

Association Between Pregnant Women's Knowledge of Oral Health Maintenance and Gingivitis Status: A Cross-Sectional Study in Surabaya, Indonesia

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ABSTRACT Gingivitis is a common oral health condition during pregnancy and may be influenced by hormonal changes, oral hygiene practices, and knowledge of appropriate oral health maintenance. Inadequate knowledge may contribute to inappropriate preventive practices and increase the risk of gingival inflammation. This study aimed to determine the association between pregnant women's knowledge of dental and oral health maintenance and their gingivitis status at Puskesmas Tembok Dukuh, Surabaya. A quantitative analytical observational study with a cross-sectional design was conducted among 36 pregnant women recruited using consecutive sampling. Knowledge was assessed using a structured 20-item questionnaire covering toothbrushing practices, fluoride toothpaste use, dietary habits, and routine dental examinations. Gingivitis status was clinically assessed using the Gingival Index based on the Loe and Silness method. Data were analyzed using Spearman's correlation test with a significance level of 0.05. The results showed that 17 respondents (47.2%) had good knowledge, 12 (33.3%) had fair knowledge, and 7 (19.4%) had poor knowledge. Clinical examination showed that 15 respondents (41.7%) had mild gingivitis, 15 (41.7%) had moderate gingivitis, and 3 (8.3%) had severe gingivitis, while only 3 (8.3%) had healthy gingiva. Spearman's correlation analysis demonstrated a statistically significant association between knowledge of dental and oral health maintenance and gingivitis status ($p = 0.010$; $\rho = 0.426$). Respondents with good knowledge predominantly presented with mild gingivitis, whereas moderate gingivitis was more frequently observed among those with fair or poor knowledge. These findings indicate that oral health knowledge is significantly associated with gingivitis status among pregnant women. Integrating oral health education, preventive counseling, and clinical oral health screening into antenatal care may strengthen maternal oral health promotion and support early prevention of gingival inflammation during pregnancy.

INDEX TERMS Oral Health Knowledge, Gingivitis, Pregnant Women, Oral Hygiene, Antenatal Care

I. INTRODUCTION

Pregnancy is a physiological period characterized by substantial hormonal and systemic changes that may affect oral health. Fluctuations in estrogen and progesterone can modify gingival vascularity and inflammatory responses to dental plaque, increasing susceptibility to pregnancy-associated gingivitis and other oral conditions [1], [2]. Recent evidence indicates that oral health problems remain common among pregnant women, with gingival inflammation, periodontal problems, and dental caries frequently reported across different populations [3], [4]. These conditions are clinically relevant because maternal oral health has been associated with maternal well-being and pregnancy-related outcomes, although the strength and causality of these associations remain subject to ongoing investigation [5]. Therefore, maintaining oral health during pregnancy represents an important component of comprehensive maternal healthcare.

In addition to physiological changes, oral health during pregnancy is strongly influenced by individual knowledge, attitudes, health literacy, and preventive behaviors. Studies among pregnant women have identified gaps in knowledge regarding pregnancy-related oral changes, appropriate oral hygiene practices, and the importance of professional dental care [6]–[8]. A cross-sectional study in India reported that pregnant women generally demonstrated reasonable knowledge of oral health but did not consistently follow recommended oral hygiene practices [9]. Similar findings have been reported in Europe, where knowledge and oral health literacy were associated with educational background, previous information, and oral health behaviors [10]. Qualitative evidence from Thailand further demonstrated that misconceptions, limited knowledge, low perceived priority of oral health, and concerns regarding dental treatment can influence oral healthcare-seeking behavior during pregnancy [11]. These findings suggest that knowledge is an important

component of oral health promotion, although knowledge alone may not fully determine clinical oral health status.

The current state of oral health promotion increasingly emphasizes education and integration of oral healthcare into antenatal services. Evidence from intervention studies indicates that structured oral health education can improve knowledge, attitudes, self-care behaviors, plaque control, and selected clinical oral health indicators among pregnant women [12]–[14]. A randomized controlled clinical trial also demonstrated the potential benefit of prenatal oral hygiene education for managing pregnancy-associated gingivitis [15]. Systematic reviews have similarly emphasized the potential value of educational tools and theory-based interventions in improving maternal oral health [16], [17]. Nevertheless, barriers remain, including misconceptions about the safety of dental treatment, limited referral practices, insufficient oral health counseling, and inadequate integration between antenatal and dental services [18], [19]. Recent international evidence also indicates that knowledge and perceptions of oral health vary substantially between populations, reinforcing the importance of context-specific research [20].

