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Epidemiological hazards of tobacco and its manifestations in oral health of a screened population in Northern India

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ABSTRACT

Introduction: Tobacco addiction and its oral manifestation are serious health hazards in India, particularly in the northern region. We conducted a large scale population based screening study to evaluate the epidemiolocal hazard of tobacco and its oral manifestations leading to precancerous lesions.
Methods: Total 78 cross-sectional health camps were organized in rural population of northern India and 8572 individuals were screened using visual screening method. Multivariable analysis was used to explore the factors related to tobacco use and oral ulceration and mucosal changes.
Results: Oral mucosal changes and trismus were common symptoms and tobacco chewing and smoking were common addictions. Risk of oral mucosal changes was maximum in the younger population (25–34 years) (AOR: 1.75, 95% CI: 1.32–2.32, $p < 0.001$), in male gender (AOR: 2.80, 95% CI: 2.23–3.51, $p < 0.001$), in tobacco chewers (AOR: 1.84: 95% CI: 1.41–2.39, $p < 0.001$) and in tobacco smokers (AOR: 1.46, 95% CI: 1.07–1.99, $p < 0.001$). Odds of trismus were highest in the youngest population (15–24 years) (AOR: 4.01, 95% CI: 1.56–10.31, $p = 0.004$), in male gender (AOR: 5.57, 95% CI: 2.46–12.59, $p < 0.001$), in tobacco chewers (AOR: 7.76: 95% CI: 4.84–12.43, $p < 0.001$) and in tobacco smokers (AOR: 1.82, 95% CI: 1.05–3.16, $p = 0.04$).
Conclusion: Findings of this study indicate that tobacco addiction (single or joint) was found to be statistically significant in association with the oral mucosal lesions and trismus. Risk of tobacco consumption in either form was present in all age groups, which is significantly contributing to increase odds of trismus and oral mucosal lesions especially in younger and middle aged population.

1. Introduction

Cancer is the second leading cause of death globally, and 8.2 million people died due to cancer throughout the world in 2013. The annual incidence of oral cavity cancer approximately doubled during 1990–2013, and more than 4,00,000 new cases of the oral cavity cancer were estimated, causing approximately 1,35,000 deaths around the globe in 2013 [1]. Oral cancer has significant public health importance in India. The share of oral cancer is approximately 30% of new cancer cases in the country [2]. The incidence of oral cavity cancer in India was 1,19,116 in 2015 and in Uttar Pradesh it was 20,424 for the same year [3]. The strong association between cancers of the oral cavity and pharynx with tobacco use is well established in the existing literature. Smokeless tobacco and excessive alcohol consumption are major risk factors which are account for about 90% of oral cancers [4]. Tobacco users – smoked, chewing or both – developed most oral lesions with an annual incidence rate ranging from 5.2/1000 to 30.2/1000, whereas non-users develop the fewest oral lesions to the frequency of 0.6/1000. Oral cancer is most frequently observed in middle-aged and elder individuals, although an alarming number of these malignancies are also being reported in younger adults globally [4,5].

In India and Southeast Asia, the chronic use of betel quid (paan) in the mouth has been strongly associated with an increased risk of oral cancer and premalignant changes. Usually, cancer begins with white patches (leukoplakia) or red patches (erythroplakia) and gradually progress to oral submucous fibrosis (SMF). Difficulties in mouth opening (Trismus) is a common symptom seen in patients with (SMF) in India and south-east Asian region [4,6,7] which may lead to unhygienic oral health causing oral Human Papilloma Virus (HPV) infection which may also cause oral and neck cancer [8,9].

Five-year survival for cancer patients is directly related to stage at diagnosis, prevention, and early detection efforts have the potential not only for decreasing the incidence but also for improving

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the survival of those who develop this disease. Despite the complete accessibility of the oral cavity to direct clinical examination, these malignancies still are often not detected until a late stage, and the survival rate for oral cancer has remained poor in India as well as in other developed nations [4,5]. Thus screening for oral cancer is important to detect precancerous lesions, early invasive cancers, which helps in improved survival after treatment of early-stage oral cancers [10]. Existing data from Indian Council of Medical Research and other studies suggests that various parts of Uttar Pradesh and Rajasthan have a high prevalence of oral cancer [11,12]. Unfortunately, no major studies were undertaken in the western Uttar Pradesh and adjoining eastern Rajasthan region to screen the oral mucosal changes/cancer patients and to examine the epidemiology of oral cancer in this area. This is the first study to our knowledge in the western parts of Uttar Pradesh and eastern Rajasthan on a larger scale, to find out the disease burden of oral mucosal changes and its principal associating factors. The present study primarily focuses on the distribution of oral mucosal changes, SMF and trismus, their relationships with the socio-demographic status of individual as well as the effect of addictions like tobacco, smoking, and alcohol on oral mucosal changes, SMF and trismus, to rule out possible cancer cases.

