

Nicotine Dependence and Its Correlates Among Tobacco Users from Urban Prayagraj: A Community Based Cross-Sectional Study

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ABSTRACT

Background: Tobacco use remains a major public health challenge and is a leading cause of preventable morbidity and mortality worldwide. Nicotine dependence is a key factor that hinders successful tobacco cessation. Understanding the extent of nicotine dependence and its associated factors is essential for planning effective tobacco-control interventions.

Objectives: To assess the prevalence of nicotine dependence among tobacco users and determine its association with selected sociodemographic characteristics in an urban population of Prayagraj, Uttar Pradesh.

Methods: A community-based cross-sectional study was conducted among current tobacco users identified from a parent survey carried out in the Urban Health and Training Centre (UHTC) field practice area, Bamrauli, Prayagraj. Of the 316 individuals surveyed, 132 current tobacco users were included in the study. Nicotine dependence was assessed using the Fagerström Test for Nicotine Dependence (FTND) for smokers and the FTND–Smokeless Tobacco (FTND–SLT) questionnaire for smokeless tobacco users. Dependence scores were categorized as low (<4), moderate (4–6), and high (>6). Data were analysed using descriptive statistics and the Mann–Whitney U test, with $p < 0.05$ considered statistically significant.

Results: Among the 132 tobacco users, 37 were exclusive smokers, 42 were exclusive smokeless tobacco users, and 53 were dual users. Moderate-to-high nicotine dependence was observed among 65% of smokers and 73% of smokeless tobacco users. Socioeconomic status showed a significant association with FTND scores among smokers ($p = 0.04$), whereas age, gender, literacy status, and occupation were not significantly associated with nicotine dependence.

Conclusion: A high prevalence of nicotine dependence was observed among both smokers and smokeless tobacco users, particularly among individuals from lower socioeconomic groups. Strengthening tobacco cessation services, behavioural counselling, and community-based tobacco-control interventions is essential to reduce the burden of nicotine addiction.

Keywords: Nicotine Dependence, Tobacco Use, Smokeless Tobacco, Fagerström Test, Urban Population.

INTRODUCTION

With nearly 7 million fatalities, disabilities, and long-term suffering from tobacco-related diseases each year, the tobacco epidemic is one of the greatest risks to global public health.¹ In addition to more than 20 different forms or subtypes of cancer, tobacco use is a significant risk factor for respiratory and cardiovascular disorders as well as numerous other crippling medical conditions.¹ India is the country with the second-highest tobacco consumption rate in the world, after China. Nearly 266.8 million (26.68 crore) persons in India who are 15 years of age or older use tobacco in some form, according to the Global Adult Tobacco Survey (GATS) India 2016–17.²

Nicotine is a highly addictive chemical found in all tobacco products, including cigarettes, smokeless tobacco, hookah, heated tobacco products, and most e-cigarettes. Regular use of these products can alter brain function, leading to nicotine dependence and cravings for continued use.³ Tobacco dependence is defined as, “Cluster of behavioral, cognitive and physiological phenomena that develop after repeated tobacco use and that typically include a strong desire to use tobacco, difficulties in controlling its use, persistence in tobacco use despite harmful consequences, a higher priority given to tobacco use than other activities and obligations, increased tolerance and sometimes a physical withdrawal state”.⁴ Presence of nicotine in tobacco products leads to hindrances in tobacco cessation. Research indicates that 50% of people who begin smoking since their adolescence carry on smoking for 15 to 20 years.⁵ Hence, early recognition and treatment of nicotine dependence are crucial for tobacco cessation and to avert morbidity and mortality due to tobacco use.

Study by Anandaraj R. et al found 39.2 % of tobacco smokers and 60.2 % of smokeless tobacco users had moderate to high nicotine dependence. The median FTND scores were significantly higher among illiterates, increasing age, in urban areas, those

smoking a greater number of cigarettes/bidis per day, and longer duration of smoking.⁶ Another study from Uttarakhand found that more than half (55%) of tobacco users were in the contemplation stage of change.⁷

In 2007 Indian government launched the The National Tobacco Control Program (NTCP), which addresses anti-tobacco initiatives.⁸ According to tobacco dependence treatment guidelines there is an urgent need to reverse this entirely preventable tobacco epidemic.⁹

It is only possible when we know the nicotine dependence status of tobacco user. This study in Prayagraj will help in determining the local data of tobacco dependence and will help in planning the tobacco cessation activities.

