



**Measurement of Association between Tobacco habits, Socioeconomic status and dental caries among a rural population in Pune district of Maharashtra state: A Cross- sectional Study**

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**Abstract**

Background – In India and other developing countries, dental caries has emerged as a major public health concern. The aim of the study was to assess the dental caries and explore its

association with Tobacco use, and Socioeconomic status (SES) among a rural population in Pune district of Maharashtra state.

**Methods** – The sample consisted of 403 participants visiting a rural hospital in Pune district. A questionnaire recorded the demographic characteristics along with Tobacco use details and SES. SES was recorded with the Revised Udai Pareek Scale. Dental caries experience was recorded with Decayed, Missing and Filled Teeth (DMFT) index. Statistical analysis included bivariate and multivariate regression analysis done by SPSS version 26.0. A p-value of  $\leq 0.05$  was considered statistically significant.

**Results** – The mean DMFT value of the participants was  $16.8 \pm 9.8$ . Bivariate and Multivariate regression analysis showed that being a female OR=1.51[95%CI(1.21 to 6.12)], age of participants above the age of 48 OR=1.39[95%CI(1.05 to 9.39)], being widowed OR=1.67[95%CI(1.15 to 6.12)] and being separated/divorced OR=2.03[95% CI(1.07 to 7.17)], being a regular smoker OR=2.98[95%CI(1.18 to 5.45)] and tobacco chewer OR= 3.32[95% CI(1.24 to 6.25)], belonging to lower middle class OR= 2.24[95% CI(1.24 to 7.14)] and lower class OR=2.78[95%CI(1.17 to 6.29)] had a significant association with increased DMFT value.

**Conclusion** – The results indicated a strong association between DMFT score, regular smokers, tobacco chewers, lower middle class and lower-class SES participants.

**Keywords** – Dental caries; DMFT; Socioeconomic status; Tobacco; Udai Pareek scale

## **Introduction**

Awareness and education regarding oral health in developing countries have a lot to be desired for. In India, there is a high incidence of oral diseases including oral cancer, periodontitis and dental caries.<sup>1,2</sup> Dental caries prevalence in India, according to various studies, is as high as 55 to 60 percent and is considered a major public health problem.<sup>3-7</sup> Dental caries, like several chronic diseases, can be attributed to numerous factors. Apart from diet and individual genetic predilection, there are various epigenetic and environmental influences which play a substantial role in the incidence of dental caries.<sup>8</sup>

It is an established fact that tobacco, in its smoked or smokeless forms, is known to cause diseases with high morbidity and mortality. It is the most common agent responsible for the

occurrence of oral and lung cancer in the Indian subcontinent.<sup>9</sup> Recent studies have also proved that tobacco usage is also associated with a high occurrence of dental caries.<sup>10-12</sup> In India, the most common smokeless tobacco consumed is in the form of “Mishri” and betel quid, whereas “bidi” or Indian cigar is the most common smoked form.<sup>9</sup> “Mishri or Masherī” is prepared by roasting tobacco leaves and then grinding them to a powder form. It is primarily a homemade preparation and is widely consumed by women in rural areas.<sup>13</sup> “Bidi” on the other hand is prepared by wrapping tobacco flake in a tendu (*Diospyros melanoxylon*) leaf tied with a string or adhesive at one end. Although there has been a decline in the usage of tobacco globally, it continues to be a significant health hazard in our country.

Socioeconomic status (SES) and inequality play a major role in the incidence of various oral diseases.<sup>14</sup> Previous studies have indicated that populations belonging to higher SES had an increased prevalence of dental caries.<sup>15</sup> However, in recent years, the trend has reversed and people belonging to the lower socioeconomic strata have become more vulnerable to dental caries and associated morbidity.<sup>16</sup>

In India, there has been few and sparse studies to show the contributory roles of both tobacco usage and SES on the occurrence of various oral diseases. Hence, this cross-sectional study has been done in order to find an association between tobacco habits, SES and dental caries among a rural population visiting a hospital in Pune district in Maharashtra state, India.

