ORIGINAL ARTICLE

Effect of Nicotine Consumption on Oral Health and Hygiene Practices Among Medical and Non-Medical Undergraduate Students: A Comparative Cross-Sectional Study in Islamabad and Peshawar

Saher Sultan[1*], Muhammad Omar Niaz[1], Javidan Awais[1], Atiqa Bashir[1], Khadija Tahira[2], Zubair Ahmed Khosa[3]

ABSTRACT

Objective: To examine patterns of nicotine consumption, oral hygiene practices, and associated oral health outcomes among undergraduate students in Pakistan, with a comparative focus on medical and non-medical disciplines across two major cities in Pakistan.

Study Design: A comparative cross-sectional study.

Place and Duration of Study: The study was conducted from March 2024 to September 2024 among undergraduate students enrolled in selected medical and non-medical universities across two major cities in Pakistan —Islamabad and Peshawar.

Methods: A total of 500 undergraduate students were invited to participate; 364 completed the survey (response rate: 73%). Participants were recruited using a structured convenience sampling approach through classroom invitations and institutional online platforms. Data were collected via a validated, self-administered questionnaire. Responses were analyzed using SPSS version 26, and associations were assessed using the chi-square test, with $P < 0.05$ considered statistically significant.

Results: The mean age was 21 ± 1.64 years. Nicotine use was reported by 58%, mainly via vapes/e-cigarettes (48%) and cigarettes (35%). Use was higher among males than females (75.2% vs. 24.8%, $P = 0.012$), with no difference between medical and non-medical students (49.5% vs. 50.5%, $P = 0.285$). Oral hygiene habits were similar, though users reported greater use of adjunctive aids (90.5% vs. 75.3%, $P < 0.001$). Oral health problems were significantly higher among users: oral lesions (38.1% vs. 13.6%), decay (40.5% vs. 11.7%), xerostomia (52.9% vs. 16.2%), bleeding gums (41.4% vs. 29.2%), halitosis (20.0% vs. 9.1%), discoloration (51.0% vs. 29.9%), and sensitivity (61.4% vs. 32.5%) (all $P < 0.05$).

Conclusion: Despite comparable hygiene behaviors across groups, nicotine consumption was strongly associated with multiple oral health problems. These findings underscore the urgent need for targeted health promotion, oral hygiene education, and campus-based nicotine cessation interventions to address this public health concern among young adults.

Keywords: Cross-Sectional Studies, Health Behavior, Health Literacy, Nicotine, Oral Health, Oral Hygiene, Public Health, Smoking, Students.

[1]Department of Community and Preventive Dentistry
Army Medical College, Rawalpindi, Pakistan
[2]Department of Oral Medicine
Foundation University College of Dentistry and Hospital, Islamabad, Pakistan
[3]World Health Organization, Islamabad, Pakistan
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Correspondence:
Dr. Saher Sultan
Assistant Professor, Community and Preventive Dentistry
Army Medical College, Rawalpindi, Pakistan
E-mail: sehr.sultan@hotmail.com
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Introduction

The consumption of various nicotine variants, such as cigarettes, e-cigarettes, cigars, and nicotine pouches, has surged among youth globally. "World Health Organization (WHO) reports that tobacco use is responsible for approximately 8 million deaths annually, making nicotine-related products the leading cause of preventable diseases and death worldwide."[1] Nicotine, a highly addictive substance,

is commonly used recreationally. Research indicates that nearly 90% of adult daily smokers in the United States began smoking before the age of 18, emphasizing the critical window for implementing preventive interventions.[2]

In Pakistan, a developing country, the use of nicotine variants has become increasingly common, particularly among university students. This trend raises public health concerns, especially as students, including those in medical schools, are frequently exposed to these products.[3] Among medical students, the prevalence of nicotine use is particularly concerning, despite their awareness of the health risks associated with smoking and other nicotine variants. Several factors contribute to nicotine consumption among youth, including peer influence, stress, anxiety, and the desire to appear socially accepted.[4] Medical students, in particular, may experience higher levels of stress due to their demanding academic schedules, which may increase the likelihood of smoking as a coping mechanism.[5]