Despite the growing international literature, evidence concerning the relationship between oral health knowledge and clinically assessed gingivitis remains limited in specific primary healthcare settings, particularly among pregnant women receiving antenatal services in Surabaya. Previous research has demonstrated associations between knowledge, oral hygiene behavior, and oral health outcomes, but differences in population characteristics, healthcare access, educational exposure, and assessment instruments may produce different findings across settings. Therefore, local clinical evidence is necessary to clarify whether knowledge of dental and oral health maintenance is associated with gingivitis status among pregnant women at Puskesmas Tembok Dukuh. This study aimed to determine the association between pregnant women's knowledge of dental and oral health maintenance and their gingivitis status. The contributions of this study are threefold: (1) to characterize the level of dental and oral health maintenance knowledge among pregnant women; (2) to describe their clinically assessed gingivitis status using the Loe and Silness Gingival Index; and (3) to examine the statistical association between knowledge and gingivitis status as empirical evidence for strengthening promotive and preventive oral health programs within antenatal care. The remainder of this article presents the research methodology, results, discussion, and conclusion.

II. METHOD

A. STUDY DESIGN AND SETTING

This study employed a quantitative analytical observational design with a cross-sectional approach. The study was conducted at Puskesmas Tembok Dukuh, Surabaya, Indonesia, from March 9 to April 2, 2026. The cross-sectional design was selected because the study aimed to assess the association between pregnant women's knowledge of dental and oral health maintenance and their gingivitis status based on measurements obtained during the same study period. Cross-sectional studies are appropriate for describing the distribution of health-related variables and examining associations between variables within a defined population at a particular period [21], [22]. The study did not involve an

intervention, treatment allocation, or follow-up period. Therefore, participants were not randomized into experimental or control groups.

B. STUDY POPULATION AND SAMPLING

The study population consisted of pregnant women attending Puskesmas Tembok Dukuh during the study period. Participants were recruited using a consecutive sampling technique, in which eligible pregnant women encountered during the data-collection period were recruited sequentially until the required number of participants was obtained. Consecutive sampling has been applied in previous cross-sectional studies involving pregnant women because it enables recruitment of participants directly from antenatal healthcare settings [23], [24]. A total of 36 pregnant women participated in the study and were included in the final analysis.

The study was observational and non-randomized. No random allocation or randomization procedure was performed because the objective was to observe the existing relationship between oral health knowledge and gingivitis status under routine healthcare conditions. The recruitment procedure was conducted after obtaining permission from the relevant health authorities and the head of Puskesmas Tembok Dukuh. Written informed consent was obtained from participants before data collection. The original study protocol did not report a formal probability-based sample-size calculation or a separate sampling frame; therefore, the final sample consisted of the participants recruited consecutively during the specified study period.

C. MEASUREMENT OF ORAL HEALTH KNOWLEDGE

Knowledge regarding dental and oral health maintenance was assessed using a structured questionnaire consisting of 20 items. The questionnaire addressed essential aspects of oral health maintenance during pregnancy, including toothbrushing technique and frequency, the use of a soft-bristled toothbrush, fluoride toothpaste, dietary practices, and routine dental visits. Questionnaire-based assessment is commonly used to measure oral health knowledge among pregnant women and can provide structured information regarding knowledge of preventive practices and oral healthcare [25], [26].

Each correct response was assigned a score of 1, whereas an incorrect response was assigned a score of 0. The total knowledge score therefore ranged from 0 to 20. The resulting scores were categorized into three levels: good knowledge, corresponding to scores of 15–20 ($\geq 75\%$); fair knowledge, corresponding to scores of 12–14 ($56\text{--}<75\%$); and poor knowledge, corresponding to scores of 0–11 ($<56\%$). These categories were used as the operational classification of the independent variable in the analysis.

