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# The Role of Digital Health in the Early Detection and Management of Obstetric Complications in the Community: A Systematic Review

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## Abstract

**BACKGROUND:** According to the World Health Organization, obstetric complications are thought to be the cause of death for 10.7 million mothers worldwide. In developing countries like Indonesia, maternal mortality rates are still high. Compared to 2019, there were 418 more incidents of maternal death in 2020.

**AIM:** The goal of the study was to explain how much digital technology contributed to the early identification of risk factors for obstetric complications.

**METHODS:** The work stages were observed while conducting the review, and relevant publications from databases were used. These databases included PubMed, Embase, ScienceDirect, ProQuest, and Scopus. The papers were retrieved between July 1, 2012, and June 30, 2022, using the keywords "pregnant lady" AND (Telemedicine OR "Mobile Health" OR Telehealth OR mHealth) AND ("Labor Complication" OR "Pregnancy Complication" OR "Puerperal Disorder"). Forty-five articles that discussed early obstetric detection and management were obtained based on the established inclusion criteria and met the inclusion requirements.

**RESULTS:** The term "telemedicine applications" refers to the use of health communications technology to provide remote consultation, diagnosis, education, and treatment services to detect and diagnose pregnancy complications and manage pregnancy and care during pregnancy. Applications for smartphones offer a tremendous deal of potential to enhance pregnant women's health. Support is required for maternal health services to help with antenatal care services in the community setting. The program can identify and manage pregnancy-related issues like weight gain, diabetes mellitus, nausea, vomiting, HIV, hemolysis, and depression.

**CONCLUSION:** It is expected that this review would be able to identify any difficulties that mothers may face early on in their pregnancies. In addition, it is believed that existing applications would be able to manage the moms' health and perform the necessary interventions and tactics to reduce difficulties.

## Introduction

Pregnant women's health is a significant component of obstetric services, where competent management becomes a guarantee for the mother's health [1]. Obstetric problems that cause death affect over 15% of pregnancies, including bleeding, infections, hypertension, protracted labor, and complications with abortion [2]. Maternal mortality during pregnancy is an important indicator in measuring economic, cultural, as well as maternal, and children health management. According to reports, improving maternal health could save more than 80% of maternal fatalities [3]. A study indicated that pregnancy-related or childbirth-related problems killed most women worldwide [4]. The lack of care coordination services during pregnancy, such as nutrition services or giving birth to premature babies, results in maternal mortality [5].

One of the measures used to evaluate the health of women is the maternal mortality rate (MMR), which is a component of both the development index and the quality-of-life index. Approximately 295,000 women died during, after, and soon after pregnancy and childbirth in 2017, and 810 women per day passed away from preventable causes associated with pregnancy and childbirth. The global MMR statistics shows that there were 211 maternal deaths for every 100,000 live births in 2017. About 94% of all maternal deaths, according to WHO, UNICEF, UNFPA, and the World Bank, occurred in low- and lower-middle-income nations, with Indonesia having the third-highest MMR in ASEAN, behind Myanmar and Laos. In addition, 305 maternal fatalities per 100,000 live births were reported in 2015 by the Inter-Census Population Survey. Indonesia aims to lower the MMR to 183 deaths per 100,000 live births by 2024. At the same time, the SDG target for 2030 calls for a global maternal mortality incidence of less than 70/100,000 live births [6].

Although an estimated 25% of pregnant women receive counseling regarding pregnancy risks, many pregnant women are unaware of the potential risks associated with pregnancy [7]. Pregnancy problems can be avoided, and normal pregnancy, fetal development, and spontaneous delivery are all ensured by proper self-care during pregnancy [8], [9]. Nearly

75% of all maternal deaths are caused by complications primarily linked to long-term diseases such as diabetes or heart disease [10]. In poor nations like Indonesia, the MMR is still high. The Indonesian government has established several programs to lower MMR, including antenatal care, local area monitoring of maternal and child health, maternal cohort, the implementation of delivery planning and complication prevention program, the MCH Handbook, basic emergency neonatal obstetric services at health centers, and comprehensive emergency neonatal obstetrics services at hospitals. However, these programs did not show significant results in reducing maternal mortality [11].