2. Methods

2.1. Study samples and data collection

This study is a part of ongoing community-based general health screening programme by Nayati Charitable Trust and Nayati Multi Superspecialty Hospital, Mathura in the northern part of India especially in western Uttar Pradesh and eastern Rajasthan, India amongst the previously unscreened population. A total of 78 health camps were organized during the month of April 2015 to December 2015 in five districts of western Uttar Pradesh (Agra, Aligarh, Firozabad, Hathras and Mathura) and Bharatpur district of Rajasthan state. These health camps were particularly focused on the rural population of the district, and demographic profile of the place (with a minimum surrounding population of 1000) was solely random to represent the coverage in the district. Male and female aged ≥15 years, who came to the health camp, voluntarily on the day of camp were selected. There was no specific exclusion criterion used. However, the persons with severe health issues were excluded from participation in the study.

2.2. Training of health professionals

Focus of the health screening programme was to screen the participant for general health related problems like oral, respiratory, heart, gynaecological issues and addictions, etc. Individuals who attended the screening camp were screened by a trained health worker under the directions of qualified medical graduates. The cancer-related information like certain addictions: tobacco (smoke or smokeless), alcohol and betel nut; and symptoms: oral mucosal changes, difficulty in opening mouth, hoarseness of voice, neck swellings, difficulty in swallowing, earache/ear discharge and nose bleeding along with age and sex were extracted from the general questionnaire. A pilot study was conducted to pre-test the questionnaire in selected study areas of western Uttar Pradesh prior to conducting the screening camps. The results of the pre-testing provided useful information in improving the clarity of questions for finalization of the questionnaire. The internal consistency of the questionnaire was estimated to 78% using Cronbach's alpha that indicated a good level of reliability.

2.3. Statistical analysis

2.3.1. Sample weight

Though the health camps were organized randomly. However, these were not representative of the district's population. Therefore, weights were calculated based on proportionality of the sample over the complete collected data. The probability proportionate is being calculated by;

$$p_r = \frac{samples\ collected\ from\ the\ district\ \ (n_i)}{Total\ \ collected\ \ data\ \ (N)} \quad (1)$$

The district weight is calculated by $w_i = 1/p_r$ and finally, the normalized weights for each district are calculated below;

$$Normalized\ \ district\ \ weight\ \ \left(w_t^n\right) = \frac{w_i}{\sum_{i=1}^{k} w_i} \quad (2)$$

The descriptive statistics were presented with mean ± SD for continuous variables and frequency with a percentage for categorical variables. The weighted and un-weighted prevalence of tobacco use was estimated with 95% confidence intervals (CIs). The chi-square test was applied to examine the association between the tobacco use and background variables. The risk of smoking in the different age groups of males and females was estimated by multiple logistic regression analysis with 95% CIs. Further, we also performed bivariate and multivariable logistic regression analysis to estimate the odds ratios for comparison and identification of the factors associated with an increasing risk of developing oral mucosal changes, SMF and trismus. The data were coded and analyzed using IBM SPSS Statistics version 21.0 (Armonk, NY, USA). The two-tailed p-value < 0.05 was considered for statistical significance.

2.4. Ethical statement

The prior consent was taken from every individual who came to the health screening camps on making observations on different addictions (tobacco- smoke or smokeless, alcohol consumption and betel nut) and oral cavity lesions.

3. Results

8572 individuals were examined, 4691 (54.7%) were male, and 3881 (45.3%) were female. The overall mean age ± SD of screened population was 43.1 ± 14.5 years. More than seventy percent (71.4%) of the persons belonged to age 35 years or more. The common reported symptoms were oral mucosal lesions (6.1%) followed by difficulties in opening mouth (SMF and trismus) (0.9%) and difficulty in swallowing (dysphagia) (0.6%). Other less frequently reported symptoms were ear discharge (0.4%), hoarseness of voice (0.4%), neck swelling (0.1%) and nose bleeding (0.1%). In the questionnaire, all visible oral mucosal lesions were broadly categorized as oral mucosal changes and our health professionals were trained to identify those lesions as mentioned in detailed in methodology. Figure 1 shows the weighted prevalence of tobacco smoking and chewing in male and female of various age groups (Fig. 1).

