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# THE EFFECTIVENESS OF DIGITAL HEALTH LITERACY AND ONLINE EDUCATION ON KNOWLEDGE, ANTENATAL CARE, AND ANXIETY AMONG PREGNANT WOMEN: A SYSTEMATIC LITERATURE REVIEW

*Efektivitas Literasi Digital Kesehatan dan Pendidikan Online Terhadap Pengetahuan, Antenatal Care dan Kecemasan Ibu Hamil: Tinjauan Sistematis*

**Felisia Juita Dahur[1*], Minarni Hardianti[1], Diniati Sukmana[1], Ovella April Reza[1], Ari Indra Susanti[2], Qorinah Estiningtyas Sakilah Adnani[2,3], Hadi Susiarno[4]**

[1]Program Studi Magister Kebidanan, Fakultas Kedokteran, Universitas Padjajaran, Bandung, Indonesia

[2]Departemen Ilmu Kesehatan Masyarakat, Fakultas Kedokteran, Universitas Padjadjaran, Bandung, Indonesia

[3]Midwifery Working Group, Pusat Studi Sistem Kesehatan dan Inovasi Pendidikan Tenaga Kesehatan, Fakultas Kedokteran, Universitas Padjadjaran, Bandung, Indonesia

[4]Departemen Obstetri dan Ginekologi, Fakultas Kedokteran, Universitas Padjadjaran, Bandung, Indonesia

*Email: felisia24001@mail.unpad.ac.id

***ABSTRAK***

*Rendahnya literasi kesehatan pada ibu hamil menjadi tantangan serius dalam upaya pencegahan komplikasi kehamilan. Di era digital, akses informasi kesehatan tersedia luas melalui aplikasi mobile, platform daring, dan media sosial. Namun, kemampuan ibu hamil dalam memahami dan memanfaatkan informasi digital tersebut sangat bervariasi. Penelitian ini bertujuan untuk mengkaji secara sistematis dampak literasi digital kesehatan dan pendidikan online terhadap kesehatan ibu hamil. Penelitian ini menggunakan metode systematic literature review dengan pendekatan kerangka PICO. Pengumpulan data dilakukan melalui tiga database ilmiah terkemuka, yaitu PubMed, ScienceDirect, dan Scopus. Artikel yang dicari merupakan publikasi tahun 2019 hingga 2024, dengan kata kunci yang relevan dan telah disesuaikan dengan fokus penelitian. Kriteria inklusi meliputi artikel dalam bahasa Indonesia atau Inggris, berfokus pada intervensi digital terkait kehamilan, melibatkan ibu hamil, tersedia dalam full text, dan open access. Dari 762 artikel yang diidentifikasi, 12 artikel memenuhi kriteria dan dianalisis menggunakan pendekatan sintesis naratif. Hasil tinjauan menunjukkan bahwa intervensi digital secara signifikan meningkatkan pengetahuan ibu hamil mengenai tanda bahaya kehamilan, serta pentingnya kunjungan antenatal. Literasi digital juga berdampak positif dalam pengelolaan kondisi seperti diabetes gestasional serta menurunkan kecemasan selama kehamilan. Temuan ini menegaskan pentingnya pengembangan program literasi digital kesehatan yang mudah diakses, inklusif, dan terintegrasi dengan layanan kesehatan untuk mendukung kehamilan yang sehat dan aman.*

***Kata kunci:*** *aplikasi kesehatan, kehamilan, kesehatan ibu hamil,literasi digital, pendidikan online*

**ABSTRACT**

Inadequate health literacy among pregnant women presents a considerable obstacle in mitigating pregnancy-related problems. In the digital age, access to health information is progressively facilitated through mobile applications, online platforms, and social media. Nonetheless, pregnant women's capacity to understand and apply digital health information



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varies considerably. This study aims to systematically examine the impact of digital health literacy and online education on knowledge, antenatal care, and anxiety of pregnant women. A systematic literature review was performed utilizing the PICO framework. Data were obtained from three principal scientific databases: PubMed, ScienceDirect, and Scopus. The investigation concentrated on publications produced from 2019 to 2024, employing keywords pertinent to the research subject. The inclusion criteria comprised publications published in English or Indonesian, centered on digital interventions pertaining to pregnancy, including pregnant women, accessible in full-text format, and available as open access. Of the 762 discovered articles, 12 fulfilled the inclusion requirements and were subjected to analysis via a narrative synthesis methodology. The evaluation revealed that digital interventions markedly enhanced pregnant women's understanding of warning signs during pregnancy and the significance of antenatal appointments. Digital health literacy also positively influenced the management of illnesses, including gestational diabetes, and alleviated anxiety throughout pregnancy. These findings underscore the necessity of creating accessible, inclusive, and well-integrated digital health literacy programs to facilitate safe and healthy pregnancies.

