

Association Between Oral Health Maintenance Knowledge and Tooth Loss Among Older Adults in Surabaya

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ABSTRACT Tooth loss remains a major oral health problem among older adults and may impair mastication, nutritional intake, communication, and quality of life. Although adequate knowledge of oral health maintenance may support preventive behaviors, evidence regarding its relationship with tooth loss among community-dwelling older adults in Surabaya remains limited. This study aimed to determine the association between oral health maintenance knowledge and the number of missing teeth among older adults attending Posyandu Lansia Sekar Arum, Kertajaya, Surabaya. An analytical observational study with a cross-sectional design was conducted among 54 older adults aged 65 years and above selected using simple random sampling from 62 registered individuals. Oral health maintenance knowledge was assessed using a validated structured questionnaire, while tooth loss was determined through direct oral examination. Data were analyzed descriptively and using the Chi-square test, with Cramér's V used to estimate the strength of association. The results showed that 46 participants (85.2%) had poor oral health maintenance knowledge, whereas 44 participants (81.5%) had lost more than ten teeth. Cross-tabulation demonstrated that 41 of 46 participants (89.1%) with poor knowledge had experienced tooth loss exceeding ten teeth. The Chi-square analysis demonstrated a statistically significant association between oral health maintenance knowledge and tooth loss ($\chi^2 = 36.42$, $df = 6$, $p < 0.001$), with Cramér's V = 0.58, indicating a strong association. These findings indicate that inadequate oral health maintenance knowledge is associated with greater tooth loss among older adults in the study population. Strengthening age-appropriate oral health education and preventive services through community-based health programs may support better oral health practices and preservation of natural teeth among older adults.

INDEX TERMS Older Adults, Oral Health Maintenance Knowledge, Oral Health, Tooth Loss, Community-Based Oral Health Promotion.

I. INTRODUCTION

Oral health is an essential component of healthy ageing because adequate oral function supports eating, speaking, social interaction, psychological well-being, and overall quality of life [1], [2]. The increasing proportion of older adults has consequently intensified the public health importance of maintaining oral health throughout later life. Older adults are particularly vulnerable to cumulative oral conditions, including dental caries, periodontal disease, tooth loss, and oral frailty, which may compromise functional ability and nutritional status [3]–[5]. Globally, oral diseases affect a substantial proportion of the population, while tooth loss represents the cumulative consequence of longstanding oral disease and inadequate access to preventive and restorative care [1], [3]. In older populations, extensive tooth loss may further contribute to impaired mastication, reduced dietary variety, social limitations, and deterioration in quality of life [4], [6], [7].

Tooth loss is a multifactorial condition commonly associated with untreated dental caries and periodontal

disease, while socioeconomic circumstances, educational attainment, healthcare accessibility, and preventive health behaviors may also influence tooth retention [8]–[11]. Recent epidemiological evidence indicates that tooth loss remains a considerable concern among older adults despite improvements in oral healthcare in some populations [3], [12]. The consequences extend beyond the oral cavity because reduced oral function has been associated with oral frailty, malnutrition, physical frailty, and other adverse outcomes in older adults [5], [13], [14]. Therefore, prevention of tooth loss should not focus solely on clinical treatment but should also incorporate behavioral and educational approaches that strengthen individuals' capacity to maintain oral health.

Oral health knowledge is an important component of preventive behavior because individuals require adequate understanding of oral hygiene practices, disease risk factors, consequences of tooth loss, and appropriate utilization of professional dental services [15], [16]. Recent research on oral health literacy indicates associations with oral hygiene behavior, number of remaining teeth, periodontal conditions,

prosthesis use, and oral health-related quality of life among older adults [16], [17]. Nevertheless, the available evidence is not completely consistent, and recent reviews have highlighted the limited number of studies specifically examining oral health literacy and clinically measured oral outcomes in older populations [16]. Educational interventions have also demonstrated potential for improving oral health knowledge and preventive practices among older adults, including community-based and technology-assisted approaches [18]–[20]. These findings support the relevance of educational factors while also indicating the need for context-specific evidence.

In Indonesia, previous studies have reported relationships between oral health knowledge, oral hygiene behavior, and tooth loss among older adults [21], [22]. However, evidence concerning community-dwelling older adults in Surabaya remains limited. The present study therefore addresses a contextual research gap by examining whether oral health maintenance knowledge is associated with the objectively assessed number of missing teeth among older adults participating in a community health-post program. This focus is particularly relevant because community-based health services provide an accessible setting for preventive oral health promotion and early identification of oral health problems. Preliminary observations at Posyandu Lansia Sekar Arum, Kertajaya, Surabaya, indicated considerable tooth loss accompanied by limited knowledge concerning oral health maintenance, providing a practical basis for further investigation.

