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The Correlation Between Gestational Age and Gingivitis Status Among Pregnant Women at Kras Community Health Center, Kediri Regency

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ABSTRACT Gingivitis is one of the most common oral health problems experienced by pregnant women, largely influenced by hormonal fluctuations that occur throughout gestation. These physiological changes increase gingival vascularity, reduce immune response, and heighten sensitivity to plaque accumulation, thereby placing pregnant women at higher risk of developing gingival inflammation. Preliminary data from the Kras Community Health Centre revealed an alarmingly high prevalence of gingivitis, indicating the need for further investigation. This study aimed to analyze the correlation between gestational age and gingivitis status among pregnant women at the Kras Community Health Centre, Kediri Regency. An analytical cross-sectional design was employed involving 75 pregnant women selected through simple random sampling. Gingivitis status was assessed using the Gingival Index, while gestational age was categorized into three trimesters. Data collection was conducted through direct clinical examinations using standardized observation sheets. Spearman's Rank Correlation Test was used to analyze the association between the two variables. The results showed that most respondents were in the second trimester (45.3%), and the majority presented with moderate gingivitis (62.7%). Statistical analysis demonstrated a significant correlation between gestational age and gingivitis status ($\rho = 0.000$; $\alpha = 0.05$), with a strong positive correlation coefficient ($r = 0.746$). These findings indicate that gingivitis severity tends to increase as pregnancy progresses. In conclusion, gestational age is significantly associated with gingival health status among pregnant women, highlighting the importance of integrating periodontal assessment and oral health education into routine antenatal services to prevent worsening gingival conditions and promote maternal well-being.

INDEX TERMS Gestational Age, Gingivitis, Pregnant Women, Oral Health, Periodontal Status.

I. INTRODUCTION

Maternal oral health represents an essential component of overall well-being during pregnancy, as physiological, hormonal, and behavioral changes significantly increase susceptibility to periodontal diseases, particularly gingivitis. Pregnancy-related gingivitis is widely recognized as one of the most prevalent oral health problems among expectant mothers, with global prevalence estimates ranging from 60% to 75% [1]. Elevated levels of estrogen and progesterone during pregnancy contribute to increased gingival vascularization, reduced immune function, and heightened sensitivity to bacterial plaque, leading to clinical signs such as erythema, edema, and bleeding upon probing [2], [3]. Indonesia continues to face a substantial burden of maternal periodontal disease, with recent studies reporting gingivitis prevalence above 70% among pregnant women [4]. In the Kras Community Health Center, preliminary data indicated that more than 97% of pregnant women exhibited gingival inflammation, highlighting a critical public health concern that warrants immediate attention.

Current research on gestational gingivitis has advanced through the integration of modern diagnostic tools, including gingival index assessment, salivary inflammatory markers, and oral microbiome analysis [5]–[9]. These approaches have improved understanding of how pregnancy alters periodontal tissues across different trimesters. Preventive strategies such as targeted oral health education, routine professional cleaning, and risk-based counseling have demonstrated promising outcomes in reducing gingival inflammation during pregnancy [10], [11]. Despite these advancements, existing literature remains limited in addressing trimester-specific gingivitis progression within community-based primary healthcare settings, particularly in rural Indonesia.

A notable research gap persists due to insufficient epidemiological studies examining how gingivitis severity varies by gestational age in real-world contexts. Many prior investigations relied on narrow clinical samples, focused predominantly on behavioral determinants, or lacked trimester-based stratification of periodontal outcomes [12]–[16]. Cultural and socioeconomic factors that influence oral hygiene practices in Indonesian communities further justify the need for localized data [17], [18]. Additionally, limited research has explored the intersection between pregnancy physiology and oral health outcomes in public health center environments where disparities in access to dental care remain significant [19], [20].

To address this gap, the present study aims to analyze the correlation between gestational age and gingivitis status among pregnant women at the Kras Community Health Center, Kediri Regency. Understanding trimester-specific periodontal changes can strengthen preventive strategies within antenatal care services. The primary contributions of this study are:

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1. **Providing empirical evidence on gingivitis severity across different gestational ages** in a community healthcare setting.
2. **Enhancing epidemiological data** on maternal oral health in rural Indonesian populations.
3. **Proposing recommendations** for integrating periodontal screening and oral health promotion into routine antenatal care.

II. METHODS

This study employed an analytical observational approach with a cross-sectional design, which allowed the independent variable (gestational age) and dependent variable (gingivitis status) to be measured simultaneously at a single point in time. Cross-sectional methods are widely used in public health and epidemiology for identifying associations between variables within a defined population, especially when longitudinal follow-up is not required [26]. The procedures described below detail the methodological steps required to replicate this study.

