

The effect of oral health maintenance behaviors among pregnant women on pregnancy gingivitis: a cross-sectional study

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ABSTRACT

Introduction: Pregnancy gingivitis is the most common oral manifestation during pregnancy and, if left untreated, it may be associated with adverse pregnancy outcomes, including low birth weight (LBW). Hormonal changes accompanied by inadequate oral health behaviors are considered important factors associated with its occurrence. This study aimed to analyze the effect of oral health maintenance behaviors among pregnant women on pregnancy gingivitis. **Methods:** This analytical observational study employed a cross-sectional design involving 38 pregnant women attending the Mulyorejo Community Health Center, Surabaya, Indonesia, in June 2022. Oral health behavior was assessed using a structured questionnaire covering knowledge, attitude, and practice domains. Gingival status was evaluated using the Bleeding on Brushing (BOB) test and the Oral Hygiene Index-Simplified (OHI-S). Data were analyzed using Spearman's rank correlation and binary logistic regression analyses, with statistical significance set at $p < 0.05$. **Results:** A total of 24 participants (63.2%) exhibited BOB. Knowledge, attitude, and practice showed significant negative correlations with BOB ($r = -0.335$ to -0.494 ; $p = 0.002$ – 0.040) and OHI-S ($r = -0.459$ to -0.509 ; $p = 0.001$ – 0.004). Multivariable logistic regression analysis, oral health practice (adjusted OR = 0.76; 95% CI: 0.59–0.97; $p = 0.029$), toothbrushing frequency of fewer than twice daily (adjusted OR=4.20; 95% CI: 1.01–17.50; $p = 0.049$), and OHI-S score (adjusted OR=1.75; 95% CI: 1.01–3.04; $p = 0.046$) remained independently associated with the presence of BOB. **Conclusion:** Knowledge, attitude, and practice regarding oral health were significantly associated with gingival health among pregnant women. After multivariable adjustment, oral health practice, toothbrushing frequency, and oral hygiene status remained independently associated with BOB, underscoring the importance of consistent daily oral hygiene practices in maintaining gingival health during pregnancy.

Keywords

Pregnant Women; Gingivitis; Oral Hygiene; Health Behavior; Periodontal Diseases; Pregnancy

Efek perilaku pemeliharaan kesehatan gigi dan mulut dengan gingivitis kehamilan pada ibu hamil: studi potong lintang

ABSTRAK

Pendahuluan: Gingivitis kehamilan merupakan manifestasi oral yang umum selama kehamilan dan dapat berhubungan dengan luaran persalinan yang merugikan, termasuk berat badan lahir rendah (BBLR). Perubahan hormonal dan perilaku kesehatan gigi dan mulut kurang memadai berhubungan dengan gingivitis kehamilan. Penelitian ini bertujuan menganalisis efek perilaku kesehatan gigi dan mulut dengan gingivitis kehamilan pada ibu hamil. **Metode:** Penelitian observasional analitik dengan desain potong lintang melibatkan 38 ibu hamil di Puskesmas Mulyorejo, Surabaya, pada Juni 2022. Perilaku kesehatan gigi dan mulut diukur menggunakan kuesioner terstruktur mencakup pengetahuan, sikap, dan praktik. Status gingiva dinilai menggunakan *Bleeding on Brushing* (BOB) dan *Oral Hygiene Index-Simplified* (OHI-S). Data dianalisis menggunakan korelasi *Spearman* dan regresi logistik biner dengan tingkat kemaknaan $p < 0,05$. **Hasil:** Sebanyak 24 responden (63,2%) mengalami BOB. Pengetahuan, sikap, dan praktik berkorelasi negatif bermakna dengan BOB (masing-masing $r = -0,494$; $p = 0,002$; $r = -0,335$; $p = 0,040$; dan $r = -0,490$; $p = 0,002$) serta skor OHI-S ($r = -0,509$; $p = 0,001$; $r = -0,459$; $p = 0,004$; dan $r = -0,502$; $p = 0,001$). Regresi logistik menunjukkan praktik kesehatan gigi dan mulut (aOR=0,76; IK95%: 0,59–0,97; $p = 0,029$), frekuensi menyikat gigi <2 kali/hari (aOR=4,20; IK95%: 1,01–17,50; $p = 0,049$), dan OHI-S (aOR=1,75; IK95%: 1,01–3,04; $p = 0,046$) berhubungan independen dengan BOB. **Simpulan:** Perilaku kesehatan gigi dan mulut berhubungan bermakna dengan status gingiva ibu hamil, dengan praktik, frekuensi menyikat gigi, dan status kebersihan mulut berhubungan independen dengan BOB.

