Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

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Abstract

Background: Oral diseases are a major public health concern, sharing modifiable risk factors with other non-communicable diseases. In India, high tobacco use, poor oral hygiene, and limited dental access worsen this burden. Workers at APMC-Azadpur Mandi, Asia's largest wholesale market, form a high-risk group with limited oral health data.

Objectives: To assess the prevalence of oral diseases, oral potentially malignant disorders (OPMDs), tobacco and alcohol use, oral hygiene practices, and dental service utilization among APMC workers in Delhi.

Methods: A descriptive cross-sectional study was conducted among 1125 workers through oral examinations and structured questionnaires using WHO diagnostic criteria. Data were analyzed using SPSS version 21.0, applying descriptive and bivariate analyses ($p < 0.05$).

Results: Most participants were male (94.5%), aged 31 - 40 years (32.4%). Gum disease (70.4%), dental caries (59.4%), and periodontal disease (32.3%) were highly prevalent. Tobacco use was reported by 55.4% (mainly smokeless), and OPMDs by 26.8%-notably tobacco pouch keratosis (15.4%) and oral submucous fibrosis (4.4%). Only 2.8% brushed twice daily; 84.9% had never visited a dentist. Tobacco use significantly correlated with OPMDs ($p < 0.001$).

Conclusion: High oral disease prevalence and risk behaviors highlight the need for workplace-based oral health and tobacco cessation programs.

Keywords: Oral Health; Oral Diseases; Tobacco Use; Potentially Malignant Disorders; Health Promotion; Occupational Health

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

02

Introduction

Oral health is a fundamental pillar of overall human health and well-being, extending beyond the mere absence of disease to encompass the ability to perform essential functions such as eating, breathing, and speaking, and profoundly influencing psychosocial dimensions like self-confidence and social engagement [1]. Globally, oral diseases, including dental caries, periodontal disease, tooth loss, and oral cancer, rank among the most prevalent Non-Communicable Diseases (NCDs), affecting an estimated 3.5 billion people [2]. This escalating global burden is particularly pronounced in low- and middle-income countries like India, where demographic shifts, including rapid population growth and an aging population, contribute significantly to the rising challenge [3].

A critical public health concern is the shared aetiology between most oral diseases and major NCDs [4]. Modifiable risk factors such as tobacco use, alcohol consumption, and diet high in free sugars are common to both categories and are increasing worldwide [5]. This intrinsic interconnectedness underscores that public health interventions targeting these shared risk factors can yield synergistic benefits, simultaneously enhancing both oral and general health outcomes [6]. Therefore, integrating oral health into broader public health strategies is not merely a clinical necessity but a strategic approach to addressing the overarching NCD burden effectively [7].

Tobacco use, a prominent modifiable risk factor for numerous oral diseases, stands as the most significant preventable public health challenge in many nations [8]. It is a leading cause of severe systemic conditions, including lung cancer, coronary artery disease, and chronic obstructive lung disease [9]. Beyond systemic impacts, tobacco products, particularly smokeless forms, exert direct local effects on the oral mucosa, leading to irritation, gum recession, and exposure of tooth roots [10]. Moreover, tobacco-specific N-nitrosamines, formed during the processing of smokeless tobacco, are known carcinogens, directly linking tobacco use to the development of oral precancerous lesions and oral cancers [11].

The Agricultural Produce Marketing Committee (APMC)-Azadpur Mandi in Delhi is Asia's largest wholesale market for fruits and vegetables. This expansive market, covering approximately 90-101 acres, is a complex ecosystem comprising numerous shops, auction sheds, and extensive cold storage facilities. It serves as a pivotal distribution hub, channelling fresh produce to multiple Northern Indian states daily and facilitating international exports. The market operates with intense, almost continuous dynamics; wherein supplies arrive overnight, with auctions commencing at sunrise and often continuing until late morning.

This operational rhythm characterizes APMC with a diverse workforce, coupled with a demanding work environment, presents unique circumstances that could significantly influence their oral health profile. This makes APMC an exceptionally valuable setting for a targeted prevalence study, as the findings may reveal unique occupational health impacts on oral health that are not readily generalizable from studies on general urban populations.

India faces significant challenges in oral health, marked by low awareness, insufficient infrastructure, and substantial economic barriers [12]. There is a notable disconnect between self-perceived oral health and actual clinical conditions, with many individuals believing their oral health is satisfactory despite underlying issues [13]. The dental workforce in India often prioritizes treatment and emergency services, with limited attention to preventive dentistry [14]. Studies in urban Indian communities consistently reveal a high prevalence of dental caries (up to 54.6%) [15], periodontal diseases (up to 51%) and gingival disease (46.6%) [16], and Oral Mucosal Precancerous Lesions and Conditions (OMPD) (ranging from 13.28% to 14.84%) [17,18]. Furthermore, prevalence of tobacco use in India is substantial, with 28.6% of individuals aged 15 and above being current users, according to GATS-II survey [19].