**Keywords:** digital literacy, health applications, maternal health, online education, pregnancy

## INTRODUCTION

Pregnancy and childbirth remain the leading causes of morbidity and mortality among women of reproductive age worldwide, with significant disparities between developed and developing countries. According to the World Health Organization (2023), approximately 287,000 women die annually from complications of pregnancy and childbirth, primarily in developing countries. The main causes are postpartum hemorrhage, preeclampsia, and infections, which are preventable with timely intervention. Limited access to accurate health information, low maternal health literacy, and lack of knowledge about appropriate prenatal care are major contributing factors to poor pregnancy outcomes[1].

The use of digital literacy is one way to improve maternal health literacy, thus helping individuals obtain, understand, and use health information to make informed decisions to maintain and improve their health. By reading extensively and obtaining information, mothers can have a healthy and safe pregnancy and prevent the risk of complications that could harm both mother and fetus[2],[3]. Maternal health literacy is not just knowledge but also interventions to prevent complications during pregnancy[4].

Lack of literacy directly impacts health decision-making during pregnancy, including delayed recognition of signs of complications, minimal participation in prenatal care, and low adherence to medical protocols[5].This has led to an increase in complications during childbirth, especially among vulnerable groups of pregnant women, such as those from ethnic minority backgrounds, refugees, and women with low socioeconomic status[6]. Social and cultural factors, such as language differences, local customs, and norms, also influence a mother's ability to understand and use health information effectively. These barriers contribute to limited access to and understanding of health services during pregnancy, increasing the risk of complications and suboptimal pregnancy outcomes[7].

In the digital age, access to health information through pregnancy apps and other platforms is readily available. Various online educational platforms have been developed, offering interactive modules tailored to gestational age, virtual classes with a participatory approach, peer support through online networks, and personalized health information systems that provide reminders and pregnancy monitoring tools. However, mothers' ability to assess the validity of the information they receive from these digital platforms varies



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widely. One study showed that 35% of pregnant women found inaccurate or unreliable information from pregnancy apps[8]. A survey of patients and healthcare workers revealed several barriers to the adoption of apps as literacy measures, including lack of motivation, limited language options, low e-literacy, and complex apps. This lack of digital literacy makes mothers vulnerable to hoaxes or misinformation, which can worsen health conditions if used without professional verification[9].

In recent years, the use of digital health literacy and online education has emerged as a potential strategy to improve maternal education about pregnancy. However, most studies are limited to short-term improvements in knowledge or behavior, without evaluating the real impact on pregnancy outcomes such as maternal and infant health status, the incidence of complications, or maternal emotional well-being. Furthermore, research rarely integrates digital literacy levels and the effectiveness of online education within a single, comprehensive analytical framework. This review aims to systematically examine how the interaction between digital health literacy and access to online education impacts maternal knowledge, antenatal care, and anxiety. The strength and novelty of this study lies in its holistic approach, linking digital literacy with behavioral changes in healthcare utilization, and then comprehensively analyzing its impact on maternal-neonatal outcomes within a single, integrated research framework.

## METHODS

This study uses a systematic literature review (SRL) methodology that aimed to examine the impact of digital health literacy and online education on knowledge, antenatal care, and anxiety of pregnant women. The main focus of this study is to collect and analyze relevant evidence related to the role of digital literacy and online education in improving knowledge and quality of maternal health during pregnancy. The article search strategy was based on the PICO (Population, Intervention, Comparison, Outcome) framework, a method commonly used in both qualitative and quantitative research to ensure transparency and clarity in formulating and answering research questions. The central theme of this review was to examine "The impact of digital health literacy and online education on maternal health."