Objectives:

1. To estimate the prevalence of nicotine dependence among urban population
2. To determine association between various socio-demographic factors with nicotine dependence among urban population.

METHODOLOGY

Study Population and Sample: It was conducted among the Residents of UHTC's field practice area in Bamrauli, Prayagraj, Uttar Pradesh for 1 year period. The parent study included 316 participants selected through a community-based survey to assess tobacco use patterns. For the present analysis, only current tobacco users identified in the parent study were included. Of the 316 participants surveyed, 132 reported current use of tobacco in any form (smoked and/or smokeless) and constituted the final study population for assessment of nicotine dependence and its correlates.

Inclusion Criteria:

1. Current tobacco users identified in the parent study.
2. People aged 15 years and above and living in the field practice area of UHTC, Bamrauli. for at least 6 months.

3. People, who provided informed consent to participate in the study, were included.

Exclusion Criteria:

1. People who were unable to participate in the interview because they were very sick or bedridden at the time of the interview.
2. People with communication problems or cognitive impairment were excluded.
3. Non-users of tobacco.

Data collection Process:

A multistage random sampling technique was used in the urban field practice area of the Urban Health & Training Center (UHTC), Bamrauli. Five of the fifteen urban areas/Mohallas were selected by simple random sampling. Population proportionate to size (PPS) sampling was applied. After obtaining written informed consent from participants and in case of adolescents consent from parents with adolescent assent, investigators conducted face-to-face interviews using a predesigned, pretested, semi-structured questionnaire. The interview obtained information on socio-demographic parameters & the standardized Fagerstrom test for nicotine dependence was used as test for the physical aspects of nicotine dependence.⁹ It have smoking and smokeless version both of them were used. Score of the FTND ranges from 0 to 10. For dual users (both smoking and smokeless), both questionnaires were administered.

Based on the score, the level of dependence was categorized as low (score less than 4), medium (score 4-6) or high (score more than 6).

Data Analysis:¹⁰

MS Excel was used for data entry. Data was analysed by utilizing available software. Frequency, percentages, and proportions were used to display for qualitative data. Non-Parametric test was used for non-normally distributed data. Continuous study variables were summarized as median with interquartile range (IQR), Mann–Whitney U test was applied to compare the median difference in FTND scores among various categories of demographic variable. Graphical presentation was also done for the ordinal data. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: The Institutional Ethics Committee (IEC) of UIMS, Prayagraj, granted ethical permission. (UIMS/IEC/EC/2025/17). Informed written consent was taken from all participants. An assent of the adolescent and consent of parents was obtained in case of adolescent participant.

RESULT

Out of a total of 132 tobacco users, 42 were exclusively SLT users, 37 were exclusive smokers, while 53 participants reported dual use of both smoked and smokeless tobacco products.

Table 1: Distribution of Tobacco Smokers according to Fagerström Test for Nicotine Dependence (FTND) (Smoking Version - 90)

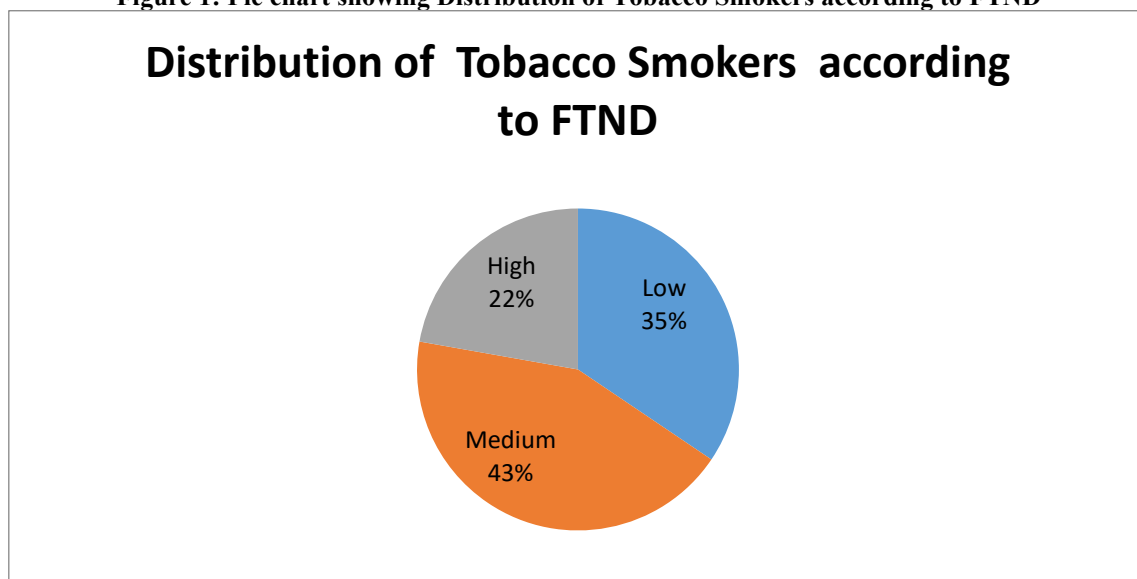
Question	Answer (Score)	Number (%)
1. How soon after you wake up do you smoke your first cigarette?	Within 5 minutes (3)	23(25.56)
	6–30 minutes (2)	28(31.11)
	31–60 minutes (1)	18(20)
	After 60 minutes (0)	21(23.33)
2. Do you find it difficult to refrain from smoking in places where it is forbidden (e.g. in church, at the library, in cinema)?	Yes (1)	57(63.33)
	No (0)	33(36.67)
3. Which cigarette would you hate most to give up?	The first one in the morning (1)	53(58.89)
	Any other (0)	37(41.11)
4. How many cigarettes per day do you smoke?	10 or less (0)	62(68.89)
	11–20 (1)	22(24.44)
	21–30 (2)	6(6.67)

