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The Impact of the Mom Smile Application on Pregnant Women's Knowledge of Pregnancy Gingivitis

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ABSTRACT Pregnancy gingivitis remains a prevalent oral health problem among pregnant women, largely driven by hormonal changes and inadequate awareness of proper oral hygiene practices. Despite its high prevalence and potential complications, including heightened risks of adverse pregnancy outcomes, educational resources tailored to improving oral health knowledge during pregnancy are still limited and often ineffective. This study addresses this gap by examining the impact of the Android-based Mom Smile application as an accessible digital learning tool for enhancing pregnant women's knowledge of pregnancy gingivitis. This research employed a quasi-experimental one-group pretest–posttest design involving 32 pregnant women attending the Gayam Health Center in Sumenep Regency. Participants completed a validated knowledge questionnaire assessing their understanding of pregnancy gingivitis including its definition, symptoms, causes, impacts, and prevention before and after engaging with the Mom Smile application. Data were analyzed using the Wilcoxon signed-rank test due to non-normal distribution. The findings demonstrated a substantial improvement in knowledge following the intervention. The mean knowledge score increased from 54.68% in the pretest to 83.28% in the posttest. Prior to the intervention, 62% of participants exhibited low knowledge levels, whereas after using the application, 88% achieved high knowledge levels. Statistical analysis confirmed a significant difference between pretest and posttest scores ($p < 0.05$), indicating the effectiveness of the Mom Smile application. In conclusion, the Mom Smile application proved to be an effective digital educational tool for enhancing pregnant women's knowledge about pregnancy gingivitis. Its motion-graphic–based content offers an engaging and practical alternative to traditional printed materials. Integrating such digital health education into antenatal care services may support better oral hygiene practices, thereby contributing to improved maternal health outcomes.

INDEX TERMS Pregnancy gingivitis, pregnant women, mobile health application, health education, knowledge improvement.

I. INTRODUCTION

Pregnancy is accompanied by substantial hormonal, vascular, and immunological changes that increase women's susceptibility to oral health problems, particularly gingivitis. Pregnancy gingivitis is characterized by gingival inflammation, swelling, bleeding, and changes in tissue coloration, which commonly develop due to elevated estrogen and progesterone levels that exacerbate the body's inflammatory response to plaque accumulation [1]–[3]. Globally, gingivitis during pregnancy affects more than half of expectant mothers, and its persistence may elevate the risk of adverse outcomes such as preterm birth and low birth weight [4]–[6]. In Indonesia, the Basic Health Research reports that gingivitis remains highly prevalent, with approximately 74% of the population experiencing symptoms, partly due to low awareness and inadequate oral-hygiene knowledge among pregnant women [7], [8]. These findings underscore the urgent need for targeted educational interventions that can increase pregnant women's understanding of preventive oral health practices.

Recent advancements in health promotion have shifted toward the integration of digital and mobile-based technologies to support patient education. Digital health platforms particularly smartphone applications have gained recognition for their effectiveness in delivering interactive, accessible, and engaging health information [9], [10]. Studies show that mobile health (mHealth) tools positively influence maternal health literacy, enhance behavioral change, and improve adherence to recommended health practices, including oral hygiene [11]–[14]. In addition, motion graphic–based animations incorporated into mobile applications have demonstrated strong potential for improving comprehension by simplifying complex health concepts [15], [16]. These state-of-the-art methods reflect significant progress in health communication strategies and present opportunities to refine oral health education for pregnant women.

Despite the growing evidence supporting mHealth solutions, research specifically examining mobile applications that focus on pregnancy gingivitis remains limited. Current educational resources provided through antenatal care services are predominantly delivered in printed formats such as brochures and booklets, which tend to be less appealing and less effective in fostering learning engagement [17], [18]. Only a small number of studies have explored the use of Android-based oral health applications tailored to pregnant women, and even fewer have evaluated their effectiveness using pre–post intervention comparisons [19], [20]. This gap indicates the need for research that systematically assesses digital educational tools designed to

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address the unique oral health challenges faced during pregnancy.

