ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr1867

Web-Based SIGI (Dental Health Information System) Innovation Model as an Effort to Monitor Tooth Brushing Skills and Anterior Gingivitis Detection in Pregnant Women

Aji Saipul Rakhman[1]; Sukini[2]; Supriyana[3]

[1,2,3]Postgraduate Polytechnic Ministry of Health Semarang, Indonesia

Publication Date: 2026/05/08

Abstract: Gingivitis is one of the most common gingival health problems among pregnant women, influenced by hormonal changes, lack of knowledge, and improper toothbrushing technique. Early detection of gingival conditions and proper toothbrushing skills are important factors in preventing periodontal disease. However, gingival examination is still mostly performed manually and has not yet been integrated into an easily accessible digital system for independent use. An innovation that may enhance early detection and monitoring of gingival health is the web-based SIGI (Dental Health Information System) equipped with SIGI-Scan and SIGI-Brush features, expected to improve tooth brushing skills and independent gingivitis detection. To develop an innovative web-based SIGI (Dental Health Information System) model that is effective, efficient, and feasible to implement in improving toothbrushing skills and early detection of gingivitis among pregnant women. This study employed a Research and Development (R&D) method with quantitative and qualitative approaches. The research stages included needs identification, system design and development, expert validation, feasibility test 1, and feasibility test 2. The study design used a pre-experimental one group pre-posttest design. Data collection techniques included interviews, observations, and questionnaires. Data were analyzed using a non-parametric test. The research sample consisted of 30 pregnant women at Puskesmas Citeras who were given SIGI application intervention for 14 days. Expert validation showed p = 0.000, indicating that SIGI is feasible to use. Effectiveness testing showed that SIGI significantly improved toothbrushing skills and supported early gingivitis detection with p = 0.000. Feasibility test 2 also obtained p = 0.000, meaning SIGI is feasible to be implemented independently by pregnant women. The web-based SIGI (Dental Health Information System) is proven to be effective, efficient, and feasible in improving toothbrushing skills and early gingivitis detection among pregnant women.

Keywords: *SIGI; Anterior Gingivitis; Toothbrushing Skills; Pregnant Women.*

How to Cite: Aji Saipul Rakhman; Sukini; Supriyana (2026) Web-Based SIGI (Dental Health Information System) Innovation Model as an Effort to Monitor Tooth Brushing Skills and Anterior Gingivitis Detection in Pregnant Women. *International Journal of Innovative Science and Research Technology*, 11(4), 3696-3700. https://doi.org/10.38124/ijisrt/26apr1867

I. INTRODUCTION

Oral and dental health is an integral part of overall health and plays an important role in improving quality of life. The World Health Organization (WHO) emphasizes that optimal oral health significantly influences individual well-being, particularly among vulnerable groups such as pregnant women [1]. During pregnancy, physiological and hormonal changes occur that may affect oral conditions, one of which is an increased risk of pregnancy-related gingivitis (pregnancy gingivitis), characterized by erythematous gingiva, edema, and a tendency to bleed [2].

Pregnancy-related gingivitis is more commonly observed in the anterior region and remains highly prevalent [3]. Data from the 2018 Indonesian Basic Health Research (Riskesdas) indicate that the prevalence of oral and dental health problems in Indonesia reached 57.6%, reflecting a substantial risk of oral health disorders among pregnant women [4]. Several studies conducted in Indonesia have reported that approximately 80% of pregnant women experience gingivitis with varying degrees of severity [5]. If left untreated, gingivitis may progress to periodontitis, which has been associated with an increased risk of adverse pregnancy outcomes, including preterm birth and low birth weight

One of the main factors contributing to the development of gingivitis is suboptimal oral hygiene, particularly due to improper toothbrushing skills. Data indicate that only approximately 2.8% of the Indonesian population brush their teeth according to recommended

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr1867

guidelines, including among pregnant women [6]. This condition reflects low levels of skill and adherence to proper oral health maintenance behaviors, highlighting the need for continuous educational and monitoring interventions.

