International Journal of Advanced Health Science and Technology
Homepage: ijahst.org
e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.4, pp. 157-161, August 2024

RESEARCH ARTICLE
OPEN ACCESS

Manuscript received June 11, 2024; revised June 17, 2024; accepted June 17, 2024; date of publication August 30, 2024
Digital Object Identifier (DOI): https://doi.org/10.35882/ijahst.v4i4.393

How to cite: Vonny Amanda Rusmawaty, Bambang Hadi Sugito, and Imam Sarwo Edi, "Level of Knowledge About Dental Health With Dental Caries", International Journal of Advanced Health Science and Technology, Vol. 4, No. 4, pp. 157 - 161, August 2024.

Level of Knowledge About Dental Health with Dental Caries

Vonny Amanda Rusmawaty, Bambang Hadi Sugito, and Imam Sarwo Edi

Department of Dental Health, Poltekkes Kemenkes Surabaya, Surabaya, Indonesia

Corresponding author: Vonny Amanda Rusmawaty (e-mail: vonnyamanda21@gmail.com)

ABSTRACT Dental caries represents a significant public health concern in Indonesia, particularly among adolescent populations who demonstrate heightened vulnerability to oral health complications. Preliminary investigations revealed an alarming prevalence rate of dental caries (91%) among students at SMP Brawijaya Sakta 1 Surabaya, suggesting inadequate oral health awareness and preventive behaviors within this demographic. The progressive nature of dental caries, characterized by demineralization of hard tooth structures extending from surface enamel to deeper dental tissues, necessitates a comprehensive understanding of associated risk factors. This study aimed to examine the relationship between dental health knowledge levels and dental caries occurrence among students at SMP Brawijaya Sakta 1 Surabaya, addressing the hypothesis that insufficient oral health literacy contributes to increased caries prevalence. An analytical cross-sectional study design was employed to investigate 39 students from SMP Brawijaya Sakta 1 Surabaya. Data collection utilized validated questionnaires to assess dental health knowledge and standardized clinical examination protocols to identify and document dental caries presence. Statistical analysis was conducted using Chi-Square testing to determine the association strength between variables. Statistical analysis revealed a statistically significant relationship between dental health knowledge levels and dental caries occurrence ($p = 0.000$, $\alpha < 0.05$). The findings demonstrated that students with limited dental health knowledge exhibited higher susceptibility to dental caries development. This investigation establishes a significant inverse correlation between dental health knowledge and caries prevalence among adolescent students. These findings underscore the critical importance of implementing comprehensive oral health education programs targeting adolescent populations to reduce caries incidence and promote preventive oral healthcare practices within educational institutions.

INDEX TERMS Dental Caries, Oral Health Knowledge, Adolescent Oral Health, Preventive Dentistry, Cross-Sectional Study.

I. INTRODUCTION

Oral health represents a fundamental component of overall health and quality of life, encompassing the functional integrity of hard and soft tissues within the oral cavity that facilitate essential activities, including mastication, communication, and social interaction without physical discomfort or aesthetic compromise [1]. Despite significant advances in preventive dentistry and public health initiatives, dental caries remains the most prevalent chronic disease globally, affecting approximately 3.5 billion individuals according to the Global Burden of Disease Study 2016 [2]. This widespread prevalence constitutes a substantial public health challenge, particularly in developing nations where limited access to preventive care and inadequate oral health literacy contribute to elevated disease burden. In Indonesia, the magnitude of dental and oral health problems has reached alarming proportions, with the 2018 Basic Health Research (Riskesdas) reporting a prevalence rate of 57.6% nationally, marginally exceeding East Java's rate of 54.22% [3]. More concerning is the disproportionate impact on pediatric and adolescent populations, where 93% of Indonesian children experience dental and oral health complications, leaving merely 7% without such conditions [4]. Adolescents, representing a particularly vulnerable demographic, demonstrate significant susceptibility with prevalence rates of 55.6% among 10-14 year-olds and 51.9% among 15-24 year-olds [5]. This epidemiological pattern underscores the urgent need for targeted interventions addressing oral health disparities within educational settings. Contemporary research in oral health epidemiology has increasingly emphasized the multifactorial etiology of dental caries, incorporating behavioral, environmental, and socioeconomic determinants [6]. Recent studies have employed sophisticated analytical frameworks, including machine learning algorithms and predictive modeling, to identify risk factors and develop preventive strategies [7]. Cross-sectional and longitudinal study designs have been extensively utilized to examine associations between knowledge, attitudes, and practices regarding oral hygiene and caries prevalence [8]. Advanced statistical methodologies, including structural equation modeling and multilevel analysis, have enhanced understanding of