D. CLINICAL ASSESMENT OF GINGIVITIS

Gingival status was assessed through direct clinical examination using the Gingival Index (GI) developed by Loe and Silness. The examination involved six index teeth: tooth 16, tooth 21, tooth 24, tooth 36, tooth 41, and tooth 44. The gingival condition was scored on a four-point scale from 0 to 3. A score of 0 indicated clinically healthy gingiva. A score of 1 represented mild gingival inflammation, a score of 2 represented moderate inflammation, and a score of 3

represented severe inflammation. The Löe and Silness Gingival Index remains an established clinical measure used in studies evaluating gingival inflammation among pregnant women [27], [28].

For classification of overall gingival status, the resulting GI scores were interpreted as follows: 0 for healthy gingiva, 0.1–1.0 for mild gingivitis, 1.1–2.0 for moderate gingivitis, and 2.1–3.0 for severe gingivitis. The same clinical assessment procedure was applied to all participants to maintain consistency in outcome measurement. The gingival assessment was performed during the study period after completion of the knowledge questionnaire.

E. DATA COLLECTION PROCEDURE

Data collection was performed sequentially. First, eligible pregnant women were identified at the study site and informed about the purpose and procedures of the research. Participants who agreed to participate provided informed consent. Second, participants completed the 20-item structured questionnaire to determine their level of dental and oral health maintenance knowledge. Third, a clinical oral examination was conducted to determine gingival status using the six specified index teeth and the Löe and Silness Gingival Index. The knowledge and clinical examination data were subsequently recorded for analysis.

The study used the same measurement instruments and operational definitions for all participants. Because the study was cross-sectional, both knowledge and gingival status represented the participants' conditions at the time of data collection rather than changes occurring over time. Consequently, the design permits assessment of statistical association but does not establish temporal sequence or causality.

F. DATA ANALYSIS

The collected data were organized according to the predefined knowledge and gingivitis categories. Descriptive analysis was used to summarize the distribution of respondents according to knowledge level and gingival status. The association between knowledge category and gingivitis status was subsequently evaluated using Spearman's rank correlation coefficient. Spearman's correlation is appropriate for assessing the association between ranked or ordinal variables and provides a coefficient ranging from -1 to $+1$ [22]. Statistical significance was evaluated using an alpha level of 0.05. A p-value below 0.05 was considered statistically significant. The analysis was conducted to determine whether a statistically significant association existed between the level of oral health knowledge and gingivitis status among the study participants.

G. ETHICAL CONSIDERATIONS

The study was conducted after obtaining research permission from the Surabaya City Health Office and approval from the head of Puskesmas Tembok Dukuh. Participants were informed about the study procedures before participation, and informed consent was obtained. Participation was voluntary, and the collected information was used for research purposes. The study involved non-invasive questionnaire administration and clinical gingival examination and did not include experimental treatment or random allocation.

III. RESULTS

This study was conducted at Puskesmas Tembok Dukuh, Surabaya, involving 36 pregnant women who visited the antenatal care (ANC) service during the study period. The clinic also operates a dental unit that provides oral health examination and treatment services for the community, including pregnant women.

TABLE 1

Distribution of Respondent Characteristics of Pregnant Women in the Working Area of Puskesmas Tembok Dukuh, Surabaya, 2026

Characteristic		n	%
Age Category	20–27 years	3	8.3
	28–35 years	14	38.9
	>35 years	19	52.8
Trimester	First	12	33.3
	Second	15	41.7
	Third	9	25.0
Education	Elementary School	1	2.8
	Junior High School	5	13.9
	Senior High School	18	50.0
	College/University	12	33.3
Occupation	Housewife	25	69.4
	Private Employee	8	22.2
	Entrepreneur	1	2.8
	Civil Servant	2	5.6

TABLE 1 shows that most respondents were over 35 years of age (52.8%), followed by those aged 28–35 years (38.9%) and 20–27 years (8.3%). Regarding gestational age, most respondents were in the second trimester (41.7%), followed by the first (33.3%) and third trimester (25.0%). By education level, most respondents had completed senior high school (50.0%), followed by college/university (33.3%), junior high school (13.9%), and elementary school (2.8%). By occupation, the majority were housewives (69.4%), followed by private employees (22.2%), civil servants (5.6%), and entrepreneurs (2.8%).