Along with the rapid development of digital technology, the utilization of information technology in the health sector (e-health) has expanded and is considered effective in supporting promotive and preventive health efforts. Web-based health information systems have the potential to facilitate real-time health monitoring, provide interactive educational content, and enhance individual awareness and adherence to healthy behaviors [7]. Numerous studies have demonstrated that the use of web-based and mobile applications can improve health-related behaviors, including the maintenance of oral and dental hygiene [8].

Nevertheless, to date, there remains a limited availability of web-based oral health information systems specifically designed to monitor toothbrushing skills and detect anterior gingivitis among pregnant women [9]. In fact, an educational approach accompanied by objective monitoring of oral health behaviors is essential as a foundation for the development of technology-based systems aimed at improving oral and dental health [10].

To address these issues, an innovative web-based model known as SIGI (Dental Health Information System) was developed, integrating features for monitoring toothbrushing skills and assessing gingivitis. The SIGI model is designed to be used independently by pregnant women or with guidance from healthcare professionals. Through the implementation of the SIGI model, it is expected that pregnant women's toothbrushing skills can be more effectively monitored, the risk of gingivitis can be controlled, and the system can serve as a promotive and preventive strategy to improve oral and dental health among pregnant women.

Based on this rationale, this study is important to develop and evaluate the effectiveness and feasibility of the web-based SIGI model as a dental health information system for monitoring toothbrushing skills and detecting anterior gingivitis among pregnant women.

II. METHODS

This study employed a Research and Development (R&D) design with a Mixed Methods approach, consisting of five main stages: (1) initial information gathering, (2) design and development of the media model, (3) expert validation, (4) model testing through a quasi-experimental design, and (5) analysis of results followed by final revisions.

The study was conducted at the Nadira Tusam Dental Clinic in Semarang City in November 2025. The study population consisted of pregnant women with gingivitis. The research employed a pre-experimental one-group pretest–posttest design. Data were collected through interviews, observations, and questionnaires, and data analysis was performed using non-parametric statistical tests. The study sample comprised 30 pregnant women with gingivitis from Citeras Primary Health Center (Puskesmas Citeras), who received an intervention in the form of the SIGI application for a duration of 14 days.

The determination of the sample size was based on inclusion and exclusion criteria. The inclusion criteria were: (1) pregnant women who were willing to participate in the study and provided written informed consent, (2) ownership of an Android-based mobile phone, and (3) the presence of gingivitis. The exclusion criteria included pregnant women who declined to provide informed consent and those who did not own an Android-based mobile phone.

This study received ethical approval with certificate number 1284/EA/F.XXIII.38/2025.

III. RESULTS AND DISCUSSION

The feasibility of the Dental Health Information System (SIGI) was assessed using a questionnaire based on the ISO 9126 software quality model, encompassing six characteristics: usability, reliability, functionality, efficiency, maintainability, and portability. The results demonstrated that SIGI achieved a good level of feasibility across all evaluated characteristics, indicating its suitability as a web-based dental health information system.

The usability assessment results indicated that SIGI is easy to operate and understand by users. The user interface was perceived as clear and visually appealing, and the menu structure was well aligned with user needs. The high level of usability suggests that SIGI can be used effectively without requiring complex training, thereby supporting increased user engagement and adherence to system utilization.

Regarding the reliability aspect, SIGI demonstrated stable performance during use. The system was able to maintain its functionality under normal operating conditions and provided data security mechanisms through controlled user access. These access restrictions play an important role in preventing unauthorized access and data modification, thereby enhancing the overall reliability of the system.

The functionality assessment indicated that the features available in SIGI were aligned with user needs. The availability of menus and functions supporting oral health monitoring and risk management processes demonstrated that the system was able to perform its intended functions optimally in accordance with its development objectives.

The efficiency evaluation showed that SIGI had a fast response time when accessed and did not require excessive system resources. This efficient system performance provided user convenience in accessing information and available features, thereby supporting the sustainable use of the system.