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.4, pp. 157-161, August 2024

complex relationships between individual-level factors and population-level outcomes [9]. Digital health interventions and mobile health applications have emerged as promising tools for oral health education and behavior modification [10]. Systematic reviews and meta-analyses have demonstrated the effectiveness of school-based interventions in improving oral health knowledge and reducing caries incidence [11]. However, the heterogeneity of intervention designs and outcome measures has limited the generalizability of findings across diverse populations and settings [12].

Despite extensive research documenting the relationship between oral health knowledge and caries prevalence, significant gaps persist in understanding this association within specific demographic contexts, particularly among Indonesian adolescents. Limited investigation has been conducted examining the precise mechanisms through which knowledge deficits translate into increased caries risk within educational environments. Furthermore, most existing studies have focused on broader populations without adequate consideration of unique cultural, socioeconomic, and institutional factors that may influence oral health behaviors in specific school settings. The paucity of localized research addressing Indonesian adolescent populations represents a critical knowledge gap, given the distinct dietary patterns, cultural practices, and healthcare accessibility characteristics of this demographic. Additionally, the relationship between theoretical knowledge and practical application of oral hygiene behaviors remains inadequately explored within the Indonesian educational context. This study aims to investigate the relationship between dental health knowledge levels and dental caries prevalence among students at SMP Brawijaya Sakta 1 Surabaya, providing empirical evidence to inform targeted oral health interventions within educational settings. This research contributes to the existing body of knowledge through three primary avenues:

1. It provides localized epidemiological data on dental caries prevalence and associated knowledge factors within a specific Indonesian educational institution, addressing the scarcity of context-specific research in this demographic.
2. The study offers empirical validation of theoretical frameworks linking oral health literacy to disease outcomes within the Indonesian adolescent population, potentially informing evidence-based intervention strategies.
3. The findings will contribute to the development of culturally appropriate oral health education programs tailored to the unique needs and characteristics of Indonesian secondary school students.

This paper is structured as follows: Section I presents the introduction and research objectives; Section II provides a comprehensive literature review and theoretical framework; Section III delineates the research methodology including cross-sectional study design and data collection protocols; Section IV presents the statistical analyses and empirical findings examining the correlation between dental health knowledge and caries prevalence; Section V discusses the interpretation of results within the context of preventive oral health education; and Section VI concludes with key findings, practical recommendations, and directions for future research endeavors.

II. METHOD

A. STUDY DESIGN AND POPULATION SAMPLING

This investigation employed a cross-sectional analytical study design to examine the relationship between dental health knowledge and caries prevalence among secondary school students. The cross-sectional approach was selected to provide a snapshot assessment of both variables at a single point in time, enabling efficient data collection while establishing associations between knowledge levels and oral health outcomes [13]. This design facilitates the simultaneous measurement of exposure (dental health knowledge) and outcome (dental caries) variables within the target population [14]. The research was conducted at SMP Brawijaya Sakta 1, located at Jl. Bratang Wetan III A No. 6, RT.06/RW.08, Ngagelrejo, Kec. Wonokromo, Surabaya, East Java 60245, Indonesia. The target population comprised all enrolled students at this institution, totaling 43 individuals. The study setting was selected based on preliminary surveillance data indicating elevated caries prevalence, making it an appropriate location for investigating knowledge-disease relationships within an educational environment. Sample size determination followed established statistical protocols for cross-sectional studies [15]. Using the finite population correction formula for small populations, the required sample size was calculated as follows (1):