	31 or more (3)	0(0)
5. Do you smoke more frequently during the first hours after waking than during the rest of the day?	Yes (1)	54(60)
	No (0)	36(40)
6. Do you smoke even if you are so ill that you are in bed most of the day?	Yes (1)	57(63.33)
	No (0)	33(36.67)

The responses to the FTND questionnaire indicate varying levels of nicotine dependence among the 90 study participants. Regarding the time to the first cigarette after waking, 31.11% of participants reported smoking within 6–30 minutes, while 25.56% smoked within 5 minutes, suggesting a relatively strong urge to smoke soon after waking. Additionally, 20.00% smoked within 31–60 minutes, whereas 23.33% waited more than 60 minutes. A majority of respondents (63.33%) reported difficulty refraining from smoking in places where smoking is prohibited, indicating a strong dependence on nicotine. Similarly, 58.89% stated that

the cigarette they would hate most to give up was the first one in the morning, which is another indicator of nicotine addiction. Most participants (68.89%) smoked 10 or fewer cigarettes per day, while 24.44% smoked 11–20 cigarettes daily, and only 6.67% smoked 21–30 cigarettes per day. None of the participants reported smoking more than 30 cigarettes daily. Furthermore, 60.00% of respondents reported smoking more frequently during the first few hours after waking than during the remainder of the day. A notable proportion (63.33%) also indicated that they continued smoking even when they were so ill that they remained in bed for most of the day.

Figure 1: Pie chart showing Distribution of Tobacco Smokers according to FTND



The pie chart presents the distribution of tobacco smokers according to their level of nicotine dependence as measured by the Fagerström Test for Nicotine Dependence (FTND). The results show that the largest proportion of smokers (43%) had moderate nicotine dependence, indicating that nearly half of the participants were moderately addicted to tobacco. Low nicotine

dependence was observed in 35% of the smokers, suggesting that more than one-third had relatively lower levels of addiction. Meanwhile, 22% of the participants were classified as having high nicotine dependence, representing a considerable minority of the study population.