A. STUDY DESIGN AND STUDY SETTING

The research applied a cross-sectional framework to evaluate the correlation between gestational age and gingivitis severity among pregnant women. This design was selected because it provides rapid data collection, minimizes resource expenditure, and is appropriate for measuring disease prevalence and associated factors within a specific timeframe [27]. No interventions, manipulations, or experimental conditions were introduced, making the study strictly observational and non-experimental.

Data collection was conducted at the Kras Community Health Center, located in Kediri Regency, East Java, Indonesia. The health center serves as a primary care facility with substantial patient volume, including antenatal care (ANC) services. The study was conducted over a three-month period from December 2024 to February 2025. During this period, all dental examinations and data recording were performed in the dental outpatient clinic of the health center, following standardized operational procedures

B. STUDY POPULATION AND ELIGIBILITY CRITERIA

The study population consisted of all pregnant women registered in the ANC services of the Kras Community Health Center between July and September 2024. The population frame included 92 pregnant women after excluding 15 women who participated only in the preliminary assessment. Inclusion and exclusion criteria ensured sample homogeneity and data reliability.

Inclusion criteria:

1. Pregnant women in the 1st, 2nd, or 3rd trimester;
2. Registered ANC patients at the study site;
3. Willing to undergo oral examination and sign informed consent.

Exclusion criteria:

1. Pregnant women with systemic diseases affecting periodontal status (e.g., uncontrolled diabetes, immunodeficiency);
2. Women undergoing periodontal treatment within the previous three months;
3. Incomplete or inconsistent clinical records.

These criteria align with methodological recommendations for reducing confounding factors in periodontal research among pregnant populations [28].

C. SAMPLING PROCEDURE

A simple random sampling (SRS) technique was employed to ensure that every eligible pregnant woman had an equal probability of being selected. The sample size was determined using Slovin's formula with a 5% margin of error, yielding 75 respondents from the total population of 92 individuals. SRS was implemented using a random number generator to minimize selection bias and to enhance the external validity of the findings [29].

D. VARIABLES AND OPERATIONAL DEFINITIONS

The study analyzed two primary variables:

1. Gestational Age (Independent Variable):

Categorized into three trimesters according to WHO guidelines:

a. Trimester 1: 0–12 weeks
b. Trimester 2: 13–27 weeks
c. Trimester 3: 28–40 weeks

Gestational age was verified from maternal ANC records.

2. Gingivitis Status (Dependent Variable):

Assessed using the Gingival Index (GI), which includes four scoring categories (0–3):

a. 0 = healthy gingiva
b. 1 = mild inflammation
c. 2 = moderate inflammation
d. 3 = severe inflammation

The GI is internationally standardized and recommended for epidemiological assessment of periodontal health [30].

E. MATERIALS AND INSTRUMENTS

The following clinical instruments were used for oral examinations:

1. Mouth mirror
2. Periodontal probe (standard GI probe)
3. Sterile tweezers
4. Disposable gloves
5. 70% alcohol for instrument disinfection

A structured observation sheet was used to record respondent identity, gestational age, and GI scores. These materials adhere to clinical recommendations for periodontal assessment in field-based research [31].

F. DATA COLLECTION PROCEDURE

Data collection followed five standardized steps:

1. **Patient Registration and Consent:** All eligible respondents were asked to sign informed consent after receiving a verbal explanation of study objectives and procedures.
2. **Verification of Gestational Age:** Researchers accessed ANC records to confirm trimester classification.
3. **Clinical Gingival Examination:** Each participant underwent a direct oral examination conducted by trained dental health professionals. GI scoring was performed under adequate lighting with sterilized instruments.
4. **Recording of Findings:** Clinical results were documented immediately on the standardized observation sheet.
5. **Quality Control:** To minimize intra-examiner variability, 10% of participants were re-examined by the

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same examiner. No discrepancies exceeding GI score ±1 were observed.

G. ETHICAL CONSIDERATIONS AND STATISTICAL ANALYSIS

Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya. All procedures complied with national research ethics standards and principles of autonomy, beneficence, nonmaleficence, and confidentiality [32].

Data were entered into SPSS software for analysis. Given that both variables were categorical with ordinal measurement scales, the **Spearman Rank Correlation Test** was selected. This test determines the strength and direction of association between non-parametric variables and is appropriate for cross-sectional observational studies [33], [34]. Statistical significance was established at $p < 0.05$, and results were presented using correlation coefficients (r) and p-values.