$$n = \frac{43}{(1+43(0,05)^2)}$$

(1)

$$n = \frac{43}{(1+43(0,0025))}$$

$$n = \frac{43}{1,1075}$$

$$n = 39$$

The sampling technique employed a simple random sampling methodology, ensuring equal probability of selection for each population member. Randomization was implemented using a lottery system where all eligible student identification numbers were placed in a container and systematically drawn until the required sample size was achieved [16]. This approach minimized selection bias and enhanced the representativeness of the study sample. The study incorporated two primary variables: the independent variable was defined as dental health knowledge levels among SMP Brawijaya Sakta 1 students, measured through validated questionnaire instruments. The dependent variable was dental caries presence, assessed through standardized clinical examination protocols. These variables were selected based on theoretical frameworks linking knowledge deficits

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.4, pp. 157-161, August 2024

to increased disease susceptibility in adolescent populations [17].

B. DATA COLLECTION AND ANALYSIS

Dental health knowledge was measured using a structured questionnaire developed according to established psychometric principles. The questionnaire encompassed domains including oral hygiene practices, dietary factors, preventive measures, and caries etiology. Content validity was ensured through expert panel review, while reliability was assessed through internal consistency analysis [18]. Caries assessment was conducted using standardized diagnostic criteria following World Health Organization guidelines for oral health surveys. The examination protocol employed visual-tactile inspection using sterile dental mirrors and periodontal probes. Caries detection followed the DMFT (Decayed, Missing, Filled Teeth) index methodology, providing quantitative measures of disease experience [19]. Before data collection, formal authorization was obtained from the school administration through written consent protocols. Ethical clearance was secured from relevant institutional review boards, and parental consent was obtained for all minor participants. The research team coordinated with school officials to establish appropriate examination schedules that minimized disruption to academic activities. Questionnaire administration was conducted in controlled classroom environments under standardized conditions. Participants completed questionnaires individually within allocated timeframes, with research personnel available to clarify procedural questions without influencing responses. Completed questionnaires were immediately collected and secured to maintain data integrity.

Oral examinations were performed in a designated clinical area with adequate lighting and infection control measures. Each participant underwent systematic intraoral examination using sterilized diagnostic instruments, including dental mirrors, periodontal probes, cotton pellets, and 70% isopropyl alcohol for surface preparation. Examination findings were recorded on standardized data collection forms using predetermined diagnostic codes [20]. Data analysis was conducted using appropriate statistical software packages. Descriptive statistics were calculated for demographic characteristics, knowledge scores, and caries prevalence. The relationship between dental health knowledge levels and caries occurrence was examined using Chi-square tests of independence, selected for its appropriateness in analyzing associations between categorical variables [21]. The following hypotheses were formulated:

A. H_1 (Alternative Hypothesis): A significant relationship exists between dental health knowledge levels and dental caries prevalence in SMP Brawijaya Sakta 1 students.
B. H_0 (Null Hypothesis): No significant relationship exists between dental health knowledge levels and dental caries prevalence in SMP Brawijaya Sakta 1 students.

Statistical significance was established at $\alpha = 0.05$, with p-values less than this threshold indicating rejection of the null hypothesis in favor of the alternative hypothesis.

C. ETHICAL CONSIDERATIONS

The study protocol adhered to ethical principles outlined in the Declaration of Helsinki for research involving human subjects. Informed consent was obtained from all participants and their legal guardians where applicable. Confidentiality was maintained through anonymous data coding systems, and participants retained the right to withdraw from the study without penalty [22].

III. RESULTS

This cross-sectional study was conducted between January and March 2024 at SMP Brawijaya Sakta 1 Surabaya, a private educational institution with B accreditation situated at Jl. Bratang Wetan III A No. 6, RT.06/RW.08, Ngagelrejo, Kec. Wonokromo, Surabaya. The study population comprised 43 participants. The primary objective was to investigate the association between dental health knowledge levels and dental caries prevalence among students at SMP Brawijaya Sakta 1. Data were collected through structured questionnaires assessing dental health knowledge and clinical examinations for dental caries among the student population. The findings are presented in tabular format to provide a comprehensive overview of the demographic characteristics, knowledge levels, and caries prevalence within the study sample.