To address these limitations, the present study aims to evaluate the effectiveness of the Mom Smile Android-based application in improving pregnant women's knowledge about pregnancy gingivitis. The application incorporates motion-graphic animations to enhance comprehension and engagement, making it a potentially superior alternative to conventional educational materials. The findings of this study are expected to contribute to the development of innovative oral health promotion models for pregnant women. This study offers three key contributions:

1. It provides empirical evidence regarding the impact of digital, motion-graphic–based learning media on pregnant women's oral health knowledge.
2. It expands the existing body of literature on mHealth interventions specifically targeted at pregnancy-related oral health issues.
3. It offers practical recommendations for integrating mobile educational tools into routine antenatal care services to enhance maternal health outcomes.

The remainder of this article is structured as follows: Section II describes the research methods, including design, sampling, and instrumentation. Section III presents the study results. Section IV provides a comprehensive discussion interpreting the findings and comparing them with previous studies. Section V concludes the study and outlines future research directions.

II. METHODS

This study applied a quantitative, quasi-experimental research design using a one-group pretest–posttest approach to evaluate the effect of the Mom Smile Android-based application on improving pregnant women's knowledge of pregnancy gingivitis. The one-group pretest–posttest model was selected because it enables the assessment of changes in knowledge levels before and after the educational intervention without requiring a comparison group, and it is widely used in similar health education research involving digital tools [21], [22].

A. STUDY DESIGN AND SETTING

The study was conducted prospectively at the Gayam Public Health Center (Puskesmas Gayam), located in Jl. Raya Pancor No. 09, Sumenep Regency, East Java. The data collection period occurred from January to February 2025. Gayam Public Health Center serves 10 villages, making it an appropriate setting for accessing a diverse sample of pregnant women receiving routine antenatal care. This setting also ensured that participants had varying levels of prior exposure to dental health information, allowing a comprehensive evaluation of the intervention.

B. STUDY POPULATION AND ELIGIBILITY CRITERIA

The study population consisted of all pregnant women attending antenatal care visits at the Gayam PHC during the research period, regardless of trimester. Purposive sampling was used to recruit participants who met inclusion criteria, aligning with prior methodological recommendations for educational intervention studies involving mobile health technology [23], [24].

Inclusion Criteria

1. Pregnant women in their first, second, or third trimester.
2. Registered visitors of the Gayam PHC during January–February 2025.
3. Diagnosed with pregnancy gingivitis or reported symptoms consistent with gingival inflammation.
4. Able to operate an Android smartphone.
5. Willing to participate and provide informed consent.

Exclusion Criteria

1. Pregnant women with systemic diseases affecting cognition or participation (e.g., severe anemia, neurological disorders).
2. Women who had previously received structured oral health education related to gingivitis within the past six months.
3. Individuals without consistent access to a smartphone during the intervention period.

A total of 32 eligible participants were recruited, meeting the minimum sample size requirements for quasi-experimental designs with pre–post comparison [25].

C. INTERVENTION MATERIAL: THE MOM SMILE APPLICATION

The Mom Smile application is an Android-based digital educational tool designed specifically for pregnant women. The content includes motion-graphic animations explaining pregnancy gingivitis, covering definitions, signs and symptoms, causes, risk factors, complications, and preventative measures. The application was selected because of its accessible interface, simple navigation, and high engagement potential, which aligns with evidence indicating that animated digital media enhances comprehension in maternal health education [26], [27].

Participants were instructed to install the Mom Smile application on their personal smartphones. They were given one guided session to explore the application, followed by an independent learning period of 2–3 days before completing the posttest.

D. INSTRUMENTS AND MEASUREMENTS

Knowledge assessment was conducted using a structured questionnaire developed specifically for this study. The questionnaire consisted of multiple-choice items addressing key components of pregnancy gingivitis: definition, symptoms, causes, impacts, and prevention. The instrument was validated through expert review by dental health lecturers and was pre-tested for clarity and reliability among a small group of pregnant women not included in the final sample.