**Table 1. PICO Analysis**

| No | Population (P) | Intervention (I) | Comparison (C) | Result (O) |
|---|---|---|---|---|
| 1 | Pregnant women, including those in resource-limited areas, ethnic minority groups, or those with limited access to health services | Digital health literacy interventions, including mobile health apps, online education platforms, social media, and digital-based educational videos | Conventional health education methods such as printed leaflets, face-to-face counseling, or without digital intervention | Increased maternal health knowledge, increased antenatal visits, changes in healthy lifestyle behavior, increased pregnancy management skills, decreased anxiety, and increased awareness of pregnancy risks. |

In this study, literature was collected through searches in various leading scientific databases, such as PubMed, ScienceDirect, and Scopus. The search was conducted using keywords structured according to the PICO framework, with a particular focus on studies discussing digital health literacy and online education applied to pregnant women. Inclusion criteria included studies discussing digital literacy, including the use of health applications, social media, and online educational platforms related to pregnancy. The primary focus of the studies was on pregnant women and efforts to prevent pregnancy complications. Furthermore, articles had to be published in Indonesian or English, published within the last


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five years (2019–2024) due to the widespread use of digital literacy methods around this time since the COVID-19 pandemic, and available in open access. Exclusion criteria included studies that only discussed the technical aspects of digital application development without evaluating their impact on pregnant women's health. Studies that do not involve pregnant women (e.g., only health workers, adolescents, or the general public), non-digital interventions such as face-to-face counseling without digital media support, editorials, opinion pieces, letters to the editor, and non-peer-reviewed articles and literature studies without systematic methods or narrative reviews without primary/secondary data.

The figure above is a PRISMA flowchart depicting the article selection process in a systematic review. Of the initial 762 articles, 12 studies remained that met the inclusion criteria after going through duplication screening, eligibility assessment, and exclusion based on population, methods, language, and abstract alone (Figure 1).

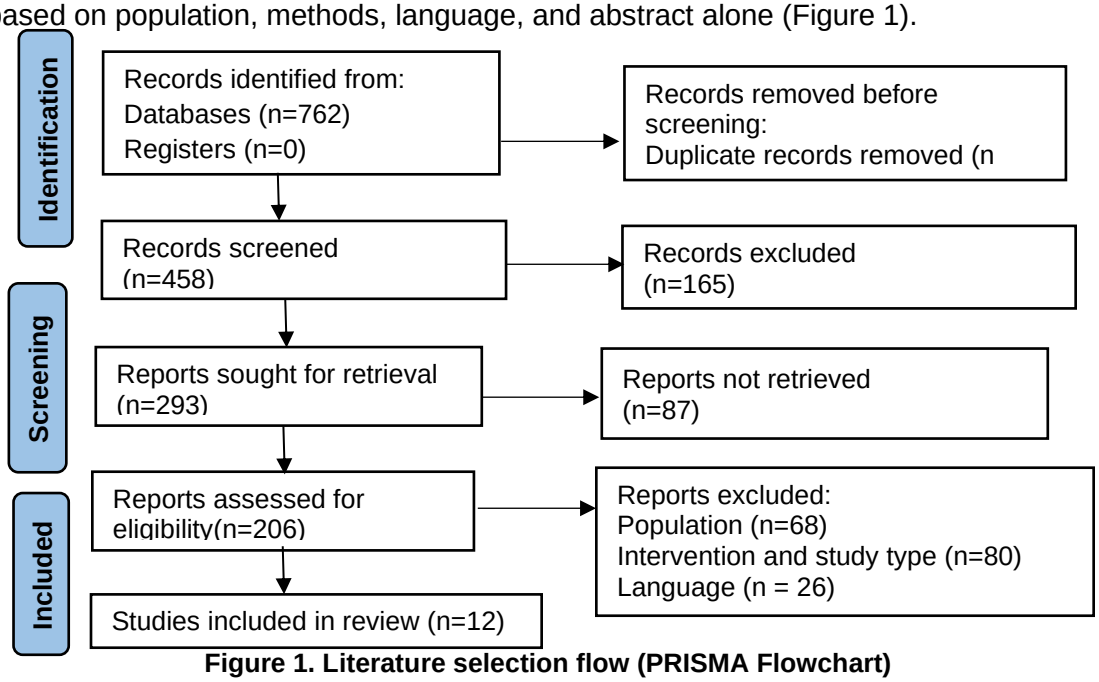


**Figure 1. Literature selection flow (PRISMA Flowchart)**

## RESULT

From the search results, 762 articles were identified based on the data search strategy, 304 duplicate articles were removed, and 165 articles were ineligible for inclusion. After reviewing the titles and abstracts, 12 articles were selected using the Joana Briggs Institute (JBI) critical appraisal tool. The literature search flow is illustrated in Table 2 below.