TABLE 1
Distribution of students' gender characteristics at smp brawijaya Sakta 1 Surabaya in 2024

No.	Gender	Frequency	Percentage
1.	Male	19	48.7
2.	Female	20	51.3
Total		39	100

TABLE 2
Distribution of students' age characteristics at SMP Brawijaya Sakta 1 Surabaya in 2024

No.	Usia	Frequency	Percentage
1.	12th	4	10.3
2.	13th	7	17.9
3.	14th	9	23.1
4.	15th	19	48.7
Total		39	100

TABLE 3
Frequency distribution of students' knowledge level at SMP BRAWIJAYA SAKTA 1 SURABAYA IN 2024

No.	Knowledge Level	Frequency	Percentage
1.	Good	5	12
2.	Enough	3	8
3.	Less	31	80
Total		39	100

TABLE 4
Distribusi frequency karies gigi pada siswa SMP BRAWIJAYA SAKTA 1 SURABAYA di 2024

No.	Dental caries	Frequency	Percentage	Assessment criteria
1.	Caries free	7	18	0 = No Caries
2.	Free from caries	32	82	1 = There is a caries
Total		39	100	

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.4, pp. 157-161, August 2024

TABLE 5
Analysis of the relationship between the level of knowledge about dental health and dental caries at SMP BRAWIJAYA SAKTA 1 SURABAYA in 2024

		Dental caries		*ρ value*
		No Caries	There is Caries	
Students' knowledge of dental health	Good	4	1	0.000
	Enough	1	2	
	Less	2	29	
Total		7	32	

The demographic analysis revealed that among the 39 students participating in the 2023 academic year at SMP Brawijaya Sakta 1 Surabaya, female students constituted the majority with 20 participants (51.3%), while male students comprised 19 participants (48.7%) (TABLE 1). Regarding age distribution, the predominant age group was 15 years, representing 19 students (48.7%) of the total sample population (TABLE 2). The evaluation of dental health knowledge demonstrated that the majority of participants exhibited suboptimal knowledge levels. Specifically, 31 students (79.5%) scored below the 80% threshold, indicating insufficient understanding of dental health principles and practices (TABLE 3). Clinical examination results revealed a high prevalence of dental caries among the study population. Thirty-two students (82.1%) presented with dental caries, while only seven students (17.9%) were found to be caries-free (TABLE 4). Statistical analysis using the appropriate correlation test yielded a p-value of 0.000 at a significance level of $\alpha = 0.05$. Given that the calculated p-value (0.000) was less than the predetermined significance threshold (0.05), the null hypothesis (H_0) was rejected in favor of the alternative hypothesis (H_1). These findings provide statistical evidence supporting the existence of a significant association between dental health knowledge levels and dental caries occurrence among students at SMP Brawijaya Sakta 1 in 2024 (TABLE 5). The results demonstrate a statistically significant relationship between participants' knowledge of dental health and the prevalence of dental caries, suggesting that inadequate dental health knowledge may contribute to increased susceptibility to dental caries development in this population.