Furthermore, medical students' attitudes and knowledge about nicotine use are essential, as they will influence how these students interact with patients in their future medical practices.[6] The relationship between nicotine use and oral health is well-documented, with nicotine consumption linked to various oral health issues such as xerostomia (dry mouth), bad breath, gingivitis, and periodontal diseases.[7] It has been observed that individuals who continue to smoke but maintain good oral hygiene practices are at a lower risk of experiencing these oral health problems, suggesting that effective oral care can mitigate some of the negative impacts of nicotine use.[8] However, despite the growing use of nicotine variants, there is a lack of comprehensive research specifically examining how these products affect oral health, particularly in the context of Pakistan. Furthermore, there is limited evidence on the potential benefits of oral health practices in reversing or reducing these adverse effects. To address these gaps, the present study was conducted as a cross-sectional survey to assess the effect of nicotine use on oral health among medical & non-medical undergraduate students in Pakistan. By comparing the two groups, we aim to evaluate their oral health practices and assess how these practices

may reduce the oral health risks associated with nicotine consumption. The findings of the study will contribute to a better understanding of the effects of nicotine variants on oral health and inform strategies to improve oral health education and intervention.

Nicotine use among university students, whether in the form of cigarettes, e-cigarettes, shisha, or smokeless products, poses serious oral health risks. Academic background may influence knowledge and behaviors, yet awareness does not always translate into reduced use. This study compares nicotine consumption between medical and non-medical students, examines its effects on oral hygiene practices, and evaluates related oral health outcomes to inform targeted preventive strategies for young adults in Islamabad and Peshawar, Pakistan.

Methods

The study was carried out among undergraduate students enrolled in medical and non-medical universities across major cities in Pakistan, including Islamabad and Peshawar, to ensure broader regional representation from March 2024 to September 2024, after taking approval from the Ethical Review Committee of Army Medical College, Rawalpindi, Pakistan vide letter No: 03/2025/455 held on dated: 20th March 2024, to assess nicotine use and its effect on oral hygiene practices. The required sample size was estimated using OpenEpi (version 3.01), assuming a 50% expected prevalence of nicotine use (which provides maximum variability), a 95% confidence level, and a 5% absolute precision (margin of error). Based on these parameters, the minimum sample size calculated was 384 participants. To account for possible non-response or incomplete questionnaires, 500 students were invited to participate. Of these, 364 completed the survey, yielding a response rate of 73% that approaches the target.

Participants were recruited using a non-probability convenience sampling method. Inclusion criteria comprised: (1) undergraduate enrollment in a recognized university of Islamabad and Peshawar; (2) age ≥18 years; and (3) provision of informed consent. Exclusion criteria included: (1) individuals below 18 years of age; (2) postgraduate or diploma students; and (3) incomplete or inconsistent

questionnaire responses. Medical students were defined as those enrolled in health science degree programs (e.g., MBBS, BDS). In contrast, non-medical students were identified based on enrollment in non-health-related disciplines (e.g., engineering, business, social sciences).

Data were collected using a structured, closed-ended, self-administered questionnaire that assessed demographic characteristics, nicotine consumption patterns (including cigarette, e-cigarette, and smokeless tobacco use), oral hygiene behaviors (e.g., brushing frequency, mouthwash use), and knowledge of nicotine-associated oral health risks.

The questionnaire underwent pilot testing with 30 undergraduate students (excluded from the final sample) to evaluate clarity, comprehension, and time feasibility. Feedback from the pilot led to minor revisions in wording and sequencing of questions. Internal consistency of the tool was assessed, yielding a Cronbach's alpha of 0.82, indicating good reliability.

Responses were entered into Microsoft Excel and analyzed using SPSS version 26. Descriptive statistics (mean, standard deviation, frequencies, and percentages) were computed. Inferential analysis was conducted using chi-square (χ^2) tests and fisher's exact test, where applicable, to examine associations between nicotine use, oral hygiene practices, and self-reported oral health outcomes. A *P-value* < 0.05 was considered statistically significant.