## Materials and Methods

This study was conceptualised as a cross-sectional study and was conducted between April 2022 to June 2022; amongst rural population of Kasurdi village in Pune district. Kasurdi is located in Bhor tehsil of Pune district in Maharashtra, India. According to the 2011 census, the total population of the village is 2755. Females accounts for about 48.4% of the total population. The village literacy rate is 63.5% whereas the female literacy rate is at 27.2%.<sup>17</sup>

Inhabitants of the village who were above eighteen years of age and visited the Rural Health Training Centre (RHTC) hospital of Kasurdi village, those who had provided consent and were present in person on the day of examination were included. Participants who were undergoing orthodontic treatment and those who were unwilling to participate on the day of examination were excluded. Based on a systematic review,<sup>2</sup> assuming the prevalence of dental

caries as 55% and margin of error as 5%, the sample size was calculated as 400 after taking into account five percent drop-out.

The study questionnaire consisted of two segments. The first segment documented the demographic, tobacco usage status and SES while the second segment was used to record the index used for measuring dental caries. Before the onset of the study, ethical approval was obtained from the Departmental Ethics Committee and participants were included only after informed consent was obtained from the participants (IEC no 159/2022).

In order to collect and analyse the data as efficiently as possible, training and calibration of the single examiner was done before the commencement of the study. Theoretical lectures with graphical representations and clinical training for diagnosing dental caries were carried out over a period of three days. In order to achieve calibration process of the single examiner for the Decayed, Missing and Filled Teeth (DMFT) index which has been used to assess the dental caries experience, a series of ten patients with dental caries, missing and filled teeth was used.<sup>18</sup> After the training and calibration procedure, the data recording of the single examiner was compared to that of a gold standard examiner. The extent or degree of inter-examiner agreement/reliability was computed with Kappa statistics where a value of 0.92 was achieved for DMFT respectively. In order to check the intra-examiner agreement for DMFT, duplicate or re-examination of every 10<sup>th</sup> participant was done during the survey process. It achieved a Kappa statistic value of 0.98 indicating high intra-examiner reliability.

Demographic characteristics, tobacco use status and SES were recorded prior to oral examination by the investigator. Demographic characteristics included age, sex and marital status. Tobacco use was categorized into five groups: regular smoker, occasional smoker, ex-smoker, tobacco chewers and non-tobacco users. Regular smokers were those who smoked at least one cigarette/bidi in a day, occasional smoker smoked less than 1 cigarette/bidi, ex-smokers smoked at least 1 cigarette/bidi in a day but discontinued at least 6 months back, tobacco chewers were those who used smokeless tobacco and non-smokers did not use any form of tobacco.

SES was assessed with the Revised Udai Pareek Socioeconomic scale which categorized the participants into upper class, upper middle class, middle class, lower middle class and lower

class (Fig 1).<sup>19</sup> Udai Pareek scale takes the following into account while measuring the SES: caste, occupation, social participation, house, farm power, education, land, material possessions and number of family members. A score of 43 and above denoted upper class, 33 to 42 denoted upper middle class, 24 to 32 denoted middle class, 13 to 23 denoted lower middle class and a score below 13 denoted lower class.

The oral examination of the participants was done by a single examiner in a well illuminated room. The participants were comfortably seated on a foldable dental chair and oral examination was carried out in an orderly manner by initially examining the maxillary right quadrant and then proceeding in a clockwise manner till the examination of mandibular right quadrant. Assessment of dental caries was done using the DMFT 1997 with the help of a Community Periodontal Index (CPI) ball end probe and a plane mouth mirror.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 26.0, SPSS Inc, Chicago, IL, USA) which included frequency distribution and association tests with Odds Ratio (OR) and 95% Confidence Interval (CI). Having achieved a p-value < 0.20 in the bivariate analysis, the dependent variable (DMFT) and the independent variables were incorporated into the multivariate logistic regression model to find statistically significant associations (p-value<0.05).