In terms of maintainability, SIGI demonstrated good potential for further development. The system allows content

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr1867

updates, the addition of educational materials, and feature enhancement without requiring significant structural modifications. This flexibility represents an advantage of SIGI in adapting to user needs and future technological developments.

The portability assessment revealed that SIGI could be accessed effectively across various hardware devices and operating systems without the need for additional effort or configuration. This adaptability enables SIGI to be used widely and flexibly, thereby increasing its accessibility and potential utilization by users. Overall, the evaluation results based on the ISO 9126 model indicate that SIGI meets software quality standards and is suitable for use as a web-based dental health information system. These findings emphasize that SIGI functions not only as an information delivery medium but also as a supportive tool for oral health monitoring and education, with the potential to promote sustainable oral and dental health maintenance behavior.

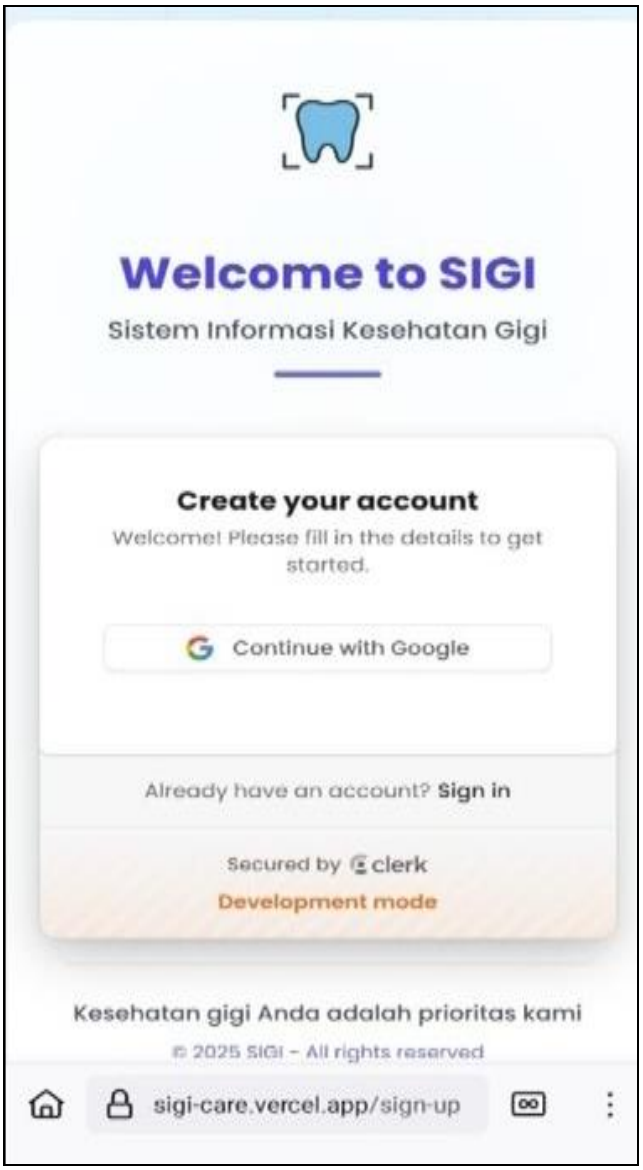

Fig 1 Login Page

Fig 2 Homepage

Fig 3 Oral Health Monitoring Module

The effectiveness of the SIGI (Dental Health Information System) model was evaluated across three main aspects: toothbrushing skills, gingivitis detection, and gingival status among pregnant women. The evaluation of toothbrushing skills was conducted to assess users' ability to apply proper toothbrushing techniques after using the SIGI model. Furthermore, the effectiveness test related to gingivitis detection aimed to determine the system's capability to support early identification of gingivitis signs, particularly in the anterior region. In addition, the effectiveness of the SIGI model on gingival status was assessed by analyzing changes in gingival condition before and after the implementation of the system. These three aspects were analyzed comprehensively to evaluate the contribution of the web-based SIGI model in improving oral hygiene skills, supporting early gingivitis detection, and enhancing gingival health status as part of promotive and preventive oral health efforts among pregnant women.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr1867