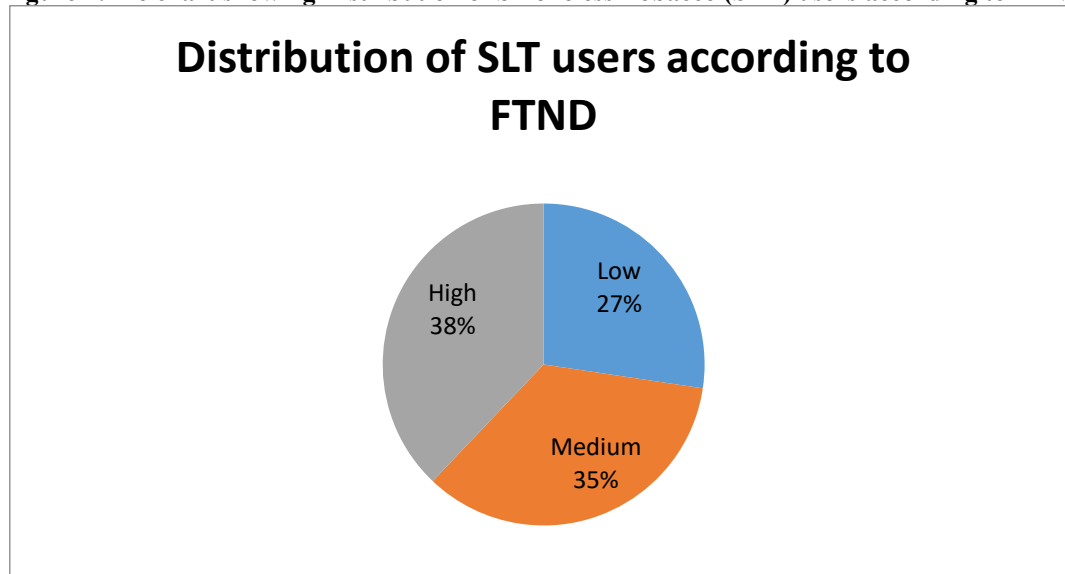
Table 2: Distribution of Smokeless Tobacco (SLT) Users according to Fagerström Test for Nicotine Dependence (FTND) (Smokeless Version - 95)

Question	Answer (Score)	Number (%)
1. How soon after you wake up do you use your first dip/chew?	Within 5 minutes (3)	18(18.94)
	6–30 minutes (2)	41(43.16)
	31–60 minutes (1)	7(7.37)
	After 60 minutes (0)	29(30.53)
2. How often do you intentionally swallow tobacco juice?	Always (2)	32(33.68)
	Sometimes (1)	35(36.84)
	Never (0)	28(29.48)
3. Which chew would you hate to give up most?	The first one in the morning (1)	57(60)
	Any other (0)	38(40)
4. How many cans/pouches per week do you use?	Less than 1 (0)	19(20)
	1-3 (1)	27(28.42)
	More than 3(2)	49(51.58)
5. Do you chew more frequently during the first hours after waking than during the rest of the day?	Yes (1)	54(56.84)
	No (0)	41(43.16)
6. Do you chew if you are so ill that you are in bed most of the day?	Yes (1)	50(52.63)
	No (0)	45(47.37)

The table presents the responses of participants to the Fagerström Test for Nicotine Dependence–Smokeless Tobacco (FTND-SLT), which assesses the level of dependence on smokeless tobacco products such as chewing tobacco or dip. Regarding the time to first use after waking, 43.16% of participants reported using their first dip or chew within 6–30 minutes, while 18.94% used it within 5 minutes of waking. In contrast, 30.53% waited for more than an hour before their first use. Early morning tobacco use is considered an indicator of stronger nicotine dependence. Concerning the intentional swallowing of tobacco juice, 33.68% of participants reported always swallowing tobacco juice, and 36.84% reported doing so sometimes, while only 29.48% stated that they never swallowed tobacco juice. This behavior may reflect greater tobacco exposure and dependence. A

majority of respondents (60.0%) indicated that the chew they would hate most to give up was the first one in the morning, suggesting a strong psychological and physiological reliance on tobacco. More than half of the participants (51.58%) used more than three cans or pouches per week, whereas 28.42% used 1–3 cans/pouches and 20.0% used less than one can/pouch per week. This indicates a relatively high level of tobacco consumption among many users. Furthermore, 56.84% of participants reported chewing tobacco more frequently during the first few hours after waking than during the rest of the day, which is another indicator of nicotine dependence. Additionally, 52.63% stated that they continued using smokeless tobacco even when they were so ill that they remained in bed most of the day, demonstrating difficulty abstaining despite illness.

Figure 2: Pie chart showing Distribution of Smokeless Tobacco (SLT) users according to FTND



The pie chart illustrates the distribution of smokeless tobacco (SLT) users according to their level of nicotine dependence, as measured by the Fagerström Test for Nicotine Dependence (FTND). The results show that 38% of the participants had high nicotine dependence, representing the largest proportion of SLT users. This indicates that more than one-third of the users were strongly dependent on smokeless tobacco products. In addition, 35% of participants exhibited moderate nicotine dependence, while 27% were classified as having low nicotine dependence. The relatively lower proportion of users in the low-dependence category suggests that many participants had developed a significant level of addiction to smokeless tobacco.