TABLE 2

Distribution of Knowledge of Dental and Oral Health Maintenance among Pregnant Women in the Working Area of Puskesmas Tembok Dukuh, Surabaya, 2026

Knowledge Category	n	%
Good	17	47.2
Fair	12	33.3
Poor	7	19.4
Total	36	100.0

TABLE 2 shows that of the 36 respondents, most had good knowledge of dental and oral health maintenance (47.2%), followed by fair knowledge (33.3%) and poor knowledge (19.4%).

TABLE 3

Distribution of Gingivitis Status among Pregnant Women in the Working Area of Puskesmas Tembok Dukuh, Surabaya, 2026

Gingivitis Category	n	%
Healthy	3	8.3
Mild	15	41.7
Moderate	15	41.7
Severe	3	8.3
Total	36	100.0

TABLE 3 shows that of the 36 respondents, mild and moderate gingivitis were equally the most common, each occurring in 15 respondents (41.7%), followed by severe gingivitis and healthy gingiva, each found in 3 respondents (8.3%).

TABLE 4

Cross-tabulation of Knowledge of Dental and Oral Health Maintenance with Gingivitis Status among Pregnant Women in the Working Area of Puskesmas Tembok Dukuh, Surabaya, 2026

Knowledge	Healthy	Mild	Moderate	Severe
Good	2 (11.8%)	12 (70.6%)	1 (5.9%)	2 (11.8%)
Fair	0 (0.0%)	2 (16.7%)	0 (83.3%)	0 (0.0%)
Poor	1 (14.3%)	1 (14.3%)	4 (57.1%)	1 (14.3%)
Total	3 (8.3%)	15 (41.7%)	15 (41.7%)	3 (8.3%)

TABLE 4 shows that among pregnant women with good knowledge (n=17), the majority experienced mild gingivitis (70.6%). Among those with fair knowledge (n=12), the majority experienced moderate gingivitis (83.3%), and among those with poor knowledge (n=7), the majority also experienced moderate gingivitis (57.1%). This pattern suggests that better knowledge of dental and oral health maintenance is associated with milder gingivitis status.

TABLE 5

Spearman Correlation Test Results between Knowledge of Dental and Oral Health Maintenance and Gingivitis Status among Pregnant Women in the Working Area of Puskesmas Tembok Dukuh, Surabaya, 2026

Test	Variables	α	p value	Correlation Coefficient
Spearman	$\frac{\text{Knowledge}}{\text{Gingivitis}}$	0.05	0.010	0.426

Based on TABLE 5 of the Spearman correlation test, a significance value (p) of 0.010 was obtained with a correlation coefficient (r) of 0.426. Since the p value is smaller than α ($0.010 < 0.05$), H_1 is accepted, indicating a significant relationship between pregnant women's knowledge of dental and oral health maintenance and gingivitis status. The Spearman correlation analysis showed a significant moderate positive relationship between knowledge and gingivitis status ($p = 0.010$; $\rho = 0.426$), indicating that poorer knowledge was associated with greater gingivitis severity.

IV. DISCUSSION

A. KNOWLEDGE OF DENTAL AND ORAL HEALTH MAINTENANCE AMONG PREGNANT WOMEN

The present study found that the largest proportion of respondents demonstrated good knowledge of dental and oral health maintenance, accounting for 17 of 36 participants (47.2%), followed by fair knowledge in 12 participants (33.3%) and poor knowledge in 7 participants (19.4%). These findings indicate that although nearly half of the respondents had an adequate level of knowledge, more than half remained within the fair or poor categories. Thus, knowledge of oral health maintenance during pregnancy was not uniformly distributed across the study population. The findings are consistent with evidence showing that oral health knowledge among pregnant women varies considerably according to individual, educational, and healthcare-related characteristics [29], [30]. A scoping review of 67 studies similarly reported substantial variation in oral health knowledge, attitudes, practices, and literacy among pregnant women, indicating that

knowledge does not develop uniformly across populations [31].

The relatively high proportion of respondents with good knowledge may partly reflect the educational characteristics of the study population. In the present sample, 50.0% of respondents had completed senior high school and 33.3% had attended college or university, while the largest age group was 28–35 years (38.9%). Higher educational attainment may facilitate the acquisition, comprehension, and application of health information. This interpretation is supported by Bunnatee et al., who found that educational level and oral health literacy were significantly associated with oral healthcare behaviors among pregnant women [32]. Similarly, research among pregnant women in Shanghai demonstrated that oral health knowledge and literacy were important aspects of maternal oral health, although gaps in awareness remained despite access to healthcare services [29].