The overall proportion of tobacco smoking and chewing was 10.3% and 12.1% respectively. More than three percent (3.3%) were addicted to betel nut, and a few (1.4%) had only alcohol addiction [Table 1]. The mean age, use of addictions and symptoms such as oral mucosal changes and difficulties in the opening mouth were significantly distributed high among males (P < 0.001) than females. However, the fraction having difficulties in swallowing was significantly more (P < 0.001) amongst females than males.

The weighted and unweighted prevalence of smoked and smokeless across the district, age group, sex, etc are presented in Table 2. From Table 2 it is evident that males were more prone for tobacco smoking (16.0%) in comparison of female (1.1%). Addiction

Table 1
Background profile of the study population.

Characteristics	N	%
Mean age ± SD (years)	43.1 ± 14.5	
Age group (years)		
15–24	808	9.4
25–34	1640	19.1
35–44	2164	25.2
45–54	1819	21.2
≥55	2141	25.0
Location		
Agra	443	5.2
Aligarh	916	10.7
Bharatpur	343	4.0
Firozabad	1286	15.0
Hathras	2027	23.6
Mathura	3557	41.5
Gender		
Male	4691	54.7
Female	3881	45.3
Oral lesions		
Oral mucosal changes	527	6.1
Dysphasia	49	0.6
SMF and Trismus	77	0.9
Ear discharge	34	0.4
Hoarseness of voice	34	0.4
Oral swelling	12	0.1
Nose bleeding	8	0.1
Addictions		
Tobacco smoking	886	10.3
Tobacco chewing	1037	12.1
Alcohol	124	1.4
Betel nut	285	3.3
Total	**8572**	**100.0**

of tobacco smoking was more common in individuals of age 55 or more (12.3%). 40% of the individual having symptoms of SMF and trismus were tobacco chewers. Addiction of alcohol consumtion was more common in tobacco smokers (44.4%).

Table 3 presents results of bivariate logistic regression analysis. On stratification of risk among males and females for tobacco use according to their age, the male individuals have been showing two times consistent increase from age group 25 and above (odds ratio: 2.2, 95% CI: 1.5–3.2, $p < 0.001$ for 25–35; 2.6, 95% CI: 1.8–3.7, $p < 0.001$, for 35–44; 2.7, 95% CI: 1.9–3.9, $p < 0.001$ for 45–54 and 2.8, 95% CI: 1.9–4.0, $p < 0.001$ for ≥ 55 years respectively). The risk of developing the habit of tobacco chewing was high in age group 25–34 years (odds ratio: 1.8, 95% CI: 1.4–2.5, $p < 0.001$) followed by 35–44 years (odds ratio: 1.5, 95% CI: 1.1–2.0, $p = 0.009$) and 45–54 years (odds ratio: 1.4, 95% CI: 1.1–1.9, $p = 0.029$). However among females, the tobacco smoking was more likely age ≥ 55 years (odds ratio: 9.8, 95% CI: 1.3–73.4, $p = 0.026$) and likelihood of smokeless tobacco was in age ≥ 35 years (odds ratio: 3.3,95% CI: 1.2-9.4, $p = 0.022$ for 35–44; odds ratio: 4.0, 95% CI: 1.4–11.3, $p = 0.009$ for 45–54 and odds ratio: 3.7, 95% CI: 1.3–10.6, $p = 0.015$ for ≥ 55 years respectively).