**Table 2. Study Characteristics**

| No | Author, Year, Title | Country | Objective | Method | Results |
|---|---|---|---|---|---|
| 1 | Tavananezhad, N., Bolbanabad, A.M., Ghelichkhani, F., Effati-Daryani, F., & Mirghafourvand, M. (2022). The relationship between health literacy and empowerment in pregnant women: a cross-sectional study[10]. | Iran | Determining the relationship between health literacy and empowerment in pregnant women | Research design: cross-sectional Sample: 355 pregnant women at a health care center in Sanandaj, Iran Sampling technique: Cluster sampling | Increased health literacy contributes to increased empowerment during pregnancy. |



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| No | Author, Year, Title | Country | Objective | Method | Results |
|---|---|---|---|---|---|
| 2 | Gourounti et.al .2022. A qualitative study of assessing learning needs and digital health literacy in pregnancy: Baby Buddy Forward Greek findings[8] | Greece | Exploring the learning and digital literacy needs of pregnant women's health | Qualitative with Focus Group Discussion (FGD) Sample: 13 multiparous and nulliparous pregnant women Sampling technique: purposive sampling | • Pregnant women expressed satisfaction with their communication with midwives,<br>• Feeling unsafe in communicating with doctors via the app.<br>• There are concerns about the validity of information obtained from the internet or applications.<br>• difficulty accessing reliable scientific sources.<br>• Pregnant women are not advised to seek information online from unskilled health service providers.<br>Pregnant women are reluctant to discuss any information they obtain from the Internet with health workers. |
| 3 | Jie Hao et al. 2023. Mobile Prenatal Education and Its Impact on Reducing AdversePregnancy Outcomes: Retrospective Real-World Study[11] | China | to develop and evaluate the effectiveness of a mobile phone-based prenatal education program in improving pregnancy outcomes. | Retrospective cohort 1941 pregnant women who had registered for PUMCH's mobile prenatal education program and subsequently delivered at PUMCH between May 2021 and August 2022. Sampling technique: total sampling | Online health education can improve pregnant women's adherence to healthy lifestyle behaviors, potentially reducing the risk of gestational diabetes mellitus, induced abortion, postpartum infections, fetal health problems, and neonatal malformations. |
| 4 | Eslahchi, V., Tavakoly Sany, S.B., Tehrani, H., Ghavami, V., & Peyman, N. (2023). Examining health literacy and self-efficacy levels and their association with preventive behaviors of urinary tract infection in Iranian pregnant women: a cross-sectional study.[12] | Iran | Determining the level of health literacy, self-efficacy, and UTI prevention behavior in pregnant women and their relationship to each other. | Cross-sectional study Sample: 235 pregnant women aged 18–42 years in Mashhad, Iran Sampling technique: Multistage sampling | The majority of participants had low to moderate levels of health literacy and self-efficacy. There was a significant positive relationship between health literacy, self-efficacy, and UTI prevention behavior. Health literacy was a stronger predictor of UTI prevention behavior than sociodemographic factors and self-efficacy. |



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| No | Author, Year, Title | Country | Objective | Method | Results |
|---|---|---|---|---|---|
| 5 | Kassi, et al. 2024. Digital transformation of antenatal education: A descriptive exploratory study of women's experiences of online antenatal education[13] | Australia | To explore the experiences of pregnant women in participating in online antenatal education | Qualitative with semi-structured interviews<br>Sample: 5 pregnant women who have attended online antenatal education<br>Sampling technique: Purposive sampling | Pregnant women can easily obtain information about ANC services, prevention, and preparation for motherhood through online antenatal education. |
| 6 | Ghotbizadeh, F., Panahi, Z., Tarafdari Manshadi, A., Soltani, S., Akbari, R., & Parsapur, M. (2023). Maternal Health Literacy and Pregnancy Outcomes: Does any Association Exist?[14] | Iran | Assessing the relationship between the level of health literacy of pregnant women and with health behavior and pregnancy outcomes. | Prospective cohort study<br>Sample: 323 pregnant women in three teaching hospitals in Tehran, Iran<br>Sampling technique with random sampling | Higher levels of health literacy (HL) were significantly correlated with: earlier and more frequent prenatal visits, earlier folate consumption, awareness of pregnancy danger signs, exercise before and during pregnancy, breastfeeding choices, and infant birth weight ($p < 0.05$). |
| 7 | Bonnie R Brammall, et al. 2024. Pregnancy mobile app use: A survey of health information practices and quality awareness among pregnant women in Australia[15] | Australia | This study aims to analyze mobile application usage patterns, the basis for decision-making, and various issues related to the quality and credibility of health information in pregnancy mobile applications. | Cross-sectional study<br>Sample: 427 pregnant women<br>Sampling technique: convenience sampling | Pregnancy apps were considered a reliable source of information by 63.8% of respondents, and the majority used them during pregnancy (94.2%). However, 35.5% (n = 115) had encountered information in the apps that they felt was unsafe or contradicted their previous knowledge or advice. |
| 8 | Parisa Farzi Karamolahi, et al. 2021. Efficacy of mobile app-based training on health literacy among pregnant women[16] | Iran | The study aims to evaluate the effect of mobile application-based training on the health literacy level of pregnant women. | *Randomized control trial*<br>Sample: 140 pregnant women (70 each in the intervention and control groups)<br>Sampling technique: purposive sampling | Providing training on using mobile apps can improve literacy among pregnant women in accessing health information and ANC services. The intervention group also found that mothers were not ready to receive information about health during pregnancy. |
| 9 | Narisa Timsin, et al. 2025. The effects of a health literacy promotion program for prevention of | Thailand | This study aims to evaluate a culturally tailored health | Quasi-Experimental<br>Sample: 31 Pregnant Women | The culturally adapted health literacy program significantly improved pregnant women's health |