➢ *Effectiveness of a Web-Based SIGI (Dental Health Information System) Model on Toothbrushing Skills*

Table 1 Effectiveness of a Web-Based SIGI (Dental Health Information System) Model on Toothbrushing Skills

Variables	**Mean ± SD *Pre-test***	**Mean ± SD *Post-test***	**Delta Δ ± SD**	***p-value***
Toothbrushing Skills	1.93±0.64	3.63±0.66	1.7±0.02	0,000

Based on the effectiveness test results presented in Table 1, the mean toothbrushing skill score increased from 1.93 ± 0.64 at the pre-test to 3.63 ± 0.66 at the post-test after the intervention using the SIGI (Dental Health Information System) model. The observed mean difference (Δ) of 1.7 indicates a clinically meaningful improvement in toothbrushing skills. Statistical analysis revealed a p-value of 0.000 ($p < 0.05$), indicating a statistically significant difference. Therefore, it can be concluded that the use of the SIGI model is effective in improving toothbrushing skills among the respondents.

➢ *Effectiveness of a Web-Based SIGI Model in Detecting Gingivitis*

Table 2 Effectiveness of a Web-Based SIGI Model in Detecting Gingivitis

Variables	**Mean ± SD Pemeriksaan Klinis**	**Mean ± SD Pemeriksaan Model SIGI**	**Delta Δ ± SD**	***p-value***
Detecting Gingivitis	12.43±0.63	2.43±0.63	0±0	0,000

Based on the effectiveness test results presented in Table 4.2, gingivitis detection conducted through clinical examination and through the SIGI Model showed the same mean value of 2.43 ± 0.63. There was no difference in the mean scores ($\Delta = 0$), indicating that the SIGI Model produced outcomes equivalent to those of clinical examination in assessing gingivitis status. Although the statistical analysis yielded a p-value of 0.000 ($p < 0.05$), the primary finding of this analysis was the high level of consistency between the SIGI Model and clinical examination. Therefore, the SIGI Model can be considered effective and demonstrates strong agreement as an alternative method for gingivitis detection.

➢ *Effectiveness of a Web-Based SIGI Model on Gingivitis Status*

Table 3 Effectiveness of a Web-Based SIGI Model on Gingivitis Status

Variabel	**Mean ± SD Pemeriksaan Klinis**	**Mean ± SD Pemeriksaan Model SIGI**	**Delta Δ ± SD**	***p-value***
Gingivitis Status	1.0±0	1.0±0	0±0	0,000

Based on the effectiveness test results presented in Table 4.3, the mean gingivitis status obtained from clinical examination and assessment using the SIGI Model (Dental Health Information System) showed identical results, with a mean value of 1.0 ± 0.0. There was no difference in the mean scores ($\Delta = 0$), indicating that all respondents were classified as having gingivitis based on both clinical examination and detection using the SIGI Model. The p-value obtained was 0.000 ($p < 0.05$), which statistically indicates no difference between the two assessment methods and demonstrates a very high level of agreement between them. Therefore, the SIGI Model can be considered effective and shows strong agreement as an alternative method for detecting gingivitis status.

The evaluation indicators of the SIGI Model for monitoring toothbrushing skills include improvements in toothbrushing skill scores before and after using the system, the accuracy of brushing techniques according to recommended standards, the consistency of brushing practices, and the system's ability to provide real-time feedback to users. By facilitating independent monitoring and evaluation, the SIGI Model enhances adherence to oral hygiene practices and supports dental health professionals in continuously observing and documenting patients' toothbrushing skills through a structured web-based system.

In addition to monitoring toothbrushing skills, the effectiveness of the SIGI Model in anterior gingivitis detection is demonstrated by its ability to accurately identify the presence or absence of gingivitis based on gingival coloration, to facilitate self-assessment by users, and to automatically classify gingival conditions into healthy, mild, moderate, or severe categories. The system provides real-time, structured results, which improve users' understanding of their anterior gingival health. Implementation of the SIGI Model in anterior gingivitis detection contributes to increasing pregnant women's awareness of their gingival condition, supports early detection of gingivitis, and assists dental health professionals in continuous monitoring through a well-documented, web-based platform.

