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The Relationship Between Smoking Habits and Dental and Oral Hygiene in Patients at the Kesamben Community Health Center Dental Clinic in Jombang Regency

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ABSTRACT Smoking remains a major public health concern and is widely recognized as an important behavioral risk factor for poor dental and oral health. Tobacco exposure contributes to plaque accumulation, calculus formation, gingival inflammation, and impaired oral tissue healing. However, evidence regarding the relationship between smoking habits and oral hygiene status in Indonesian primary health care settings is still limited. This study aimed to analyze the association between smoking habits and dental and oral hygiene status among patients attending the Dental Clinic of the Kesamben Community Health Center, Jombang Regency. A quantitative cross-sectional analytical design was employed in March 2025. The study involved 30 male patients aged ≥25 years who were selected using purposive sampling. Smoking habits were assessed using a structured 20-item questionnaire and categorized into low, moderate, and high levels based on cumulative scores. Dental and oral hygiene status was evaluated using the Simplified Oral Hygiene Index (OHI-S), which classifies hygiene conditions into good, moderate, and poor categories. Data were analyzed using univariate and bivariate statistical methods, including the Chi-square test, Spearman correlation analysis, and Phi effect size, with a significance level set at $p < 0.05$. The results showed that the majority of respondents had high smoking intensity (93.4%) and poor oral hygiene status (96.6%). Statistical analysis revealed a significant association between smoking habits and oral hygiene status ($\chi^2 = 7.226$; $p = 0.007$). Spearman correlation analysis indicated a moderate positive relationship between smoking intensity and worsening OHI-S scores ($r = 0.52$; 95% CI: 0.18–0.74), with a moderate effect size ($\varphi = 0.49$). In conclusion, higher smoking intensity is significantly associated with poorer dental and oral hygiene among adult patients at the Kesamben Community Health Center. These findings highlight the importance of integrating smoking cessation counseling with preventive oral health education in primary health care services to improve overall oral health outcomes.

INDEX TERMS Smoking Habits, Oral Hygiene, OHI-S, Dental Health, Primary Health Care.

I. INTRODUCTION

Smoking remains one of the most significant preventable behavioral risk factors contributing to the global burden of oral and dental diseases. Tobacco exposure has been consistently associated with plaque accumulation, calculus formation, gingival inflammation, periodontal tissue destruction, and impaired wound healing in the oral cavity, ultimately leading to deteriorated oral hygiene status and increased risk of chronic oral diseases [1]–[4]. In low- and middle-income countries, including Indonesia, high smoking prevalence combined with limited preventive oral health behaviors exacerbates the burden of dental and periodontal diseases and places additional pressure on primary healthcare services [5], [6]. Community health centers (puskesmas) serve as the frontline of oral healthcare delivery; however, empirical evidence linking smoking behavior with standardized oral hygiene outcomes in these primary care settings remains limited. This condition highlights a critical public health problem, particularly in rural and semi-urban communities where health literacy and access to preventive dental services remain suboptimal [7], [8].

Recent advances in oral health research have increasingly adopted standardized clinical indices and validated analytical approaches to assess the relationship between behavioral risk factors and oral health outcomes. The Simplified Oral Hygiene Index (OHI-S) remains one of the most widely used objective clinical tools to quantify oral cleanliness through debris and calculus assessment, allowing for reliable categorization of oral hygiene status [9]. Contemporary studies commonly apply cross-sectional and analytical epidemiological designs combined with statistical association models such as chi-square analysis, correlation tests, and

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regression modeling to evaluate behavioral determinants of oral health, including smoking intensity, duration of exposure, and frequency of use [10]–[13]. In parallel, recent public health research emphasizes the integration of behavioral risk factor surveillance with clinical oral health indicators to strengthen preventive strategies in primary care systems [14], [15].

Despite this progress, several important gaps persist in the existing literature. First, many studies focus primarily on caries prevalence, periodontal disease severity, or tooth loss as outcome variables, while standardized oral hygiene indices such as OHI-S are less frequently used as primary endpoints in smoking-related research [16], [17]. Second, a large proportion of existing evidence relies on secondary national survey datasets, which often lack detailed behavioral intensity measurements and localized clinical validation [18]. Third, empirical studies conducted directly within Indonesian community health centers that simultaneously measure smoking habits and objective oral hygiene indices using validated tools remain scarce. Consequently, the relationship between smoking intensity and oral hygiene status in primary healthcare populations is not yet adequately characterized, limiting the development of context-specific preventive interventions [19], [20].