Accordingly, this study aimed to determine the association between oral health maintenance knowledge and the number of missing teeth among older adults at Posyandu Lansia Sekar Arum, Kertajaya, Surabaya. The study provides three principal contributions. First, it provides empirical evidence regarding the distribution of oral health maintenance knowledge among community-dwelling older adults. Second, it evaluates the relationship between knowledge and clinically assessed tooth loss rather than relying exclusively on self-reported oral health status. Third, it provides community-level evidence that may support the development of targeted oral health education and preventive programs for older adults in Surabaya. The remainder of this article is organized as follows: Section II describes the study design, setting, participants, variables, data collection procedures, statistical analysis, and ethical considerations; Section III presents the study findings; Section IV discusses the interpretation of the results, comparison with previous evidence, methodological limitations, and practical implications; and Section V presents the conclusions and recommendations for future research.

II. METHOD

A. STUDY DESIGN AND SETTING

This study employed a quantitative analytical observational design with a cross-sectional approach to examine the association between oral health maintenance knowledge and tooth loss among older adults. The cross-sectional design was selected because the exposure variable, namely oral health maintenance knowledge, and the outcome variable, namely tooth loss, were assessed during the same study period without experimental intervention or longitudinal follow-up. This design is appropriate for evaluating associations between

variables within a defined population, provided that causal relationships are not inferred from the findings [23], [24]. The study was conducted at Posyandu Lansia Sekar Arum, Kertajaya, Surabaya, Indonesia, from January to February 2026. The study followed the general principles of transparent reporting for observational research, including explicit descriptions of the study design, setting, participants, variables, measurement procedures, and statistical analysis [23].

B. STUDY POPULATION AND PARTICIPANTS

The target population comprised all older adults registered at Posyandu Lansia Sekar Arum during the study period. The accessible population consisted of 62 registered older adults. Participants were eligible if they were aged 65 years or older, were registered at the study site, were willing to participate, and provided written informed consent. Individuals were excluded if they refused participation, did not complete the questionnaire, or were unable to undergo the oral examination because of severe illness or insufficient cooperation during data collection. The eligibility criteria were established before recruitment to maintain consistency in participant selection.

The sample size was determined using the Slovin formula with a population size of 62 individuals and an error tolerance of 5%. The calculation resulted in a minimum sample of 54 participants. A simple random sampling technique was then used to select the participants from the eligible population, giving each population member an equal probability of selection. A total of 54 participants completed both the questionnaire and oral examination, and no participant was lost during data collection. The use of explicit eligibility criteria, participant selection procedures, and sample-size justification is consistent with recommended reporting principles for cross-sectional observational studies [23], [24].

C. STUDY VARIABLES AND OPERATIONAL DEFINITIONS

The independent variable was oral health maintenance knowledge. Knowledge was assessed through a structured questionnaire covering fundamental aspects of oral hygiene, causes and consequences of tooth loss, preventive practices, and the importance of professional dental care. The total questionnaire score was converted into three categories: good knowledge (>75%), moderate knowledge (56–74%), and poor knowledge (<55%). The use of structured oral-health knowledge or literacy instruments among older adults is consistent with recent studies investigating oral health literacy and related oral health outcomes [25], [26].

The dependent variable was tooth loss, defined as the number of permanent teeth absent from the oral cavity as a consequence of dental disease, particularly dental caries or periodontal disease. Tooth loss was categorized into four groups: fewer than 6 teeth lost, 6–10 teeth lost, more than 10 teeth lost, and complete tooth loss. Third molars, teeth removed for orthodontic treatment, retained roots, dental implants, and congenitally absent teeth were not included in the tooth-loss count to minimize classification errors and improve comparability of clinical measurements. Tooth retention and the number of remaining natural teeth are recognized indicators of oral health status among older adults [27].

D. DATA COLLECTION INSTRUMENTS AND PROCEDURES

Data collection consisted of two sequential procedures: administration of the oral health maintenance knowledge questionnaire and direct oral examination. Before the main data collection, the questionnaire was pilot-tested to assess its face and content suitability for the target population. The questionnaire was presented in Indonesian to facilitate comprehension among older participants. Internal consistency was assessed using Cronbach's alpha, with a coefficient greater than 0.70 considered acceptable for the instrument used in this study. Recent research among older adults has similarly applied validated oral-health literacy instruments and assessed their internal consistency before analysis [25], [26].