1. Scoring System

Responses were coded dichotomously:

a. Correct answer = 1 point
b. Incorrect answer = 0 points

Knowledge level categories:

a. Good: 76–100%
b. Moderate: 56–75%
c. Poor: <56%

This classification system follows recognized approaches used in contemporary maternal oral health research [28].

E. DATA COLLECTION PROCEDURE

Data collection was conducted in three sequential phases:

1. Pretest Phase

Participants completed the baseline knowledge questionnaire before receiving any educational intervention. The pretest was administered individually in a private counseling room at the PHC.

2. Intervention Phase

Participants were introduced to the Mom Smile application through a brief demonstration. They were then permitted to

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use the application independently. No additional oral health materials were provided to avoid bias.

3. Posttest Phase

After 2–3 days of using the application, participants completed the posttest questionnaire under supervision. The time interval was selected to minimize recall bias while ensuring adequate exposure to the educational content.

F. DATA ANALYSIS

Data were processed using SPSS version 26. Descriptive statistics were used to summarize demographic data and pre–post knowledge scores. Because both pretest and posttest data failed the Shapiro–Wilk normality test, the Wilcoxon signed-rank test was employed to determine the significance of changes in knowledge scores. This non-parametric test is widely recommended for paired non-normal data in quasi-experimental educational studies [29], [30]. A significance level of $\alpha = 0.05$ was used. Results with $p < 0.05$ were considered statistically significant.

III. RESULT

TABLE 1
Knowledge Assessment Criteria

Scores	Knowledge Categories
76-100%	Baik
56-75%	Cukup
<56%	Kurang

TABLE 2
Recapitulation of Pregnant Women's Knowledge on Pregnancy Gingivitis Before Receiving Education Using the Mom Smile Application in 2025

Knowledge Criteria	Frequency (N)	Percentage
High	5	16%
Moderate	7	22%
Low	20	62%
Total	32	100%

As indicated by data in TABLE 1, the knowledge level of pregnant women at Puskesmas Gayam prior to their education using the Mom Smile application was classified as low for 20 participants (62%) on TABLE 2, while the rest were categorized as having moderate to high knowledge.

TABLE 3
Recapitulation of Pregnant Women's Knowledge on Pregnancy Gingivitis After Receiving Education Using the Mom Smile Application in 2025.

Knowledge Criteria	Frequency (N)	Percentage
High	28	88%
Moderate	4	12%
Low	0	0%
Total	32	100%

As shown in TABLE 3, the knowledge level of pregnant women at Puskesmas Gayam following education through the Mom Smile application was predominantly high, with 28 participants (88%) categorized as having a high level of knowledge and 4 participants (12%) categorized as moderate.

The TABLE 4 reveals that the average knowledge score of pregnant women regarding pregnancy gingivitis was 54.68% prior to receiving education through the Mom Smile application. Following the educational intervention, this score increased significantly to 83.28%.

TABLE 4
Recapitulation of Pregnant Women's Knowledge on Pregnancy Gingivitis Before and After Receiving Education Using the Mom Smile Application in 2025

Level of knowledge	Before			After			Difference
	N	%	Mean	N	%	Mean	
High	5	16%	54.68%	28	88%	83.28%	28.60%
Moderate	7	22%		4	12%		
Low	20	62%		0	0%		
Total	32	100%		32	100%		

TABLE 5
Shapiro-Wilk Normality Test

	Statistics	Frequency (N)	Sig.
Pre Test	0.916	32	0.016
Post Test	0.888	32	0.003

TABLE 5 indicates that the data deviate from a normal distribution, as evidenced by a value (p) falling below the predetermined significance level of $\alpha = 0.05$. Consequently, the Wilcoxon test was utilized for data analysis.

TABLE 6
Wilcoxon Test Results

Variable	Knowledge Criteria			*P Value*
	High	Moderate	Low	
Pre Test	5	7	20	0,000
Post Test	28	4	0	

Based on TABLE 6, Before the intervention, 62% of participants had low knowledge, and only 16% had high knowledge. After the intervention, 88% had high knowledge, indicating a significant increase in understanding of pregnancy gingivitis ($p < 0.05$).