Given this substantial global and national burden of oral diseases, their strong association with modifiable risk factors (especially tobacco), and potentially vulnerable, high-density population within APMC, a prevalence study was conducted in this setting. Such an investigation is imperative to yield crucial baseline data on the oral health status of this specific occupational/ industrial group.

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

03

Therefore, a study was conducted with the aim to assess the prevalence of oral health conditions, tobacco status, Oral Pre-malignant disorders (OPMDs), oral hygiene practices, treatment needs, and referral patterns among the population working in APMC, Asia's largest vegetable and fruit market in Delhi.

Objectives of the Study

- To assess the overall oral disease burden, including the prevalence of common oral conditions, tobacco use, and Oral Pre-malignant Disorders (OPMDs), among the population working in APMC, Delhi.

- To evaluate the oral hygiene practices, utilization of dental services, treatment need and referral pattern of the market's workforce.

Methodology

Study design and setting

A descriptive cross-sectional study was conducted to assess the prevalence of oral health conditions, oral hygiene practices, deleterious habits like tobacco and alcohol use, oral pre-malignant disorders and utilisation of dental service-among workers in the Agricultural Produce Marketing Committee (APMC)-Azadpur Mandi, Delhi.

The APMC-Azadpur Mandi, Asia's largest wholesale market for fruits and vegetables, is characterized by a high-density, dynamic environment with a constant influx of traders, labourers, and transporters, presenting a unique occupational setting.

Study population and sampling

The target population for this study comprised industrial workers engaged in various activities within the APMC-Azadpur Mandi. A convenience sampling method was utilized to recruit participants. A total of 1125 workers who were present at the market during the data collection period and provided informed consent were included in the study.

Ethical considerations

Prior to the commencement of the study, ethical approval was obtained from the Institutional Ethics Committee. Informed consent was obtained from all participants after a clear explanation of the study's objectives and their right to withdraw at any time without penalty. Confidentiality and anonymity of the collected data were strictly maintained.

Data collection

Data collection was conducted over a span of five consecutive days through a meticulously organized oral health screening camp established within the APMC market premises. A team of trained and calibrated team of Dentists, proficient in oral health screenings, performed the oral examinations. Diagnostic dental instruments (e.g. mouth mirrors, probes) were used under adequate illumination to ensure thorough clinical assessments.

A pre-tested, structured proforma was utilized for data collection, encompassing the following variables:

- **Sociodemographics:** Age, gender, education level, occupation.

- **Deleterious habits:** Detailed information on tobacco use (smoking, smokeless forms, frequency, duration, reason of initiation) and alcohol consumption (type, frequency, duration).

- **Common oral diseases:** Clinical assessment for the presence and severity of dental caries (diagnosed using WHO criteria for dental caries), gingivitis, periodontal disease, dental fluorosis, malocclusion and detailed examination of the oral mucosa for any abnormal lesions (e.g. leukoplakia, erythroplakia, oral submucous fibrosis etc).

- **Oral hygiene practices:** Information on brushing frequency, type of brushing aid used, and use of ancillary cleaning aids (e.g. dental floss, mouthwash).

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

04

- **Utilization of dental services:** History of Dental visits, reasons for visiting or not visiting a Dentist.
- **Referral:** Identification of participants requiring further intervention and subsequent referral to appropriate dental facilities for comprehensive treatment.

Diagnostic criteria and standardization

All clinical diagnoses were made by the examining Dentists based on standardized diagnostic criteria. To ensure inter-examiner and intra-examiner reliability, a pilot study was conducted, and the examining dentists underwent thorough training and calibration sessions prior to the main study. Kappa statistics were used to assess the agreement between examiners.

Statistical analysis

The collected data were entered into a Microsoft Excel spreadsheet and subsequently analyzed using SPSS Software Version 21.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the sociodemographic characteristics, prevalence of oral diseases, and other study variables. Prevalence rates were calculated with 95% confidence intervals. Bivariate analysis such as Chi-square test for categorical variables, independent t-test/ANOVA for continuous variables) was performed to explore associations between oral health conditions and various sociodemographic factors and deleterious habits. A p-value of < 0.05 was considered statistically significant.

Results

A total of 982 workers from the Agricultural Produce Marketing Committee (APMC)-Azadpur Mandi in Delhi participated in this cross-sectional study. The demographic characteristics of the study population revealed a predominantly male workforce, with specific age and education distributions.