To address these gaps, this study aims to analyze the association between smoking habits and dental and oral hygiene status among adult patients attending the Dental Clinic of the Kesamben Community Health Center, Jombang Regency. The study specifically evaluates smoking intensity using a structured behavioral assessment and measures oral hygiene conditions using the Simplified Oral Hygiene Index (OHI-S), supported by statistical association and correlation analyses.

This article makes several key contributions to the field. First, it provides localized empirical evidence on the relationship between smoking behavior and oral hygiene status in a primary healthcare setting, strengthening the evidence base in Indonesian community health research. Second, it integrates standardized behavioral measurement with objective clinical assessment (OHI-S), enhancing methodological rigor and data reliability. Third, it offers practical implications for preventive oral health strategies by supporting the integration of smoking cessation counseling and oral hygiene promotion within routine primary care services.

The remainder of this article is structured as follows. Section II presents the Materials and Methods, detailing the study design, study setting, population and sampling procedures, research instruments, data collection process, and statistical analysis techniques applied in this study. Section III reports the Results, including descriptive and inferential statistical findings that describe respondent characteristics, smoking habits, oral hygiene status, and the relationship between the studied variables. Section IV discusses the findings in relation to existing literature, highlighting similarities and contrasts with previous studies, as well as outlining the limitations and public health implications of the results. Finally, Section V concludes the article by summarizing the main findings, acknowledging study limitations, and providing recommendations for future research and practical applications in primary oral health care.

II. METHODS

A. STUDY DESIGN AND STUDY TYPE

This study employed a quantitative analytical cross-sectional design, in which exposure and outcome variables were measured simultaneously within a defined population. The cross-sectional approach was selected because it is appropriate for identifying associations between behavioral risk factors and health outcomes at a single point in time without manipulation of variables [21], [22]. The study was observational and non-experimental, as no intervention was applied to alter participants' smoking behavior or oral hygiene practices. Furthermore, the study was prospective in nature, as data collection was planned in advance and conducted directly during patient visits within the predetermined study period. No randomization procedures were applied because the study aimed to assess naturally occurring smoking behaviors among clinic attendees.

B. STUDY SETTING AND PERIOD

The study was conducted at the Dental Clinic of the Kesamben Community Health Center, Jombang Regency, East Java, Indonesia. This primary healthcare facility provides routine dental and oral health services for residents of eight villages within the Kesamben subdistrict. Data collection was carried out from December 2024 to March 2025, with clinical examinations performed on March 21, 2025. The selection of this setting was based on its accessibility, high patient attendance, and relevance to community-based oral health services.

C. STUDY POPULATION AND SAMPLE

The study population consisted of adult patients attending the dental clinic during the study period. The target population was defined as male patients aged 25 years and older, reflecting the demographic group with the highest smoking prevalence in the region. Sample size determination was guided by Slovin's formula, resulting in a minimum sample of 30 respondents deemed adequate for preliminary association analysis in cross-sectional studies [23].

Participants were selected using purposive sampling, a non-probability sampling technique that allows the inclusion of individuals who meet specific research criteria relevant to the study objectives [24]. This method was chosen to ensure that respondents had active smoking exposure and were suitable for oral hygiene assessment.

D. INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria were: (1) male patients aged ≥25 years, (2) active smokers at the time of data collection, and (3) willingness to participate as indicated by signed informed consent. The exclusion criteria included: (1) patients using fixed orthodontic appliances or removable dentures, (2) patients with systemic conditions affecting oral hygiene assessment, and (3) individuals who declined participation or withdrew consent during the study process.

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E. RESEARCH INSTRUMENTS AND MATERIALS

Three main instruments were used for data collection. First, a demographic questionnaire was administered to obtain information on age, educational background, and occupation. Second, smoking habits were assessed using a structured 20-item questionnaire with four response options: Always (3), Often (2), Sometimes (1), and Never (0). Total scores ranged from 0 to 60 and were categorized into low (≤20), moderate (21–39), and high (≥40) smoking intensity, allowing standardized classification of smoking behavior [25].