III. RESULT

Demographically, the total population in the Kras Health Center working area reaches 37,744 people. In the Kras Health Center working area there are 1 main health center, 1 auxiliary health center, 2 hospitals/clinics, and 4 pharmacies that can be utilized by the population as an effort to improve health status in the community.

TABLE 1
Operational Definition

Variable	Indicator	Assessment Criteria
Gestational Age	A reasonable duration of pregnancy lasts 280 days, which is equivalent to approximately 40 weeks or 9 months and 7 days. This period of pregnancy is divided into 3 trimesters [13]. Namely: a. 1st Trimester b. Trimester 2 c. Trimester 3	a. First Quarter: From 0 to 12 weeks of gestation b. Second Quarter: 13 to 27 weeks gestation c. Third Quarter: From 28 to 40 weeks of gestation
Gingivitis Status In Pregnant Women	Gingival Index Assessment Parameters and Measurement Standards for Evaluation of Gum Tissue Condition [14]: a. 0 = normal gingiva, no inflammation, no discoloration b. 1 = mild inflammation: there is slight discoloration and edema, but no bleeding on probing c. 2 = moderate bleeding: reddish color, presence of edema, and bleeding occurs when probing d. 3 = heavy bleeding: bright red color, presence of edema, ulceration, spontaneous bleeding	a. 0 = healthy *gingiva* b. 0,1 - 1,0 = mild inflammation c. 1,1 - 2,0 = moderate inflammation d. 2,1 - 3,0 = severe inflammation

Based on TABLE 1, the results show study aims to analyze the correlation between the gestation period and the condition of gum inflammation in pregnant women at the Kras Health Center health facility. The research is scheduled to take place over three months, starting from December 2024 to February 2025. The study subjects consisted of 75 pregnant women who came to the dental clinic to undergo antenatal care examinations at the Kras Health Center.

TABLE 2
Distribution based on Age of Pregnant Women and Maternal Pregnancy Sequence at Kras Health Center, Kediri Regency

Respondent characteristics		N	%
Age of Pregnant Mother	< 18 years	0	0
	18 – 23 years	11	14,7
	24 – 29 years	33	44
	30 – 35 years	26	34,7
	> 36 years	5	6,6
Pregnancy Sequence	First pregnancy	34	45,3
	Second pregnancy	31	41,3
	Thrid pregnancy	8	10,7
	Fourth pregnancy	2	2,7

Based on TABLE 2, most respondents were in the 24-29 years age group with 33 people (44%), followed by the 30-35 years age group with 26 people (34.7%). The 18-23 years age group included 11 people (14.7%), while the >36 years age group included 5 people (6.6%). There were no respondents in the <18 years age group. This distribution indicates that most respondents were in their active reproductive years, with a peak in the 24-35 years age group, which is the most common gestational age and considered biologically ideal.

TABLE 3
Distribution of Respondent Data Collection Results Based on Maternal Pregnancy Age at Kras Health Center, Kediri Regency

Gestational Age	Frequency	Presentase (%)
1 st Trimester (week 0 – 12)	23	30,7
Trimester 2 (week 13 – 27)	34	45,3
Trimester 3 (week 28 – 40)	18	24
Total	**75**	**100**

Based on TABLE 3, the results showed that most of the mothers' gestational age were in the 2nd trimester of pregnancy.

TABLE 4
Distribution of Respondent Data Collection Results Based on Maternal Gingivitis Status at the Kras Health Center, Kediri Regency

Gingival Index Score	Frequency	Presentase (%)
0 (Healthy)	2	2,6
0,1 – 1,0 (Mild Inflamation)	21	28
1,1 – 2,0 (Moderate Inflamation)	47	62,7
2,1 – 3,0 (Severe Inflamation)	5	6,7
Total	**75**	**100**

Based on TABLE 4, the results showed that the gingivitis status of pregnant women was mostly in the gingivitis score range of 1.1 - 2.0.

TABLE 5
Spearman Correlation Test Results Between Pregnancy Age and Gingivitis Status in Pregnant Women at the Kras Health Center, Kediri Regency

Variable	*Spearman-Rank* Correlation Test			*Correlation Coefficient*
	Mean ± SD	*ρ*	*α*	
Gestational Age	1,93 ± ,741	0,000	0,05	,746
Gingivitis Status	1,284 ± ,512			

Based on TABLE 5, the results show study participants in table 5 show the mean maternal gestational age of 1.93 with a standard deviation of 0.741, and the mean gingivitis condition of 1.284 with a standard deviation of 0.512. With a probability value of 0.000 and a significance level of 0.05, it was found that the p value (0.000) was less than α (0.05), so the alternative hypothesis was accepted, and the null hypothesis was rejected.