Sociodemographic characteristics

The majority of participants were male, accounting for 94.5% (n = 1063) of the total study population, while females constituted 5.5% (n = 62). The age distribution showed that the largest proportion of workers were between 31 and 40 years old (32.4%, n = 364), followed by those aged 20 - 30 years (28.2%, n = 317) and 41 - 50 years (25.4%, n = 286). Workers aged 51 - 60 years made up 14.0% (n = 158) of the cohort. In terms of education, a significant portion of the workforce had primary education (31.9%, n = 359), while 25.6% (n = 288) had middle school education and 21.8% (n = 245) were uneducated. High school graduates comprised 16.4% (n = 184), with smaller percentages having intermediate (2.0%, n = 23), diploma (0.6%, n = 7), or graduate (1.7%, n = 19) level education (Table 1).

Prevalence of oral diseases

Sociodemographic details		n (%)
Age	20-30	317 (28.2)
	31-40	364 (32.4)
	41-50	286 (25.4)
	51-60	158 (14.0)
Gender	Male	1063 (94.5)
	Female	62 (5.5)
Education	Uneducated	245 (21.8)
	Primary	359 (31.9)
	Middle school	288 (25.6)
	High school	184 (16.4)
	Intermediate	23 (2.0)
	Diploma	07 (0.6)
	Graduate	19 (1.7)

Table 1: *Sociodemographic details of study participants.*

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

05

The study found a high prevalence of various oral diseases among the APMC workforce. Gum disease was the most common condition, affecting 70.4% (n = 792) of the participants. Dental caries was present in 59.4% (n = 668) of individuals, with grossly decayed teeth observed in 22.4% (n = 252). Periodontal disease was diagnosed in 32.3% (n = 363) of the workers. Other conditions included wasting diseases (26.7%, n = 300), fluorosis (8.7%, n = 98), and malocclusion (8.4%, n = 94) (Table 2).

Dental Diseases	Present n (%)	Absent n (%)
Dental Caries	668 (59.4)	457 (40.6)
Grossly Decayed	252 (22.4)	873 (77.6)
Gum disease	792 (70.4)	333 (29.6)
Periodontal disease	363 (32.3)	762 (67.7)
Malocclusion	94 (8.4)	1031 (91.6)
Fluorosis	98 (8.7)	1027 (91.3)
Wasting Diseases	300 (26.7)	825 (73.3)

Table 2: Prevalence of oral diseases of study participants.

Oral hygiene practices

The assessment of oral hygiene practices revealed that the majority of participants cleaned their teeth once a day (79.4%, n = 893). Only a small percentage reported cleaning twice a day (2.8%, n = 32), while 16.6% (n = 187) cleaned a few times a week, and 1.2% (n = 13) never cleaned their teeth. Toothbrush was the most common cleaning aid used (79.3%, n = 892), followed by neem stick (13.3%, n = 150) and finger (7.3%, n = 82). Toothpaste was the primary medium for brushing (75.8%, n = 853), with toothpowder (11.6%, n = 130) and "gul" (1.8%, n = 20) also in use. A notable finding was that 82.2% (n = 925) of participants did not know if their toothpaste contained fluoride (Table 3).

Oral Hygiene Practices		n (%)
Cleaning of teeth	Once a day	893 (79.4)
	Twice a day	32 (2.8)
	Few times a week	187 (16.6)
	Never	13 (1.2)
Type of cleaning	Toothbrush	892 (79.3)
	Neem stick	150 (13.3)
	Finger	82 (7.3)
	Wooden toothpicks	1 (0.1)
Medium of brushing	Toothpaste	853 (75.8)
	Toothpowder	130 (11.6)
	Gul	20 (1.8)
	None	122 (10.8)
Use of toothpaste containing fluoride	Yes	22 (2.2)
	No	178 (15.8)
	Don't Know	925 (82.2)

Table 3: Oral hygiene practices of study participants.

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

06

Tobacco and alcohol use

Tobacco use was prevalent among the study population, with 55.4% (n = 621) identified as current users. Among tobacco users, smokeless forms were more common (37.2%, n = 418), followed by smoke form (12.6%, n = 142), and both forms (5.4%, n = 61). Beedi (88.1%, n = 179) was the predominant smoke form, while Gutka (37.7%, n = 181), Khaini (28.2%, n = 135), and tobacco (21.9%, n = 105) were frequently used smokeless forms. A significant proportion of tobacco users reported daily use (51.8%, n = 583), and many had been using tobacco for more than 10 years (17.9%, n = 202). Alcohol consumption was reported by 17.7% (n = 199) of the participants (Table 4).