Results

A total of 500 undergraduate students were invited to participate, with 364 providing responses, yielding a response rate of 73%. Participants were aged between 18 and 25 years. Mean age of 21 years with a standard deviation of 1.64. A chi-square test of independence revealed a statistically significant association between gender and nicotine use, χ^2 (1, N = 364) = 6.36, *P* = 0.012. Nicotine use was reported by 75.2% of males compared to 24.8% of females. Whereas no statistically significant association between school type and nicotine use, χ^2 (1, N = 364) = 1.15, *P* = 0.285. Nicotine use was reported by 49.5% of medical students and 50.5% of non-medical students. (Table 1, Figure. 1).

Table 1: Demographics of nicotine users

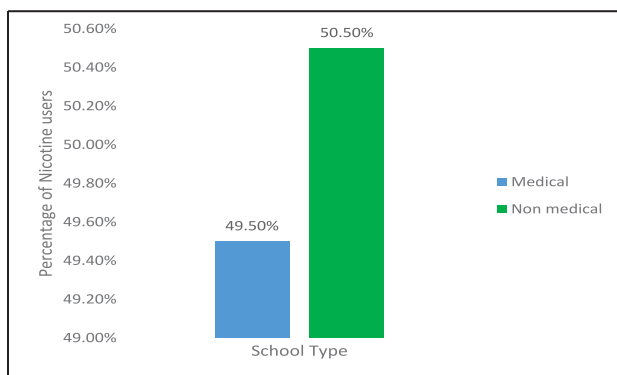| Characteristics	N (%)
Gender	
Male	158 (75.2)
Female	52 (24.8)
School Type	
Medical	104 (49.5)
Non-medical	106 (50.5)

Fig.1: Nicotine Consumption Among Medical and Non-Medical Students (%)

Among them, 210 (58%) reported current use of nicotine products in various forms. The distribution among nicotine users included vapes/e-cigarettes (48%), cigarettes (35%), Shisha (13%), smokeless products (2%), and individuals using all (2%). (Table 2, Figure.2)

Nicotine consumption varied significantly across academic years (*P* = 0.022). The highest proportions of users were observed in the 2nd year (27.1%) and the 4th year (25.7%), followed by the 3rd year (21.0%). Use was lower in the 1st year (18.6%) and lowest in the 5th year (7.6%) (Table 3).

Table 2: Nicotine users and nonusers

Characteristics	N (%)
Nicotine Users	210 (58)
Non-users	154 (42)
Total	364

Table 3: Nicotine Consumption among Different Years of Medical and Non- Medical Students

Year of Study	Users N (%)	Non Users N (%)	χ^2 value	P-value
First year	39 (18.6)	31 (20.1)		
Second year	57 (27.1)	62 (40.3)		
Third year	44 (21.0)	31 (20.1)	11.441	0.022
Fourth year	54 (25.7)	25 (16.2)		
Fifth year	16 (7.6)	5 (3.2)		

Table-4: Frequency Of Oral Hygiene Practices Reported By The Participants

| Oral Health Related Practices	Users N (%)	Non Users N (%)	χ^2 value	P value
Do you clean your teeth?				
Yes	208 (99)	153(99.4)	0.10	1.00
No	02 (1)	01 (0.6)		
Which tool do you use to clean your teeth?				
Toothbrush	196 (93.3)	146 (94.8)		
Miswak	12 (5.7)	7 (4.5)	0.43	0.920
Don't use any tool	2 (1)	1 (0.6)		
Frequency of cleaning teeth?				
Once a day	100 (47.6)	81 (52.6)		
Twice a day	94 (44.8)	61 (39.6)	1.25	0.792
Thrice a day	14 (6.7)	11 (7.1)		
Don't brush	2 (1.0)	8 (0.6)		
Other cleaning aids used, like floss, tongue scraper, and mouthwash?				
Yes	190 (90.5)	116 (75.3)	15.23	<0.001
No	20 (9.5)	38 (24.7)		