IV. DISCUSSION

A. INTERPRETATION OF FINDINGS

The results of this study demonstrated a substantial increase in pregnant women's knowledge regarding pregnancy gingivitis following the use of the Mom Smile application. Prior to the intervention, the majority of participants (62%) had low knowledge scores, indicating limited understanding of oral health changes during pregnancy. This is consistent with the broader literature noting that many pregnant women lack awareness of the etiology, symptoms, and risks associated with gingivitis, despite its high prevalence during pregnancy [31]. The baseline findings suggest that insufficient exposure to structured oral health education and the absence of easily accessible educational resources may contribute to the persistence of poor oral hygiene practices among pregnant women.

After the educational intervention, knowledge scores increased significantly, with 88% of participants achieving high knowledge levels. This improvement illustrates the effectiveness of the Mom Smile application as a health education medium. The application's use of motion-graphic animations and interactive explanations likely enhanced comprehension and retention of key concepts. Digital media with visual components have been shown to be particularly effective in health literacy interventions because they reduce cognitive load and increase participant engagement [32].

Statistical analysis using the Wilcoxon signed-rank test showed $p = 0.000$, indicating a highly significant difference between pre- and post-intervention scores. The results confirm that the application not only facilitated learning but

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also effectively addressed gaps in previous knowledge. According to behavioral and cognitive theories, digital educational tools serve as external stimuli that promote internal processing of information, ultimately shaping user behavior and decision-making [33]. In this context, the Mom Smile application succeeded as a stimulus that helped participants better understand pregnancy gingivitis.

These findings reaffirm that targeted oral health education can improve maternal knowledge levels. Enhanced awareness enables pregnant women to make informed decisions regarding oral hygiene practices, potentially reducing the severity of gingivitis and associated complications. Given the established association between periodontal health and pregnancy outcomes, such knowledge improvements are clinically relevant and beneficial for maternal–fetal health.

B. COMPARISON WITH PRIOR RESEARCH

The results of this study align with previous evidence demonstrating the effectiveness of digital health interventions in maternal education. Several studies have reported that mobile applications and digital platforms significantly improve knowledge retention and support positive behavioral changes among pregnant women [34], [35]. For instance, Setyaningrum et al. (2023) found that Android-based education improved pregnant women's adherence to health recommendations, similar to the positive outcomes observed in the present study.

Furthermore, the use of animations and visual aids in the Mom Smile application is supported by earlier findings showing that motion-graphic–based learning materials improve user comprehension more effectively compared to text-only resources. Animated educational media capture attention and present information in a simplified, engaging form, leading to deeper cognitive processing [36]. This is consistent with the observed increase in posttest knowledge scores.

Comparisons with studies specifically examining oral health during pregnancy also support the present findings. Research by Gavic et al. (2022) reported that pregnant women often have limited awareness about oral health, particularly concerning the relationship between periodontal disease and pregnancy outcomes. Their study emphasized the need for effective counseling strategies, which the Mom Smile application appears to provide. By delivering personalized and portable educational content, the application addresses many of the limitations inherent in traditional antenatal counseling formats.

In contrast, some studies have highlighted challenges in implementing mobile health interventions, such as inconsistent phone access, user fatigue, or limited digital literacy among pregnant women [37]. However, none of these issues significantly affected participant engagement in the present study, likely due to the user-friendly nature of the Mom Smile platform. It is also noteworthy that most participants had tertiary education or at least moderate digital literacy, which might have facilitated adoption.

The findings are also consistent with telehealth research from broader maternal health contexts. Applications used for gestational diabetes monitoring, hypertension education, or breastfeeding support have shown effectiveness comparable to the current study, demonstrating that mobile applications can be reliable tools in improving maternal health literacy [38], [39]. These similarities support the generalizability of the Mom Smile application as part of the emerging trend in mobile-based maternal education.

Nevertheless, the present results contrast with earlier studies suggesting that knowledge improvement through mobile applications may decline over time without reinforcement. The present study only conducted posttests shortly after intervention; therefore, long-term retention remains unknown. This limitation emphasizes the need for longitudinal assessments, as highlighted by previous literature stating that sustainable health behavior change requires continuous informational reinforcement [40].