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| No | Author, Year, Title | Country | Objective | Method | Results |
|---|---|---|---|---|---|
| | preterm birth among pregnant women who received antenatal care services in the hospital-based[17] | | literacy program to improve health literacy. | Sampling technique: convenience sampling | literacy scores from 0–64 to 40–80 (Z = 4.01, p < 0.001) and risk perception scores from 10–50 to 33–50 (Z = 3.54, p < 0.001). |
| 10 | Döndü S. Guler, et al. 2020. Health literacy and knowledge of antenatal care among pregnant women[18] | Turkey | This study aims to determine the level of health literacy and assess knowledge about antenatal care among pregnant women. | Cross-sectional study<br>Sample: 460 pregnant women<br>Sampling technique: convenience sampling | The health literacy program showed that primiparous mothers had adequate health literacy, particularly in terms of knowledge related to reading and seeking health information related to pregnancy care, preventing pregnancy risks, preparing for childbirth, and postpartum (P<0.05). However, some pregnant women still had inadequate health literacy, which was related to their low level of knowledge about antenatal care. |
| 11 | Filiz Aslantekin Özçoban, et al. 2021. Effects of health literacy education on adaptation to pregnancy, self-efficacy, fear of childbirth and health literacy in Turkish pregnant women[19] | Turkey | This study aimed to evaluate the impact of health literacy (HL) education on Turkish pregnant women's adaptation to pregnancy, self-efficacy, fear of childbirth, and HL levels. | Research design: Randomized Control Trial (RCT)<br>Sample: 182 pregnant women. Pregnant women involved were 26-35 weeks pregnant.<br>Sampling technique: convenience sampling | Educational interventions through health literacy and antenatal education were highly effective in reducing fear of childbirth. Post-education fear of childbirth scores were significantly higher in the literacy and education group compared to the group receiving only antenatal care and general education (p = 0.036). |
| 12 | Mehran Rostamzadeh, et al. 2021. Maternal health literacy and pregnancy outcomes in Afghanistan[20] | Afghanistan | This study aims to evaluate the relationship between maternal health literacy and maternal health conditions during pregnancy/child birth. | Research design: cross-sectional<br>Sample: 200 pregnant women who had ANC and had given birth at Barchi National Hospital, Kabul<br>Sampling technique: convenience sampling | There is a positive relationship There is a positive and significant relationship between maternal health literacy (MHL) and pregnancy outcomes (PO) (P < 0.0001). Mothers with better health literacy tend to have more regular ANC visits, deliver babies with more optimal birth weight, and experience fewer complications during the third trimester and labor. |



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After further investigation, the characteristics of this study were identified in several developing and developed countries, using different research designs, such as randomized control trials, cross-sectional, cohort, and qualitative methods. A description of these characteristics can be seen in the diagram below.