After questionnaire completion, participants underwent a direct oral examination conducted by qualified dental health personnel. The examination was performed using a plane mouth mirror and dental explorer under adequate lighting conditions. Standard infection-control procedures were applied throughout the examination. The examiner recorded the presence or absence of permanent teeth on a standardized oral examination form. The number of missing teeth was subsequently calculated according to the predefined operational criteria. Direct clinical assessment was used rather than self-reported tooth loss to reduce dependence on participant recall and provide an objective measurement of the outcome. Previous research has also used clinical assessment of tooth retention or tooth loss when examining oral health outcomes among older adults [27], [28].

E. DATA MANAGEMENT AND STATISTICAL ANALYSIS

Completed questionnaires and examination forms were checked for completeness before data entry. Data were coded and entered into IBM SPSS Statistics for statistical analysis. Descriptive statistics were used to summarize the distribution of oral health maintenance knowledge and tooth-loss categories using frequencies and percentages.

Before inferential analysis, questionnaire item validity was assessed using Pearson's product-moment correlation, while internal consistency was evaluated using Cronbach's alpha. The association between oral health maintenance knowledge and tooth loss was examined using the Chi-square test of independence because both variables were categorized into nominal or ordinal groups. Statistical significance was determined at a two-sided p-value of <0.05 . The Chi-square statistic, degrees of freedom, and p-value were reported. Because statistical significance alone does not describe the magnitude of an association, Cramér's V was additionally calculated as an effect-size measure for the contingency table. Exact probability values were reported, and values smaller

than 0.001 were expressed as $p < 0.001$ rather than $p = 0.000$. This analytical approach was selected to provide both evidence of statistical association and an estimate of its strength.

F. ETHICAL CONSIDERATIONS

Permission to conduct the study was obtained from the management of Posyandu Lansia Sekar Arum before participant recruitment. Each eligible participant received an explanation of the study objectives, procedures, potential requirements, and voluntary nature of participation before providing written informed consent. Participants were informed that they could decline participation or discontinue their involvement without consequences. Personal information was kept confidential, and participant identities were protected during data collection, data processing, analysis, and reporting. All procedures involving human participants were conducted in accordance with applicable

TABLE 1
Distribution of Oral Health Maintenance Knowledge Among Older Adults (n = 54)

Category	Frequency	Percentage(%)
Good	4	7.4%
Moderate	4	7.4%
Poor	46	85.2%
Total	54	100%

ethical principles for health research.

III. RESULTS

The study was conducted between January and February 2026 at Posyandu Lansia Sekar Arum, Kertajaya, Surabaya. Fiftyfour older adults were recruited from a total population of 62 registered elderly individuals. Data were obtained through a structured questionnaire assessing oral health maintenance knowledge, followed by a clinical oral to evaluate the extent of tooth loss by counting the missing teeth.

According to the data presented in [TABLE 1](#), the majority of elderly respondents had poor knowledge regarding oral and dental health maintenance, accounting for 46 respondents

TABLE 2
Distribution of Tooth Loss Among Older Adults (n = 54)

Category	Frequency	%
<6 teeth lost	1	1.9%
6-10 teeth lost	6	11.1%
>10 teeth lost	44	81.5%
Complete tooth loss	3	5.5%
Total	54	100%

TABLE 3
Cross-Tabulation of Oral and Dental Health Maintenance Knowledge and Tooth Loss Among Elderly at Posyandu Lansia Sekar Arum, Kertajaya, Surabaya

Knowledge Category	Tooth Loss Category				Total	Test Statistic	P-Value	Cramer's V
	<6 Teeth Loss	6-10 Teeth Loss	>10 Teeth Loss	Complete Tooth Loss				
Good	1	3	0	0	4	Chi-square ($X^2=36.42$, $df=6$)	<0.001	0.58 (Strong)
Moderate	0	1	3	0	4			
Poor	0	2	41	3	46			
Total	1	6	44	3	54			

(85.2%). Meanwhile, only 4 respondents (7.4%) were categorized as having good knowledge and 4 respondents (7.4%) had moderate knowledge. These findings indicate that the overall level of oral and dental health maintenance knowledge among elderly individuals at Posyandu Lansia Sekar Arum was generally low.