Tobacco Use	Smoke form	142 (12.6)
	Smokeless form	418 (37.2)
	Both Smoke and Smokeless form	61 (5.4)
	Total Users	621 (55.4)
	Non-Users	504 (44.8)
Type of Smoke form	Beedi	179 (88.1)
	Cigarettes	24 (11.8)
	Total users	203 (32.7)
Type of Smokeless form	Gutka	181 (37.7)
	Khaini	135 (28.2)
	Tobacco	105 (21.9)
	Paan with Acrecanut	58 (12.1)
	Total users	479 (77.1)
Duration of use of tobacco	>10 years	202 (17.9)
	5-10 years	176 (15.6)
	1-5 years	179 (15.9)
	6 months-1 year	58 (5.15)
	< 6 months	10 (0.8)
	None	504 (44.8)
Frequency	Daily	583 (51.8)
	Occasionally	42 (3.7)
	None	504 (44.8)
Alcohol	Yes	199 (17.7)
	No	926 (82.3)

***Table 4:** Tobacco and alcohol consumption of study participants.*

Oral potentially malignant disorders (OPMDs)

In the present study, Oral Potentially Malignant Disorders (OPMDs) were observed in 26.8% of the participants, with the majority (73.2%) showing no lesions. Among the OPMDs, tobacco pouch keratosis was the most prevalent (15.4%), followed by smoker's palate (5.1%), oral submucous fibrosis (4.4%), leukoplakia (1.7%), and erythroplakia (0.2%), while oral lichen planus and candidiasis were not detected (Table 5).

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

07

Type of OPMD	n (%)
Leukoplakia	19 (1.7)
Erythroplakia	02 (0.2)
Oral Lichen Planus	0
OSMF	50 (4.4)
Tobacco Pouch Keratosis	173 (15.4)
Candidiasis	0
Smoker's palate	57 (5.1)
None	824 (73.2)

Table 5: *Distribution of study participants with respect to OPMDs.*

Utilization of dental services and treatment needs

The study revealed low utilization of dental services, with a vast majority of participants (84.9%, n = 955) having never visited a dentist. Among those who had visited a dentist (n = 170), the primary reason for the visit was pain or trouble with teeth, gums, or mouth (83.5%, n = 142). Regarding treatment needs, comprehensive care was required by 66.4% (n = 747) of the workers, while 26.8% (n = 301) needed primary/preventive care, and 2.1% (n = 24) required urgent care. Only 4.7% (n = 53) had no apparent treatment needs (Table 6).

How long since you had visited a Dentist	n (%)
Never	955 (84.9)
5 years or more	84 (7.5)
2 years or more but less than 5 years	40 (3.6)
More than 1 year but less than 2 years	25 (2.2)
6-12 months	14 (1.2)
less than 6 months	07 (0.6)
If yes, Reason to visit Dentist (n = 170)	
Pain or trouble with teeth, gums or mouth	142 (83.5)
Treatment/ follow-up treatment	11 (6.5)
Routine check-up	04 (2.4)
Consultation/advise	0
Don't know/don't remember	13 (7.6)
Treatment required	**n (%)**
Primary care/preventive care	301 (26.8)
Urgent care	24 (2.1)
Comprehensive care	747 (66.4)
None	53 (4.7)

Table 6: *Utilization of dental services and treatment needs of study participants.*

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

08

Correlational analysis of various age groups with dental caries

Among APMC market workers, the prevalence of dental caries increased significantly with age, rising from 55.2% in the 21-30 age group to 67.7% in those aged 51-60 years (χ^2 = 7.83, p = 0.006*) (Table 7).

Parameter-	Age Groups					
Caries Prevalence	**21-30**	**31-40**	**41-50**	**51-60**	**Chi square χ^2(df)**	**P value**
Caries Present	175 (55.2)	210 (57.7)	176 (61.5)	107 (67.7)	7.83 (3)	0.006*
Caries Absent	142 (44.8)	154 (42.3)	110 (38.5)	51 (32.3)		

Table 7: Correlational analysis of various age groups with dental caries.

*Statistically significant at p < 0.05; NS = Not significant.

Correlational analysis of various age groups with tobacco and alcohol consumption

Tobacco use was highest in the 31-40 age group (61.5%) and remained above 55% in all older groups (p = 0.001). Chewing tobacco was most common among workers aged 31-50 years, peaking at 47.8% (p = 0.002), while rates of smoking did not differ significantly by age (p = 0.413). Alcohol use was also significantly higher in older workers, increasing from 11% in 21-30-year-olds to over 19% in those above 40 years (p = 0.003) (Table 8).

Parameter- Deleterious Habits	Age Groups						
	21-30	**31-40**	**41-50**	**51-60**	**Total**	**Chi square χ^2(df)**	**P value**
Tobacco User	148 (46.6)	224 (61.5)	162 (56.6)	87 (55.0)	621	12.6	0.001*
Non-Tobacco Users	169 (53.3)	140 (38.5)	124 (43.3)	71 (44.9)	504		
	317	364	286	158			
Smoking						13.4	0.413
Smokers	62 (19.5)	71 (19.5)	43 (15)	27 (17)	203		
Non-Smokers	255 (80.4)	293 (80.5)	243 (85)	131 (83)	922		
	317	364	286	158			
Tobacco Chewing						76.25	0.002*
Users	108 (34.1)	174 (47.8)	131 (45.8)	66 (41.8)	479		
Non-Users	209 (66)	190 (52.2)	155 (54.2)	92 (58.2)	646		
	317	364	286	158			
Alcohol						45.33	0.003*
Alcohol Users	35 (11)	77 (21.2)	56 (19.6)	31 (19.7)	199		
Non-Alcohol Users	282 (90)	287 (78.4)	230 (80)	127 (80.3)	926		
	317	364	286	158			

Table 8: Correlational analysis of various age groups with tobacco and alcohol consumption.