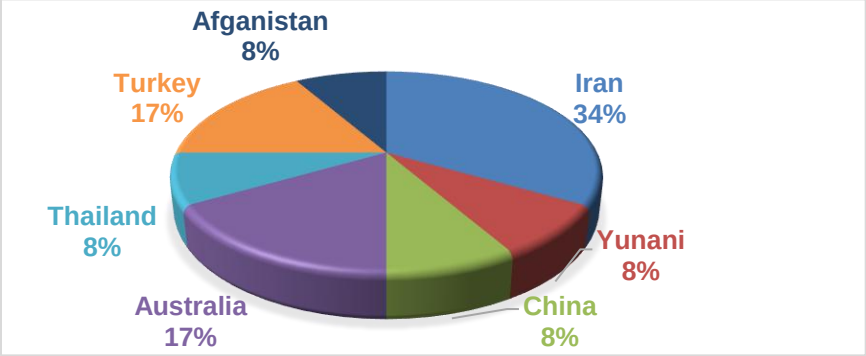


**Figure 2. Distribution of Research Countries**

Of the 12 articles used, the largest number came from Iran (4), followed by one from Greece, Afghanistan, Thailand, and China (1 each), two from Turkey, and two from Australia. Of these 12 articles, nine came from developing countries and three from developed countries.

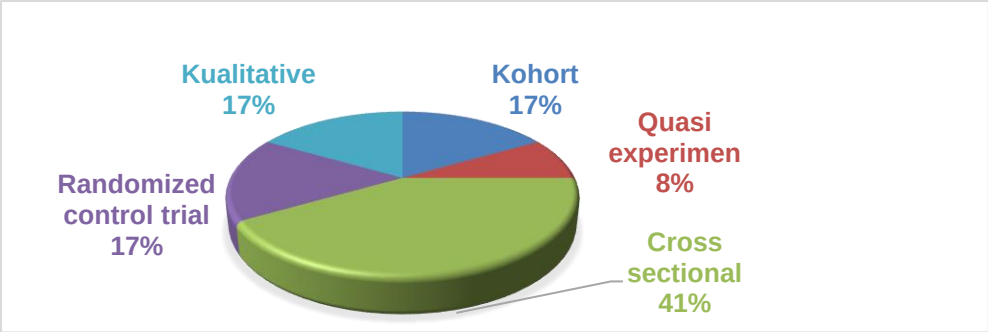


**Figure 3 Research Characteristics Based on Research Design**

The articles used in this article are quantitative research methods (10 articles) and qualitative (2 articles). Of the 12 articles, 5 articles have a cross-sectional design, 2 articles are cohort studies, 1 article is a quasi-experimental study, and 2 articles are randomized control trials.

## Research Instruments

**Table 3. Critical Appraisal Tools Cohort Studies**

| No | Writer | Question Number | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 1 | Ghotbizadeh, et al. 2023 | Y | Y | Y | Y | Y | Y | Y | Y | Y | T | Y | 10 |
| 2 | Jie Hao et al. 2023 | T | Y | Y | Y | Y | Y | Y | Y | T | NA | Y | 8.5 |

*Note: Y: yes/ 1 point, T: no/ 0 points, NA: Not Applicable/ 0.5

Study quality assessment in this research was conducted using the Critical Appraisal Tools (CAT) from the Joanna Briggs Institute (JBI), adapted based on the type of study design. The evaluation began with cohort studies (Table 3) using 11 questions, followed by quasi-experimental studies (Table 4) with 8 items, cross-sectional studies (Table 5) with 8 items, randomized controlled trials (RCTs) (Table 6) with 13 items, and qualitative studies



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(Table 7) assessed using 10 items. Each item was scored as “Yes” (1 point), “No” (0 points), or “Not Applicable” (0.5 points) to assess the validity and reliability of the study. This systematic approach ensured consistent and thorough assessment, thereby strengthening the reliability of the findings in this literature review.

**Table 4. Critical Appraisal Tools Quasi-Experimental Study**

| No | Writer | Question Number | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 1 | Timsin, et al. 2025 | Y | T | T | Y | Y | Y | T | Y | 5 |

*Note: Y: yes/ 1 point, T: no/ 0 points, NA: Not Applicable/ 0.5

**Table 5. Critical Appraisal Tools Cross-Sectional Study**

| No | Writer | Question Number | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 1 | Guler, et al. 2020 | Y | Y | Y | Y | T | T | Y | Y | 6 |
| 2 | Brammall, et al. 2024 | Y | Y | Y | Y | T | T | Y | Y | 6 |
| 3 | Rostamzadeh, et al. 2021 | Y | Y | Y | Y | Y | Y | Y | Y | 8 |
| 4 | Tavananezhad, N. et al. 2022 | Y | Y | Y | Y | Y | Y | Y | Y | 8 |
| 5 | Eslami, V. et al, 2023 | Y | Y | Y | Y | Y | Y | Y | Y | 8 |