## **Results**

The present study was conducted to assess the relation between tobacco usage status, SES and dental caries (DMFT) amongst inhabitants of a remote village in Pune over a period of three months. 403 subjects agreed to enroll in the study and were included in the final analysis.

Among the 403 participants, 51.1 % were males. Forty-eight was the median age of the participants and 58.3% of the participants were above the age of forty-eight. Most of the participants were married (58.3%) followed by unmarried marital status (25.8%). Maximum of the participants were tobacco chewers (35%) followed by those who were regular smokers (25.3%). Majority of the participants belonged to Lower middle class (36.5%) and Lower class (22.8%) according to Udai Pareek scale.(Table 1)

The mean DMFT value of the participants was  $16.8 \pm 9.8$ . Among the participants, females had higher DMFT values as compared to males, those above the median age of 48 had higher

DMFT values, separated/divorced and widowed individuals had higher DMFT values. Tobacco chewers and regular smokers had higher DMFT as compared to others. Participants belonging to Lower class and Lower middle class had the highest DMFT values. (Table 2)

Bivariate analysis between the independent variables (Demographic characteristics, tobacco usage status and SES) and outcome variable (DMFT) showed a significant association between sex, age, marital status, tobacco status and SES and DMFT values ( $p < 0.20$ ) and were included in the multivariate regression analysis.

Multivariate regression analysis showed that females OR=1.51[95%CI(1.21 to 6.12)] and age of participants above the age of 48 OR=1.39[95%CI(1.05 to 9.39)] had a significant association with increased DMFT value. Participants who were widowed OR=1.67[95%CI(1.15 to 6.12)] and separated/divorced OR=2.03[95% CI(1.07 to 7.17)] had a statistically significant association with increased DMFT. Regular smokers OR=2.98[95%CI(1.18 to 5.45)] and tobacco chewers OR= 3.32[95% CI(1.24 to 6.25)], belonging to lower middle class OR= 2.24[95% CI(1.24 to 7.14)] and lower class OR=2.78[95%CI(1.17 to 6.29)] too had a significant association with increased DMFT value. (Table 3)

## **Discussion**

The present cross-sectional study showed a mean DMFT value of  $16.8 \pm 9.8$  amongst participants from a remote village located in Pune district in the state of Maharashtra. The DMFT value seen in India ranges from 18 to 20. The DMFT value derived in our study is considerably lower than the average value of 19 reported by various studies conducted in the Western part of the country.<sup>2,6</sup> The reason for this lower DMFT score could be due to fluoridation of drinking water. A particular institute conducts various health promotion programs, including dental treatment, in the villages which might be another reason for the reduction in the DMFT score. DMFT index records the accumulated effect of dental caries i.e., past and present experience of an individual or population. Apart from the diet and personal habits, there are various factors which lead to an increased DMFT in individuals or population. The data in the current study reveals the causative factors associated with an increase in DMFT value.

Females as compared to males have shown a higher significant association with increased DMFT value. This finding is similar to studies conducted by Raja K et al and Mehta A.<sup>6,7</sup> In females, teeth erupt earlier in the oral cavity, hence are more susceptible to caries as compared to males. Also traditionally, females spend more time in the kitchen and consequently develop the habit of frequent snacking. Studies have also shown that due to hormonal changes during pregnancy, there is a decrease in the host resistance to caries, resulting in higher DMFT value.<sup>20</sup> However, studies conducted by Satheesh et al showed that males were more prone to development of root caries as a result of gingival recession due to improper tooth brushing and neglect of oral health.<sup>21</sup>