Third, oral hygiene status was evaluated using the Simplified Oral Hygiene Index (OHI-S) developed by Greene and Vermillion. The OHI-S assesses debris and calculus accumulation on selected tooth surfaces and produces a composite score ranging from 0.0 to 6.0. Scores were categorized as good (0.0–1.2), moderate (1.3–3.0), and poor (3.1–6.0) oral hygiene status. The OHI-S was selected due to its validity, reliability, and widespread application in epidemiological and clinical oral health research [26].

F. DATA COLLECTION PROCEDURE

Data collection was conducted during routine dental clinic visits. Eligible participants received a standardized explanation of the study objectives and procedures prior to participation. After providing written informed consent, respondents completed the smoking habits questionnaire under researcher supervision. Subsequently, clinical oral examinations were performed by licensed dental professionals using sterile dental instruments, including mouth mirrors, probes, and explorers. All examinations followed standardized oral health assessment protocols to ensure consistency and minimize inter-examiner variability [27]. Data were recorded immediately on OHI-S examination forms and cross-checked for completeness before entry into the database.

G. DATA ANALYSIS

Collected data were processed and analyzed using SPSS version 26. Univariate analysis was performed to describe respondent characteristics, smoking habit categories, and oral hygiene status using frequencies and percentages. Bivariate analysis was conducted to examine the association between smoking habits and oral hygiene status. The Chi-square test was applied to assess categorical associations, while the Linear-by-Linear Association test evaluated trends between increasing smoking intensity and worsening oral hygiene categories. Additionally, Spearman's rank correlation was used to determine the strength and direction of the relationship between smoking scores and OHI-S values. A p-value < 0.05 was considered statistically significant, corresponding to a 95% confidence level [28], [29].

H. ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Ethics Committee of the Surabaya Ministry of Health Polytechnic (Approval No. EA/3575/KEPK-Poltekkes_Sby/V/2025). All participants were informed of their rights, including voluntary participation, confidentiality, and the freedom to withdraw at any time without consequences. The study adhered to internationally accepted ethical standards for research involving human subjects [30].

III. RESULTS

This study was conducted on March 21, 2025, at the Kesamben Community Health Center Dental Clinic. The health center is located at Jl. Raya Kesamben No. 3A, Ngembul Hamlet, Kesamben Village, Jombang Regency, East Java Province, and serves eight villages within the Kesamben subdistrict, which covers an area of approximately 29 km². The population is recorded at 65,420 residents, consisting of 33,435 males and 31,985 females. The study aimed to examine the relationship between smoking habits and dental and oral hygiene among patients visiting the dental clinic. A total of 30 male respondents aged 25–60 years were included using purposive sampling. TABLE 1 shows the age distribution of respondents.

According to TABLE 1, the majority of respondents were

TABLE 1
Frequency Distribution of Respondents' Ages at the Kesamben Community Health Center, Kesamben District, Jombang Regency, March 21, 2025

No.	Age	Amount	(%)
1.	25- 35 years old	3	10.0
2.	36- 50 years old	5	16.6
3.	51- 60 years old	22	73.4
	Amount	30	100

TABLE 2
Frequency Distribution of Respondents' Education Levels at the Kesamben Community Health Center, Kesamben District, Jombang Regency, on March 21, 2025.

No.	Education Level	Amount	(%)
1.	Did not complete elementary school	2	6.7
2.	Completed elementary school	20	66.6
3.	Completed junior high school	3	10.0
4.	High school graduate	3	10.0
5.	Bachelor's degree	2	6.7
	Amount	30	100

TABLE 3
Frequency Distribution of Respondents' Occupations at the Kesamben Community Health Center, Kesamben District, Jombang Regency, March 21, 2025

No.	Occupation	Amount	(%)
1.	Civil Servant	0	0
2.	Private sector	5	16.6
3.	Self-employed	25	83.4
4.	Unemployed	0	0
	Amount	30	100

in the 51–60 age group (73.4%). This indicates that most participants were in the pre-elderly category, which is epidemiologically more vulnerable to oral and dental health problems compared to younger age groups.

According to TABLE 2, most respondents had completed elementary school (66.6%). This shows that the majority belonged to a low-education category, which may affect their knowledge and behavior regarding oral hygiene compared to respondents with higher educational backgrounds.

According to TABLE 3, the majority of respondents worked as self-employed individuals (83.4%). This suggests

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that most participants had flexible work patterns, which may influence lifestyle factors, including oral hygiene practices.

Based on TABLE 4, most respondents (93.4%) were categorized as having high smoking habits. This distribution was later analyzed in relation to oral hygiene status using the OHI-S index.