Chi Square test/Fisher Exact test
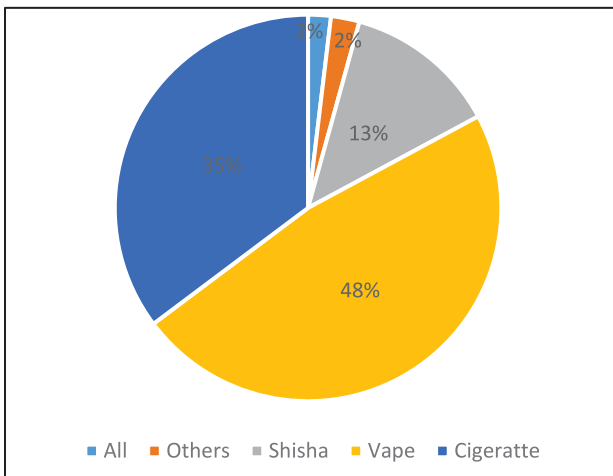
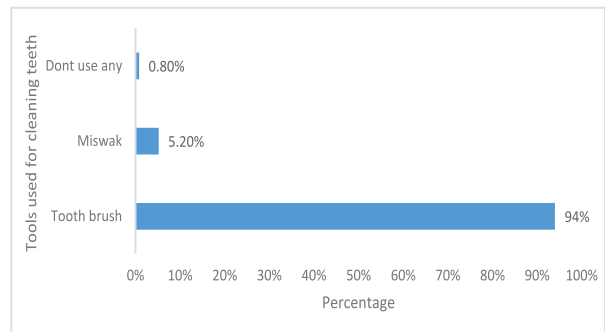**Fig. 2: Nicotine use among participants**

Fig. 3: Tools Used for Cleaning in Medical and Non-Medical Students

Toothbrush use was the predominant cleaning method among both medical and non-medical students, with nearly identical proportions as shown in Figure.3. Only 5% of the respondents reported

using miswak, while very few did not use any tool. The difference between the two groups was not statistically significant (P= 0.920).

Oral hygiene habits were similar in both groups, with almost all participants reporting daily tooth cleaning and toothbrush use (users: 93.3%; non-users: 94.8%; P = 0.920). Brushing frequency also showed no significant difference between groups (P= 0.792). However, nicotine users were significantly more likely to use adjunctive aids such as mouthwash, floss, or tongue scrapers (90.5% vs. 75.3%; P< 0.001) (Table 4).

Nicotine users reported significantly higher rates of oral health problems compared to non-users, including lesions, decay, xerostomia, bleeding gums, halitosis, tooth staining, and sensitivity (all P< 0.05). These findings demonstrate that nicotine consumption is strongly associated with a greater burden of both hard and soft tissue oral conditions (Table 5, Figure. 4).

Table 5: Self-Perceived Oral Health Problems Within Nicotinic Users and Non-Users

