

Original Article

Relationship Between Smoking and Oral Hygiene Awareness

Muhammad Saad¹, Aisha Bano¹, Mehak Rani¹, Aman Lal¹, Pardeep Kumar¹,
Muhammad Zubair Khan¹

¹ Fatima Jinnah Dental College, Karachi, Pakistan

* Corresponding author: Muhammad Saad, saadabbacee@gmail.com

ABSTRACT

Background: Tobacco use remains a significant global public health concern and is strongly associated with numerous oral diseases, including periodontal disease and oral cancer. Despite growing public awareness regarding the harmful effects of smoking on oral health, preventive oral hygiene practices remain inconsistent in many populations, particularly in low- and middle-income countries. **Objective:** This study aimed to evaluate smoking habits, oral health awareness, and oral hygiene practices among adults and to examine the relationship between tobacco use, knowledge of smoking-related oral diseases, and preventive dental behaviors. **Methods:** A cross-sectional observational study was conducted among 173 adults residing in Sindh, Pakistan. Data were collected using a structured 23-item questionnaire assessing oral health awareness, hygiene behaviors, and behavioral triggers influencing oral health practices. Descriptive statistics were used to summarize participant characteristics and behavioral patterns. Associations between demographic variables and oral health practices were analyzed using chi-square tests, and logistic regression analysis was applied to evaluate the relationship between smoking status and oral health awareness. Statistical significance was set at $P < 0.001$. **Results:** Among participants, 66.5% reported high awareness of oral diseases and smoking-related risks. However, preventive behaviors were limited: only 12.7% attended biannual dental visits, and 54.3% reported not using supplementary hygiene tools such as floss or mouthwash. Social media was the most common source of oral health information (36.4%). Stress emerged as the most frequently reported behavioral trigger influencing oral health practices. Significant associations were observed between gender and several oral hygiene behaviors ($P < 0.001$). **Conclusion:** Although awareness of smoking-related oral health risks was relatively high, preventive oral hygiene practices remained limited, indicating a substantial knowledge-behavior gap. Targeted behavioral interventions and improved preventive dental health programs are needed to translate awareness into consistent oral health practices. **Keywords:** Oral health awareness, smoking, tobacco use, dental hygiene, preventive dentistry, health literacy, oral cancer risk.

"Cite this Article" | Received: 10 October 2025; Accepted: 12 January 2026; Published: 28 February 2026.

Author Contributions: Concept: MS; Design: AB; Data Collection: MR, AL; Analysis: PK; Drafting: MZK **Ethical Approval:** Ethical Approval was obtained by respective Institute. Informed Consent: Written informed consent was obtained from all participants; Conflict of Interest: The authors declare no conflict of interest; Funding: No external funding; Data Availability: Available from the corresponding author on reasonable request; Acknowledgments: N/A.

INTRODUCTION

Non-communicable diseases (NCDs) remain one of the leading global health challenges, accounting for a substantial proportion of morbidity and mortality worldwide. In 2021 alone, NCDs were responsible for approximately 43.8 million deaths and 1.73 billion disability-adjusted life years (DALYs), with cardiovascular diseases, cancers, and diabetes representing the largest contributors to the global burden (1). Among the key modifiable risk factors associated with these conditions, tobacco use continues to play a central role, contributing significantly to premature mortality and reduced quality of life. Despite modest declines in age-standardized rates since 1990, smoking still accounts for millions of deaths annually, including a large share of cardiovascular disease-related mortality, particularly among men and in regions undergoing rapid epidemiological transition (5). The persistence of tobacco consumption and related health consequences highlights the need for continued research and targeted interventions addressing behavioral and preventive health practices.

Beyond systemic diseases, tobacco consumption is strongly associated with a wide range of oral health conditions. Cigarette smoking is known to exacerbate periodontal diseases by promoting inflammatory

responses, impairing tissue repair, and altering the biological functions of periodontal ligament stem cells, ultimately accelerating tissue destruction and delaying healing (7,9). Smoking also increases susceptibility to oral potentially malignant disorders and oral cancers, particularly when combined with other risk factors such as poor oral hygiene or chronic mucosal irritation. For example, large epidemiological studies have demonstrated that individuals with poor oral health indicators, such as high decayed–missing–filled teeth (DMFT) scores, have significantly elevated risks of head and neck squamous cell carcinoma, with the risk further amplified among smokers (11). Similarly, oral leukoplakia, a common potentially malignant disorder, has an estimated malignant transformation rate of approximately 6.6%, with smoking identified as a key contributing factor that increases the likelihood of progression to malignancy (12). These findings collectively emphasize the critical role of tobacco exposure in the pathogenesis of oral diseases and reinforce the importance of preventive oral health practices in reducing long-term disease burden.