*Note: Y: yes/ 1 point, T: no/ 0 points, NA: Not Applicable/ 0.5

**Table 6. Critical Appraisal Tools Randomized Controlled Trial Standard (RCT)**

| No | Writer | Question Number | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| 1 | Karamolahi, et al. 2021 | Y | T | Y | T | T | T | Y | Y | Y | Y | Y | Y | Y | 9 |
| 2 | Aslantekin, et.al.2021 | Y | T | Y | T | T | T | Y | Y | T | Y | Y | Y | Y | 8 |

*Note: Y: yes/ 1 point, T: no/ 0 points, NA: Not Applicable/ 0.5

**Table 7. Critical Appraisal Tools Qualitative Studies**

| No | Writer | Question Number | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1 | Gourounti et.al .2022 | Y | Y | Y | Y | Y | T | T | Y | Y | Y | 8 |
| 2 | Kassie Whitworth, et al. 2024 | Y | Y | Y | Y | Y | T | T | Y | Y | Y | 8 |

*Note: Y: yes/ 1 point, T: no/ 0 points, NA: Not Applicable/ 0.5

Figure 4 shows the results, highlighting health literacy as the primary focus, with blue nodes indicating its central role in various aspects of health, particularly in the context of pregnancy. Health literacy serves as the foundation that enables pregnant women to access, understand, and apply information obtained from digital sources and online education. Yellow nodes, such as digital health literacy, mobile applications, and digital health, emphasize the strong link between digital literacy and pregnancy health. The use of digital applications and platforms makes it easier for pregnant women to monitor their condition independently, thereby reducing the risk of high-risk pregnancy and adverse pregnancy outcomes. Green nodes illustrate the role of online education in increasing pregnant women's confidence in making informed health decisions. Elements such as health education, preventive behaviors, and health promotion demonstrate that online learning materials encourage healthy behaviors that positively impact the well-being of both mother and fetus. Pink clusters (e.g., maternal health literacy, health disparities, determinants of health) demonstrate that digital literacy can reduce knowledge and access gaps, especially for mothers with educational or language barriers. Nodes such as limited language



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proficiency emphasize the importance of inclusive information. Dark blue nodes such as knowledge of antenatal care, maternal health, and low birth weight, demonstrate the tangible impact of digital health literacy in increasing antenatal knowledge, reducing the risk of low birth weight, and improving overall pregnancy outcomes (Figure 4).

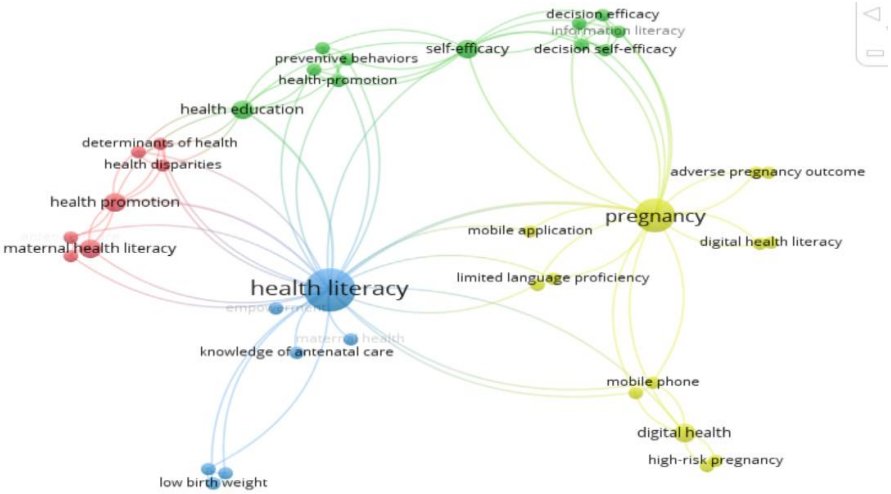


**Figure 4. Visualization of Vos Viewer results**

## DISCUSSION

The review results showed an increase in health literacy, knowledge about antenatal care, and prevention of pregnancy risks, such as gestational diabetes and postpartum infections[21]. Digital health literacy has emerged as a strategic approach to empowering women during pregnancy. Technology-based interventions, such as mobile apps, online platforms, and educational videos, can improve pregnant women's knowledge of important topics such as nutrition, pregnancy danger signs, and the importance of antenatal visits[14][10]. However, mothers' distrust, such as feeling less satisfied with communication with health workers, doubts about the validity of information obtained from the internet or applications, especially when it is not accompanied by scientific evidence or support from health workers, are major challenges[8].