This study has shown that higher age group of participants was significantly associated with higher DMFT values. This result is in accordance to studies conducted by Sharma et al and Reddy et al where the caries prevalence and incidence has increased with the advancement of age.<sup>4,5</sup> As DMFT index measures the cumulative caries experience of an individual, the DMFT score increases with increase in age. The results of the study indicated that being divorced, separated or widowed was significantly associated with increase in one's DMFT value. The likely explanation for such an observation is that a change in marital status often causes altered psychological and behavioral aspects in an individual. Such changes lead to change in dietary habits and decreased maintenance of oral hygiene.<sup>22</sup>

In this study, regular smokers and tobacco chewers showed a significantly higher predilection towards increase in DMFT values. This is similar to the study conducted by Duong M et al.<sup>9</sup> Among individuals who smoke regularly, there is a marked xerostomia, hence the buffering capacity of the saliva is lost leading to an increased caries experience. Also, regular smokers might indulge in sugary snacks and might be less careful about maintenance of oral hygiene as compared to a non-smoker. However, studies done by Schmidt et al suggested protective action of smoking from dental caries by stimulating the secretion of Thiocyanate in the oral cavity.<sup>23</sup> Tobacco chewers generally consume tobacco added with some sweetening agent as it helps in overcoming the harsh taste of the tobacco itself. These sweetening agents in turn breakdown into various substrates, allowing in reduction of salivary pH and thus increasing the caries experience of an individual. Another possible mechanism is that as a result of

continuous chewing, there is a breakdown of the keratinized gingiva, leading to an increase in the incidence of root caries.<sup>11</sup>

The present study showed that participants belonging to the Lower class and Lower middle class were significantly associated with an increased DMFT score. The result is similar to study conducted by Bastos JL et al.<sup>16</sup> The possible explanation for such an outcome is that individuals belonging to the lower socioeconomic strata are deprived of nutrition which acts as a protective agent from dental caries. The adoption of various deleterious habits and altered psychosocial behavior increases the caries experience of an individual. The other reasons might be that lower educational levels prevalent among lower SES individuals result in a lack of knowledge and motivation about oral hygiene maintenance.

Our study was successful in focusing on the key factors causing problems to oral health in rural India. However, a major limitation of the current study was the convenience sampling, hence, extrapolation of the results should be done with caution. The revised Udai Pareek Scale used to determine the SES is highly effective; however, the major limitation is that it does not have an income component. This study can be beneficial to derive future policies which could further be utilized for various welfare programs to decrease the disease burden prevalent in rural India. In the future, multicentric, prospective studies can be done to further elicit the various factors and determine their relative contribution on the oral disease burden.

## **Conclusion**

The current study had revealed that regular smokers, tobacco chewers, SES including the Lower middle class and Lower class had significantly higher risk of developing dental caries as compared to others. Although the study had few inherent limitations, it did manage to establish the role of deleterious habits and inequality affecting the oral health. Further long-term prospective research and trials need to be conducted to overcome the limitations and bring out new scientific evidence regarding the incidence of dental caries.

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Fig 1. Revised Udai Pareek Socioeconomic Scale

Components	Score	Components	Score
Caste		Education	
Scheduled Caste	1	Illiterate	0
Lower Caste	2	Can read only	1
Artisan Caste	3	Can read and write	2
Agriculture Caste	4	Primary	3
Prestige Class	5	Middle	4
Dominant Class	6	High School	5
Occupation		Graduate and above	6
None	0	Land	
Laborer	1	No land	0
Caste occupation	2	<1 acre	1
Business	3	1-5 acre	2
Independent Profession	4	5-10 acre	3
Cultivation	5	10-15 acre	4
Service	6	15-20 acre	5
>20 acre	6	Material Possessions	
Social Participation		Bullock cart	0
None	0	Cycle	1
Member of one organization	1	Radio	2
Member of more than one organization	2	Chairs	3
Office holder in such an organization	3	Mobile Phone	4
Wide public leader	4	Television	5
House		Refrigerators	6
No house	0	Family Member	
Hut	1	Up to 5	2
Kutch house	2	>5	1
Mixed house	3		
Pucca house	4		
Mansion	5		
Farm Power			
No draft animals	1		
1-2 draft animals	2		
3-4 draft animals	4		
5-6 draft animals	6		