Tobacco quitting behavior: Among tobacco users, 69 (52.27%) reported plans to quit tobacco within the next year. However, only 46 (34.85%) had attempted to quit during the previous 12 months, with an

average of 3.21 quit attempts per user. 59 (44.7%) of tobacco user received help for tobacco quitting. Help was received from a program or professional 10 (16.95%), from friend 30 (50.85%), family member 13 (22.03%), from all above mentioned 6 (10.17%). 46 (34.85%) of tobacco user were aware of tobacco cessation centers or helpline.

Exposure to Anti-Tobacco Messages: 103 (78.03%) tobacco users saw or heard any anti-tobacco messages on televisions, radio, internet, or movies during past 30 days. 44 (33.33%) of tobacco users saw or heard any anti-tobacco messages at sports events, fairs, concerts, or community events, or social gatherings during past 30 days. 111 (84.09%) tobacco user saw any health warnings on cigarette packages/smokeless tobacco pouch. 61 (46.21%) tobacco user had information about the dangers of tobacco use from health worker. 119 (90.15%) of tobacco user aware of the health risks of tobacco.

Table 3: Association of various sociodemographic characteristics with nicotine dependence (Mann-Whitney U test)

U test)				
Sociodemographic characteristics	FTND Smokers score		FTND-SLT score	
	Median (IQR)	p value	Median (IQR)	p value
Age(years)				
≤40	5.0 (6.0 - 3.0)	0.35	5.0 (7.2 -3.0)	0.06
>40	5.0 (7.5 - 2.50)		6.0 (9.0 – 4.0)	
Gender				

Male	5.0 (6.0 - 3.0)	0.67	5.5 (8.0 – 4.0)	0.98
Female	4.0 (6.5 -1.50)		4.0 (6.2 – 2.5)	
Literate				
Illiterate	5.0 (6.7 – 3.0)	0.50	6.0 (9.0 - 4.0)	0.08
Literate	5.0 (6.0 – 2.0)		5.0 (8.0 – 3.0)	
Occupation				
Unemployed	6.0 (7.0 – 3.0)	0.44	5.0 (6.25 – 3.0)	0.40
Employed	5.0 (6.0 – 3.0)		5.0 (8.0 -3.7)	
Socioeconomic Status				
Lower	6.0 (7.0 – 3.0)	0.04	6.0 (8.0 – 4.0)	0.39
Upper	5.0 (6.0 -3.0)		5.0 (8.0 – 3.0)	

FTND = Fagerstrom Test for Nicotine Dependence, IQR=Interquartile range, FTND - SLT= FTND-smokeless tobacco

The median FTND-Smoker score was comparable across different age groups, genders, literacy status, and occupation categories, with no statistically significant differences observed ($p > 0.05$). Although participants aged above 40 years had a slightly higher FTND-SLT score [6.0 (IQR: 9.0–4.0)] compared to those aged below 40 years [5.0 (IQR: 7.2–3.0)], the difference was not statistically significant ($p = 0.06$). Similarly, no significant differences in FTND-Smoker or FTND-SLT scores were found between males and females ($p = 0.67$ and $p = 0.98$, respectively), indicating that nicotine dependence levels were comparable across genders. With regard to educational status, illiterate participants demonstrated slightly higher FTND-SLT scores [6.0 (IQR: 9.0–4.0)] than literate participants [5.0 (IQR: 8.0–3.0)]; however, this difference did not reach statistical significance ($p = 0.08$). FTND-Smoker scores were also similar between the two groups ($p = 0.50$). No significant association was observed between occupational status and either FTND-Smoker or FTND-SLT scores ($p = 0.44$ and $p = 0.40$, respectively). Socioeconomic status was the only sociodemographic characteristic significantly associated with FTND-Smoker scores. Participants belonging to the lower socioeconomic group had significantly higher FTND-Smoker scores [6.0 (IQR: 7.0–3.0)] compared to those from the upper socioeconomic group [5.0 (IQR: 6.0–3.0)] ($p = 0.04$), suggesting greater nicotine dependence among smokers from lower socioeconomic backgrounds. However,

FTND-SLT scores did not differ significantly by socioeconomic status ($p = 0.39$).