Moreover, the SIGI Model is web-based, allowing access through various devices such as smartphones and laptops without requiring additional installation. Its simple interface and user-friendly features enable pregnant women to independently and continuously monitor their oral health while simultaneously serving as a supportive tool for dental health professionals in implementing promotive and preventive oral health activities.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr1867

IV. CONCLUSION

- The SIGI Model (Dental Health Information System) is effective in improving toothbrushing skills, as demonstrated by the increase in toothbrushing skill scores following intervention through the SIGI-Brush feature compared to pre-intervention scores.
- The SIGI Model is effective in detecting anterior gingivitis, as evidenced by the system's ability to accurately identify the presence or absence of gingivitis in respondents during field testing, showing high agreement with manual examinations conducted by dental health professionals.
- The SIGI Model is suitable for independent use by pregnant women to enhance toothbrushing skills and support early detection of gingivitis, as indicated by a statistically significant p-value of 0.018

REFERENCES

[1]. World Health Organization. Oral health [Internet]. Geneva: World Health Organization; 2024. Available from: https://www.who.int/health-topics/oral-health

[2]. American College of Obstetricians and Gynecologists (ACOG). Oral health care during pregnancy and through the lifespan. Obstet Gynecol [Internet]. 2013 Nov 2;122(2 Pt 1):417–22. Available from: https://www.acog.org/clinical/clinicalguidance/committee opinion/articles/2013/08/oral-health-care-during-pregnancy-and-through-the-lifespa

[3]. Satrio R, Mulyawati E. Penatalaksanaan gingivitis gravidarum pada ibu hamil di RSGM Universitas Jenderal Soedirman. STOMA (Jurnal Kedokt Gigi) [Internet]. 2022 Nov 2;19(1):45–8. Available from: https://doi.org/10.19184/stoma.v19i1.30701

[4]. Kementerian Kesehatan RI. Potret Sehat Indonesia: Riskesdas 2018 [Internet]. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018. Available from: https://kemkes.go.id/id/potret-sehat-indonesia-riskesdas-2018

[5]. Wahyulisty WI, Maulida A. Pemeliharaan kesehatan gigi dan mulut ibu hamil melalui posyandu. J Gizi Mandiri [Internet]. 2023 Nov 2;2(2). Available from: https://doi.org/10.29238/ohc.v11i2.1847

[6]. Universitas Gadjah Mada. Only 2.8 per cent of Indonesians brush their teeth correctly [Internet]. Yogyakarta: Universitas Gadjah Mada; 2023 Nov. Available from: https://ugm.ac.id/en/news/only-2-8-percent-of-indonesians-brush-their-teeth-correctly/

[7]. World Health Organization. Global strategy on digital health 2020–2025 [Internet]. Geneva: World Health Organization; 2020 Nov. Available from: https://www.who.int/docs/default-source/documents/gs4dhdaa2a9f352b0445bafbc79ca799dce4d.pdf

[8]. Özvarış SS, Çoğulu D. Effects of a mobile application to improve oral hygiene in children. J Pediatr Res [Internet]. 2024 Nov 2;11(1):11–6. Available from: https://jpr.galenos.com/articles/effects-of-a-mobile-application-to-improve-oral-hygiene-in children/jpr.galenos.2024.82956

[9]. Sukini S, Nugraheni H, Sadimin S. Determinan perilaku pencegahan karies gigi siswa Sekolah Dasar di Kota Semarang. J Kesehat Gigi [Internet]. 2019 Nov 2;6(1):26–34. Available from: https://garuda.kemdikbud.go.id/documents/detail/1874363

[10]. Supriyana S. Peran pola perilaku keluarga terhadap kejadian karies pada anak sekolah dasar di Kota Semarang: case control study [Internet]. Proposal Riset Hibah Bersaing. [Semarang]: Poltekkes Kemenkes Semarang; 2017. Available from: https://repository.poltekkes-smg.ac.id/id/eprint/23794.