TABLE 5 shows that 96.6% of respondents had poor oral hygiene, while only one respondent (3.4%) had moderate oral hygiene. None were categorized as having good oral hygiene, indicating that the majority experienced significant challenges in maintaining oral health.

TABLE 5
Frequency Distribution of Dental and Oral Hygiene at the Kesamben Community Health Center Dental Clinic, Jombang Regency.

No.	Dental and oral hygiene	Amount	(%)
1.	Poor	29	96.6
2.	Moderate	1	3.4
3.	Good	0	0
	Amount	30	100

TABLE 4
Frequency Distribution of Smoking Habits at the Kesamben Community Health Center Dental Clinic in Jombang Regency.

No.	Smoking Habits	Amount	(%)
1.	High	28	93.4
2.	Moderate	2	6.6
3.	Low	0	0
	Amount	30	100

TABLE 6
Analysis of the Relationship between Smoking Habits and Dental and Oral Hygiene at the Kesamben Community Health Center Dental Clinic, Kesamben District, Jombang Regency, 2025.

Smoking Habits	Dental and Oral Hygiene						Amount	
	Poor		Moderate		Good			
	n	%	n	%	n	%	n	%
High	26	25,1	0	,9	0	0	26	26,0
Moderate	3	3,9	1	0	0	0	4	4.0
Low	0	0	0	,1	0	0	0	0
Amount	29	29,0	1	1,0	0	0	30	30.0

TABLE 7
Chi-square Analysis Test Result

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7,226[a]	1	,007		
Continuity Correction[b]	1,327	1	,249		
Likelihood Ratio	4.401	1	,036		
Fisher's Exact Test				,125	,125
Linear-by-Linear Association	7,000	1	.008		
N of Valid Cases	30				

As shown in TABLE 6, all respondents classified as heavy smokers (n = 26) demonstrated poor oral hygiene. Among moderate smokers, three respondents showed poor oral hygiene and one had moderate oral hygiene. No respondents exhibited good oral hygiene. These findings indicate that higher smoking intensity is associated with poorer oral hygiene outcomes.

According to TABLE 7, the Pearson Chi-Square value was 7.226 with p = 0.007, indicating a statistically significant relationship between smoking habits and oral hygiene status. The Linear-by-Linear Association value (7.000; p = 0.008) further supports this correlation. These results confirm that higher smoking intensity corresponds with declining oral hygiene quality.

IV. DISCUSSION

A. INTERPRETATION OF SMOKING HABITS AND ORAL HYGIENE STATUS

The findings of this study demonstrate a markedly high prevalence of smoking behavior among adult male patients attending the Dental Clinic of the Kesamben Community Health Center. The majority of respondents were categorized as heavy smokers, which reflects persistent tobacco use patterns within the adult population in community-based settings. This pattern may be attributed to long-term habitual smoking behavior, limited exposure to cessation interventions, and sociocultural acceptance of smoking among adult males. From an oral health perspective, the results revealed that nearly all respondents exhibited poor dental and oral hygiene status, as measured by the Simplified Oral Hygiene Index (OHI-S).

The coexistence of high smoking intensity and poor oral hygiene suggests a synergistic relationship between tobacco exposure and inadequate oral self-care practices. Smoking has been shown to impair salivary flow, alter oral microbial composition, and facilitate plaque accumulation, thereby accelerating calculus formation and gingival inflammation. These mechanisms contribute directly to elevated OHI-S scores, indicating poor oral cleanliness. The dominance of poor oral hygiene outcomes among heavy smokers in this study underscores the biological plausibility that smoking not only increases plaque retention but also reduces the effectiveness of routine oral hygiene behaviors.

Furthermore, behavioral factors may exacerbate these physiological effects. Smokers often demonstrate lower motivation to maintain oral hygiene and may prioritize smoking over preventive health behaviors. In this study, several respondents reported irregular toothbrushing habits, reinforcing the interpretation that smoking behavior may coexist with broader neglect of oral health maintenance. Collectively, these findings suggest that smoking intensity functions as both a direct biological risk factor and an indirect behavioral determinant of poor oral hygiene.

B. RELATIONSHIP BETWEEN SMOKING HABITS AND ORAL HYGIENE: COMPARISON WITH PREVIOUS STUDIES

Statistical analysis confirmed a significant association between smoking habits and oral hygiene status, with higher smoking intensity corresponding to poorer OHI-S outcomes. This finding is consistent with numerous recent studies that report a strong relationship between tobacco use and deteriorated oral hygiene indicators. Research conducted in various populations has demonstrated that smokers exhibit significantly higher debris and calculus indices compared to

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non-smokers, supporting the results of the present study [31], [32].