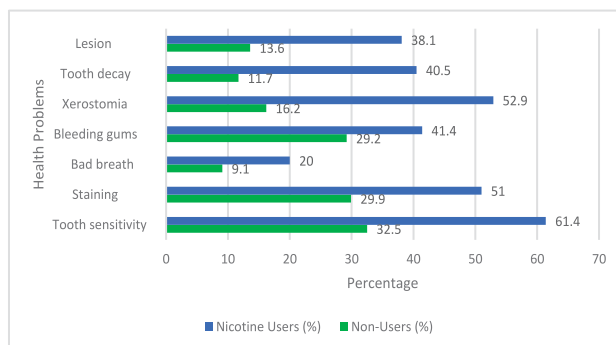| Effects Of Nicotine Usage	Users N (%)	Non-Users N (%)	χ² value	*P*-value
Lesions Yes No	80 (38.1%) 130 (61.9%)	21 (13.6%) 133 (86.4%)	26.51	< 0.001
Tooth Decay Yes No	85 (40.5%) 125 (59.5%)	18 (11.7%) 136 (88.3%)	36.29	< 0.001
Xerostomia Yes No	111 (52.9%) 99 (47.1%)	25 (16.2%) 129 (83.8%)	50.9	< 0.001
Bleeding Gums Yes No	87 (41.4%) 123 (58.6%)	45 (29.2%) 109 (70.8%)	5.73	0.017
Bad Breath Frequent Not that often No bad breath	42 (20.0%) 82 (39.0%) 86 (41.0%)	14 (9.1%) 56 (36.4%) 84 (54.5%)	10.56	0.005
Tooth Staining Yes No	107(51.0%) 103 (49.0%)	46 (29.9%) 108 (70.1%)	16.21	< 0.001
Tooth Sensitivity Yes No	129 (61.4%) 81 (38.6%)	50 (32.5%) 104 (67.5%)	29.82	< 0.001

Fig.4: Prevalence of Oral Health Problems Within Nicotine Users and Non-Users

Discussion

This study provides significant insights into the influence of diverse nicotine-containing products on oral health status among medical and non-medical undergraduate students in Islamabad and Peshawar, Pakistan. A study conducted in Florida demonstrated that attitudes towards oral health significantly influence oral hygiene behaviors, which in turn affect oral health outcomes.[9] Factors such as parental influence, culture, geographic region, and individual motivation play critical roles in shaping these

attitudes.

The prevalence of nicotine use was similar between medical (49.5%) and non-medical students (50.5%) (χ^2 = 1.145, *P*= 0.285), indicating no statistically significant difference between the two groups (Table 1). This suggests that knowledge of nicotine's adverse health effects is potentially greater among medical students. Still, it does not necessarily translate into reduced consumption, underscoring the influence of non-academic factors such as peer pressure, stress, and social norms. A study conducted at a medical university in Turkey (2022) found that, despite being aware of the health risks, medical students remain vulnerable to nicotine use due to stress and academic pressure.[10] This study also found a marked gender difference in nicotine use (Table 1), with 75.2% (N=158) of nicotine users being male and 24.8% (N=52) female. This aligns with global trends that report a higher prevalence of smoking among men, particularly in countries with higher education levels.[11] A finding from the Oral Cancer Foundation, USA, revealed that higher smoking prevalence among educated males was a significant risk factor for oral diseases, including cancer.[12]

The findings from this study underscore the need for a deeper understanding of the factors that contribute to nicotine consumption and its subsequent effects on oral health, particularly in young adults. In this study (Table 2), 58% (N=210) of students reported using different forms of nicotine, while 42% (N=154) did not use any nicotine products, highlighting a significant prevalence of nicotine use among this population. Notably, there was an increasing trend in nicotine consumption among students aged 21 years, suggesting that nicotine use is becoming more common as students progress through their academic careers.

Nicotine use showed significant variation across different academic years (*P*= 0.022) (Table 3). The highest proportions of users were reported in the 2nd year (27.1%) and 4th year (25.7%), followed by the 3rd year (21.0%). In contrast, fewer users were observed in the 1st year (18.6%), and the lowest prevalence was found in the 5th year (7.6%). The statistically significant *P*-value (<0.05) indicates that the year of study is meaningfully associated with nicotine consumption patterns. This suggests that academic progression influences nicotine use, with consumption peaking in the mid-years and declining toward the final year, possibly due to increased academic responsibility or professional maturity. This supports the need for public health initiatives aimed at reducing the initiation of nicotine use at younger ages.[13]