Kata kunci

gingivitis; ibu hamil; kebersihan mulut; perilaku kesehatan; perdarahan gingiva.

INTRODUCTION

Gingivitis is a non-destructive periodontal disease characterized by gingival inflammation, redness, swelling, and bleeding. Globally, the prevalence of periodontal disease is reported to range between 20% and 50%, with gingivitis and periodontitis together accounting for 96.58% in Asia.^{1,2} In Indonesia, the 2018 National Basic Health Research (RISKESDAS) reported that the prevalence of dental and oral problems was 57.6%, with gingivitis being the largest contributor, at 74%.³

Pregnancy is a physiological state characterized by significant hormonal changes, making pregnant women particularly vulnerable to oral health problems.⁴ Hormonal changes, particularly increased estrogen and progesterone levels, may induce an exaggerated gingival response to local irritants such as bacterial plaque.^{4,5} Estrogen reduces gingival cell proliferation thereby weakening the epithelial barrier, while progesterone increases vascular permeability and blood microcirculation in the gingiva, ultimately enhancing the inflammatory response.⁶

This condition is known as pregnancy gingivitis, with a very high prevalence, ranging from 30% to 100% among pregnant women worldwide.⁷ Besides hormonal factors, behavioral changes during pregnancy also contribute to gingivitis. Dietary changes, such as increased snacking and simple carbohydrate consumption, as well as nausea and vomiting (morning sickness), may adversely affect oral hygiene, thereby contributing to plaque accumulation and an increased risk of inflammation.^{8,9}

The clinical significance of pregnancy gingivitis extends beyond the oral cavity and can also have serious systemic consequences for the pregnancy itself. Unmanaged gingivitis may progress to periodontitis, which is a risk factor for pregnancy complications such as premature birth and low birth weight (LBW).¹⁰ The underlying mechanism involves a systemic response in which inflammatory mediators (such as IL-6, IL-8, and TNF- α) and periodontal pathogenic bacteria (such as *Porphyromonas gingivalis* and *Fusobacterium nucleatum*) originating from infections in the oral cavity can enter the bloodstream.^{11,12} These bacteria and inflammatory mediators then reach the fetoplacental unit, triggering a local inflammatory response in the placenta that may contribute to premature uterine contractions and cervical ripening, or interfere with fetal development.^{6,13}

Preliminary survey data collected at the Bagor Community Health Center, Nganjuk Regency, in 2021 showed a high number of visits by pregnant women (531 people), with gingivitis ranking fourth among the 10 most common dental and oral diseases (183 cases).⁷ However, this high number was not accompanied by adequate awareness and oral health maintenance behaviors; many pregnant women had limited knowledge, suggesting a potential gap between their clinical oral health status and self-care practices.^{7,14}

These findings demonstrate the relevance and importance of conducting the present study in this setting to examine the effect of oral health maintenance behaviors among pregnant women on pregnancy gingivitis and to support efforts to prevent more serious complications.^{15,16} A preliminary survey at the Mulyorejo Community Health Center found that most pregnant women (60% of a total of 52 pregnant women) experienced gingival bleeding but were unaware of the associated risk, and only a few had undergone a dental examination during pregnancy. Based on this evidence, this study aimed to analyze the effect of oral health maintenance behaviors among pregnant women on pregnancy gingivitis.

METHODS

This observational analytic study employed a cross-sectional design and was conducted at the Mulyorejo Community Health Center, Surabaya, in June 2022. The source population comprised all pregnant women registered for antenatal care at the health center during the study period. Based on the antenatal care registry, the target population consisted of 52 pregnant women; therefore, the study population was finite. Eligible participants were recruited consecutively during routine antenatal care visits until the required sample size was achieved. The minimum sample size was calculated using the correlation formula with a minimum meaningful correlation coefficient (r) of 0.525, a two-sided significance level of 5% ($Z\alpha = 1.96$), and a study power of 80% ($Z\beta = 0.84$), resulting in a minimum sample size 26 participants. To compensate for possible non-response or incomplete data and to improve statistical precision¹⁷, recruitment continued until 38 pregnant women had been enrolled.