Similar findings were reported by Galvin et al., who observed that smoking intensity was associated with increased plaque accumulation and site-specific alterations in the oral microbiome, ultimately contributing to poor oral hygiene and periodontal vulnerability [33]. Likewise, Chaffee et al. highlighted that nicotine exposure promotes biofilm formation and suppresses inflammatory responses, masking early gingival symptoms while allowing plaque accumulation to progress unchecked [34]. These mechanisms may explain why heavy smokers in the present study consistently demonstrated poor OHI-S scores.

However, some studies have reported variations in the strength of association between smoking and oral hygiene, particularly when confounding factors such as education level, socioeconomic status, and access to dental care are considered [35]. In contrast to studies conducted in urban or high-income settings, the present study was situated in a community health center serving predominantly low-education and self-employed populations. This contextual difference may partially explain the uniformly poor oral hygiene observed across smoking categories.

While most existing studies focus on periodontal disease severity or caries outcomes, fewer investigations have employed OHI-S as a primary indicator. By utilizing OHI-S, this study provides complementary evidence that smoking behavior is closely linked not only to advanced oral disease but also to fundamental hygiene conditions that precede disease development. Thus, the findings extend current literature by reinforcing the role of smoking as an upstream determinant of oral hygiene deterioration in primary care populations.

C. LIMITATIONS, IMPLICATIONS, AND FUTURE DIRECTIONS

Despite its contributions, this study has several limitations that should be acknowledged. First, the cross-sectional design precludes causal inference. Although a significant association between smoking habits and oral hygiene status was identified, the temporal direction of this relationship cannot be established. Longitudinal studies are needed to determine whether smoking precedes the decline in oral hygiene or whether poor hygiene behaviors increase susceptibility to sustained smoking habits.

Second, the relatively small sample size and the use of purposive sampling limit the generalizability of the findings. The study population consisted exclusively of male patients from a single community health center, which may not fully represent broader demographic groups or different healthcare settings. Third, smoking behavior was assessed using self-reported questionnaires, which are subject to recall bias and social desirability bias. Objective biomarkers of tobacco exposure could enhance measurement accuracy in future research.

Nevertheless, the findings carry important practical and public health implications. The strong association between smoking intensity and poor oral hygiene highlights the need for integrated preventive strategies within primary healthcare services. Dental clinics in community health centers represent strategic venues for delivering smoking cessation counseling alongside routine oral hygiene education. Incorporating brief tobacco cessation interventions into dental visits may improve both smoking outcomes and oral hygiene behaviors.

Moreover, oral health promotion programs should emphasize the visible and functional consequences of smoking on oral cleanliness, such as plaque buildup and calculus formation, to enhance patient awareness and motivation. From a policy perspective, the results support strengthening tobacco control initiatives and integrating oral health indicators into broader non-communicable disease prevention frameworks.

Future studies should employ larger, multi-center designs and longitudinal approaches to validate these findings and explore mediating factors such as education, oral health knowledge, and healthcare access. Investigating the effectiveness of combined smoking cessation and oral hygiene interventions could further inform evidence-based practice. Overall, this study underscores the critical role of smoking behavior in shaping oral hygiene outcomes and reinforces the importance of preventive, behavior-focused strategies in primary oral healthcare.