Table 4 presents results of bivariate and multivariable binary logistic regression analysis taking oral mucosal changes, SMF and trismus as the dependent dichotomous variable. The low prevalence category in each factor variable is considered as reference group. The regression analyses for oral mucosal changes illustrated the all age groups (adjusted odds ratio [aor]: 1.5,95% CI: 1.1–2.2, $p = 0.004$ for 15–24; aor: 1.8, 95% CI 1.3–2.3, $p < 0.001$ for 25–34; aor: 1.6, 95% CI: 1.2–2.1, $p < 0.001$ for 35–44 and 1.6, 95% CI: 1.2–2.2, $p < 0.001$ for 45–54 with respect to ≥ 55 years), male gender (aor: 2.8, 95% CI: 2.2–3.5, $p < 0.001$), tobacco use (aor: 1.5, 95% CI: 1.1–2.0, $p = 0.03$ for smoking and aor: 1.8, 95% CI: 1.4–2.4, $p < 0.001$ for chewing) were identified as independent predictors of oral mucosal changes. Similarly for SMF and trismus, the multivariable logistic regression analyses showed all age groups (adjusted odds ratio [aor]: 4.0, 95% CI: 1.6–10.3, $p < 0.001$ for 15–24; aor: 2.7, 95% CI: 1.1–6.4, $p = 0.004$ for 25–34; aor: 3.3., 95% CI:1.4–7.4, $p < 0.001$ for 35–44 and 3.2, 95% CI: 1.4:7.2, $p < 0.001$ for 45–54 with respect to ≥ 55 years), male gender (aor: 5.6, 95% CI: 2.5–12.6, $p < 0.001$), tobacco use (aor: 1.8, 95% CI: 1.1–3.2, $p < 0.001$ for smoking and aor: 7.8, 95% CI: 4.8–12.4, $p < 0.001$ for chewing) and joint addiction of smoking and chewing (aor: 8.1, 95% CI: 4.2–15.3, $p < 0.001$) were significantly associated with the development of SMF and trismus.

4. Discussion

Since oral cavity is an easily accessible site of examination, the visual screening method of examination is fairly straightforward, and it can be easily done by trained healthcare professionals at the community level, and it was reported in the literature that visual screening method seems to be an effective screening method to detect early oral neoplasia (29). We have decided to adopt the same approach for our population-based screening study for its cost effectiveness and outcome. It was reported in the literature that early detection of oral cancer cases have a better prognosis than those were detected in more advanced stage. In literature we found that there was no definite evidence to indicate that organized and systematic, population-based oral screening study may reduce the death from oral cancer, but early detection surely makes the treatment outcome better. Rengaswamy et al. reported that routine use of oral, visual screening is effective in the reduction of oral cancer mortality in the high-risk group of users of tobacco or alcohol, or both. [10]. They further recommended oral screening of high-risk individuals in routine health services in the country, in light of the high burden of disease.In this study, we have analyzed the data of 8752 individuals. In view of the existing evidence, we have found in this present study that the primary symptoms were oral mucosal lesions (6.1%) followed by SMF and trismus (0.9%), dysphagia (0.6%), ear discharge and hoarseness in voice (0.4%) respectively. In our study we found that out of total SMF and trismus patients; 20% have an addiction to smoking tobacco and 20% of persons having symptoms of hoarseness of voice were smoking tobacco. Similarly, 40% of the SMF and trismus patients have an addiction of tobacco chewing, and 21.6% persons complaining oral mucosal changes were tobacco chewers.

In the present study, we also tried to investigate joint effect of various addictions on oral mucosal lesions, SMF and trismus. We found that those who were addicted to either tobacco chewing or tobacco smoking about 33% of the patients having SMF and trismus were consuming tobacco in any form. It was observed that about 22% of the individuals having oral mucosal changes were either tobacco chewers or tobacco smokers, about 17% persons having hoarseness of voice were tobacco chewers or smokers. About 9% of individuals of oral mucosal changes had a common addiction of alcohol and tobacco chewing, and about 6% of SMF and trismus individuals had same combined addiction. Similarly, those who were addicted to both tobacco smoking and alcohol consumption, we found that most common symptom was oral mucosal lesion (6.3%), and it was followed by SMF and trismus (3.2%).

The multivariate risk ratio for SMF and trismus is maximum for age group 15–24 years followed by 35–44 years and 45-54 years AOR: 4.01 (95% CI: 1.56–10.31, $p = 0.004$), 3.26 (95% CI: 1.44–7.36, $p = 0.004$) and 3.16 (95% CI: 1.38–7.23, $p = 0.006$) respectively. The presence of oral mucosal lesions, SMF and trismus and in younger age may be due to the habit of Gutka (scented tobacco) chewing in younger individuals. Many authors supported the hypothesis that Gutka use increases the oral mucosal disorders [13,14].