This study was conducted at Posyandu Lansia Sekar Arum, Kertajaya Village, Surabaya, from January to February 2026. A total of 54 elderly respondents participated in the study, selected from a population of 62 elderly individuals. Data collection was carried out using a validated questionnaire to measure knowledge of oral and dental health maintenance and a dental examination sheet to determine the number of missing teeth. The results are presented descriptively and analytically in the following [TABLE 2](#).

According to the cross-tabulation in [TABLE 3](#), the vast majority of older adults with poor oral health maintenance knowledge experienced extensive tooth loss (>10 teeth lost), accounting for 41 respondents (89.1% of the poor knowledge group). Conversely, participants with good knowledge mostly retained more teeth, with 3 respondents (75.0%) experiencing only 6–10 teeth lost and 1 respondent (25.0%) losing fewer than 6 teeth.

The Chi-square test ($X^2 = 36.42$, $df = 6$) revealed a statistically significant association between oral health maintenance knowledge and tooth loss among older adults ($p < 0.001$). Furthermore, Cramér's V was calculated at 0.58, indicating a strong effect size/association between lower knowledge levels and a greater degree of tooth loss.

IV. DISCUSSION

A. INTERPRETATION OF THE MAIN FINDINGS

This study demonstrated a statistically significant association between oral health maintenance knowledge and tooth loss among older adults attending Posyandu Lansia Sekar Arum, Kertajaya, Surabaya. The Chi-square analysis produced a value of $\chi^2 = 36.42$ with 6 degrees of freedom and $p < 0.001$, while Cramér's V was 0.58. The magnitude of the association indicates that differences in knowledge categories were accompanied by substantial differences in the distribution of tooth-loss categories within the study population. However, because the present study used a cross-sectional design, the statistical association should not be interpreted as evidence that poor knowledge directly caused tooth loss. Rather, the findings indicate that oral health maintenance knowledge and the extent of tooth loss were significantly related at the time of assessment.

The descriptive findings provide an important context for interpreting this association. Of the 54 participants, 46 individuals (85.2%) were categorized as having poor oral health maintenance knowledge, whereas only 4 participants (7.4%) were classified as having good knowledge and another 4 participants (7.4%) as having moderate knowledge. At the same time, 44 participants (81.5%) had lost more than ten teeth, 6 participants (11.1%) had lost 6–10 teeth, 1 participant (1.9%) had lost fewer than six teeth, and 3 participants (5.5%) experienced complete tooth loss. The concentration of participants in the poor-knowledge and extensive-tooth-loss categories suggests that oral health problems in this community should be considered in relation to long-term

patterns of oral hygiene, disease prevention, dental attendance, and treatment-seeking behavior.

The cross-tabulation further illustrates this pattern. Among the 46 participants with poor knowledge, 41 individuals (89.1%) had lost more than ten teeth and 3 individuals (6.5%) experienced complete tooth loss. In contrast, none of the participants with good knowledge were classified as having lost more than ten teeth or having complete tooth loss. Participants with moderate knowledge showed an intermediate distribution, with 3 of 4 individuals (75.0%) experiencing loss of more than ten teeth. This gradient is consistent with the concept that knowledge can form an important component of health behavior, although knowledge alone is not sufficient to explain the development of oral disease.

Recent evidence provides support for the relevance of oral health literacy to tooth loss among older adults. Li et al. reported that oral health literacy was significantly associated with the number of lost teeth among 407 older adults after adjustment for sociodemographic characteristics, economic factors, and oral-health-related behaviors. Their Poisson regression analysis indicated that participants with higher oral health literacy had fewer lost teeth than those with lower literacy. This finding is directionally consistent with the present study, although the analytical approaches differed. The current study used categorized knowledge levels and the Chi-square test, whereas Li et al. treated tooth loss within a multivariable regression framework. Consequently, the present findings should be interpreted as an observed association rather than an independently adjusted effect.

The relationship is also consistent with broader evidence concerning oral health literacy. A 2024 scoping review reported associations between oral health literacy and several oral-health outcomes among older adults, including the number of remaining teeth, oral hygiene, periodontitis, and use of dental prostheses. However, the review also emphasized that findings across studies were not completely consistent and that research involving older populations remains limited. Therefore, the strong association observed in the present study adds community-based evidence from an Indonesian older-adult population but does not establish that knowledge is the sole determinant of tooth loss.

The findings may also be interpreted within the broader process of healthy ageing. Tooth retention has been associated with general health, functional status, nutrition, and quality of life in older adults. A scoping review involving 140 studies concluded that retaining more natural teeth was generally associated with more favorable health and quality-of-life outcomes. Thus, the high proportion of participants with extensive tooth loss in the current study represents more than an isolated dental finding; it may reflect a broader vulnerability in oral function and healthy ageing.