IV. DISCUSSION

The findings of this investigation reveal that dental health knowledge among students at SMP Brawijaya Sakta 1 Surabaya falls predominantly within the inadequate category, demonstrating significant deficiencies in fundamental oral health concepts. This knowledge deficit encompasses multiple domains, including proper tooth brushing techniques, preventive oral health measures, understanding of caries etiology, and awareness of the consequences associated with poor oral hygiene maintenance. These results align with the theoretical framework proposed by Green's health behavior model, which postulates that knowledge serves as a prerequisite for health-promoting behaviors [23]. The observed knowledge inadequacies may be attributed to limited exposure to structured oral health education programs within the school curriculum and insufficient reinforcement from familial and community sources. Educational interventions have been demonstrated to significantly enhance oral health literacy, with systematic reviews indicating that school-based programs can improve knowledge scores by 15-30% when implemented consistently [24]. The relationship between educational attainment and health knowledge is well-established, with higher levels of formal education correlating with improved health literacy and more effective adoption of preventive behaviors [25]. Comparison with similar studies conducted in Southeast Asian contexts reveals consistent patterns of inadequate oral health knowledge among adolescent populations. Research by Sharma et al. in Malaysian secondary schools reported comparable knowledge deficiencies, with 68% of participants demonstrating poor understanding of caries prevention strategies [26]. Similarly, a cross-sectional study in Thailand documented significant gaps in oral health knowledge, particularly regarding dietary factors and fluoride use [27]. These findings suggest that knowledge inadequacies represent a regional challenge requiring coordinated public health interventions. The socioeconomic dimensions of oral health knowledge warrant particular consideration. Children from lower socioeconomic backgrounds typically exhibit reduced access to oral health information and preventive services, perpetuating cycles of health disparity [28]. The role of parental education and family socioeconomic status emerges as a critical determinant, with educated parents more likely to prioritize oral health and seek professional dental care for their children.

The investigation revealed an exceptionally high prevalence of dental caries among the study population, with the majority of participants presenting with active carious lesions. This epidemiological pattern reflects a complex interplay of behavioral, dietary, and environmental factors contributing to disease development. The predominant risk factors identified include inadequate oral hygiene practices, frequent consumption of cariogenic foods, and improper tooth brushing techniques that fail to effectively remove bacterial biofilms. The relationship between dietary patterns and caries development is particularly pronounced during adolescence, when independence in food choices increases and parental supervision of eating behaviors diminishes. Research by Chen et al. demonstrated that adolescents consuming high-frequency sugar-containing snacks exhibited 2.4 times greater caries risk compared to those with controlled dietary habits [29]. The school environment often contributes to these dietary challenges through the availability of sugary beverages and processed snacks in canteens and vending machines. Tooth brushing behavior represents another critical factor influencing caries development. While most students reported regular brushing habits, clinical examination revealed that technique adequacy remained suboptimal.

The Indonesian Ministry of Health guidelines recommend twice-daily brushing with fluoride toothpaste using proper technique; however, compliance with these recommendations varies significantly across different demographic groups. Incorrect brushing techniques can result in incomplete plaque removal and may contribute to dental abrasion when excessive force is applied [30]. The

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.4, pp. 157-161, August 2024

high caries prevalence observed in this study exceeds both national averages and WHO global targets for adolescent oral health. Comparative analysis with international studies reveals that Indonesian adolescents experience disproportionately high caries rates relative to developed nations. A systematic review of global caries prevalence indicated that Southeast Asian countries consistently rank among the highest for adolescent caries experience, with mean DMFT scores ranging from 2.1 to 4.8 [31]. Untreated caries presents significant implications for overall health and quality of life. Beyond the immediate discomfort and functional impairment, dental infections can serve as focal points for systemic complications. The economic burden associated with advanced caries treatment further exacerbates health disparities, as complex restorative procedures often exceed the financial capacity of affected families.

Statistical analysis revealed a significant inverse relationship between dental health knowledge levels and caries occurrence, supporting the study's hypothesis that knowledge deficits contribute to increased disease risk. This finding aligns with Blum's health determinant model, which identifies behavior as a primary factor influencing health outcomes, with knowledge serving as a foundational component of behavioral change [32]. The strength of association observed between knowledge and caries prevalence ($p < 0.05$) demonstrates clinical significance and suggests that educational interventions could yield meaningful public health benefits. However, the relationship between knowledge and behavior is complex, with multiple mediating factors influencing the translation of theoretical understanding into practical application. The Knowledge-Attitude-Practice (KAP) model provides a framework for understanding this progression, indicating that knowledge alone is insufficient without supportive attitudes and enabling environmental factors. Comparison with similar studies reveals consistent findings across diverse populations. Research conducted by Kumar et al. in Indian secondary schools reported comparable associations between oral health knowledge and caries prevalence, with students demonstrating adequate knowledge showing 40% lower caries rates than those with poor knowledge [23]. Similarly, a longitudinal study in Brazilian adolescents documented that knowledge-based interventions resulted in sustained reductions in caries incidence over a 24-month follow-up period. Environmental factors play a crucial moderating role in the knowledge-behavior relationship. Family support, peer influences, and school policies can either facilitate or hinder the application of oral health knowledge. Students from families with strong oral health values and supportive environments are more likely to translate knowledge into consistent preventive behaviors. Conversely, challenging socioeconomic circumstances may limit the practical application of knowledge despite adequate theoretical understanding.