C. LIMITATIONS AND IMPLICATIONS

Although the findings demonstrate the effectiveness of the Mom Smile application, several limitations should be acknowledged. First, the study employed a one-group pretest–posttest design without a control group. This design restricts the ability to attribute the observed changes exclusively to the intervention because external influences cannot be ruled out. Future studies should incorporate randomized controlled trials to establish stronger causal inferences.

Second, the sample size of 32 participants, while adequate for preliminary evaluation, limits the generalizability of the findings to broader populations. Pregnant women with lower digital literacy, those living in rural regions without adequate smartphone access, or those with limited antenatal care attendance may respond differently to the digital intervention. Expanding the sample size and recruiting participants from diverse backgrounds would enhance the robustness of future research.

Third, the post-intervention assessment was conducted within a short timeframe. This does not allow for evaluation of long-term knowledge retention or actual behavioral changes, such as improved oral hygiene practices or reduced gingival inflammation. A follow-up study measuring dental health outcomes over several months would provide meaningful insights into the clinical relevance of the knowledge gained.

Despite these limitations, the study presents important implications. The effectiveness of the Mom Smile application supports its integration into antenatal care services. Digital education tools offer flexibility, accessibility, and consistency that traditional counseling may lack. Health workers can incorporate the application into routine check-ups or recommend it as a supplementary resource for pregnant women at home.

Additionally, enhancing maternal knowledge about oral health can positively impact pregnancy outcomes, given the documented links between periodontal disease, preterm birth, and low birth weight. Strengthening oral health literacy through mobile applications may therefore contribute indirectly to reducing pregnancy-related complications.

Finally, this study contributes to the growing body of evidence supporting mobile health innovations in Indonesia. Digital platforms have tremendous potential to address gaps in health education, especially in communities with limited access to in-person counseling. By adopting user-centered design principles and evidence-based content, applications like Mom Smile can play a vital role in public health promotion.

V. CONCLUSION

This study aimed to evaluate the effectiveness of the Mom Smile Android-based application in improving pregnant women's knowledge regarding pregnancy gingivitis, a condition that remains highly prevalent due to hormonal changes and insufficient awareness of proper oral hygiene

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practices during pregnancy. The findings demonstrated a significant improvement in knowledge levels following the intervention, increasing from an average pretest score of 54.68% to a posttest score of 83.28%, with the proportion of participants in the "high knowledge" category rising from 16% to 88%. These results indicate that the application's motion-graphic learning content serves as an effective educational tool for enhancing comprehension of oral health information. The improvement observed supports the growing body of evidence that digital health platforms can effectively supplement traditional antenatal education, particularly in contexts where printed materials or face-to-face counseling may be limited or underutilized. The study provides empirical support for integrating mobile-based oral health education into routine maternal care services to promote preventive behaviors and reduce the risks associated with pregnancy gingivitis. However, the study's design, which lacked a control group and employed a relatively small sample size, limits the generalizability of the findings. Therefore, future research should incorporate randomized controlled trials with larger and more diverse populations to validate these results and explore the long-term retention of knowledge, behavioral changes, and clinical improvements in periodontal health. Additionally, future studies should examine user engagement factors and optimize digital learning features within the application to maximize educational impact. Overall, the present study underscores the potential of the Mom Smile application as a practical, accessible, and scalable solution for enhancing maternal oral health literacy and strengthening preventive strategies within antenatal care services.

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DATA AVAILABILITY

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTION

All authors contributed substantially to the conception, design, execution, and reporting of this study. Nabila Safir led data collection, intervention implementation, statistical analysis, and manuscript drafting. Ratih Larasati supervised study design, validated research instruments, and provided critical revisions to the manuscript. Silvia Prasetyowati contributed to methodological development, interpretation of findings, and refinement of the final manuscript. All authors reviewed and approved the final version of the article.

DECLARATIONS

ETHICAL APPROVAL

The study adhered to ethical standards and received approval from the Institutional Ethics Committee of Poltekkes Kemenkes Surabaya. Informed consent was obtained from all participants prior to involvement in the study.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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