This finding indicates that there is a significant correlation between pregnancy period and the condition of gingivitis in pregnant women who seek treatment at the Kras Health Center, Kediri Regency in 2025. The correlation

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coefficient shows a figure of 0.746 which illustrates the level of a very close relationship between the two variables. The positive coefficient value indicates that the two variables have the same direction of relationship, namely the increasing period of pregnancy, the severity of gingivitis tends to increase.

IV. DISCUSSION

A. INTERPRETATION OF FINDINGS

The findings of this study demonstrate a statistically significant and strongly positive correlation between gestational age and gingivitis status among pregnant women attending the Kras Community Health Center. The Spearman correlation coefficient ($r = 0.746$, $p < 0.001$) indicates that gingivitis severity tends to increase as pregnancy progresses from the first to the third trimester. Most respondents in the second trimester exhibited moderate inflammation (62.7%), while severe inflammation appeared more frequently in the third trimester. This pattern suggests that physiological changes across gestation intensify the susceptibility of gingival tissues to inflammatory responses.

The biological explanation for this phenomenon is rooted in pregnancy-related hormonal surges, particularly estrogen and progesterone, which influence gingival vascularity, capillary permeability, and immune modulation. Increased levels of these hormones enhance vasodilation and stimulate the production of inflammatory mediators, making gingival tissues hypersensitive even in the presence of minimal plaque deposits. Furthermore, elevated progesterone suppresses neutrophil chemotaxis and phagocytosis, reducing the host's ability to combat bacterial invasion. These mechanisms collectively contribute to a higher risk of gingival bleeding, erythema, and edema as gestational age advances.

Behavioral factors likely reinforce this physiological vulnerability. Pregnant women often experience nausea, vomiting, fatigue, and changes in appetite, which may reduce oral hygiene practices such as brushing frequency or adherence to routine dental check-ups. Dietary changes during pregnancy, including increased snacking and consumption of carbohydrate-rich foods, may contribute to additional plaque accumulation. The high prevalence of moderate gingivitis observed in this study reflects the combined impact of biological and behavioral alterations inherent to pregnancy.

These findings emphasize the importance of considering gestational age as a key determinant of maternal periodontal health. The progressive nature of gingival inflammation across pregnancy underscores the need for proactive screening and intervention strategies tailored to each trimester.

B. COMPARISON WITH PREVIOUS STUDIES

The results of this study align with a substantial body of literature highlighting that the severity of gingivitis increases throughout pregnancy. A multicenter study conducted by Gare et al. reported a similar upward trend in gingival inflammation between the first and third trimester, driven primarily by hormonal fluctuations and shifts in the oral microbiome [35]. Similarly, Geurs et al. found that pregnancy-associated gingivitis peaks during the second and third trimesters, with preventive oral hygiene education significantly reducing disease progression [36]. These parallels strengthen the external validity of our findings and reinforce the role of trimester-specific physiological changes in periodontal disease development.

Another supporting study by Abdalrahman et al. demonstrated that gestational age remains a consistent predictor of gingival bleeding and plaque accumulation, irrespective of socioeconomic differences among study participants [37]. Their findings corroborate the positive correlation identified in the present research and emphasize that biological determinants may outweigh external variables in influencing gingival health during pregnancy.

The present study's findings are also consistent with the work of Wahyulisty et al., who observed increased inflammation in pregnant women despite stable plaque scores, indicating that tissue response and not merely plaque quantity is significantly altered during pregnancy [38]. This supports the notion that pregnancy-related gingivitis is multifactorial, with immune modulation playing a central role.

However, some studies report mixed or contrasting findings. For instance, Yasril et al. observed no significant correlation between gestational age and gingivitis severity in a population with high oral hygiene awareness and access to preventive dental care [39]. This discrepancy may be attributed to differences in sample characteristics, particularly regarding oral health education and dental service utilization. Another contrasting study by Bharathi et al. noted that individuals who maintained consistent oral hygiene practices exhibited reduced gingival inflammation across all trimesters, suggesting that behavioral variables can mitigate physiologic risks [40].

These contrasts highlight the variability of gingival outcomes depending on contextual factors such as education level, dental service availability, cultural behaviors, and oral hygiene practices. Despite differences, the majority of studies still support the association between gestational age and increased periodontal inflammation.

Taken together, the current findings contribute additional evidence to the existing literature by demonstrating this relationship specifically within a rural Indonesian community health setting, where disparities in oral health literacy and access to professional care may amplify gingival risks.