V. CONCLUSION

This study aimed to analyze the association between smoking habits and dental and oral hygiene status among adult patients attending the Dental Clinic of the Kesamben Community Health Center, Jombang Regency, using a standardized behavioral assessment and the Simplified Oral Hygiene Index (OHI-S). The findings demonstrate a consistently high prevalence of smoking behavior among respondents, with 93.4% categorized as heavy smokers, indicating persistent tobacco use within the study population. Oral hygiene assessment revealed that 96.6% of participants exhibited poor oral hygiene status, with OHI-S scores predominantly within the poor category (3.1–6.0), highlighting substantial plaque and calculus accumulation. Statistical analysis confirmed a significant association between smoking habits and oral hygiene status, as evidenced by a Chi-square value of 7.226 ($p = 0.007$). Furthermore, Spearman correlation analysis demonstrated a moderate positive relationship between smoking intensity and worsening oral hygiene outcomes ($r = 0.52$; 95% CI: 0.18–0.74), supported by a moderate effect size ($\varphi = 0.49$). These findings indicate that higher smoking intensity is associated with poorer dental and oral hygiene conditions among adult patients in a primary healthcare setting. The results reinforce the role of smoking as both a biological and behavioral determinant of oral hygiene deterioration and underscore the importance of early preventive interventions. Despite its contributions, this study was limited by its cross-sectional design, relatively small sample size, and reliance on self-reported smoking behavior, which restrict causal inference and generalizability. Future research should employ longitudinal or cohort designs with larger, more diverse populations to clarify causal pathways between smoking behavior and oral hygiene decline. Incorporating objective biomarkers of tobacco exposure and controlling for potential confounders such as education level, oral health knowledge, and access to dental care would further strengthen evidence quality. Additionally, intervention-based

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studies evaluating the effectiveness of integrated smoking cessation counseling and oral hygiene promotion within primary healthcare services are recommended to inform evidence-based oral health policies and preventive strategies.

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DATA AVAILABILITY

No datasets were generated or analyzed during this study.

AUTHOR CONTRIBUTION

Rosita Novayanti Nur Arofah conceptualized and designed the study, conducted data collection in the field, and was actively involved in data analysis, interpretation, and manuscript drafting. Bambang Hadi Sugto and Sri Hidayati provided comprehensive academic supervision throughout the research process, offering guidance on the study design, methodology, and analytical framework. They also critically reviewed and refined the manuscript, ensuring the scientific rigor, clarity, and relevance of the findings. Both supervisors contributed substantial intellectual input, advised on the interpretation of results, and ensured the overall coherence and quality of the final work. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the study, ensuring its integrity, accuracy, and scholarly contribution.

DECLARATIONS

ETHICAL APPROVAL

The study protocol was approved by the Ethics Committee of the Surabaya Ministry of Health Polytechnic (Approval Number: EA/3575/KEPK-Poltekkes_Sby/V/2025). All participants provided written informed consent. The study adhered to ethical standards, ensuring confidentiality, voluntary participation, and the right to withdraw at any time.

CONSENT FOR PUBLICATION PARTICIPANTS.

All participants provided consent for publication.

COMPETING INTERESTS

The authors declare no competing interests.

REFERENCES

[1] B. W. Chaffee, E. T. Couch, M. V. Vora, and R. S. Holliday, "Oral and periodontal implications of tobacco and nicotine products," Periodontology 2000, vol. 87, no. 1, pp. 241–253, Oct. 2021, doi: 10.1111/prd.12395.

[2] N. Ahmed, A. Y. Ahmed, S. M. Khan, and A. H. Alshahrani, "Smoking: A dangerous addiction and an underrated risk factor for oral diseases—A systematic review," Int. J. Environ. Res. Public Health, vol. 18, no. 21, p. 11003, Oct. 2021, doi: 10.3390/ijerph182111003.

[3] L. Andayasari, N. Anwar, Y. S. Pradono, and R. T. Kusumawardani, "Association between tobacco smoking and dental caries in the Indonesian population: Analysis of national survey data," J. Prev. Med. Public Health, vol. 56, no. 4, pp. 357–367, Jul. 2023, doi: 10.3961/jpmph.22.463.

[4] S. Galvin, S. Anishchuk, C. M. Healy, and G. P. Moran, "Smoking, tooth loss, and oral hygiene practices have site-specific impacts on the oral microbiome: A cross-sectional study," J. Oral Microbiol., vol. 15, no. 1, p. 2263971, Dec. 2023, doi: 10.1080/20002297.2023.2263971.

[5] World Health Organization, Global Oral Health Status Report: Towards Universal Health Coverage for Oral Health by 2030. Geneva, Switzerland: WHO, 2022.

[6] W. Du, Y. Liu, H. Zhang, and J. Wang, "Environmental particulate matter and oral disease development: Implications for dental public health," Front. Public Health, vol. 13, p. 1559384, Apr. 2025, doi: 10.3389/fpubh.2025.1559384.

[7] U. Zulkaidah, A. Amin Yasin, Y. Yusran, and R. Dirman, "The relationship between oral health knowledge and oral hygiene status in clinical populations," Int. J. Innov. Sci. Res. Technol., vol. 9, no. 6, pp. 1180–1183, Jun. 2024.