*Statistically significant at p < 0.05; NS = Not significant.

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

09

Correlational analysis of tobacco and oral premalignant disorders (OPMD)

The analysis revealed a highly significant association between tobacco use and OPMD, with a chi-square value of 305.00 (df = 5) and a p-value <0.001, indicating a strong relationship. Duration of tobacco use was also positively correlated with OPMD, with a Spearman's correlation coefficient of 0.084 (p = 0.036), signifying a gradual increase in risk with longer tobacco exposure (Table 9).

Parameters	Chi square χ^2(df)	P value
Tobacco use vs OPMD	305.00(5)	<0.001*
Duration tobacco vs OPMD	Spearman ρ = 0.084	0.036*

Table 9: *Correlational analysis of tobacco and oral premalignant disorders (OPMD).*

*Statistically significant at p < 0.05; NS = Not significant.

Correlational analysis of oral hygiene and oral diseases

Furthermore, oral hygiene was significantly associated with dental caries (χ^2 = 20.55, df = 3, p = 0.001), gum disease (χ^2 = 18.97, df = 3, p<0.004), and periodontal disease (χ^2 = 76.75, df = 3, p = 0.000). All reported associations were statistically significant at p<0.05 (Table 10).

Parameters	Chi square χ^2(df)	P value
Oral hygiene vs Dental Caries	20.551 (3)	0.001*
Oral hygiene vs Gum disease	18.97 (3)	<0.004*
Oral hygiene vs Periodontal Disease	76.75 (3)	0.000*

Table 10: *Correlational analysis of oral hygiene and oral diseases.*

*Statistically significant at p < 0.05; NS = Not significant.

Discussion

The present study highlights the profound burden of oral diseases and associated risk behaviors among the workforce of APMC-Azadpur, a highly dynamic occupational environment representing the labour sector in India. The findings reflect systemic neglect of preventive oral healthcare in occupational settings, exacerbated by socio-economic, behavioral, and environmental vulnerabilities.

Several studies indicate that dental caries prevalence among industrial workers is a significant public health issue. Studies have reported caries prevalence ranging from 46.5% among lock factory workers to 88.4% among sugar factory workers [20]. Prevalence can also be as high as 81% among construction workers [21]. The prevalence of dental caries (59.4%) in the APMC workforce is in line with the average findings of Janapareddy., *et al.* who observed a 62.5% prevalence among industrial steel workers in Maharashtra [22] and among thermal power station workers in south India [23]. These values are notably higher than those in general urban populations, emphasizing the impact of occupational context on oral health.

The high prevalence of dental caries among industrial workers can be attributed to a combination of occupational, lifestyle, and socio-economic factors. Limited access to dental care due to work schedules, financial constraints, and lack of awareness often prevents timely treatment. Poor oral hygiene practices, irregular eating habits, and frequent consumption of sugary snacks and drinks during shift work

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

10

further increase risk. Additionally, widespread tobacco use and the influence of lower socio-economic and educational status exacerbate poor oral health outcomes, collectively making industrial workers a vulnerable group for dental caries.

The finding of 32% periodontal disease in our study is notably lower than this national average, while the 70% gingival disease rate is significantly higher than the broader population estimate-highlighting a distinct occupational health burden in your study group [16]. The high prevalence of gingival disease may be attributed to inadequate oral hygiene practices, irregular dental visits, tobacco use and occupational factors such as exposure to dust, food particles, and irregular work schedules that discourage proper oral care.

In terms of periodontal disease, our study found a prevalence of 32.3%, which is concerning but lower than the 86.2% observed among brick kiln workers in Odisha [24]. This disparity might be explained by differences in tobacco consumption types, occupational dust exposure, and oral hygiene behaviors. However, the co-prevalence of gum disease suggests early gingivitis is widespread and likely to progress without intervention, particularly given the poor oral hygiene habits noted.

Oral hygiene practices were suboptimal-only 2.8% brushed twice daily, 20% used either neem stick or fingers to clean teeth and over 80% were unaware of fluoride in their toothpaste. These behaviours are consistent with studies reported in spinning mill workers in Guntur district [25] and fertilizer factory workers of Northern India [26] who also exhibited poor brushing frequency, low fluoride toothpaste usage, and reliance on indigenous cleaning tools such as chew sticks and ash. Such patterns were attributed to affordability issues, misinformation, and cultural practices.