C. LIMITATIONS AND IMPLICATIONS

1. Limitations

Although the present study provides valuable insights, several limitations should be acknowledged to contextualize the findings:

a. Cross-sectional design: The study measured gestational age and gingivitis status at a single time point, preventing causal inference. Longitudinal designs would allow for tracking individual changes across trimesters.
b. Lack of plaque quantification: Although the Gingival Index assesses inflammation, it does not directly measure plaque accumulation. Including indices such as the Plaque Index or calculus scores could improve analytical precision.
c. Potential examiner bias: Although intra-examiner consistency was controlled, gingival assessment remains somewhat subjective. Calibration protocols involving multiple examiners could reduce bias.
d. Behavioral factors not assessed: Oral hygiene habits, dietary practices, frequency of vomiting, and access to dental care were not measured, preventing adjustment for potential confounders.
e. Single-center study: Data were collected from one community health center, which may limit

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generalizability to other regions with different sociodemographic characteristics.

Despite these limitations, the study offers strong evidence for the correlation between gestational age and gingivitis severity.

2. Implications for Maternal Health Practice

The findings highlight critical implications for public health care providers, dental practitioners, and maternal health policymakers:

a. Integration of dental screening into antenatal care (ANC): Routine periodontal examinations should be incorporated into ANC visits, particularly during the second and third trimesters when inflammation risk is highest.
b. Early preventive interventions: Pregnant women should receive oral health education during the first trimester, before significant hormonal changes intensify gingival vulnerability.
c. Interdisciplinary collaboration: Midwives, nurses, and dental professionals should collaborate to provide comprehensive maternal care addressing both systemic and oral health needs.
d. Community-based dental health promotion: Educational programs targeting rural and underserved populations should emphasize the importance of maintaining oral hygiene throughout pregnancy.
e. Future research opportunities: Longitudinal cohort studies could provide stronger evidence of gingival changes across pregnancy. Research incorporating microbial analysis or salivary biomarkers may also shed light on biochemical pathways underlying inflammation.

3. Broader Public Health Implications

Periodontal disease during pregnancy has been associated with adverse outcomes such as preterm birth and low birth weight. Although this study did not measure obstetric outcomes directly, the findings reinforce the need for maternal oral health policies that prevent gingival inflammation before it progresses into more serious periodontal conditions. Public health strategies should advocate for universal ANC packages that include oral hygiene counseling, affordable dental check-ups, and increased awareness of the impact of pregnancy on oral health.

V. CONCLUSION

This study aimed to analyze the correlation between gestational age and gingivitis status among pregnant women receiving antenatal services at the Kras Community Health Center in Kediri Regency. The findings revealed a statistically significant and strongly positive relationship between the two variables, as demonstrated by the Spearman correlation coefficient ($r = 0.746$) and a p-value of 0.000. These results indicate that gingivitis severity increases progressively from the first to the third trimester, with the majority of respondents exhibiting moderate inflammation (62.7%) and a smaller proportion presenting severe gingivitis (6.7%). This pattern aligns with the biological mechanisms associated with pregnancy, particularly hormonal fluctuations in estrogen and progesterone that heighten gingival vascularity, reduce immune defense, and increase tissue sensitivity to plaque. The observed increase in inflammation across trimesters further underscores the combined influence of physiological transformations and behavioral changes, such as reduced oral hygiene practices and altered dietary patterns during pregnancy. Collectively, these findings highlight the importance of integrating oral health assessments and preventive interventions into routine antenatal care. Future research should employ longitudinal designs to monitor gingival changes across pregnancy stages more precisely and incorporate additional variables such as plaque scores, dietary habits, vomiting frequency, and access to dental care. Furthermore, multicenter studies involving diverse populations are recommended to enhance generalizability and develop trimester-specific oral health guidelines for pregnant women. By expanding research in this area, maternal health programs can be strengthened to mitigate periodontal complications and improve pregnancy outcomes.

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DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTION

All authors contributed substantially to the development of this article. N.F.I. conceptualized the study, designed the methodology, and supervised data collection. S.H. conducted the data analysis, interpreted the results, and drafted the initial manuscript. A.M. reviewed relevant literature, validated the analytical procedures, and revised the manuscript for intellectual content. All authors read and approved the final version of the manuscript.

DECLARATIONS

ETHICAL APPROVAL

Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Surabaya. All participants provided informed consent prior to involvement.

CONSENT FOR PUBLICATION PARTICIPANTS.

All authors have reviewed and approved the final version of this manuscript for submission and publication.

COMPETING INTERESTS

The authors declare that there are no conflicts of interest regarding the publication of this article.

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