be aimed for cessation of tobacco habit stating its effect on systemic and oral health. Intervention in the form of curative services is desperately needed for subjects with shallow and deep periodontal pockets. There is a need to assess by longitudinal studies the relationship between tobacco use and periodontal disease in Indian population, where the habits of smoke as well as smokeless tobacco use are more common.

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