The prevalence of tobacco use (55.4%), especially smokeless forms (37.2%), was alarmingly high. This trend resonates with data from Shridhar., *et al.* who reported 62.3% tobacco usage among Karnataka's transport workers, and Sawhney., *et al.* who observed 57% prevalence among informal port workers in Mumbai [7,8]. The occupational stress, social acceptability, and perceived stimulation from tobacco often contribute to its pervasive use in high-demand labor environments.

The prevalence of tobacco use in our study population (55.4%), with a predominance of smokeless forms (37.2%), was substantially higher than the national average reported in the Global Adult Tobacco Survey-2 (GATS-2, 2016-17), where 28.6% of Indian adults used tobacco and 21.4% reported smokeless forms [1]. Our findings are also significantly higher than other occupational cohorts in India-41% users in Western India [27], 40% among security guards in Delhi [28] and in textile mill workers in Bhopal wherein 20.8% used smokeless tobacco, 7.9% used a smoking form of tobacco, and 6.7% used both) [29]. The exceptionally high burden observed among food and vegetable market workers may be attributed to easy availability of areca nut and tobacco products at the workplace, long working hours [30], and low health awareness.

In the present study, 26.8% of participants exhibited one or more oral potentially malignant disorders (OPMDs), predominantly tobacco pouch keratosis (15.4%), followed by smoker's palate (5.1%), oral submucous fibrosis (OSMF; 4.4%), leukoplakia (1.7%), and erythroplakia (0.2%). The findings closely mirror patterns observed in several Industrial workers across India [29,31]. This emphasizes the urgent need for targeted screening, early detection, and workplace-based tobacco cessation interventions among high-risk groups to mitigate malignant transformation risk in this vulnerable populations.

Over two-thirds (66.4%) of APMC workers required comprehensive dental care underscores the cumulative burden of untreated oral disease within this occupational group. Similar findings have been reported in other occupational settings [32-34].

Tobacco cessation, in particular, benefits from workplace integration [35]. Parashar., *et al.* stated that a suitable plan for quitting keeping in mind this vulnerable group of workers such as the industrial workers, should be developed depending on the predictors of intention to quit- literacy, type of tobacco used, and nicotine dependency. Encouragingly**,** integrating oral health promotion at workplaces

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

11

has shown promising results [36]. Bakri., *et al.* stated that appropriate times and locations, organizational and logistic arrangements and a variety of health delivery options contributed to successful programme planning and implementation [37]. These findings align with the "common risk factor approach" proposed by Sheiham and Watt, which advocates simultaneous targeting of shared NCD risk factors (diet, tobacco, hygiene) for broader health impact [6]. The occupational environment, therefore, is both a risk factor and a platform for effective work-place based interventions.

This finding of dental caries prevalence increases significantly with age is consistent with a meta-analysis of Indian populations, which reported an age-specific caries prevalence of 62% in adults over 18 years compared with 52% in younger cohorts (3-18 years). The progressive accumulation of risk factors such as inadequate oral hygiene, comorbidities, and limited access to preventive programs likely contributes to this age-related trend [38]. Additionally, the strong associations observed between tobacco use and oral premalignant disorders (OPMD)-and a positive correlation with duration of use align with recent systematic reviews indicating that tobacco users have an odds ratio of 15.22 (95% CI: 10.01-23.15) for developing OPMDs compared to non-users [39]. Regarding oral potentially malignant disorders (OPMD), 8.6% of workers in our cohort had at least one OPMD, and all cases occurred exclusively among tobacco users (11.4% of tobacco users; P = 0.001), mirroring findings in factory workers of Udupi [40]. This strong association highlights the urgent need for targeted tobacco cessation and workplace oral screening programs.

Moreover, poor oral hygiene emerges as a significant risk factor for oral diseases in this cohort. The observed associations between inadequate hygiene and dental caries (χ^2 = 20.55, p = 0.001), gum disease (χ^2 = 18.97, p < 0.004), and periodontal disease (χ^2 = 76.75, p < 0.001) mirror findings from a comprehensive meta-analysis reporting that fair to poor oral hygiene increases periodontitis risk two- to five-fold (OR = 2.04-5.01). Regular toothbrushing and professional dental care, which were shown to reduce periodontitis odds by 34% and 32%, respectively, should be emphasized in workplace health programs [41].

Limitations of the Study

One limitation of this study is the use of convenience sampling, which may limit the generalizability of the findings to the entire APMC workforce or other similar occupational settings. Future research could benefit from a probability sampling method to enhance representativeness. Additionally, the cross-sectional design captures a snapshot in time and does not allow for the establishment of cause-and-effect relationships. Longitudinal studies would be valuable to understand the progression of oral diseases and the long-term impact of interventions in this population.