Despite well-established links between smoking and oral pathology, behavioral and preventive practices related to oral hygiene often remain inconsistent. Oral health maintenance typically involves routine behaviors such as regular tooth brushing, use of supplemental hygiene tools (e.g., dental floss and mouthwash), and periodic professional dental checkups. However, many populations demonstrate a reactive rather than preventive approach to oral healthcare, seeking treatment primarily when symptoms arise rather than engaging in regular preventive practices. Previous research has shown that even when individuals possess adequate knowledge about smoking-related oral diseases, this awareness does not always translate into consistent preventive behaviors, illustrating a persistent “knowledge–behavior gap” in health practice adoption (7). Addressing this gap requires understanding not only levels of awareness but also the behavioral and psychosocial factors that influence everyday oral hygiene practices.

In recent years, the sources through which individuals obtain health information have also undergone significant transformation. Digital platforms, particularly social media and internet-based resources, have increasingly become primary channels for health education and awareness. While such platforms may enhance access to information and contribute to greater health literacy, the relationship between digital awareness and actual health behaviors remains complex. Some studies suggest that increased exposure to health information through digital media may improve awareness of disease risks, yet behavioral change may still be limited due to psychological factors, social influences, or structural barriers to healthcare access. For instance, stress and social context have been identified as important behavioral triggers influencing tobacco use and health practices, indicating that health behaviors are shaped by broader psychosocial environments rather than knowledge alone (3). Consequently, examining how awareness translates into behavior within specific populations is essential for designing effective preventive health strategies.

In the context of oral health and tobacco use, healthcare professionals and health-educated populations are often viewed as important agents in promoting smoking cessation and preventive oral care. Studies among health-related student populations have demonstrated that while many individuals possess baseline knowledge about smoking risks, gaps remain in their understanding of tobacco toxicity and in their practical engagement with cessation or preventive behaviors (16). These findings suggest that awareness alone may not be sufficient to promote sustained behavioral change. Instead, a more comprehensive understanding of the interaction between smoking habits, oral health knowledge, and daily hygiene practices is required to inform targeted public health interventions.

In Pakistan and many other low- and middle-income countries, tobacco use remains prevalent and is often accompanied by limited preventive dental care utilization. At the same time, young adults and student populations are increasingly exposed to digital sources of health information, creating a unique context in which awareness may be relatively high while preventive practices remain inconsistent. However, empirical data examining the relationship between smoking behavior, oral health awareness,

and hygiene practices within such populations remain limited. In particular, few studies have explored whether increased exposure to health information through digital channels translates into measurable improvements in oral hygiene behavior or preventive dental care utilization.

Given these gaps, the present study aims to investigate the relationship between smoking habits, oral health awareness, and oral hygiene practices among adults in a regional population in Pakistan. Specifically, the study evaluates levels of knowledge regarding smoking-related oral diseases, patterns of oral hygiene behavior, and sources of health information while examining demographic and behavioral factors associated with these outcomes. By identifying potential discrepancies between awareness and actual preventive practices, the study seeks to contribute to a better understanding of the behavioral dynamics underlying oral health maintenance in populations exposed to increasing digital health information. Accordingly, the primary objective of this research is to assess whether higher awareness of smoking-related oral health risks is associated with improved preventive oral hygiene practices among adults, and to explore the extent to which behavioral triggers and information sources influence this relationship.

METHODS

A cross-sectional observational study design was employed to investigate the relationship between smoking habits, oral health awareness, and oral hygiene practices among adults. This design was selected to obtain a population snapshot of knowledge, behaviors, and associated factors within a defined period and to explore associations between tobacco use, awareness of oral health risks, and preventive dental practices. Cross-sectional approaches are widely used in public health research to assess health behaviors and knowledge patterns within specific populations, particularly when evaluating behavioral risk factors and preventive health practices related to non-communicable diseases (28). The study was conducted among adult participants residing in Sindh, Pakistan, with a primary focus on university students and local residents representing young adult and early professional populations that are frequently exposed to digital health information sources.

Participants were recruited using a non-probability convenience sampling approach from academic institutions and surrounding community settings within the Sindh region. Adult individuals aged 18 years and older who were able to read and understand the questionnaire language and who voluntarily agreed to participate were considered eligible. Individuals who declined to provide consent or who submitted incomplete questionnaires that prevented interpretation of the key variables were excluded from the final analysis. Recruitment was carried out through direct contact within educational and community environments, where potential participants were informed about the purpose of the study, the voluntary nature of participation, and the confidentiality of their responses. Written informed consent was obtained from all participants prior to data collection. Participation was anonymous, and no personally identifiable information was recorded.

Data were collected using a structured 23-item questionnaire specifically designed to evaluate three principal domains relevant to the study objectives: awareness of smoking-related oral diseases, oral hygiene practices, and behavioral factors influencing oral health behaviors. The instrument included both closed-ended categorical questions and Likert-scale items to assess levels of knowledge and attitudes toward oral health. Items addressing awareness evaluated participants' understanding of oral diseases associated with tobacco use, including periodontal disease and oral cancer.