DISCUSSION

The present study demonstrates a considerable burden of nicotine dependence among both smokers and smokeless tobacco (SLT) users. Although most smokers reported consuming a relatively small number of cigarettes per day, several key indicators of nicotine dependence were highly prevalent. A large proportion of participants reported smoking shortly after waking, experiencing difficulty refraining from smoking in restricted areas, considering the first cigarette of the day as the most satisfying, smoking more frequently during the early hours of the day, and continuing to smoke despite illness. These findings suggest that nicotine dependence extends beyond the quantity of tobacco consumed and reflects a strong physiological and behavioral reliance on nicotine.

The high prevalence of moderate-to-high nicotine dependence observed in the present study is consistent with findings from several studies conducted in India. Manimunda et al. reported substantial levels of nicotine dependence among tobacco users in the Andaman and Nicobar Islands, highlighting the widespread nature of tobacco addiction across different population groups.¹¹ Similarly, Jandoo T et al. emphasized that nicotine dependence remains a major barrier to successful tobacco cessation in India and requires

systematic identification and treatment through evidence-based cessation services.¹² The greater burden of nicotine dependence among smokeless tobacco users observed in the present study is particularly important in the Indian context, where smokeless tobacco products are widely used. The findings of the present study support these observations and indicate that smokeless tobacco users should receive the same level of attention as smokers within tobacco-control programmes.

The association between lower socioeconomic status and higher nicotine dependence observed in this study is also supported by previous research. Hosseinpoor et al. demonstrated that tobacco use and nicotine dependence are disproportionately concentrated among socioeconomically disadvantaged populations, contributing to health inequalities worldwide.¹³ Individuals from lower socioeconomic backgrounds may experience greater psychosocial stress, lower health literacy, and reduced access to cessation support, thereby increasing the likelihood of persistent tobacco use and dependence.

Although age, gender, literacy status, and occupation were not significantly associated with nicotine dependence in the present study, previous investigations have reported mixed findings. While Anandaraj et al. observed higher dependence among older adults and illiterate participants, other studies have found that nicotine dependence may be influenced more strongly by patterns of tobacco consumption and duration of use than by demographic characteristics alone.^{6,14} Such variations may be attributable to differences in study populations, sample size, cultural factors, and tobacco-use behaviours.

The finding that many participants intended to quit tobacco but relatively few had made recent quit attempts is consistent with previous research on tobacco cessation behaviour. Prochaska and DiClemente's Trans theoretical Model suggests that many tobacco users remain in the contemplation

stage for prolonged periods before progressing to action and successful cessation.¹⁵ This underscores the importance of providing accessible counselling services, motivational interventions, and pharmacological support to facilitate movement from intention to actual quitting behaviour.

Recommendations

1. Strengthen implementation of the National Tobacco Control Programme (NTCP) at the community level, with special emphasis on urban low-income populations.
2. Expand access to tobacco cessation services, including Tobacco Cessation Centres (TCCs), quitlines, and behavioural counselling.
3. Increase awareness regarding available cessation resources through mass media campaigns, community outreach activities, and healthcare providers.
4. Integrate routine screening for nicotine dependence and brief cessation counselling into primary healthcare services.
5. Promote targeted interventions for smokeless tobacco users, considering the high prevalence of moderate-to-high dependence in this group.
6. Encourage healthcare workers to actively educate tobacco users regarding cessation strategies and available support systems.
7. Conduct periodic community-based awareness programmes focusing on the addictive nature of both smoked and smokeless tobacco products.

Limitations

1. The cross-sectional design limits the ability to establish causal relationships between sociodemographic factors and nicotine dependence.
2. Information regarding tobacco use and dependence was self-reported and may be subject to recall bias or social desirability bias.

3. The study was conducted in a single urban field practice area of Prayagraj; therefore, the findings may not be generalizable to other urban or rural populations.
4. The sample size of tobacco users was relatively small, which may have reduced the statistical power to detect significant associations for certain variables.
5. Biochemical validation of tobacco use and nicotine dependence was not performed, and dependence was assessed solely using the Fagerström Test for Nicotine Dependence.

CONCLUSION

The present study revealed a high prevalence of nicotine dependence among tobacco users in urban Prayagraj. Approximately two-thirds of smokers and nearly three-fourths of smokeless tobacco users exhibited moderate-to-high nicotine dependence. Dependence was particularly pronounced among individuals belonging to lower socioeconomic groups. While most participants were aware of the harmful effects of tobacco and many expressed an intention to quit, actual quit attempts and awareness of cessation services remained limited. These findings highlight the continued burden of tobacco addiction and the need for comprehensive tobacco-control measures in the community.

Declaration by Authors

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