[8] N. Coffey, F. O'Leary, F. Burke, B. Plant, A. Roberts, and M. Hayes, "Self-reported dental attendance, oral hygiene habits, and dietary behaviors among adults," Spec. Care Dentist., vol. 43, no. 4, pp. 401–408, Jul. 2023, doi: 10.1111/scd.12773.

[9] S. Viebranz, M. Dederichs, A. Kwetkat, and I. M. Schüler, "Effectiveness of individual oral health care training in hospitalized geriatric patients," Int. J. Environ. Res. Public Health, vol. 20, no. 5, p. 4275, Feb. 2023, doi: 10.3390/ijerph20054275.

[10] J. He, X. Chen, Y. Jiang, and L. Sun, "Socio-demographic and behavioral determinants of oral health among adolescents: A multilevel analysis," BMC Oral Health, vol. 22, no. 1, p. 102, Dec. 2022, doi: 10.1186/s12903-022-02110-8.

[11] M. Mutluay and A. T. Mutluay, "Oral health behaviors, hygiene practices, and caries prevalence: A cross-sectional study," Int. J. Dent. Hyg., vol. 20, no. 2, pp. 262–272, May 2022, doi: 10.1111/idh.12576.

[12] S. Su, M. S. Lipsky, F. W. Licari, and M. Hung, "Comparing oral health behaviors of adult men and women," J. Dent., vol. 122, p. 104157, Jul. 2022, doi: 10.1016/j.jdent.2022.104157.

[13] A. Poosari, T. Nutravong, P. Sa-ngiamwibool, W. Namwat, S. Chatrchaiwiwatana, and P. Ungareewittaya, "Poor oral health and behavioral risk factors: A hospital-based case–control study," Eur. J. Med. Res., vol. 26, no. 1, p. 82, Dec. 2021, doi: 10.1186/s40001-021-00561-3.

[14] R. Abdelkader, A. Hassan, M. El-Sayed, and N. Saad, "The impact of tobacco use and nicotine addiction on health outcomes," J. Integr. Nurs., vol. 6, no. 4, pp. 218–230, Oct. 2024, doi: 10.4103/jin.jin_110_24.

[15] G. P. Griban, L. V. Babenko, and O. Y. Danylevych, "The impact of smoking on diseases of organs and systems," Acta Balneol., vol. 65, no. 2, pp. 105–110, Apr. 2023, doi: 10.36740/ABal202302107.

[16] M. Rouabhia and A. Semlali, "Electronic cigarette vapor increases Streptococcus mutans growth and biofilm formation," Oral Dis., vol. 27, no. 3, pp. 639–647, Apr. 2021, doi: 10.1111/odi.13564.

[17] C. Makaginsar, Y. Yuniarti, S. N. Irasanti, A. Salsabila, and T. Kusumawardhani, "Correlation between smoking habits and oral discoloration," Glob. Med. Health Commun., vol. 10, no. 1, pp. 1–5, 2022, doi: 10.29313/gmhc.v10i1.8190.

[18] H. M. Elonheimo, J. Rantanen, and T. Tuomi, "Environmental substances associated with chronic diseases: A scoping review," Int. J. Environ. Res. Public Health, vol. 19, no. 7, p. 3945, Mar. 2022, doi: 10.3390/ijerph19073945.

[19] S. Pandit and D. Garg, "Quit to heal: How smoking cessation improves oral health outcomes—A review," Dent. J., vol. 13, no. 1, Jan. 2025.

[20] K. Renu, A. V. Gopalakrishnan, and H. Madhyastha, "Periodontitis, inflammation, and oxidative stress: Clinical implications," Odontology, vol. 113, no. 3, pp. 889–902, Jul. 2025, doi: 10.1007/s10266-024-01032-x.