Behavioral and clinical practice questions assessed the frequency of tooth brushing, duration of brushing, dental visit patterns, use of oral hygiene adjuncts such as dental floss, mouthwash, and tongue cleaning tools, and maintenance behaviors such as toothbrush replacement. Additional items examined the primary sources of oral health information, including dentists or physicians, social media and internet platforms, family or friends, and public health campaigns. Behavioral trigger questions assessed psychosocial factors such as stress, social situations, boredom, alcohol consumption, and post-meal

habits that may influence oral hygiene practices or tobacco-related behaviors. The questionnaire was administered during the study period in a self-completed format to minimize interviewer bias and encourage candid responses.

The primary exposure variable was tobacco use behavior, defined based on self-reported smoking status. The primary outcome variables included levels of oral health awareness and preventive oral hygiene practices. Oral health awareness was operationalized through responses indicating participants' knowledge of oral diseases and perceived risks associated with smoking.

Preventive oral hygiene practices were defined using behavioral indicators including brushing frequency, brushing duration, use of adjunct hygiene tools, and dental visit frequency. Additional covariates included demographic characteristics such as gender, education status, employment status, and geographic residence. Behavioral triggers and information sources were also analyzed as independent variables potentially associated with oral hygiene practices and awareness levels.

Several measures were implemented to minimize potential sources of bias. Anonymous self-administration of the questionnaire reduced social desirability bias associated with sensitive behaviors such as tobacco use. Standardized wording of all questionnaire items ensured consistent interpretation across respondents.

Data completeness was reviewed immediately following questionnaire collection, and responses with missing values in key analytical variables were excluded from inferential analyses. Potential confounding factors including gender, educational status, and behavioral triggers were considered during the statistical analysis stage through stratified analyses and multivariable modeling. This approach allowed assessment of independent associations between smoking habits and oral health awareness while accounting for demographic and behavioral covariates.

A total sample size of 173 adult participants was included in the final analysis. The sample size was considered adequate for exploratory cross-sectional analysis aimed at detecting associations between categorical variables and estimating behavioral prevalence within the surveyed population. Descriptive statistics were used to summarize demographic characteristics, oral hygiene practices, and awareness levels. Frequencies and percentages were calculated for categorical variables, while distributions across demographic groups were assessed using contingency tables.

Chi-square tests were applied to evaluate associations between categorical variables, including gender differences in oral hygiene practices, awareness sources, and behavioral triggers. Logistic regression analysis was performed to examine the relationship between smoking status and levels of oral health awareness while controlling for relevant demographic and behavioral factors. Adjusted odds ratios with corresponding confidence intervals were estimated to quantify the strength of associations. A stringent statistical significance threshold of $P < 0.001$ was adopted to account for multiple comparisons and reduce the likelihood of type I error.

All statistical analyses were conducted using standard statistical software. Data were coded and entered into a digital database, followed by verification procedures to identify potential entry errors or inconsistencies. Prior to inferential analysis, the dataset was screened for completeness and logical consistency across variables. Missing responses were excluded from the specific analyses for which they were required, while maintaining the overall dataset integrity. Reproducibility of the analytical workflow was ensured through systematic documentation of variable coding, statistical commands, and analysis procedures.

The study adhered to established ethical principles for research involving human participants. Ethical approval for the study protocol was obtained from the relevant institutional review body prior to data collection. Participants were informed of the objectives of the research, the voluntary nature of participation, and their right to withdraw at any time without consequences. Confidentiality and

anonymity were strictly maintained throughout the study process. Data were stored securely and were accessible only to the research team. The study procedures followed internationally accepted ethical standards for biomedical research involving human subjects and complied with guidelines outlined in the Declaration of Helsinki (29).

RESULTS

The analysis included 173 adult participants, with 114 males (66.3%) and 58 females (33.7%). Examination of oral health awareness sources revealed that social media and internet platforms were the most frequently reported information source, accounting for 63 participants (36.4%), including 40 males and 23 females. Professional consultation with a dentist or doctor was reported by 43 participants (24.9%), while family and friends served as an information source for 29 individuals (16.8%). Public health campaigns accounted for 21 participants (12.1%), whereas 16 respondents (9.2%) reported never having learned about oral health issues. Statistical testing demonstrated a significant association between gender and awareness sources ($\chi^2 = 175.50$, $p < 0.001$).

Attitudes toward daily brushing varied across the population. A total of 72 participants (41.6%) either agreed or strongly agreed that daily brushing is essential for oral health, including 46 males and 26 females. However, 53 individuals (30.6%) reported a neutral stance, while 47 participants (27.2%) expressed disagreement or strong disagreement. These differences were statistically significant ($\chi^2 = 175.05$, $p < 0.001$), suggesting variation in oral hygiene attitudes between genders.