Nevertheless, the presence of 33.3% of respondents with fair knowledge and 19.4% with poor knowledge indicates that the availability of information does not necessarily result in comprehensive understanding. Knowledge gaps may concern the recognition of pregnancy-related gingival changes, appropriate toothbrushing techniques, the importance of fluoride toothpaste, dietary control, and the need for dental visits during pregnancy. Previous research has demonstrated that pregnant women may recognize the importance of oral health while still having incomplete understanding of periodontal disease, preventive practices, or the safety and necessity of dental care [30], [33]. Qualitative evidence also indicates that perceptions, previous experiences, health literacy, and information received from healthcare professionals can influence how pregnant women understand and practice oral health maintenance [34].

An important implication of these findings is that oral health education during antenatal care should not be limited to the delivery of general information. Education should emphasize practical behaviors, including appropriate toothbrushing, plaque control, dietary management, and timely dental consultation. Evidence from prenatal oral hygiene interventions suggests that structured education can contribute to improvements in gingival health when education is combined with appropriate oral hygiene practices [35]. However, because the present study was cross-sectional, the observed distribution of knowledge cannot demonstrate that knowledge itself caused differences in gingival status. Other factors, including oral hygiene behavior, socioeconomic conditions, access to dental services, gestational age, previous dental experiences, and individual motivation, may also contribute to clinical oral health.

The relatively small sample and single-center setting further limit the generalizability of the knowledge findings. The results primarily describe pregnant women attending Puskesmas Tembok Dukuh and may not represent pregnant women receiving antenatal services in other health facilities or geographic areas. Nevertheless, the findings provide useful local evidence that can support the development of targeted oral health education within antenatal services. In particular, women with fair or poor knowledge may benefit from repeated, simple, and practical counseling delivered by dental and maternal health personnel.

B. GINGIVITIS STATUS AMONG PREGNANT WOMEN

Clinical examination using the Löe and Silness Gingival Index demonstrated that gingival inflammation was highly prevalent in the study population. Of the 36 respondents, 15 (41.7%) had mild gingivitis, 15 (41.7%) had moderate gingivitis, and 3 (8.3%) had severe gingivitis, whereas only 3 (8.3%) had healthy gingiva. Consequently, 33 respondents (91.7%) exhibited some degree of gingival inflammation. This finding indicates that gingivitis was a substantial oral health problem among the pregnant women examined at Puskesmas Tembok Dukuh. The result is broadly consistent with international evidence showing that gingivitis and other oral manifestations are common during pregnancy [36].

The predominance of mild and moderate gingivitis may be explained by the interaction between pregnancy-related physiological changes and local plaque-related factors. Pregnancy involves hormonal changes that can modify gingival vascular responses and inflammatory reactions to dental plaque. A recent systematic review of oral manifestations in pregnancy identified gingivitis among the most frequently observed oral conditions during pregnancy [36]. Similarly, a clinical trial involving pregnant women with moderate-to-severe gingivitis confirmed that gingival inflammation is prevalent during pregnancy and can be addressed through prenatal oral hygiene interventions [35].

However, pregnancy-related hormonal changes should not be interpreted as the sole explanation for gingivitis. Local oral hygiene practices remain important determinants of gingival inflammation. Inadequate plaque removal can allow biofilm accumulation at the gingival margin and subsequently increase inflammatory responses. A cross-sectional study of 405 pregnant women in Thailand found that 88.1% had gingivitis and reported associations between oral health literacy, education, and oral healthcare behavior [32]. These findings support the interpretation that physiological susceptibility and behavioral factors may operate together rather than independently.

The present study also found that 41.7% of respondents were in the second trimester. Although the original study observed that gingivitis severity may vary according to gestational stage, the cross-sectional design does not permit determination of whether gingival inflammation increased as pregnancy progressed. Gestational age should therefore be considered a potential explanatory or confounding factor rather than a demonstrated cause of the observed gingivitis distribution. Longitudinal studies following the same participants from the first to the third trimester would be more appropriate for evaluating changes in gingival condition over time.