In our study, we found the proportion of oral mucosal lesions was 6.1% which is lower in comparison to the previous studies from Vidisha 8.4% (29) and higher from Chennai study 4.1% (33). In our

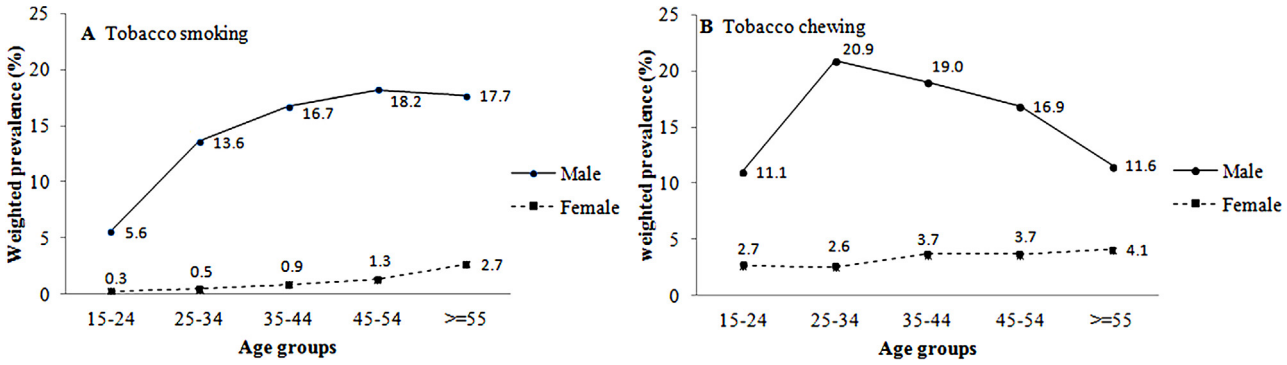

Fig. 1. Gender wise prevalence of smoked and smokeless tobacco in different age groups.

Table 2
Distribution of prevalence of tobacco smoking, chewing and any form with 95% confidence intervals (C.I.s).