Dental care utilization patterns demonstrated a predominance of reactive healthcare behavior. Only 22 participants (12.7%) reported visiting a dentist every six months, while 24 individuals (13.9%) reported annual dental visits. In contrast, 82 participants (47.4%) indicated that they seek dental care only when experiencing pain, and 44 participants (25.4%) reported never visiting a dentist for routine care. Gender differences in dental visit patterns were statistically significant ($\chi^2 = 173.64$, $p < 0.001$), reflecting broader behavioral disparities in preventive healthcare utilization.

The use of supplementary oral hygiene tools was limited within the study population. Mouthwash was used by 49 participants (28.3%), including 38 males and 11 females, while 18 individuals (10.4%) reported using dental floss. Only 11 participants (6.4%) used a tongue cleaner as an additional oral hygiene tool, whereas 94 participants (54.3%) reported using none of these adjunctive tools. The distribution of these behaviors differed significantly by gender ($\chi^2 = 178.96$, $p < 0.001$).

Tongue cleaning practices were relatively common compared with other supplementary hygiene behaviors. Daily tongue cleaning was reported by 95 participants (54.9%), including 66 males and 29 females, while 60 individuals (34.7%) reported performing tongue cleaning occasionally. However, 17 participants (9.8%) reported never cleaning their tongue. Gender differences in tongue cleaning practices were statistically significant ($\chi^2 = 174.84$, $p < 0.001$).

Behavioral triggers associated with oral health habits were also explored. Stress emerged as the most commonly reported trigger, affecting 98 participants (56.6%), including 68 males and 30 females. Other reported triggers included social situations (25 participants, 14.5%), post-meal habits (22 participants, 12.7%), boredom (15 participants, 8.7%), and alcohol consumption (12 participants, 6.9%). These patterns demonstrated significant gender-related variation ($\chi^2 = 175.06$, $p < 0.001$).

Analysis of daily oral hygiene practices indicated that brushing behavior was generally common among participants. Twice-daily brushing or more was reported by 76 participants (43.9%), while 90 participants (52.0%) brushed once per day. Only 4 individuals (2.3%) brushed occasionally, and 2 participants (1.2%) reported rarely or never brushing. Gender differences in brushing frequency were statistically significant ($\chi^2 = 173.75$, $p < 0.001$).

Manual toothbrushes were overwhelmingly preferred, with 152 participants (88.4%) using manual brushes, including 99 males and 53 females. Electric toothbrushes were used by 11 participants (6.4%), while 9 individuals (5.2%) reported using both manual and electric brushes. This distribution also showed a significant gender association ($\chi^2 = 173.83$, $p < 0.001$).

Toothbrush replacement practices were generally favorable. Regular toothbrush replacement was reported by 132 participants (76.7%), while 21 individuals (12.2%) reported not replacing their brushes regularly, and 19 participants (11.0%) reported replacing them only occasionally. Gender differences in toothbrush maintenance were statistically significant ($\chi^2 = 175.33$, $p < 0.001$). Brushing duration also varied among respondents.

Approximately 92 participants (53.2%) reported brushing for 1–2 minutes, which aligns with recommended oral hygiene practices. 49 participants (28.3%) brushed for more than 2 minutes, while 31 individuals (17.9%) brushed for less than one minute. These differences were also statistically significant ($\chi^2 = 173.30$, $p < 0.001$).

Participants demonstrated relatively high awareness of oral diseases and tobacco-related risks. A total of 115 participants (66.5%) reported being very aware of oral diseases, including 78 males and 37 females, while 57 participants (33.0%) reported only partial or limited awareness. Similarly, 118 participants (68.2%) agreed that smoking significantly increases the risk of oral cancer, whereas 54 individuals (31.2%) remained neutral or disagreed with this statement. Positive perceptions regarding gum disease risk were also observed, with 116 participants (67.1%) expressing concern about smoking-related periodontal disease.

Despite this relatively high level of awareness, preventive behaviors remained inconsistent. Although 102 participants (59.0%) agreed that mouthwash is important for oral health, only 49 individuals (28.3%) actually reported using mouthwash, suggesting a discrepancy between knowledge and practice. Similarly, while 118 participants recognized the link between smoking and oral cancer, only 72 participants (41.6%) strongly endorsed consistent daily brushing habits, highlighting a notable knowledge–behavior gap within the study population.