The finding that only 8.3% of participants had healthy gingiva is clinically important. It suggests that routine antenatal services may provide an opportunity for early oral health screening. The implication is not that every pregnant woman will necessarily develop clinically significant gingivitis, but rather that pregnancy represents a period in which systematic assessment and preventive counseling may be particularly relevant. Evidence from prenatal oral hygiene education trials demonstrates that oral health education delivered during prenatal care can reduce gingival inflammation, particularly when combined with an appropriate home-care regimen [35].

Several limitations should be considered when interpreting the clinical findings. First, the sample consisted of only 36 participants, limiting statistical power and external validity. Second, participants were recruited from a single community health center, which restricts generalization to other populations. Third, examiner calibration and formal inter- or intra-examiner reliability assessment were not reported. Consequently, some measurement variability in the Gingival Index assessment cannot be excluded. Fourth, other clinical variables, such as plaque index, calculus, periodontal probing measurements, and previous periodontal conditions, were not incorporated into the analysis. These factors may contribute to gingival inflammation independently of knowledge.

Despite these limitations, the high proportion of participants with gingivitis supports the practical relevance of integrating oral health assessment into antenatal care. Collaboration between dental personnel and maternal-child health staff could facilitate early identification of gingival inflammation, provide individualized oral hygiene counseling, and encourage appropriate dental referral when clinically indicated.

C. ASSOCIATION BETWEEN KNOWLEDGE OF DENTAL AND ORAL HEALTH MAINTENANCE AND GINGIVITIS STATUS

The primary analytical finding of this study was a statistically significant association between knowledge of dental and oral health maintenance and gingivitis status. Spearman's analysis produced a p-value of 0.010 and a correlation coefficient of $\rho = 0.426$. Because the p-value was below the predetermined significance level of 0.05, the null hypothesis of no statistical association was rejected. The magnitude of the coefficient indicates a moderate association. The descriptive distribution also showed that respondents with good knowledge were predominantly classified as having mild gingivitis, whereas moderate gingivitis was more frequently observed among respondents with fair or poor knowledge.

The finding is consistent with previous evidence indicating that oral health knowledge and literacy are related to oral healthcare behaviors among pregnant women. Bunntee et al. reported that educational level and oral health literacy were associated with oral healthcare behavior in a large sample of pregnant women [32]. Similarly, Tenenbaum and Azogui-Levy identified knowledge as a central component of oral health-related knowledge, attitudes, practices, and literacy among pregnant women [31]. These findings support a plausible pathway in which knowledge may contribute to healthier oral health practices, although the present study did not directly measure the behavioral pathway.

The result is also consistent with intervention evidence. Geurs et al. demonstrated that prenatal oral hygiene education accompanied by an enhanced oral home-care regimen produced reductions in gingival inflammation among pregnant women [35]. This supports the practical importance of education as part of prenatal oral health promotion. Nevertheless, an intervention study cannot be directly equated with the present observational study. The current findings demonstrate an association between variables measured at one point in time, whereas an intervention study evaluates change following a defined treatment or educational exposure.

Conversely, differences between studies may arise because knowledge does not automatically translate into behavior. Pregnant women may possess adequate knowledge but experience barriers such as nausea, limited access to dental services, financial constraints, anxiety about dental treatment, lack of professional counseling, or insufficient family and healthcare support. Research on pregnant women has demonstrated that knowledge, attitudes, practices, and literacy represent related but distinct constructs [31], [34]. Therefore, the moderate rather than perfect correlation observed in this study is plausible because gingival status is likely influenced by multiple factors

The interpretation of the positive Spearman coefficient must also follow the ordinal coding used in the analysis. A positive coefficient does not independently mean that better knowledge causes more severe gingivitis. The direction of an ordinal correlation depends on how the categories were numerically coded. Therefore, the safest interpretation is that the study identified a statistically significant moderate association between knowledge category and gingivitis status, while the descriptive cross-tabulation provides the clinical pattern observed in the sample. This distinction is particularly important because the cross-sectional design cannot establish temporal precedence or causality.

The present findings have several implications for primary healthcare practice. First, oral health education could be incorporated into routine antenatal care rather than being provided only when pregnant women report dental complaints. Second, educational content should focus on actionable behaviors rather than knowledge acquisition alone. Third, screening using a standardized clinical approach may facilitate early identification of gingival inflammation. Fourth, collaboration between the dental unit and maternal and child health program may improve continuity between education, screening, and referral.