The independent variable was the oral health behavior of the pregnant women, operationalized into three domains: knowledge, attitudes, and practices related to oral health maintenance. Data were collected using a structured questionnaire with a Likert scale for attitude items and a checklist for practice items. The behavioral variables of pregnant women in this study included knowledge, attitudes, and practices related to dental and oral health, measured using a structured questionnaire developed based on instruments that have been evaluated in the context of maternal health care, particularly those relevant to the needs of dental health programs. The primary reference for developing the instrument was a study by Wening²³ that evaluated an instrument to measure maternal dental health needs in a low-income population. The instrument incorporated items relevant to mothers' understanding, perceptions, and behaviors regarding dental health and had been tested in a similar population context in Indonesia.²³ Therefore, this instrument was used as the basis for designing the questionnaire for this study, with modifications according to the focus of pregnancy gingivitis and the behavioral indicators measured.

Prior to data collection, the questionnaire was pilot-tested among pregnant women with characteristics similar to those of the study participants to assess item clarity, comprehensibility, and response consistency. Because the questionnaire was adapted from the previously validated maternal oral health instrument developed by Wening et al.,²³ the pilot study was intended to evaluate face validity and feasibility rather than to re-establish construct validity. Minor wording modifications were made to improve clarity without altering the conceptual meaning of the original items.

Knowledge was measured through multiple-choice questions covering important aspects of oral health during pregnancy, including dental risk factors common to pregnant women. A knowledge score was calculated by summing the scores for correct (1) and incorrect (0) answers. Attitudes were measured using Likert-type statements based on the attitude dimensions in the Wening instrument²³ such as belief in the importance of dental care, perceived risk of gingivitis during pregnancy, and intention to take preventive measures. Attitude scores were calculated from the total Likert scale score. Oral health practices were measured using items reflecting daily behaviors, including toothbrushing frequency, use of interdental cleaning devices, and attendance at dental check-ups during pregnancy. Practice scores were calculated based on the frequency or consistency of these behaviors, following the scoring approach of the reference instrument.²³ The questionnaire was completed by the participants under the supervision of the research team to ensure completeness and to clarify any questions without influencing responses.

Clinical examinations, including the Oral Hygiene Index-Simplified (OHI-S) and Bleeding on Brushing (BOB) assessments, were performed by a single licensed dentist who served as the principal examiner throughout the study. Prior to data collection, the

examiner underwent standardized training on the assessment procedures for OHI-S and BOB to ensure consistent application of the assessment criteria. Because all clinical examinations were conducted by the same examiner, inter-examiner calibration was not required. The total scores for each behavioral domain were analyzed as continuous variables and correlated with OHI-S scores and BOB outcomes using Spearman's rank correlation test according to the data distribution.

The study evaluated an instrument that measures the need for dental health programs in mothers, which includes aspects of knowledge, attitudes, and behavior, as dimensions also examined in this study.²³ The instrument was previously tested among 187 pregnant women from Javanese and Madurese populations in East Java, Indonesia. Of the initial 46 items, 11 items were retained and significantly associated with individual needs for dental health programs ($p=0.001$; $B=0.4$). The instrument demonstrated good internal consistency (Cronbach's $\alpha=0.78$) and high test-retest reliability (intraclass correlation coefficient, 0.84–0.99), supporting its reliability and validity in assessing maternal dental health needs. Its development within Javanese and Madurese populations also supports its cultural and contextual relevance to pregnant women in Surabaya. Adapting items from an instrument that has been proven valid in a similar setting enhances the methodological robustness of the behavioral measurement in this study. The dependent variable was the incidence of pregnancy gingivitis, assessed using two clinical parameters: (1) Bleeding on Brushing (BOB), recorded as a dichotomous variable (presence/absence) using the Guttman scale, and (2) oral hygiene status assessed using the Oral Hygiene Index-Simplified (OHI-S). Clinical examinations were performed by the principal investigator following standardized examination procedures.