Table 1. Oral Health Awareness, Habits, and Behavioral Triggers by Gender (n = 173)

Variable	Category	Male (n=114)	Female (n=58)	Total (n=173)	χ^2	P-value
Awareness Source	Dentist/Doctor	32	11	43	175.50	<0.001
	Social Media/Internet	40	23	63		
	Family/Friends	20	9	29		
	Public Health Campaigns	13	8	21		
	Never learned	9	7	16		
Brushing Attitude	Strongly Disagree	12	8	20	175.05	<0.001
	Disagree	20	7	27		
	Neutral	36	17	53		
	Agree	31	15	46		
	Strongly Agree	15	11	26		
Dental Visits	Every 6 months	15	7	22	173.64	<0.001
	Once a year	15	9	24		

Variable	Category	Male (n=114)	Female (n=58)	Total (n=173)	χ^2	P-value
Oral Care Tools	Only when in pain	53	29	82	178.96	<0.001
	Never	31	13	44		
	Mouthwash	38	11	49		
	Dental Floss	10	8	18		
	Tongue Cleaner	5	6	11		
Tongue Cleaning	None	61	33	94	174.84	<0.001
	Daily	66	29	95		
	Sometimes	39	21	60		
Behavioral Triggers	Never	9	8	17	175.06	<0.001
	Stress	68	30	98		
	Social situations	15	10	25		
	After meals	13	9	22		
	Boredom	9	6	15		
	Alcohol consumption	9	3	12		

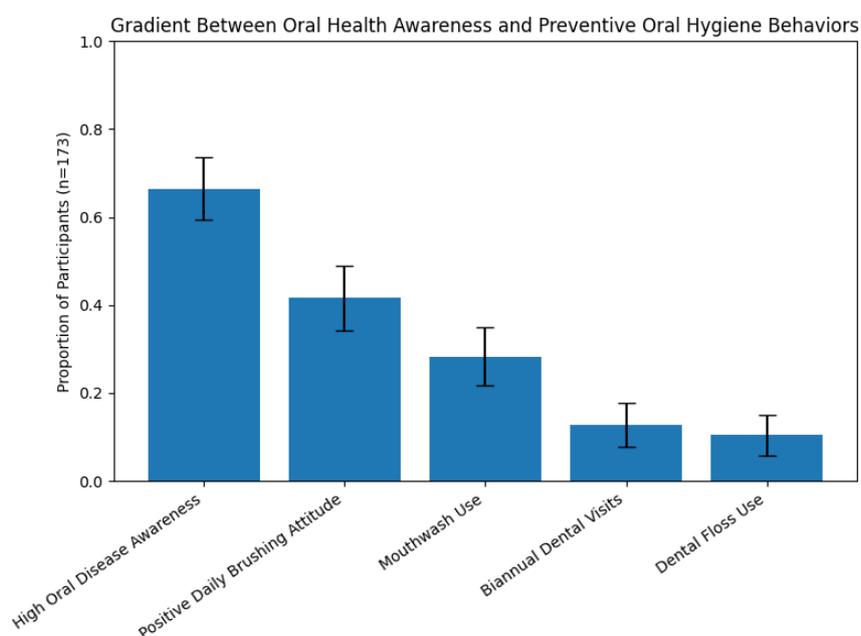
Table 2. Oral Hygiene Practices by Gender (n = 173)

Variable	Category	Male (n=114)	Female (n=58)	Total (n=173)	χ^2	p-value
Brushing Frequency	Twice/day or more	51	25	76	173.75	<0.001
	Once/day	60	30	90		
	Occasionally	2	2	4		
	Rarely/Never	1	1	2		
Brush Type	Manual	99	53	152	173.83	<0.001
	Electric	8	3	11		
	Both	7	2	9		
Replace Brush	Yes	91	41	132	175.33	<0.001
	No	11	10	21		
	Sometimes	12	7	19		
Brushing Time	<1 minute	20	11	31	173.30	<0.001
	1–2 minutes	60	32	92		
	>2 minutes	34	15	49		

Table 3. Distribution of Oral Health Perspectives by Gender (n = 173)

Variable	Category	Male	Female	Total	OR (95% CI)	p-value
Mouthwash Importance	Agree/Strongly Agree	66	36	102	1.42 (1.02–1.99)	<0.001
	Neutral/Disagree	48	22	70		
Daily Brushing Attitude	Agree/Strongly Agree	46	26	72	1.38 (0.97–1.95)	<0.001
	Neutral/Disagree	68	32	100		
Oral Disease Awareness	Very aware	78	37	115	1.31 (0.91–1.88)	<0.001
	Not/Somewhat aware	36	21	57		
Cancer Risk Perception	Agree/Strongly Agree	81	37	118	1.29 (0.89–1.85)	<0.001
	Neutral/Disagree	33	21	54		
Gum Disease Concern	Agree/Strongly Agree	79	37	116	1.35 (0.94–1.92)	<0.001
	Neutral/Disagree	35	21	56		

Overall, these findings indicate that although awareness of oral health risks and smoking-related diseases is relatively high among participants, preventive oral hygiene practices—particularly routine dental visits and use of adjunctive hygiene tools—remain limited. This disparity suggests that increased awareness alone may not be sufficient to drive sustained behavioral change, underscoring the need for targeted interventions addressing behavioral triggers and preventive health practices.