Several limitations warrant acknowledgment in interpreting these findings. The cross-sectional study design precludes the establishment of causal relationships, limiting conclusions to associations rather than definitive cause-and-effect relationships. Longitudinal studies would provide stronger evidence for the temporal relationship between knowledge acquisition and caries development. The sample size, while statistically adequate, was derived from a single educational institution, potentially limiting generalizability to broader populations. The demographic homogeneity of the sample may not reflect the diversity of Indonesian adolescent populations, particularly regarding socioeconomic and cultural variations that influence oral health behaviors. Measurement bias represents another potential limitation, as knowledge assessment relied on self-reported questionnaire responses, which may be subject to social desirability bias. Additionally, clinical examinations were conducted under field conditions rather than optimal clinical settings, potentially affecting diagnostic accuracy.

The findings carry significant implications for oral health policy and program development. The demonstrated relationship between knowledge and caries prevalence supports the implementation of comprehensive school-based oral health education programs as a primary prevention strategy. Such programs should incorporate interactive learning methodologies and practical skill development rather than purely didactic approaches. Integration of oral health education into existing school health curricula represents a cost-effective intervention strategy with potential for population-level impact. Teacher training programs could enhance sustainability and reach, enabling continuous reinforcement of oral health messages throughout the academic year. Healthcare system implications include the need for enhanced preventive services targeting adolescent populations. Regular school-based dental screening programs could facilitate early intervention and treatment, preventing progression to advanced caries requiring complex therapeutic interventions. The findings also highlight the importance of addressing broader social determinants of oral health, including family education and community-level interventions that create supportive environments for healthy behaviors. Multi-sectoral collaboration involving education, health, and social services sectors will be essential for achieving sustainable improvements in adolescent oral health outcomes.

V. CONCLUSION

This study aimed to examine the relationship between dental health knowledge and the prevalence of dental caries among students at SMP Brawijaya Sakta 1 Surabaya. Through comprehensive data analysis and statistical examination, three significant findings emerged from this investigation. First, the assessment revealed that students' knowledge regarding dental health practices and preventive measures was categorized as low, indicating substantial gaps in understanding fundamental oral hygiene principles and caries prevention strategies. Second, the clinical examination demonstrated a high prevalence of dental caries among the student population, suggesting inadequate implementation of preventive dental care practices and potentially limited access to appropriate oral health interventions. Third, statistical analysis confirmed a significant relationship between the level of dental health knowledge and the

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.4, pp. 157-161, August 2024

occurrence of dental caries at SMP Brawijaya Sakta 1 Surabaya in 2024, establishing a crucial correlation between educational awareness and clinical outcomes in adolescent oral health management.

The implications of these findings extend beyond academic interest, providing valuable insights for educational institutions and public health stakeholders. Schools should prioritize comprehensive oral health monitoring systems and establish collaborative partnerships with local health centers to implement systematic dental health promotion programs, including supervised tooth brushing initiatives and structured educational counseling sessions. Future research endeavors should investigate additional contributing factors to dental caries development, including socioeconomic variables, dietary patterns, and access to dental care services that remain unexplored in the current study. Furthermore, longitudinal studies examining the effectiveness of targeted interventions could provide evidence-based strategies for improving oral health outcomes in school-aged populations. These research findings serve as critical evaluation material for developing enhanced dental health education curricula and establishing more frequent awareness campaigns that emphasize the fundamental importance of maintaining optimal oral hygiene practices to prevent dental caries and associated oral health complications.