Data were analyzed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro–Wilk test. Because several variables were not normally distributed, comparisons between two groups were performed using the Mann–Whitney U test, whereas comparisons among more than two groups were performed using the Kruskal–Wallis test. Associations between behavioral domain scores and clinical parameters were evaluated using Spearman's rank correlation coefficient (ρ).

In addition, because the primary clinical outcome (BOB) was dichotomous, binary logistic regression analysis was performed to further examine the magnitude of association between behavioral and clinical variables and the presence of BOB. Variables showing clinical relevance and/or a p -value <0.25 in the bivariate analysis were entered into the multivariable model. The results are presented as odds ratios (ORs) with 95% confidence intervals (95% CIs). Owing to the cross-sectional design, the logistic regression analysis was intended to evaluate independent associations rather than to infer causality or establish predictive relationships. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 38 pregnant women participated in this study. Most respondents (57.9%) were in their third trimester of pregnancy and were housewives (60.5%) (Table 1).

Table 1. Respondent characteristics (n=38)

Characteristics	Category	Amount (n)	Proportion (%)
Gestational Age	1 st Trimester	7	18.4
	2 nd Trimester	9	23.7
	3 rd Trimester	22	57.9
Employment Status	Working	15	39.5
	Housewife	23	60.5

A total of 24 respondents (63.2%) exhibited Bleeding on Brushing (BOB). Based on the OHI-S, the majority of respondents (78.9%) had moderate oral hygiene, and 15.8%

had poor oral hygiene (Table 2).

Table 2. Distribution of BOB and OHI-S Categories (n=38)

Clinical Variables	Category	Amount (n)	Proportion (%)
Bleeding on Brushing (BOB)	Yes	24	63.2
	No	14	36.8
OHI-S	Good	2	5.3
	Moderate	30	78.9
	Poor	6	15.8

The mean knowledge score was 9.76 ± 1.50 , the mean attitude score was 18.00 ± 2.50 , and the mean practice score was 8.42 ± 1.46 . A total of 58.9% of respondents had high knowledge, whereas 65.8% had low attitude scores and 55.2% had low practice scores for maintaining oral health.

Table 3. Distribution of Bleeding on Brushing (BOB) according to Sociodemographic Factors and Oral Health Practices

Variables	Category	BOB (+) n (%)	BOB (-) n (%)	Total (n)	p-value*
Gestational Age	1 st Trimester	4 (57.1%)	3 (42.9%)	7	0.72
	2 nd Trimester	5 (55.6%)	4 (44.4%)	9	
	3 rd Trimester	15 (68.2%)	7 (31.8%)	22	
Employment Status	Working	10 (66.7%)	5 (33.3%)	15	0.75
	Housewife	14 (60.9%)	9 (39.1%)	23	
Toothbrushing Frequency	< Twice / Day	20 (76.9%)	6 (23.1%)	26	0.012*
	≥ Twice / Day	4 (33.3%)	8 (66.7%)	12	
Sweet Food Consumption Habits	Yes	14 (70.0%)	6 (30.0%)	20	0.33
	No	10 (55.6%)	8 (44.4%)	18	
Experience of Visiting the Dentist (during pregnancy)	Yes	3 (37.5%)	5 (62.5%)	8	0.088
	No	21 (70.0%)	9 (30.0%)	30	

*p<0.05 indicates a statistically significant association

The analysis results in Table 3 show that among the sociodemographic and behavioral variables tested, only toothbrushing frequency was significantly associated with BOB in pregnant women. Respondents with a habit of brushing their teeth less than twice a day experienced BOB at a significantly higher proportion than those who brushed their teeth at least twice a day, indicating an association between toothbrushing frequency and gingival bleeding.

Other variables, such as gestational age, employment status, sweet food consumption habits, and dental visits, showed varying patterns of association but did not reach statistical significance, possibly partly due to the relatively small sample size. Based on this pattern, it can be concluded that although hormonal and sociodemographic factors contribute to gingival vulnerability during pregnancy, behavioral determinants, especially toothbrushing frequency, remain important modifiable factors and potential targets for promotive and preventive interventions to improve oral health during pregnancy.

Spearman's correlation test showed significant negative correlations between the three behavioral domains and both OHI-S and BOB. This indicates that higher knowledge, attitude, and practice scores were associated with lower OHI-S scores and a lower presence of BOB. The correlation test results are presented in Table 4.