Socioeconomic status class	Total scale
Upper Class	>43
Upper Middle Scale	33-42
Middle Scale	24-32
Lower Middle Scale	13-23
Lower Class	<13

**Table 1. Frequency distribution of the demographic characteristics, tobacco use and SES of the population.**

Characteristics(Demographic, Tobacco use and SES)	n(%)

Sex	Males	206 (51.1)
	Females	197 ((48.9)
Age	Less than or equal to 48	165 (40.9)
	More than 48	235 (58.3)
Marital Status	Unmarried	104 (25.8)
	Married	235 (58.3)
	Widowed	61 (15.1)
	Separated or divorced	03 (0.7)
Tobacco Status	Regular smoker	102 (25.3)
	Occasional smoker	38 (9.4)
	Ex-smoker	25 (6.2)
	Tobacco chewers	141(35.0)
	Non-tobacco user	97 (24.1)
SES	Upper class	42 (10.4)
	Upper middle class	49 (12.2)
	Middle class	73 (18.1)
	Lower middle class	147 (36.5)
	Lower class	92 (22.8)

**Table 2. Demographic, tobacco use and SES by group; data expressed as DMFT(SD).**

Characteristics(Demographic, Tobacco use and SES)		DMFT (SD)
Sex	Males	15.2(10.1)
	Females	18.5(9.8)
Age	Less than or equal to 48	13.4(9.1)
	More than 48	18.1(10.3)

Marital Status	Unmarried	12.3(9.2)
	Married	15.9(10.2)
	Widowed	18.5(10.7)
	Separated or divorced	19.3(12.3)
Tobacco Status	Regular smoker	17.9(9.9)
	Occasional smoker	15.6(8.8)
	Ex-smoker	16.2(9.5)
	Tobacco chewers	18.1(10.4)
	Non-tobacco user	11.9(8.9)
SES	Upper class	12.3(8.2)
	Upper middle class	14.1(8.1)
	Middle class	16.3(9.2)
	Lower middle class	17.2(10.3)
	Lower class	19.2(10.8)

**Table 3. Results of the multivariate regression analysis of the association between the variables studied and DMFT**

Variables	OR (95% CI)	p-value
1. Sex		
a. Males	1.00	
b. Females	1.51(1.21 to 6.12)	<b>0.041*</b>
2. Age		
a. Less than or equal to 48	1.00	
b. More than 48	1.39(1.05 to 9.39)	<b>0.035*</b>
3. Marital Status		
a. Unmarried	1.00	

b. Married	0.43(-2.11 to 1.53)	0.295
c. Widowed	1.67(1.15 to 6.12)	<b>0.035*</b>
d. Separated or divorced	2.03(1.07 to 7.17)	<b>0.029*</b>
4. Tobacco status		
a. Non-tobacco user	1.00	
b. Regular smoker	2.98(1.18 to 5.45)	<b>0.023*</b>
c. Occasional smoker	1.12(0.15 to 5.29)	0.341
d. Ex-smoker	1.23(0.09 to 4.72)	0.089
e. Tobacco chewers	3.32(1.24 to 6.25)	<b>0.012*</b>
5. Socioeconomic status		
a. Upper class	1.00	
b. Upper middle class	1.23(-0.59 to 6.94)	0.673
c. Middle class	1.47(-0.35 to 4.79)	0.537
d. Lower middle class	2.24(1.24 to 7.14)	<b>0.023*</b>
e. Lower class	2.78(1.17 to 6.29)	<b>0.001*</b>

OR = Odds Ratio, CI= Confidence Interval,  $p \leq 0.05$  considered as statistically significant