Conclusion

The findings of this study reinforce the critical public health concern posed by oral diseases and tobacco use within specific occupational groups. The high prevalence of oral diseases, coupled with inadequate oral hygiene practices and low dental service utilization, points to a significant unmet need for oral healthcare in the APMC workforce. Comprehensive interventions integrating oral health education, tobacco cessation programs, and accessible dental services are urgently required to improve the oral health and overall well-being of this vital segment of the population.

Author's Contribution

Nagaraj M: Provided overall institutional and administrative support and critical review of the manuscript.

Mansi Atri: Conceptualized and designed the study, supervised data collection, and drafted and critically revised the manuscript.

Anitha G: Site and field coordination.

Chaity Sarkar: Coordinated field work, data collection and analysis, and drafting the manuscript.

Nithya S: Data interpretation and review of manuscript.

Jitin Kharbanda: Data analysis and critical review of manuscript.

Ankit Sharma: Review of manuscript.

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

12

Bibliography

1. Fisher Julian., *et al*. "Achieving oral health for all through public health approaches, interprofessional, and transdisciplinary education". *NAM Perspectives* (2023).

2. Peres Marco A., *et al*. "Oral diseases: a global public health challenge". *The Lancet* 394.10194 (2019): 249-260.

3. GBD 2017 Oral Disorders Collaborators., *et al*. "Global, regional, and national levels and trends in burden of oral conditions from 1990 to 2017: a systematic analysis for the global burden of disease 2017 study". *Journal of Dental Research* 99.4 (2020): 362-373.

4. Botelho Joao., *et al*. "An umbrella review of the evidence linking oral health and systemic noncommunicable diseases". *Nature Communications* 13.1 (2022): 7614.

5. Murtomaa Heikki., *et al*. "Neglected epidemics: The role of oral public health to advance global health". *Journal of Global Health* 12 (2022): 02001.

6. Sheiham Aubrey and Richard Geddie Watt. "The common risk factor approach: a rational basis for promoting oral health". *Community Dentistry and Oral Epidemiology: Commentary* 28.6 (2000): 399-406.

7. Christian Bradley., *et al*. "Strategies to integrate oral health into primary care: a systematic review". *BMJ Open* 13.7 (2023): e070622.

8. Mohanty Vikrant Ranjan., *et al*. "Role of dental institutions in tobacco cessation in India: current status and future prospects". *Asian Pacific Journal of Cancer Prevention* 14.4 (2013): 2673-2680.

9. St Claire Simone., *et al*. "Lung health, tobacco, and related products: gaps, challenges, new threats, and suggested research". *American Journal of Physiology-Lung Cellular and Molecular Physiology* 318.5 (2020): L1004-L1007.

10. Tomar SL. "Oral health effects of tobacco products: science and regulatory policy". *Advances in Dental Research* 30.1 (2019): 2-3.

11. Pandya Divya., *et al*. "Prevalence of oral potentially malignant disorders among tobacco users in Kolkata: A hospital-based study". *Cureus* 16.10 (2024): e72084.

12. Dasson Bajaj Parul., *et al*. "A scoping review exploring oral health inequalities in India: a call for action to reform policy, practice and research". *International Journal for Equity in Health* 22.1 (2023): 242.

13. Narang Prashant., *et al*. "India's oral health outlook: challenges, economic impact and need for preventative strategies". *Frontiers in Dental Medicine* 6 (2025): 1544899.

14. Gambhir Ramandeep Singh., *et al*. "Dental public health in India: An insight". *Journal of Family Medicine and Primary Care* 5.4 (2016): 747-751.

15. Pandey Pragya., *et al*. "Prevalence of dental caries in the Indian population: A systematic review and meta-analysis". *Journal of International Society of Preventive and Community Dentistry* 11.3 (2021): 256-265.

16. Janakiram Chandrashekar., *et al*. "Prevalence of periodontal disease among adults in India: A systematic review and meta-analysis". *Journal of Oral Biology and Craniofacial Research* 10.4 (2020): 800-806.

17. Kumar, Sandeep., *et al*. "Prevalence and risk factors for oral potentially malignant disorders in Indian population". *Advances in Preventive Medicine* (2015): 208519.

18. Gautam Janesh Kumar., *et al*. "Prevalence and determinants of oral potentially malignant disorders in western Rajasthan". *Scientific Reports* 15.1 (2025): 15611.

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

13

19. Verma M., *et al*. "Trends and determinants of tobacco use initiation in India: analysis of two rounds of the global adult tobacco survey". *BMJ Open* 13.9 (2023): e074389.

20. Puja CY., *et al*. "Prevalence of dental caries among sugar factory workers-a cross sectional survey". *Open Access Journal of Dental Sciences* 4.2 (2019): 1-6.