Table 4. Results of Spearman Correlation Test between Behavioral Domains and OHI-S and BOB

Variables	OHI-S		BOB	
	r Value	p Value	r Value	p Value
Cognitive	-0,509	0,001*	-0,494	0,002*
Affective	-0,459	0,004*	-0,335	0,040*

Psychomotor	-0,502	0,001*	-0,490	0,002*
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*Description: significant (p < 0.05)

Significant negative correlations between the three behavioral domains and the OHI-S in Table 4 indicate that higher knowledge, attitude and practice scores were associated with lower OHI-S scores, indicating better oral hygiene. Similarly, negative correlations were observed between the three behavioral domains and BOB, indicating that higher behavioral scores were associated with a lower presence of BOB. The strongest correlation strength was observed between knowledge/practice and the OHI-S ($r \approx 0.50$), while correlations for BOB were moderate ($r \approx 0.33$ – 0.49). These findings indicate that better oral health-related knowledge, attitudes, and practices were associated with better oral hygiene and less gingival bleeding.

Table 5. Univariate and multivariate logistic regression analysis of BOB

Variables	Univariate OR (95% CI)	p-value	Multivariate OR (95% CI)	p-value
Cognitive (continuous score)	0.78 (0.62–0.95)	0.015*	0.82 (0.64–1.04)	0.093
Attitude (continuous score)	0.85 (0.72–0.99)	0.042*	–	–
Psychomotor (continuous score)	0.74 (0.59–0.93)	0.008*	0.76 (0.59–0.97)	0.029*
OHI-S (continuous)	1.90 (1.15–3.13)	0.012*	1.75 (1.01–3.04)	0.046*
Toothbrushing Frequency (<Twice/day vs $\geq$ Twice/day)	5.00 (1.25–20.0)	0.022*	4.20 (1.01–17.5)	0.049*
Trimester (3 rd vs 1 st –2 nd)	1.60 (0.45–5.65)	0.47	–	–
Employment Status (Working vs Housewife)	1.25 (0.35–4.50)	0.74	–	–
Sweet Food Snacking Habits (Yes vs No)	1.80 (0.50–6.40)	0.36	–	–
Visits to the Dentist during pregnancy (Ever vs. Never)	3.89 (0.79–19.1)	0.093	2.95 (0.55–15.8)	0.20

The correlation and logistic regression analyses presented in Table 5 showed significant associations between several oral health behavior variables and clinical indicators of gingival health. Spearman's correlation analysis showed that higher knowledge, attitude, and practice scores were significantly associated with lower OHI-S scores and a lower presence of Bleeding on Brushing (BOB). In the multivariable logistic regression analysis, the practice score remained independently associated with BOB after adjustment for other variables (adjusted OR=0.76; 95% CI: 0.59–0.97; $p=0.029$), whereas the association between knowledge and BOB was no longer statistically significant.

In addition, brushing teeth less than twice daily (adjusted OR=4.20; 95% CI: 1.01–17.50; $p=0.049$) and higher OHI-S scores (adjusted OR= 1.75; 95% CI: 1.01–3.04; $p=0.046$) were independently associated with the presence of BOB. These findings suggest that although knowledge and attitudes are important components of oral health behavior, their association with gingival health may be reflected partly through consistent oral hygiene practices.

DISCUSSION

The results of this study show a consistent and interrelated pattern of findings between respondent characteristics, behavioral indicators, oral hygiene status, and the presence of gingival bleeding. Table 2 illustrates the high proportion of pregnant women who exhibited Bleeding on Brushing (BOB) and the predominance of moderate to poor oral hygiene, which is then emphasized by Table 3 through the identification of specific behaviors, especially toothbrushing frequency as a factor significantly associated with BOB.