Variables	Tobacco prevalence					
	Smoking		Chewing		Smoking or chewing	
	Un-weighted (95% C.I.)	Weighted (95% C.I.)	Un-weighted(95% C.I.)	Weighted (95% C.I.)	Un-weighted(95% C.I.)	Weighted(95% C.I.)
Location						
Agra	2.9 (1.3–4.5)	3.1 (1.5–4.7)	3.8 (2.0–5.6)	3.9 (2.1–5.7)	4.5 (2.6–6.4)	4.7 (2.7–6.7)
Aligarh	6.2 (4.6–7.8)	6.3 (4.7–7.9)	9.7 (7.8–11.6)	9.4 (7.5–11.3)	12.9 (10.7–15.1)	12.6 (10.4–14.7)
Bharatpur	14.0 (10.8–17.2)	14.1 (10.9–17.3)	9.6 (6.5–12.7)	9.4 (6.3–12.5)	16.6 (12.7–20.5)	16.4 (12.4–20.3)
Firozabad	3.3 (1.6–5.0)	3.1 (1.4–4.7)	4.6 (3.4–5.7)	4.7 (3.5–5.9)	4.5 (3.3–5.6)	4.7 (3.5–5.9)
Hathras	14.1 (12.6–15.6)	14.1 (12.6–15.6)	14.4 (12.9–16.0)	14.1 (12.6–15.6)	21.2 (19.4–23.0)	21.1 (19.3–22.9)
Mathura	12.3 (11.2–13.4)	12.5 (11.4–13.6)	15.4 (14.2–16.6)	15.6 (14.4–16.8)	20.4 (19.1–21.7)	20.3 (18.9–21.6)
Age group						
15–24	4.3 (3.1–5.8)	4.1 (2.7–5.5)	9.0 (7.0–11.0)	5.5 (3.9–7.1)	5.8 (4.2–7.4)	8.1 (6.2–10.0)
25–34	15.8 (13.5–18.4)	6.4 (5.2–7.6)	14.0 (12.2–15.7)	10.6 (9.1–12.2)	17.1 (15.3–18.9)	12.0 (10.4–13.6)
35–44	23.6 (20.9–26.5)	7.8 (6.6–8.9)	12.1 (10.7–13.5)	10.4 (9.1–11.7)	23.7 (21.9–25.5)	11.9 (10.5–13.3)
45–54	22.6 (19.9–25.5)	9.6 (8.2–11.0)	12.8 (11.3–14.3)	10.1 (8.7–11.5)	22.5 (20.6–24.4)	14.0 (12.4–15.6)
≥55	33.7 (30.7–36.9)	12.3 (10.9–13.7)	11.3 (9.9–12.6)	8.9 (7.7–10.1)	31.0 (29.0–33.0)	17.2 (15.6–18.8)
Gender						
Male	17.8 (16.7–18.9)	16.0 (14.9–17.0)	19.2 (18.1–20.3)	15.8 (14.7–16.8)	26.3 (25.0–27.6)	22.1 (20.9–23.3)
Female	1.3 (0.9–1.7)	1.1 (0.8–1.4)	3.5 (2.9–4.1)	2.9 (2.4–3.4)	4.5 (3.9–5.2)	4.0 (3.4–4.6)
Oral lesions						
Oral mucosal changes	21.1 (17.6–24.6)	19.2 (15.8–22.6)	26.9 (23.1–30.7)	21.6 (18.1–25.1)	27.5 (23.7–31.3)	21.6 (18.1–25.1)
Dysphasia	6.1 (0.6–12.9)	5.3 (0.9–11.7)	6.1 (0.6–12.9)	5.7 (0.7–12.2)	8.2 (0.5–15.9)	6.6 (0.4–13.6)
SMF and Trismus	26.0 (16.2–35.8)	20.0 (11.1–28.9)	53.2 (42.1–64.2)	40.0 (29.1–50.9)	40.3 (29.3–51.3)	33.3 (22.8–43.8)
Ear discharge	14.7 (2.8–26.6)	12.7 (1.5–23.9)	20.6 (7.0–34.2)	16.7 (4.1–29.2)	17.6 (4.8–30.4)	15.1 (3.1–27.1)
Hoarseness of voice	20.6 (7.0–34.2)	20.0 (6.6–33.2)	14.7 (2.8–26.6)	11.9 (1.0–22.8)	17.6 (4.8–30.4)	16.3 (3.9–28.7)
Swelling oral	8.3 (7.3–23.9)	7.4 (5.4–22.2)	8.3 (7.3–23.9)	6.9 (5.0–21.2)	16.7 (4.4–37.8)	13.3 (5.9–32.5)
Nose bleeding	12.5 (10.4–35.4)	10.3 (8.7–31.4)	25.0 (5.0–55.0)	23.4 (5.9–52.7)	12.5 (10.4–35.4)	10.3 (8.7–31.4)
Other addictions						
Alcohol	50.8 (42.0–59.6)	44.4 (35.7–53.1)	47.6 (38.8–56.4)	44.4 (35.7–53.1)	27.4 (19.6–35.3)	22.2 (14.9–29.5)
Betel nut	21.4 (16.6–26.2)	19.0 (14.5–23.6)	29.8 (24.5–35.1)	28.6 (23.4–33.8)	29.5 (24.2–34.8)	23.8 (18.9–28.7)
Total	**10.3 (9.6–10.9)**	**8.9 (8.2–9.5)**	**12.1 (11.4–12.8)**	**9.5 (8.9–10.1)**	**16.4 (15.6–17.2)**	**13.3 (12.6–14.0)**

study, we also found that tobacco smoking was highest prevalent (12.3%) in the age group of more than 55 years. Tobacco chewing is highest prevalent (10.6%) in the age group 25–34 years and in the group the odds ratio of having oral mucosal lesions was maximum AOR: 1.75, (95% CI: 1.32–2.32, $p < 0.001$) concerning the individuals aged more than 55 years.

Genetically gender has no association with oral mucosal lesions, SMF and trismus, but the findings suggest that male are more prone to have oral mucosal changes as well as SMF and trismus in comparison to female, AOR: 2.80 (95% CI: 2.23–3.51, $p < 0.001$) and 5.57 (95% CI: 2.46–12.59, $p < 0.001$). This may be due to the fact that in study population tobacco use in any form was more common in men (22%) in comparison to women (4%) which is supported by various studies throughout the globe [15–18].

Findings of the study suggests that tobacco chewing increases chances of oral mucosal lesions by approximately two times (AOR: 1.84, 95% CI: 1.41–2.39, $p < 0.001$) while tobacco smoking increases the odds of oral mucosal lesions by almost one and half times (AOR: 1.46, 95% CI: 1.07–1.99, $p < 0.001$) in comparison to non-users. The same findings were reported from various studies in India and other countries [4,19–21]. Similarly the tobacco chewing increases the probability of SMF and trismus by about 8 times (A0R: 7.76, 95% CI: 4.84-12.43, $p < 0.001$) and tobacco smoking increase chances of SMF and trismus by almost two times in the studied individuals (AOR: 1.82, 95% CI: 1.05-3.16, $p = 0.04$), the same findings were reported from various parts of the world [22,23].