B. COMPARISON WITH PREVIOUS STUDIES

The present findings are broadly consistent with recent international research demonstrating that oral health knowledge or literacy is related to oral health behaviors and outcomes. Li et al. found that oral health literacy was associated with the number of lost teeth, even after adjustment

for several sociodemographic and behavioral factors. Similarly, the scoping review by Yu et al. identified evidence linking oral health literacy with oral hygiene practices and the number of remaining teeth among older adults. Nevertheless, Yu et al. emphasized substantial heterogeneity between studies, indicating that the relationship between literacy and oral health outcomes may vary according to population characteristics, measurement instruments, and contextual factors.

An important contrast is provided by Mafla et al., who examined 384 older adults aged 65–89 years in Colombia using intraoral assessment and a standardized oral health literacy instrument. Their study found that oral health literacy was significantly associated with the number of replaced teeth but was not significantly associated with the number of lost teeth. The authors suggested that the very high prevalence of tooth loss in their older population may have limited the ability to detect an association with literacy. This differs from the current study, in which a significant relationship between categorized oral health maintenance knowledge and tooth-loss categories was observed. The difference may reflect variations in population size, clinical setting, measurement instruments, classification of the exposure, and statistical methodology.

The current findings are also compatible with evidence connecting oral health knowledge and behavior with oral frailty. A 2025 structural equation modeling study among community-dwelling older adults found that oral health knowledge and beliefs were related to oral frailty through oral health behaviors, while tooth loss and oral health status were also associated with oral frailty. The study identified oral health behavior as an important pathway linking knowledge and oral outcomes. This provides a plausible conceptual explanation for the present association: knowledge may influence preventive behavior, while repeated oral health behaviors and access to appropriate care may influence the accumulation of oral disease and subsequent tooth loss. However, this pathway was not directly tested in the present study and therefore should be regarded as a possible explanatory framework rather than a demonstrated mediation mechanism.

The high prevalence of extensive tooth loss in this study should also be considered in relation to oral frailty. Recent systematic reviews have reported that oral frailty is common among older adults and is associated with factors including fewer natural teeth, physical frailty, malnutrition, and other adverse outcomes. Although oral frailty itself was not measured in this study, the high proportion of participants with more than ten missing teeth suggests that tooth retention deserves attention as part of community-based healthy-ageing programs.

Another relevant consideration is the accessibility and continuity of oral healthcare. Chan et al. emphasized that older adults may experience barriers to oral healthcare and that oral health is frequently addressed separately from broader healthcare for older populations. They advocated integrated and patient-centered approaches involving oral healthcare professionals and other health professionals. Accordingly, improving knowledge through education should not be considered an isolated intervention. Educational activities at

Posyandu should ideally be accompanied by opportunities for screening, referral, preventive treatment, and follow-up.

C. LIMITATIONS, IMPLICATIONS AND FUTURE RESEARCH

Several limitations should be considered when interpreting these findings. First, the cross-sectional design limits temporal interpretation. Oral health maintenance knowledge was measured at the same period as tooth loss, whereas tooth loss is generally the cumulative consequence of oral conditions and treatment decisions occurring over many years. Consequently, it cannot be determined whether inadequate knowledge preceded tooth loss or whether individuals who had already experienced extensive tooth loss subsequently developed different perceptions or knowledge regarding oral health. Similar limitations have been recognized in recent cross-sectional research examining oral health literacy and oral health outcomes.

Second, the sample consisted of only 54 older adults from a single community health post. Although simple random sampling was used within the accessible population, the relatively small and geographically specific sample limits the generalizability of the findings to older adults in other areas of Surabaya or Indonesia. Differences in socioeconomic status, educational attainment, healthcare access, cultural beliefs, and availability of dental services may influence both oral health knowledge and tooth loss.

Third, the analysis was primarily bivariate and therefore did not adjust for potential confounding variables. Factors such as age, educational level, socioeconomic status, smoking, diabetes mellitus, dental attendance, dietary patterns, previous dental treatment, and access to dental services may influence tooth loss independently of oral health knowledge. The stronger analytical approach used by Li et al., which incorporated sociodemographic and behavioral covariates into regression models, illustrates the value of multivariable analysis for determining whether oral health literacy remains independently associated with tooth loss.