The study nevertheless has important methodological limitations. The small sample size limited the possibility of adjusting the association for potential confounders. Variables such as age, education, gestational age, parity, oral hygiene behavior, dental attendance, dietary habits, socioeconomic status, and previous periodontal condition were not simultaneously controlled. Furthermore, the single-center design limits generalizability. Examiner calibration was also not performed, which may introduce measurement variability in gingival assessment. Finally, the cross-sectional design means that the temporal relationship between knowledge and gingivitis cannot be determined. These limitations indicate that the observed association should be interpreted as an empirical relationship within the studied population rather than evidence of a causal effect.

Overall, the findings provide preliminary evidence that knowledge of dental and oral health maintenance is associated with gingivitis status among pregnant women attending Puskesmas Tembok Dukuh. The results support strengthening integrated oral health promotion within antenatal services while recognizing that knowledge is only one component of maternal oral health. Future studies should employ larger multicenter samples, longitudinal follow-up, examiner calibration, and multivariable analysis incorporating behavioral, clinical, socioeconomic, and healthcare-access variables.

V. CONCLUSION

This study aimed to determine the association between pregnant women's knowledge of dental and oral health maintenance and their gingivitis status at Puskesmas Tembok Dukuh, Surabaya. Among the 36 pregnant women included in the study, 17 respondents (47.2%) demonstrated good knowledge, 12 (33.3%) demonstrated fair knowledge, and 7 (19.4%) demonstrated poor knowledge of dental and oral health maintenance. Clinical assessment using the Löe and Silness Gingival Index showed that 15 respondents (41.7%) had mild gingivitis, 15 (41.7%) had moderate gingivitis, 3 (8.3%) had severe gingivitis, and only 3 (8.3%) had healthy gingiva, indicating that 91.7% of the participants exhibited some degree of gingival inflammation. Statistical analysis using Spearman's correlation demonstrated a statistically significant association between knowledge category and gingivitis status, with a correlation coefficient of $\rho = 0.426$ and $p = 0.010$. The moderate correlation indicates that knowledge category was meaningfully associated with the observed variation in gingivitis status; however, the direction of the coefficient must be interpreted according to the numerical coding of the ordinal categories, and the cross-sectional design does not establish a causal relationship. The findings emphasize the potential value of incorporating systematic oral health education, clinical gingival screening, and preventive counseling into routine antenatal care, particularly through collaboration between dental and maternal-child health personnel. Nevertheless, the interpretation of the findings is constrained by the small sample size, single-center recruitment, absence of multivariable adjustment for potential confounding factors, and lack of formal examiner calibration or reliability assessment. Future research should therefore involve larger and multicenter populations to improve representativeness, employ longitudinal designs to examine changes in gingival status throughout pregnancy, and incorporate additional determinants such as oral hygiene behavior, dietary practices, dental attendance, socioeconomic characteristics, gestational age, and healthcare support. Such studies may provide stronger evidence regarding the temporal relationship between oral health knowledge, preventive behavior, and gingival health during pregnancy.

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DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and institutional restrictions.

AUTHOR CONTRIBUTION

Sutra Aulia Damayanti contributed to conceptualization, methodology, investigation, data collection, formal analysis, and preparation of the original manuscript. Sri Hidayati contributed to supervision, methodological review, interpretation of findings, and critical revision of the manuscript. Imam Sarwo Edi contributed to study supervision, clinical assessment, validation of the research procedures, and critical review of the manuscript. Sunomo Hadi contributed to supervision, data interpretation, manuscript review, and final approval of the version to be published. All authors reviewed the manuscript, approved the final version, and agreed to be accountable for the integrity and accuracy of the work.

DECLARATIONS

ETHICAL APPROVAL

The study was conducted after obtaining research permission from the Surabaya City Health Office and the head of Puskesmas Tembok Dukuh. The research procedures were conducted in accordance with applicable ethical principles for research involving human participants.

CONSENT FOR PUBLICATION PARTICIPANTS

Written informed consent was obtained from all participants before participation. Participants were informed about the purpose and procedures of the study and their voluntary participation.

COMPETING INTERESTS

The authors declare that there are no competing interests that could have influenced the conduct, analysis, interpretation, or reporting of this study.

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