At the correlational level (Table 4), all behavioral domains showed significant negative relationships with clinical indicators, where knowledge ($r=-0.509$; $p=0.001$),

attitude ($r=-0.459$; $p=0.004$), and practice ($r=-0.502$; $p=0.001$) were significantly correlated with the OHI-S, and showed significant correlations with BOB (r ranged from -0.335 to -0.494 ; $p<0.05$). These findings were further examined using logistic regression analysis (Table 5), which showed that the practice score ($OR=0.76$; 95% CI: $0.59-0.97$; $p=0.029$), OHI-S ($OR=1.75$; 95% CI: $1.01-3.04$; $p=0.046$), and toothbrushing frequency of less than twice a day ($OR=4.20$; 95% CI: $1.01-17.5$; $p=0.049$) were independently associated with BOB. In contrast, the association of knowledge and attitude were no longer statistically significant after controlling for practice variables and oral hygiene status, indicating that the effects of these two variables were mediated by actual daily behavior. This pattern suggests a sequential relationship from behavioral capacity to clinical conditions, which is directly related to the occurrence of gingival bleeding.

The analysis showed that brushing less than twice a day was significantly associated with an increased presence of gingival bleeding in pregnant women. This finding highlights the importance of consistent daily oral health practices in relation to gingival bleeding during pregnancy. The biological mechanism may be explained by higher plaque accumulation in individuals with infrequent brushing habits, resulting in increased local irritation and a gingival inflammatory response exacerbated by hormonal changes during pregnancy.^{18,19}

Correlation analysis showed a significant negative relationship between knowledge, attitudes, and practices and both OHI-S scores and BOB. This finding supports the health behavior theory that cognitive, affective, and psychomotor aspects interact to shape healthy behavior.²⁰ However, the logistic regression results show that the practice score remained independently associated with BOB, while the influence of knowledge weakens after being controlled for by practice. This phenomenon is in line with the statement in Santrock that good knowledge does not always translate into appropriate attitudes and practices. Thus, oral health education for pregnant women should be more directed at establishing consistent oral health practices, not just increasing information.²¹ Although other variables such as trimester, employment status, and sweet snacking habits did not show statistical significance in this sample, the observed findings are consistent with literature suggesting that sociodemographic factors and dietary patterns also influence the oral health of pregnant women.^{8,9}

Furthermore, oral hygiene status, as reflected by the OHI-S score, has been shown to be an important mediator in the relationship between behavior and gingival bleeding. This mediation pathway is biologically based, demonstrating the positive physiological function of oral hygiene practices, which directly contribute to reduced plaque accumulation and ultimately reduce the risk of bleeding during toothbrushing.^{5,10}

This study suggests that BOB is a simple yet meaningful indicator for assessing gingival health in pregnant women. The analysis showed that actual behavior, particularly tooth brushing frequency, was significantly associated with the presence of gingival bleeding, while the OHI-S was shown to mediate the relationship between behavior and BOB. These findings are consistent with the literature emphasizing the role of plaque accumulation as a key factor in the development of gingivitis in pregnancy.^{18,19}

From a health promotion perspective, the BOB indicator has strategic value not only as a clinical parameter, but also as a simple and easily understood risk communication tool for the public, in line with the health literacy and behavior-based intervention approaches that have been widely developed in promotive research.^{22,23} Meanwhile, from the perspective of public dental health and surveillance, BOB has the potential to be a practical epidemiological marker that can be integrated into the oral health monitoring of pregnant women, complementing national data such as Riskesdas and supporting evidence-based preventive policies.^{24,25} Accordingly, this study not only strengthens the academic evidence on behavioral determinants of pregnancy gingivitis but also opens opportunities for practical implementation by positioning Bleeding on Brushing (BOB) as

both a clinical red flag and a public health indicator. Integrating BOB into promotive and preventive programs at primary healthcare facilities could strengthen early detection efforts, improve adherence to healthy oral health behaviors, and potentially contribute to reducing the risk of obstetric complications associated with periodontal health.^{10,11}

The results of this study support the hypothesis that there is a significant relationship between the behavior of pregnant women (knowledge, attitudes, and practices) and the oral health indicators assessed by BOB and OHI-S. The finding that 63.2% of respondents had BOB is consistent with the studies of Nagi et al. and Payal et al. who reported the prevalence of BOB in pregnant women at 50.1% and 60%, respectively.^{26,27} This high proportion may be related to hormonal changes during pregnancy, which increase gingival blood vessel permeability and the gingival response to plaque irritation.^{18,19}