The analysis showed the combination of smoking and chewing increases risk of SMF and trismus by almost eight times in a comparison to non-users (AOR: 8.05, 95%CI: 4.22–15.34, $p = 0.001$), the effect of all other combinations were statistically insignificant on oral mucosal lesions as well as SMF and trismus.

It is well documented that in more than 30% of cases oral symptoms are neglected, and a persistent oral mucosal changes may convert in a case of oral cancer thus having oral mucosal changes in young age indicates the oral cancer pandemic in Northern India [24]. A study from North India indicates up to 70% delay in the reporting of the oral cancers, authors of the study concluded that only 6% of individuals having precancerous symptoms visited a

Table 3
Risk of developing tobacco related addictions in different age groups for male and female.

Factors	Tobacco smoking		Tobacco chewing		Either form of tobacco use	
	Odds ratio (95% C.I.)	*p*value	Odds ratio (95% C.I.)	*p*value	Odds ratio (95% C.I.)	*p*value
Male						
Age group						
15–24®	1		1		1	
25–34	2.17 (1.48–3.18)	$p < 0.001$	1.83 (1.35–2.47)	$p < 0.001$	1.71 (1.28–2.29)	$p < 0.001$
35–44	2.58 (1.78–3.74)	$p < 0.001$	1.49 (1.10–2.00)	0.009	1.86 (1.41–2.47)	$p < 0.001$
45–54	2.70 (1.86–3.92)	$p < 0.001$	1.39 (1.04–1.89)	0.029	1.90 (1.43–2.53)	$p < 0.001$
≥ 55	2.79 (1.95–4.01)	$p < 0.001$	0.99 (0.73–1.33)	0.929	1.89 (1.44–2.48)	$p < 0.001$
Female						
Age group						
15–24®	1		1		1	
25–34	1.78 (0.19–16.02)	0.605	2.49 (0.85–7.28)	0.096	2.17 (0.82–5.74)	0.118
35–44	4.49 (0.59–34.27)	0.147	3.34 (1.19–9.39)	0.022	3.21 (1.27–8.12)	0.014
45–54	5.09 (0.66–39.26)	0.119	4.01 (1.42–11.33)	0.009	4.11 (1.62–10.42)	0.003
≥ 55	9.81 (1.31–73.37)	0.026	3.69 (1.29–10.58)	0.015	5.06 (1.20–12.80)	0.001
Combined						
Age group						
15–24®	1		1		1	
25–34	1.89 (1.31–2.74)	0.001	1.64 (1.24–2.17)	$p < 0.001$	1.54 (1.78–2.01)	0.002
35–44	2.17 (1.52–3.09)	$p < 0.001$	1.38 (1.05–1.82)	0.021	1.64 (1.23–2.12)	$p < 0.001$
45–54	2.50 (1.75–3.58)	$p < 0.001$	1.47 (1.12–1.94)	0.006	1.89 (1.46–2.45)	$p < 0.001$
≥ 55	3.29 (2.32–4.66)	$p < 0.001$	1.28 (0.97–1.68)	0.082	2.29 (1.78–3.00)	$p < 0.001$

Table 4
Multivariable logistics regression analysis for factors related with oral mucosal changes, SMF and trismus.