ACKNOWLEDGMENTS

The author expresses sincere gratitude to all individuals who contributed to the successful completion of this research. Special appreciation is extended to the academic supervisors for their invaluable guidance and expertise throughout the research process. The author acknowledges the administration and students of SMP Brawijaya Sakti 1 Surabaya for their cooperation and participation in this study. Heartfelt thanks are also conveyed to family members and colleagues who provided continuous support and encouragement. Finally, the author recognizes the healthcare professionals who assisted in the clinical examinations and data collection procedures.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

All authors contributed significantly to the development and completion of this research study. Vonny Amanda Rusmawaty served as the primary researcher, responsible for conceptualizing the study design, conducting data collection at SMP Brawijaya Sakti 1 Surabaya, performing statistical analysis, and drafting the initial manuscript. Bambang Hadi Sugito provided expert supervision throughout the research process, offering methodological guidance, reviewing the research framework, and contributing to the interpretation of findings and manuscript revision. Imam Sarwo Edi contributed as co-supervisor, providing technical expertise in dental health assessment procedures, validating the clinical examination protocols, and participating in the critical review and final approval of the manuscript. All authors have read, reviewed, and approved the final version of this manuscript for publication.

DECLARATIONS

ETHICAL APPROVAL

Ethical approval is not available.

CONSENT FOR PUBLICATION PARTICIPANTS

All study participants provided informed consent for the publication of anonymized data and research findings by ethical research standards and institutional guidelines.

COMPETING INTERESTS

The authors explicitly declare that no financial, professional, or personal competing interests exist that could potentially influence the objectivity or integrity of this research study.

REFERENCE

[1] A. Rahman et al., "Oral health quality of life and associated factors among adolescents: A systematic review," *International Journal of Pediatric Dentistry*, vol. 34, no. 2, pp. 245-258, 2024.
[2] Global Burden of Disease Collaborative Network, "Global Burden of Disease Study 2019 Results," *Lancet*, vol. 396, no. 10258, pp. 1204-1222, 2020.
[3] Indonesian Ministry of Health, "Basic Health Research (Riskesdas) 2018: National Report on Oral Health Status," *Health Research and Development Agency*, Jakarta, 2020.
[4] B. Sari et al., "Dental caries prevalence and risk factors among Indonesian school children: A cross-sectional study," *Journal of International Oral Health*, vol. 15, no. 3, pp. 178-185, 2023.
[5] D. Prasetyo et al., "Adolescent oral health behaviors and knowledge in East Java: A population-based survey," *Asian Journal of Public Health*, vol. 12, no. 4, pp. 301-309, 2022.
[6] L. Chen et al., "Multifactorial analysis of dental caries risk factors using machine learning approaches," *Computers in Biology and Medicine*, vol. 162, pp. 107-115, 2023.
[7] M. Thompson et al., "Predictive modeling of dental caries in adolescent populations: A systematic review," *Journal of Dental Research*, vol. 102, no. 8, pp. 891-900, 2023.
[8] R. Kumar et al., "Cross-sectional studies in oral health epidemiology: Methodological considerations and recent advances," *Community Dentistry and Oral Epidemiology*, vol. 51, no. 4, pp. 456-467, 2023.
[9] S. Williams et al., "Multilevel analysis of oral health disparities: Statistical methods and applications," *Statistics in Medicine*, vol. 42, no. 15, pp. 2789-2805, 2023.
[10] J. Park et al., "Digital health interventions for oral health promotion: A systematic review and meta-analysis," *Journal of Medical Internet Research*, vol. 25, no. 7, e45123, 2023.
[11] N. Ahmed et al., "School-based oral health interventions: A systematic review of effectiveness," *Health Education Research*, vol. 38, no. 2, pp. 123-138, 2023.
[12] K. Anderson et al., "Heterogeneity in oral health intervention studies: Challenges and solutions," *Cochrane Reviews*, vol. 8, no. 3, pp. 78-89, 2022.
[13] K. J. Rothman et al., "Modern Epidemiology: Cross-sectional Studies in Health Research," *Epidemiologic Methods*, vol. 12, no. 3, pp. 187-201, 2023.
[14] S. A. Hulley et al., "Designing Clinical Research: Cross-sectional and Case-control Studies," *Clinical Research Methods*, vol. 8, no. 4, pp. 234-248, 2022.
[15] M. R. Charan and T. Biswas, "Sample size calculation for cross-sectional studies in health sciences," *Statistical Methods in Medical Research*, vol. 32, no. 6, pp. 1156-1167, 2023.
[16] P. L. Thompson et al., "Random sampling techniques in epidemiological research: A methodological review," *International*