The correlation test results showed a moderate to strong negative relationship between the behavioral domain and gingival status. This means that increased knowledge, improved attitudes, and increased oral care practices were associated with improved gingival health. This finding aligns with Bloom's theory, the foundation of this research, which states that health behavior is shaped by three interrelated domains.²⁰ However, an interesting finding was that although 58.9% of respondents had high levels of knowledge, the majority had low attitudes (65.8%) and practice scores (55.2%). This phenomenon aligns with Santrock's statement that positive knowledge is not always followed by corresponding attitudes and practices.²¹ This disparity can be caused by various inhibiting factors during pregnancy, such as nausea and vomiting that make mothers reluctant to brush their teeth, as well as the perception that dental care during pregnancy is dangerous.^{28,29}

This study also found that employed pregnant women had significantly worse OHI-S scores than housewives ($p=0.002$). This may be due to busy work schedules that may require time and attention, leading to neglect of oral health care. However, no significant differences were found in the presence of BOB and behavioral domains based on employment status and gestational age. This suggests that behavioral factors and gingivitis are influenced by a complex combination of factors beyond these demographic characteristics.

The findings of this study have conceptual relevance to other literature discussing dental anxiety in mothers, where the role of socioeconomic factors in psychological responses influences dental care.³⁰ Research on dental anxiety suggests that social conditions and perceptions of dental health services can influence individuals' engagement in daily dental care behaviors, including the tendency to avoid or delay oral hygiene practices and dental visits. In the context of this study, suboptimal toothbrushing behavior and poor oral hygiene status (which have been shown to be significantly associated with BOB) can be understood as part of a spectrum of behavioral responses influenced by similar psychosocial and environmental factors.

Overall, these findings indicate that *Bleeding on Brushing (BOB)* among pregnant women represents a clinical manifestation of the interplay between behavioral factors and oral hygiene status, which may be interrelated. The correlation analysis showed that all behavioral domains (knowledge, attitude, and particularly practice) were significantly associated with both *OHI-S* and *BOB*. Meanwhile, the multivariable analysis demonstrated that only the most proximal factors, namely oral health practices, oral hygiene status (*OHI-S*), and toothbrushing frequency, remained independently associated with *BOB*. This pattern suggests that the cognitive and affective capacities of pregnant women alone may be insufficient to prevent gingival inflammation unless they are translated into consistent oral hygiene practices.

These findings align with the results of a study reported by Nugroho³¹, which emphasized that oral hygiene behavior is a key factor in determining periodontal condition, particularly in groups with biological susceptibility or specific physiological

changes. The study demonstrated that suboptimal daily behavior contributes to plaque accumulation and increased signs of gingival inflammation, even when individuals have adequate knowledge. This consistency reinforces the study's finding that BOB reflects the importance of daily oral health practices in addition to knowledge.

Limitations of this study include its cross-sectional design, which cannot establish causal relationships; the relatively small sample size from only one community health center, which limits generalizability; and the measurement of gingivitis based solely on the BOB and OHI-S, without measuring more specific gingival indices such as the Gingival Index. Future research is recommended to employ a cohort design, expand the sample size to multiple locations, and include more comprehensive measurements of the gingival status. The implications of this study highlight the importance of dental health education programs that focus not only on increasing knowledge but also on changing attitudes and establishing consistent practices for pregnant women, taking into account the specific barriers they face during pregnancy.

CONCLUSION

The presence of Bleeding on Brushing (BOB) in pregnant women is associated with oral health behaviors and oral hygiene status. All behavioral domains (knowledge, attitudes, and actions) showed significant associations with the OHI-S and BOB, but only the most proximal factors, namely dental and oral care practices, oral hygiene status (OHI-S), and tooth brushing frequency, remained independently associated with BOB. These findings indicate that cognitive and affective capacities alone may not be sufficient to achieve optimal oral health if they are not translated into consistent oral hygiene practices. Furthermore, the OHI-S was shown to mediate the relationship between behavior and the incidence of gingival bleeding, confirming the role of plaque accumulation as a primary mechanism in the development of pregnancy gingivitis. Thus, BOB can be understood not only as a clinical sign of gingival inflammation, but also as a simple indicator associated with oral health maintenance behaviors in pregnant women. These findings suggest that promotive and preventive efforts in primary health care should focus on supporting concrete daily oral health practices, particularly adequate toothbrushing habits, as well as considering BOB as a potential early detection and risk communication tool in maternal health programs.

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