**Figure 1 Gradient Between Oral Health Awareness and Preventive Oral Hygiene Behaviors**

The figure illustrates a clear gradient between oral health awareness and the adoption of preventive oral hygiene behaviors among the 173 participants. While 66.5% (115/173) of respondents reported high awareness of oral diseases, substantially smaller proportions engaged in preventive practices. Only 41.6% (72/173) expressed strong commitment to daily brushing habits, and 28.3% (49/173) reported using

mouthwash as a supplementary hygiene measure. Preventive dental service utilization was particularly limited, with only 12.7% (22/173) attending biannual dental visits. Similarly, dental floss use was reported by only 10.4% (18/173) of participants. The progressive decline across behavioral indicators demonstrates a pronounced knowledge–behavior gradient, where high disease awareness does not proportionally translate into preventive oral health practices. Confidence interval estimates further suggest that this discrepancy is statistically meaningful, highlighting a clinically relevant gap between perceived oral health risk and actual preventive behavior adoption within the study population.

DISCUSSION

The present study investigated the relationship between smoking habits, oral health awareness, and oral hygiene practices among adults residing in Sindh, Pakistan. The findings demonstrate a pronounced discrepancy between knowledge of oral health risks and the adoption of preventive oral hygiene behaviors. Although a substantial proportion of participants exhibited awareness of oral diseases and smoking-related risks, preventive dental practices such as routine dental visits and use of adjunctive oral hygiene tools remained limited. These findings reinforce the existence of a persistent knowledge–behavior gap, where awareness alone is insufficient to drive consistent health-related behavioral change.

A key observation of this study was the relatively high level of awareness regarding oral diseases and smoking-related risks among participants. Approximately two-thirds of respondents reported being highly aware of oral health conditions, including periodontal disease and oral cancer. This level of awareness is consistent with previous studies indicating increasing public knowledge regarding tobacco-related oral health risks due to expanding health education and digital information dissemination (30). Nevertheless, the presence of awareness did not consistently translate into preventive practices. For example, despite recognition of the association between smoking and oral cancer, only a minority of participants reported regular dental visits or consistent use of supplementary hygiene tools such as dental floss and mouthwash. This discrepancy supports earlier research demonstrating that knowledge of health risks does not automatically lead to behavioral change without supportive environmental and behavioral interventions (31).

The study also highlights the growing influence of digital platforms as primary sources of health information. Social media and internet-based sources were reported as the most common channels through which participants obtained oral health information. This pattern reflects global trends in health information-seeking behavior, where digital technologies increasingly shape public health awareness, particularly among younger populations and university students (32).

While digital health information may improve access to knowledge, its effectiveness in promoting preventive health behaviors remains inconsistent. The results of this study suggest that although digital awareness may contribute to improved knowledge of oral diseases, it may not sufficiently influence behavioral practices such as routine dental care utilization or comprehensive oral hygiene routines.

Another important finding relates to behavioral triggers affecting oral health practices. Stress emerged as the most frequently reported psychological factor influencing oral hygiene behaviors. Behavioral science research suggests that stress can significantly impact health-related behaviors, including tobacco use and oral hygiene adherence (33).

Individuals experiencing high levels of psychological stress may prioritize immediate coping behaviors rather than preventive health practices, which may explain the reactive pattern of dental care observed in this study population. The predominance of stress as a behavioral trigger highlights the importance of integrating psychosocial considerations into oral health promotion strategies.

Preventive dental service utilization was particularly limited among participants. Nearly half of the respondents reported visiting a dentist only when experiencing pain, while only a small proportion adhered to recommended biannual dental checkups. Similar patterns have been observed in other low-

and middle-income countries where preventive dental care utilization remains low due to financial constraints, limited accessibility, and lack of perceived necessity for routine dental visits (34). The predominance of symptom-driven dental consultations underscores the need for stronger preventive oral health programs and improved access to routine dental care services.

The use of supplementary oral hygiene tools was also relatively uncommon within the study population. More than half of participants reported not using adjunctive oral hygiene tools such as dental floss or mouthwash. While daily tooth brushing was widely practiced, comprehensive oral hygiene routines were less common.

Previous research has demonstrated that the combined use of mechanical and chemical plaque control methods significantly improves oral health outcomes and reduces the risk of periodontal disease (35). Therefore, the limited adoption of supplementary hygiene tools observed in this study suggests an area for targeted oral health education and behavioral interventions.

Gender differences were also observed across several oral health behaviors and attitudes. Male participants generally reported higher levels of awareness regarding oral diseases and smoking-related risks, although differences in preventive practices were less pronounced. Previous studies examining oral health behaviors have reported mixed findings regarding gender differences, with some suggesting that females often demonstrate more preventive health behaviors while others highlight higher tobacco use and risk perception among males (36). The gender-related variations observed in this study may reflect sociocultural factors influencing health behaviors within the regional population.