Furthermore, the digital access gap remains a significant barrier to improving maternal health literacy. This is particularly true for women with limited basic literacy, language barriers, or those living in rural areas where internet access is limited. These barriers limit pregnant women's access to relevant and up-to-date health information[6]. Language use also plays a crucial role, as mothers who do not speak the primary language of their country of residence tend to have lower levels of health literacy and face difficulties and barriers in accessing digital education services[22].This situation has a direct impact on the readiness of pregnant women to face childbirth and respond to complications[23]. Conversely, groups of mothers with better digital access have a greater opportunity to obtain relevant information regarding prenatal care, childbirth preparation, and complication prevention, thus emphasizing the importance of educational interventions that are inclusive, linguistically adaptive, and contextualized to local needs[24].

This systematic review found that improving digital literacy during pregnancy can help in recognizing pregnancy danger signs and making decisions about the place of delivery, thus contributing to better pregnancy outcomes, such as reduced preterm birth rates, lower incidence of low birth weight (LBW) babies, and reduced labor complications. These findings demonstrate the importance of digital literacy not only for behavioral change and increased



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knowledge, but also for significantly improving obstetric outcomes for mothers and babies[12][25]. Through increasing literacy and online education, anxiety can also be reduced, and psychological well-being can be improved during pregnancy[26]. Pregnant women who received psychosocial support through online education experienced significantly reduced stress, particularly in high-risk pregnancies. This reinforces the role of technology as an emotional support tool, not just a means of information, particularly when facing childbirth[27]. Other research shows that online education and the use of digital literacy can change maternal behavior, such as increasing maternal compliance with antenatal visits and supplement consumption, helping with early detection of pregnancy complications, strengthening self-care, and preparing for childbirth[28],[29].

This review integrates digital education and maternal–neonatal outcomes within a single systematic framework. Using an SLR based on the PICO approach and quality assessment with the Joanna Briggs Institute (JBI) tool, the study ensured rigorous and relevant article selection. The analysis includes evidence from both developed and developing countries with diverse designs—cross-sectional, cohort, quasi-experimental, RCTs, and qualitative—providing a broad global perspective. A thematic synthesis approach enabled an in-depth examination of various digital interventions, including app-based education and technology-supported health communication for antenatal care and childbirth preparation.

However, the study has limitations. The heterogeneity of research designs and intervention types makes it difficult to draw consistent or generalizable conclusions. Most included studies assessed short-term improvements in knowledge and behavior rather than direct obstetric outcomes such as prematurity, low birth weight, or delivery complications. Additionally, the influence of social, cultural, economic, and basic literacy factors on the effectiveness of digital interventions was not comprehensively explored.

The implications of this research are significant for midwifery practice and public health policy. The development of accessible, inclusive, multilingual digital health literacy programs with support from healthcare professionals is crucial, particularly for pregnant women in areas with limited access. Further research is recommended to directly measure the impact of digital literacy on clinical pregnancy outcomes, while also considering socioeconomic and cultural aspects. The results can inform strategic policies to improve the quality of maternal and child health services.

## CONCLUSION

Digital health literacy and online education have a significant impact on maternal health. Technology-based interventions—such as mobile apps, online platforms, and educational videos—have been shown to improve pregnant women's knowledge of pregnancy danger signs and the importance of antenatal visits, while also helping prevent risks such as gestational diabetes and postpartum infections. App use also offers psychological benefits, including reduced anxiety and improved well-being, particularly in high-risk pregnancies.

However, the implementation of digital health literacy still faces challenges, such as a lack of trust in non-evidence-based information and disparities in digital access for pregnant women with limited literacy and language skills, or those living in rural areas. Furthermore, optimization of reminder features and two-way communication with health workers is needed to increase engagement among pregnant women.

As a recommendation, developing inclusive and affordable digital health literacy programs is crucial to ensure the benefits of technology are shared equitably, especially in areas with limited access. Further research is also needed to understand the social, economic, and cultural factors that influence the effectiveness of digital interventions, as well as to assess their impact on obstetric outcomes such as prematurity, low birth weight, and


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the need for medical intervention. These findings are expected to inform the development of more effective health policies and programs to support maternal health through digital literacy.

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