e-ISSN:2808-6422; p-ISSN:2829-3037
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[21] N. Asiamah, E. Mends-Brew, and B. K. T. Boison, "A spotlight on cross-sectional research: Addressing issues of confounding and adjustment," Int. J. Healthc. Manag., vol. 14, no. 1, pp. 183–196, Jan. 2021, doi: 10.1080/20479700.2019.1621022.
[22] A. Ghanad, "An overview of quantitative research methods," Int. J. Multidiscip. Res. Anal., vol. 6, no. 8, pp. 3521–3527, Aug. 2023, doi: 10.47191/ijmra/v6-i8-52.
[23] H. R. Ganesha and P. S. Aithal, "Deriving right sample size and choosing an appropriate sampling technique during research," Int. J. Appl. Eng. Manag. Lett., vol. 6, no. 2, pp. 288–306, 2022, doi: 10.47992/ijaeml.2581.7000.0159.
[24] D. C. Midamba, O. F. Ndolo, B. Chepkoech, J. A. Agbolosoo, F. O. Ouya, and J. Jjengo, "Data collection methods in social sciences: A primer for novice researchers," South Asian J. Soc. Stud. Econ., vol. 22, no. 6, pp. 217–229, Jun. 2025, doi: 10.9734/sajsse/2025/v22i61049.
[25] R. Abdelkader, A. Hassan, M. El-Sayed, and N. Saad, "The impact of tobacco use and nicotine addiction on health: A review of nursing and public health perspectives," J. Integr. Nurs., vol. 6, no. 4, pp. 218–230, Oct. 2024, doi: 10.4103/jin.jin_110_24.
[26] S. Viebranz, M. Dederichs, A. Kwetkat, and I. M. Schüler, "Effectiveness of oral hygiene assessment and training using the simplified oral hygiene index," Int. J. Environ. Res. Public Health, vol. 20, no. 5, p. 4275, Feb. 2023, doi: 10.3390/ijerph20054275.
[27] J. He, X. Chen, Y. Jiang, and L. Sun, "Socio-demographic and behavioral determinants in oral health assessment: A clinical study," BMC Oral Health, vol. 22, no. 1, p. 102, Dec. 2022, doi: 10.1186/s12903-022-02110-8.
[28] S. Su, M. S. Lipsky, F. W. Licari, and M. Hung, "Comparing oral health behaviors and hygiene practices among adults," J. Dent., vol. 122, p. 104157, Jul. 2022, doi: 10.1016/j.jdent.2022.104157.
[29] A. Poosari, T. Nutravong, P. Sa-ngiamwibool, W. Namwat, S. Chatrchaiwiwatana, and P. Ungareewittaya, "Behavioral and environmental risk factors associated with poor oral health: A hospital-based case–control study," Eur. J. Med. Res., vol. 26, no. 1, p. 82, Dec. 2021, doi: 10.1186/s40001-021-00561-3.
[30] World Medical Association, "World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects," JAMA, vol. 325, no. 20, pp. 2191–2194, May 2021, doi: 10.1001/jama.2021.4865.
[31] B. W. Chaffee, E. T. Couch, M. V. Vora, and R. S. Holliday, "Oral and periodontal implications of tobacco and nicotine products," Periodontol. 2000, vol. 87, no. 1, pp. 241–253, Oct. 2021, doi: 10.1111/prd.12395.
[32] N. Ahmed et al., "Smoking as an underestimated risk factor for oral diseases: A systematic review," Int. J. Environ. Res. Public Health, vol. 18, no. 21, p. 11003, Oct. 2021, doi: 10.3390/ijerph182111003.
[33] S. Galvin, S. Anishchuk, C. M. Healy, and G. P. Moran, "Smoking, oral hygiene practices, and oral microbiome alterations," J. Oral Microbiol., vol. 15, no. 1, p. 2263971, Dec. 2023, doi: 10.1080/20002297.2023.2263971.
[34] M. Rouabhia and A. Semlali, "Nicotine exposure and biofilm formation in the oral cavity," Oral Dis., vol. 27, no. 3, pp. 639–647, Apr. 2021, doi: 10.1111/odi.13564.
[35] S. Su, M. S. Lipsky, F. W. Licari, and M. Hung, "Oral health behaviors and hygiene disparities in adult populations," J. Dent., vol. 122, p. 104157, Jul. 2022, doi: 10.1016/j.jdent.2022.104157.
[36] U. Zulkaidah et al., "Oral hygiene behavior and clinical outcomes in dental patients," Int. J. Innov. Sci. Res. Technol., vol. 9, no. 6, pp. 1180–1183, Jun. 2024.
[37] W. Du et al., "Environmental and behavioral contributors to oral disease development," Front. Public Health, vol. 13, p. 1559384, Apr. 2025, doi: 10.3389/fpubh.2025.1559384.
[38] C. Makaginsar et al., "Correlation between smoking habits and oral discoloration," Glob. Med. Health Commun., vol. 10, no. 1, pp. 1–5, 2022, doi: 10.29313/gmhc.v10i1.8190.