21. Patel Ayeesha Simran., *et al*. "Dental caries, oral hygiene status and deleterious habits among migrant construction workers of Belagavi, India". *Journal of Preventive Medicine and Hygiene* 65.1 (2024): E65.

22. Janapareddy Karishma., *et al*. "Oral health status and oral health-related quality of life (OHRQoL) among steel factory workers of Visakhapatnam-a cross-sectional study". *Journal of Family Medicine and Primary Care* 9.10 (2020): 5309-5315.

23. Pillai Dinesh Dhamodhar Mathevan., *et al*. "Prevalence of dental caries among thermal power station workers in South India". *Journal of Pharmacy and Bioallied Sciences* 16.2 (2024): S1396-S1399.

24. Baishya Banashree., *et al*. "Oral hygiene status, oral hygiene practices and periodontal health of brick kiln workers of Odisha". *Journal of Indian Society of Periodontology* 23.2 (2019): 163-167.

25. Bommireddy Vikram Simha., *et al*. "Oral hygiene habits, oral health status, and oral health care seeking behaviors among spinning mill workers in Guntur district: A cross-sectional study". *Journal of Family Medicine and Primary Care* 9.6 (2020): 3025-3029.

26. Gupta Vivek V., *et al*. "Assessment of oral hygiene habits, oral hygiene practices and tooth wear among fertilizer factory workers of Northern India: A Cross sectional study". *Journal of Clinical and Experimental Dentistry* 7.5 (2015): e649-e655.

27. Divinakumar KJ., *et al*. "Prevalence and patterns of tobacco use and nicotine dependence among males industrial workers". *Industrial Psychiatry Journal* 26.1 (2017): 19-23.

28. Chauhan Neha., *et al*. "Investigating the association between tobacco use and oral health among security guards at a tertiary healthcare centre in New Delhi: a cross-sectional study". *Frontiers in Oral Health* 5 (2024): 1375792.

29. Kaur Arshdeep., *et al*. "The predominance of tobacco propensities and tobacco-related oral lesions in textile mill workers of Bhopal: a cross-sectional study". *Cureus* 15.6 (2023): e41085.

30. Baek Seong-Uk., *et al*. "Long working hours and preventive oral health behaviors: a nationwide study in Korea (2007-2021)". *Environmental Health and Preventive Medicine* 29 (2024): 48.

31. Aslesh Ottapura Prabhakaran., *et al*. "High prevalence of tobacco use and associated oral mucosal lesion among interstate male migrant workers in urban Kerala, India". *Iranian Journal of Cancer Prevention* 8.6 (2015): e3876.

32. Rao B Vengal., *et al*. "Oral health status and treatment needs of Gunj marketing yard laborers of Raichur City, Karnataka". *Journal of Pharmacy and Bioallied Sciences* 9.3 (2017): 195-200.

33. Halappa Mythri. "Oral health status and treatment needs among multiple factory workers, Tumkur City-A cross sectional study". *Journal of Indian Association of Public Health Dentistry* 18.3 (2020): 232-235.

34. Patil Vishal V., *et al*. "Tooth loss, prosthetic status and treatment needs among industrial workers in Belgaum, Karnataka, India". *Journal of Oral Science* 54.4 (2012): 285-292.

35. Mishra Gauravi A., *et al*. "Establishing a model workplace tobacco cessation program in India". *Indian Journal of Occupational and Environmental Medicine* 13.2 (2009): 97-103.

36. Javanmardi Sasha., *et al*. "Effectiveness of workplace health promotion programs for industrial workers: a systematic review". *BMC Public Health* 25.1 (2025): 168.

Burden of Oral Diseases and Oral Pre-Malignant Disorders among Workers at Asia's Largest Wholesale Market: A Cross-Sectional Study

14

37. Bakri NN., *et al*. "Workplace oral health promotion activities among community-aged care workers: A qualitative exploration". *Community Dentistry and Oral Epidemiology* 52.4 (2024): 389-397.

38. Pandey Pragya., *et al*. "Prevalence of dental caries in the Indian population: A systematic review and meta-analysis". *Journal of International Society of Preventive and Community Dentistry* 11.3 (2021): 256-265.

39. Gupta Bhavana., *et al*. "Occurrence of oral premalignant lesions among Tobacco users in a Tribal Population: a systematic review and Meta-analysis". *Cureus* 15.10 (2023): e47162.

40. Kumar Yeturu Sravan., *et al*. "Prevalence of oral potentially malignant disorders in workers of Udupi taluk". *South Asian Journal of Cancer* 4.3 (2015): 130-133.

41. Lertpimonchai Attawood., *et al*. "The association between oral hygiene and periodontitis: a systematic review and meta-analysis". *International Dental Journal* 67.6 (2017): 332-343.