Fourth, the present study assessed oral health maintenance knowledge rather than a comprehensive multidimensional measure of oral health literacy. Knowledge represents an important component of health literacy, but it does not necessarily capture an individual's ability to obtain, understand, evaluate, communicate, and apply oral health information. Recent research has increasingly emphasized oral health literacy as a broader construct encompassing these capabilities. Future research could therefore employ validated multidimensional oral health literacy instruments together with behavioral and clinical indicators.

Despite these limitations, the findings have practical implications for community-based oral healthcare. The concentration of poor knowledge and extensive tooth loss indicates the importance of strengthening oral health promotion among older adults at community health posts. Educational programs should address practical issues such as correct toothbrushing, prevention of dental caries and periodontal disease, recognition of oral symptoms, the importance of routine dental examinations, and the misconception that tooth loss is an unavoidable consequence

of ageing. Education should be combined with periodic oral screening and referral pathways so that knowledge can be translated into preventive action.

Future studies should recruit larger samples from multiple community health posts and incorporate multivariable regression to control for relevant sociodemographic, behavioral, and clinical confounders. Prospective cohort studies would be particularly useful for examining whether baseline oral health knowledge predicts subsequent changes in oral health status and tooth retention. Intervention studies could additionally evaluate whether structured oral health education improves knowledge, preventive behavior, dental attendance, and clinical outcomes. Such approaches would provide stronger evidence regarding the mechanisms underlying the association observed in this study and would support the development of more targeted oral health promotion strategies for older adults.

V. CONCLUSION

This study aimed to determine the association between oral health maintenance knowledge and tooth loss among older adults attending Posyandu Lansia Sekar Arum, Kertajaya, Surabaya. The findings demonstrated a statistically significant association between the level of oral health maintenance knowledge and the degree of tooth loss among the 54 older adults included in the study. Specifically, 46 participants (85.2%) were categorized as having poor oral health maintenance knowledge, while only 4 participants (7.4%) had good knowledge and 4 participants (7.4%) had moderate knowledge. Regarding tooth loss, 44 participants (81.5%) had lost more than ten teeth, 6 participants (11.1%) had lost 6–10 teeth, 1 participant (1.9%) had lost fewer than six teeth, and 3 participants (5.5%) experienced complete tooth loss. The cross-tabulation showed that 41 of the 46 participants with poor knowledge (89.1%) had lost more than ten teeth, whereas none of the participants with good knowledge experienced tooth loss exceeding ten teeth or complete tooth loss. The Chi-square analysis confirmed a statistically significant association between oral health maintenance knowledge and tooth loss ($\chi^2 = 36.42$, $df = 6$, $p < 0.001$), with Cramér's $V = 0.58$, indicating a substantial association between the two variables. These findings suggest that oral health maintenance knowledge should be considered an important component of community-based oral health promotion among older adults, while recognizing that the cross-sectional design does not establish a causal relationship. Future research should involve larger and more diverse samples across multiple community health settings and incorporate multivariable analyses to account for potential confounding factors such as education, socioeconomic status, systemic disease, smoking, dental attendance, and access to oral healthcare. Prospective cohort studies are also recommended to determine whether baseline oral health knowledge is associated with subsequent tooth loss over time. In addition, intervention-based research should evaluate whether structured, age-appropriate oral health education combined with routine oral screening, professional referral, and follow-up can improve oral health knowledge, preventive behaviors, dental service utilization, and preservation of natural teeth among older adults.

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DATA AVAILABILITY

Due to data access restrictions, the datasets underlying this study are not publicly available. Requests for access may be directed to the corresponding author, subject to reasonable justification, in accordance with institutional policies and ethical guidelines.

AUTHOR CONTRIBUTION

Yanita Almas Chandra Dewi initiated the research idea, was responsible for data collection and statistical analysis. Sunomo Hadi contributed to the study design and provided overall supervision throughout the research. Siti Fitria Ulfah assisted in interpreting the findings, critically reviewed the manuscript, and provided scientific recommendations. All authors participated in preparing, revising, and approving the final manuscript before submission.

DECLARATIONS

ETHICAL APPROVAL

Approval in the form of an ethical exemption was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya prior to the commencement of the study. (No. EA/4429/KEPK-Poltekkes_Sby/V/2026). Every stage of the study complied with ethical principles governing research involving human participants. Before data collection, each respondent received an explanation regarding the study objectives and procedures and voluntarily agreed to participate by providing informed consent. Throughout the research process, all participant identities and personal information were securely protected and kept confidential.

CONSENT FOR PUBLICATION PARTICIPANTS

All participants provided informed consent for publication.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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