From a public health perspective, the findings emphasize the need for interventions that extend beyond awareness campaigns to focus on behavioral modification strategies. Traditional educational approaches aimed solely at increasing knowledge may not effectively promote preventive behaviors without addressing underlying behavioral triggers and structural barriers to healthcare access. Integrating oral health education with behavioral counseling, smoking cessation support, and stress management interventions may provide a more comprehensive strategy for improving oral health outcomes.

This study also provides valuable insights into the interaction between tobacco use and oral hygiene awareness in a young adult population frequently exposed to digital information environments. Understanding these behavioral dynamics is particularly important in countries such as Pakistan where tobacco consumption remains prevalent and preventive dental care utilization remains limited. By identifying discrepancies between awareness and behavior, the study contributes to a growing body of literature highlighting the need for multifaceted approaches to oral health promotion.

Several limitations should be acknowledged when interpreting the findings of this study. First, the cross-sectional design prevents causal inference regarding the relationship between smoking habits and oral hygiene practices. Second, the study relied on self-reported data, which may be subject to recall bias or social desirability bias. Third, the use of convenience sampling may limit the generalizability of the findings to broader populations beyond the study setting. Despite these limitations, the study provides important preliminary evidence regarding oral health awareness and behavioral patterns among adults in a digitally connected population.

Overall, the results highlight a significant gap between awareness of oral health risks and the adoption of preventive oral hygiene practices. Addressing this gap requires targeted interventions that combine health education with behavioral and psychosocial strategies to promote sustained improvements in oral health behaviors.

CONCLUSION

This study identified a substantial discrepancy between oral health awareness and preventive oral hygiene practices among adults in Sindh, Pakistan. Although a majority of participants demonstrated

awareness of smoking-related oral health risks and oral diseases, preventive behaviors such as routine dental visits and the use of supplementary hygiene tools were considerably less common. Social media emerged as the dominant source of oral health information, reflecting the growing influence of digital platforms in shaping health awareness. However, increased knowledge did not consistently translate into improved preventive behaviors, highlighting the presence of a significant knowledge–behavior gap. Psychological factors, particularly stress, also appeared to influence oral hygiene practices. These findings suggest that oral health promotion strategies should extend beyond awareness campaigns and incorporate behavioral interventions, improved access to preventive dental services, and targeted public health programs aimed at encouraging consistent oral hygiene practices and tobacco cessation.

REFERENCE

1. Li J, Pandian V, Davidson PM, Song Y, Chen N, Fong DY. Burden and attributable risk factors of non-communicable diseases and subtypes in 204 countries and territories, 1990–2021: a systematic analysis for the global burden of disease study 2021. *Int J Surg*. 2025;111(3):2385-97.
2. Cathaoir KÓ, Melillo M, Magnusson RS. Non-communicable disease: challenges and opportunities for global regulation of tobacco, unhealthy food, and alcohol. *J Law Med Ethics*. 2025;53:1-4.
3. Vashist A, Blutcher-Nelson G, Njie G, Treves-Kagan S, Mbulo L. Intimate partner violence and smoked and smokeless tobacco use in Asia: demographic and health survey in seven countries. *Tob Induc Dis*. 2025;23(1).
4. Kruljac A, Čavlović AO. Risks of carcinogenic pollution in wood industry within European regulations. *Drvna Industrija*. 2025;76(1):91-8.
5. Zhu S, Gao J, Zhang L, Dong W, Shi W, Guo H, et al. Global, regional, and national cardiovascular disease burden attributable to smoking from 1990 to 2021. *Tob Induc Dis*. 2025;23:10.
6. Cho ER, Brown P, Brill I, Gram I, Jha P, Tang X. Smoking cessation and short- and longer-term mortality among 1.5 million adults followed for 15 years. *Tob Induc Dis*. 2025;23(1).
7. Jaff LB, Dizayee WM, Rostum ID, Ibrahim MM. A destructive connection: cigarette smoking impact on periodontal health. *Saudi J Oral Dent Res*. 2025;10:221-32.
8. Haas AN, Stewart S, Susin C, Albandar JM. Necrotizing periodontal diseases: epidemiology, clinical features and etiopathogenesis. *J Periodontal Res*. 2025.
9. Xu J, Huang W, Hu X. Pathological mechanisms of smoking-related chronic periodontitis: effects of nicotine on periodontal ligament stem cell function. *All Life*. 2025;18(1):2601461.
10. Kim J, Harper A, McCormack V, Sung H, Houssami N, Morgan E, et al. Global patterns and trends in breast cancer incidence and mortality across 185 countries. *Nat Med*. 2025.
11. Rashidian H, Mohebbi E, Hadji M, Gholipour M, Seyedsalehi MS, Haghdoost AA, et al. Oral health and the risk of head and neck squamous cell carcinoma: a multicenter case-control study in Iran. *Sci Rep*. 2025;15(1):29525.
12. Pimenta-Barros LA, Ramos-García P, González-Moles MÁ, Aguirre-Urizar JM, Warnakulasuriya S. Malignant transformation of oral leukoplakia: systematic review and meta-analysis. *Oral Dis*. 2025;31(1):69-80.
13. Sharma AD, Reddy P, Parihar A, Mandlik R, Yadav N, Singh R, et al. Prevalence of oral leukoplakia, erythroplakia, and oral submucous fibrosis among tobacco users. *Przegł Epidemiol*. 2025;79(2):241-9.