Regarding oral hygiene practices (Table 4), our findings showed no significant differences in oral hygiene behaviors between nicotine users and non-users, with 99.4% of non-users and 99.0% of nicotine users reporting tooth cleaning (*P* = 1.000). Toothbrush use was the primary cleaning tool among 94.8% of non-users and 93.3% of users, followed by miswak (4.5% vs. 5.7%, respectively), with less than 1% reporting no tool use (*P* = 0.920). These results align with previous studies. A notable study on dental professionals demonstrated that smoking negatively influences professional preventive behaviors, but not daily oral hygiene routines.[14] A study conducted in 2023 on a cohort of Brazilian adolescents aged 12 years highlights that brushing frequency is a key factor in maintaining oral health, with evidence showing that individuals who brush at least twice a day tend to have better oral hygiene and fewer oral health issues.[15] A statistically significant association was observed between nicotine use and the utilization of supplementary oral hygiene aids (*P* < 0.001). Nicotine users were substantially more likely to report using adjunctive measures, such as mouthwash, dental floss, or tongue scrapers (90.5%), than non-users (75.3%). However, despite this higher reported use of additional oral hygiene practices, indicators of poor oral health remain more prevalent among nicotine users, suggesting that adjunctive measures alone may not adequately counteract the detrimental effects of nicotine exposure.

This study found significant associations between nicotine use and multiple adverse oral health outcomes (Table 5). Nicotine users showed higher prevalence of oral lesions (38.1% vs 13.6%), tooth decay (40.5% vs 11.7%), xerostomia (52.9% vs 16.2%), bleeding gums (41.4% vs 29.2%), bad breath (frequent: 20.0% vs 9.1%), tooth discoloration (51.0% vs 29.9%), and tooth sensitivity (61.4% vs

32.5%). These findings align with recent evidence that nicotine and tobacco products impair oral mucosal integrity, reduce salivary flow, alter microbial composition, and accelerate periodontal breakdown, increasing the risk of caries and soft tissue lesions.[16,17] Nicotine-induced vasoconstriction may mask early signs of gingivitis while contributing to progressive tissue destruction.[18] The high prevalence of xerostomia among users supports recent reports linking nicotine to salivary gland hypofunction and dysbiosis.[19] Aesthetic impacts such as staining and halitosis, also more common in users, can be attributed to deposition of tar and pigments, as well as microbial shifts toward volatile sulfur compound-producing species.[20-22]

This study emphasizes the need for targeted public health interventions that focus on raising awareness of the oral health risks associated with nicotine use, particularly among young adults. Dentists and other healthcare professionals should adopt a proactive approach in identifying nicotine users and providing appropriate preventive and therapeutic interventions for associated oral health conditions. With the increasing popularity of alternative nicotine products, such as e-cigarettes and smokeless tobacco, there is a pressing need for further research to elucidate their long-term effects on oral health. A deeper understanding of these risks is essential for developing comprehensive, evidence-based strategies to mitigate their impact and guide public health policy.[23]

This study has certain limitations. First, because the research was conducted among undergraduate students in only two cities —Islamabad and Peshawar —the findings may not be fully generalizable to the broader student population across Pakistan. Second, the use of convenience sampling and a relatively small sample size may further limit the representativeness of the results. Third, reliance on self-reported data introduces the potential for recall and social desirability biases, particularly regarding nicotine use and oral health behaviors. Finally, although efforts were made to differentiate between medical and non-medical students, additional stratification by academic discipline, socioeconomic status, and gender could have provided more profound insights.

Conclusion

The prevalence of nicotine use was comparable between medical and non-medical students, with no statistically significant differences in usage rates. Once-daily tooth brushing was the most commonly reported oral hygiene practice in both groups, suggesting a similar baseline awareness of oral care. University-based interventions such as targeted education on the oral health consequences of nicotine (including e-cigarettes and smokeless products) and structured cessation programs could play a pivotal role in supporting young adults to adopt healthier behaviors. Such initiatives would not only mitigate the oral health burden associated with nicotine use but also improve overall health outcomes in this population.

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Author Contributions

SS: Conception and design of the work

MON: Revising, editing, and supervising for intellectual content

JA: Writing the original draft, proofreading, and approval for final submission

AB: Manuscript writing for methodology design and investigation

KT: Data acquisition, curation, and statistical analysis

ZAK: Validation of data, interpretation, and write-up of results

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