Variables	N	Oral mucosal changes			SMF and Trismus		
		(%)	Odds ratio (95% C.I.)		(%)	Odds ratio (95% C.I.)	
			Unadjusted	Adjusted		Unadjusted	Adjusted
Age group							
15–24	808	6.1	1.29 (0.91–1.83)	1.52e (1.06–2.17)	1.2	3.34e (1.31–8.50)	4.01f (1.56–10.31)
25–34	1640	7.1	1.54f (1.17–2.02)	1.75f (1.32–2.32)	1.0	2.63e (1.12–6.15)	2.69e (1.14–6.36)
35–44	2164	6.3	1.35e (1.04–1.76)	1.58f (1.21–2.07)	1.1	2.86e (1.28–6.15)	3.26f (1.44–7.36)
45–54	1819	6.7	1.44f (1.10–1.88)	1.59f (1.21–2.10)	1.1	2.96e (1.30–6.75)	3.16f (1.38–7.23)
> = 55®	2141	4.8	1	1	0.4	1	1
Gender							
Male	4691	8.8	3.23f (2.61–3.99)	2.80f (2.23–3.51)	1.5	8.38f (3.85–18.25)	5.57f (2.46–12.59)
Female®	3881	2.9	1	1	0.2	1	1
Addictions							
Tobacco smoking	886	12.5	2.50f (2.01–3.13)	1.46e (1.07–1.99)	2.3	3.09f (1.85–5.17)	1.82e (1.05–3.16)
Tobacco chewing	1037	13.7	2.95f (2.40–3.62)	1.84f (1.41–2.39)	4.0	8.58f (5.45–13.48)	7.76f (4.84–12.43)
Alcohol	124	6.5	1.05 (0.51–2.17)	0.64 (0.15–2.68)	2.4	2.81 (0.87–9.02)	0.87 (0.26–2.98)
Betel nut	285	8.1	1.36 (0.88–2.10)	0.55 (0.27–1.12)	1.4	1.60 (0.58–4.41)	0.86 (0.31–2.44)
Joint addictions							
Smoking + Chewing	258	20.9	4.39f (3.21–6.01)	1.43 (0.87–2.35)	5.8	8.22f (4.61–14.65)	8.05f (4.22–15.34)
Smoking + Alcohol	63	6.3	1.04 (0.38–2.86)	0.71 (0.06–8.54)	3.2	3.69 (0.89–15.36)	2.43 (0.87–8.71)
Smoking + Betel nut	61	16.4	3.03f (1.53–6.01)	1.69 (0.64–4.42)	3.3	3.81 (0.92–15.89)	0.38 (0.04–3.92)
Chewing + Alcohol	59	8.5	1.42 (0.57–3.56)	1.57 (0.20–12.53)	5.1	6.11f (1.87–20.00)	1.15 (0.31–4.26)
Chewing + Betel nut	85	15.3	2.80f (1.54–5.09)	1.52 (0.60–3.87)	3.5	4.16e (1.29–13.46)	2.75 (0.43–17.40)
Smoking + Chewing + Alcohol	44	6.8	1.12 (0.35–3.62)	0.30 (0.01–6.91)	4.5	5.37e (1.28–22.58)	0.74 (0.16–3.39)

qualified medical practitioner in time and the primary delay was reported for up to 3 years (10% of cases) [25,26].

The association between late diagnosis and advanced stage oral cancer is well documented in various studies and the odds ratio varied from 0.5–3.0 and pooled odds ratio was reported as 1.5 [27]. This study reveals the pandemic condition of oral mucosal changes, SMF and trismus in western Uttar Pradesh and eastern Rajasthan, which require urgent attention of policymakers and planners. This ongoing screening programme will bring out further relevant findings in its future to bring in more support to the fact that this area is emerging as the cancer spot of India.

In this study we found a statistical association of oral mucosal changes with younger adults, male sex, and tobacco addiction either chewing or smoking. Statistically probability of SMF and trismus was highest in the younger population and of male sex. Tobacco chewing contributes maximum to the SMF and trismus.

5. Conclusion

This is the one of the important screening studies conducted in this region to include more than 8500 individuals. In the present study settings from northern India (western Uttar Pradesh and eastern Rajasthan, India) it was observed that oral mucosal lesions, SMF and trismus, were the most prominent oral health issues. Findings of this study indicate that addiction of tobacco chewing or smoking is most common and in many cases joint addictions (tobacco chewing and smoking, alcohol, betel nuts) were also witnessed. Tobacco addiction (single or joint) was found to be statistically significant with the oral mucosal lesions, SMF and trismus. Risk of tobacco consumption in either form was present in all age groups, which is significantly contributing to increase odds of SMF, trismus and oral mucosal lesions especially in younger and middle aged population. It was a worthwhile initiative to sensitize the huge numbers of rural

communities, health workers to early detection and prevention of oral cancer. Through this study we were able to achieve the training of the health workers in visual screening method of early detection of oral cancer. Another achievement of this study was education of the community about self examination of oral cavity as well as primary prevention effort to reduce tobacco (smoking or chewing) and alcohol abuse.

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Conflict of interests

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