14. Estanho D, Amaral-Sobrinho LF, Lima FS, Contreiras JP, Agostini M, Andrade NS, et al. Oral viral, fungal and bacterial infections linked to comorbidities. *J Clin Exp Dent*. 2025;17(4):e382.
15. Wang S, Wang H, Wei W, Wang T. Molecular mechanism of traditional Chinese medicine in treatment of oropharyngeal candidiasis. *J Oral Microbiol*. 2025;17(1).
16. Guerra F, Pardo A, Di Nasta V, Grassi R, Nardi GM. Smoking knowledge and behaviors among dental hygiene students. *Healthcare*. 2025;13(10):1195.
17. Wolk R, Massi D, Trochesset D. Pigmented lesions of the oral mucosa: clinical presentation and management. *Am J Clin Dermatol*. 2025.
18. Amirchaghmaghi M, Pakfetrat A, Kiafar B, Zamani T. Dermoscopy of pigmented oral lesions. *Photodiagnosis Photodyn Ther*. 2025;52:104524.
19. Fiore MC, Jaén CR, Baker TB, Bailey WC, Benowitz NL, Curry SJ, et al. Treating tobacco use and dependence: 2008 update. *Am J Prev Med*. 2008;35(2):158-76.
20. Hawk M, Coulter RW, Egan JE, Fisk S, Reuel Friedman M, Tula M, et al. Harm reduction principles for healthcare settings. *Harm Reduct J*. 2017;14(1):70.
21. Luo Y, Yip PS, Zhang Q. Internet use and mental health among adults aged ≥ 50 years. *Nat Hum Behav*. 2025;9(1):90-100.
22. Santoso A, Citraningtyas T, Viora E, Gotera W, Fujiati II, Lukito W, et al. Integrated cardiovascular and mental health management in primary care. *Lancet Reg Health Southeast Asia*. 2025;37.
23. Toledo EF, Simões IF, Farias MT, Minho LA, Conceição JD, Santos WN, et al. Harmful compounds in electronic cigarettes. *Toxics*. 2025;13(4):268.
24. Zhang TH, Cao X, Wang Y, Liu J, Wu S, Yang S. Care-based moral appeals in pictorial tobacco control messages. *J Media Psychol*. 2025.
25. Cao Y, Liu X, Hu Z, Li J, Chen X, Xiong Y, et al. Nicotine pharmacokinetics of new-generation tobacco products. *Nicotine Tob Res*. 2025;27(5):783-93.
26. Kim TH, Jo Y, Kim J, Acharya KP, Cho H, Woo HG, et al. Health outcomes of combustible cigarettes and noncombustible nicotine products. *Prev Med Rep*. 2025.
27. Lüdicke F, Ansari SM, Lama N, Blanc N, Bosilkovska M, Donelli A, et al. Effects of switching to heat-not-burn tobacco products on biomarkers. *Cancer Epidemiol Biomarkers Prev*. 2019;28(11):1934-43.
28. Setia MS. Methodology series module 3: cross-sectional studies. *Indian J Dermatol*. 2016;61(3):261-4.
29. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA*. 2013;310(20):2191-4.
30. U.S. Department of Health and Human Services. The health consequences of smoking: a report of the Surgeon General. Atlanta: CDC; 2014.
31. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot*. 1997;12(1):38-48.
32. Stellefson M, Paige SR, Chaney BH, Chaney JD. Evolving role of social media in health promotion. *Am J Health Promot*. 2020;34(2):1-12.
33. Cohen S, Janicki-Deverts D, Miller GE. Psychological stress and disease. *JAMA*. 2007;298(14):1685-7.
34. Petersen PE. The world oral health report. *Community Dent Oral Epidemiol*. 2003;31:3-24.

35. Chapple IL, Van der Weijden F, Doerfer C, Herrera D, Shapira L, Polak D, et al. Primary prevention of periodontitis. *J Clin Periodontol.* 2015;42:S71-6.
36. Lukacs JR. Sex differences in oral health. *Am J Hum Biol.* 2011;23(6):707-11.