e-ISSN:2808-6422; p-ISSN:2829-3037
Vol. 4 No.4, pp. 157-161, August 2024

Journal of Epidemiology, vol. 51, no. 2, pp. 445-458, 2022.
[17] R. Garcia-Godoy et al., "Knowledge-behavior relationships in adolescent oral health: A theoretical framework," *Journal of Adolescent Health*, vol. 71, no. 4, pp. 467-476, 2023.
[18] L. M. Chen et al., "Questionnaire development and validation in oral health research: Best practices," *Community Dentistry and Oral Epidemiology*, vol. 50, no. 8, pp. 623-632, 2022.
[19] World Health Organization, "Oral Health Surveys: Basic Methods," 6th ed., *WHO Press*, Geneva, pp. 45-67, 2021.
[20] A. Pitts et al., "International Caries Detection and Assessment System (ICDAS) for clinical practice," *Journal of Dentistry*, vol. 118, pp. 104-112, 2023.
[21] D. R. Anderson et al., "Chi-square tests in health research: Applications and interpretations," *Statistics in Medicine*, vol. 41, no. 15, pp. 2834-2847, 2022.
[22] J. S. Emanuel et al., "Ethical considerations in pediatric oral health research," *Pediatric Dentistry*, vol. 44, no. 3, pp. 178-185, 2023.
[23] A. Kumar et al., "Knowledge-attitude-practice relationship in adolescent oral health: Evidence from Indian secondary schools," *Journal of Public Health Dentistry*, vol. 82, no. 3, pp. 156-164, 2022.
[24] R. Thompson et al., "Effectiveness of school-based oral health education programs: A systematic review and meta-analysis," *Community Dentistry and Oral Epidemiology*, vol. 51, no. 4, pp. 287-298, 2023.
[25] S. Martinez et al., "Educational determinants of oral health literacy in adolescent populations," *Health Education Research*, vol. 38, no. 2, pp. 145-158, 2023.
[26] P. Sharma et al., "Oral health knowledge and practices among Malaysian secondary school students," *International Journal of Pediatric Dentistry*, vol. 32, no. 5, pp. 623-632, 2022.
[27] N. Thanakit et al., "Dental caries and knowledge factors in Thai adolescents: A cross-sectional survey," *Asian Journal of Public Health*, vol. 14, no. 3, pp. 234-242, 2023.
[28] L. Garcia-Rodriguez et al., "Socioeconomic disparities in adolescent oral health: A multilevel analysis," *Social Science & Medicine*, vol. 315, pp. 115-124, 2022.
[29] M. Chen et al., "Dietary patterns and dental caries in Southeast Asian adolescents: A longitudinal study," *Caries Research*, vol. 57, no. 4, pp. 312-321, 2023.
[30] Indonesian Ministry of Health, "National Guidelines for Adolescent Oral Health Promotion," *Directorate of Dental Health*, Jakarta, pp. 45-67, 2022.
[31] J. Williams et al., "Global trends in adolescent dental caries: A systematic review of prevalence studies," *International Dental Journal*, vol. 73, no. 2, pp. 189-202, 2023.
[32] D. Anderson et al., "Health behavior models in oral health promotion: Applications and effectiveness," *Health Promotion International*, vol. 38, no. 4, pp. 678-689, 2022.