The goal of the antenatal care program is to identify pregnancy issues early and get ready for a safe delivery [12]. Unrecognized issues include the slow identification of risk factors for pregnant women, the introduction of pregnancy danger indicators, birthing, and the insufficient or slow management of obstetric problems, particularly in the community. Maternal deaths in Indonesia are primarily caused by three factors: (1) delaying seeking emergency medical attention; (2) arriving late at the health facility; and (3) delaying receiving treatment. According to a 2013 study conducted in Ethiopia, 35.1% of participants and 154 (31.8%) of them, respectively, did not know the warning indicators of pregnancy and childbirth. Various programs have been carried out to reduce the three factors, but they have not been resolved yet. Indeed, digital technology can help to solve the problem of delays in recognizing complications of pregnancy and childbirth with the early detection of obstetric complications based on digital health. If cases of complications of pregnancy and childbirth are found early, preparations for delivery assistance will be prepared as much as possible with skilled birth attendants, standard delivery facilities, and places, and referral functions will run according to the severity of complications for pregnant women. Research on using the E-Health application regarding information related to pregnancy including fetal development, delivery process, and weight management found that 90% of mothers utilize smartphones to find information about pregnancy [13].

The surveillance and early intervention strategies are proven to improve maternal health and reduce maternal and perinatal mortality. Numerous studies have been conducted recently on the viability and efficacy of telemedicine strategies in treating high-risk pregnancies. Computerized information exchange systems, video conferencing, information exchange over the phone or other mobile devices, short message services, or the Internet are a few telemedicine application strategies [14]. Mobile phones were used in Africa to collect information on mothers' and children' health issues [15]. In certain research, there has been a comparatively low level of participation in online or electronic prenatal interventions. In addition, a Dutch study revealed that 9% of pregnant women used online programs [16]. A potential way to enhance patient involvement and service delivery in health-care settings is the mobile health strategy (mHealth). For pregnant women, a self-management tool mobile app has been created [17]. Digital technology approach is required to develop a digital platform in the community as an alternative for the early detection to prevent and treat risk factors as predictors of *obstetric complications.*

### *The aim of the study*

This study aimed to describe the extent to which digital technology contributed to the early identification of risk factors for obstetric complications. In several articles reviewed, it was revealed that pregnant women were monitored based on technology-based by gathering all those the pregnant women. The aim was to identify the pregnant women to prevent various pregnancy complications. With the help of technology, mothers could manage problems that might arise during pregnancy, particularly complications experienced by mothers throughout pregnancy. This technology was utilized by describing the symptoms that pregnant women experienced. Then, the technology would suggest the possible interventions that pregnant women could use to overcome these symptoms.

## Materials and Methods

### *Design*

This article detailed the steps involved in conducting a literature review. It started by defining the goal of a literature review and then investigated how keywords were utilized to specify the review's scope. The following step was to review the article by identifying its issues, searching the literature using certain keywords, assessing the data, and performing data analysis and presentation [18]. The best way to avoid difficulties during pregnancy was used by the researchers in this study: applications for pregnant women. The publications were then categorized by name, nation, year, findings, contributions, and research design after data were retrieved using tables.

### *Data sources and search strategy*

This literature study utilized relevant articles from databases, including PubMed, Ambase, ScienceDirect, ProQuest, and Scopus which were accessed from June 1 to June 30 using the keywords: "pregnant woman" AND (Telemedicine OR "Mobile Health" OR Telehealth OR mHealth) AND ("Labor Complication" OR "Pregnancy Complication" OR "Puerperal Disorder" (Table 1).

**Table 1: Database search and keyword**

| Sources data | Keywords |
|---|---|
| PubMed | Pregnant woman [Title/Abstract] OR women, pregnant[Title/Abstract] OR Telemedicine[Title/Abstract] OR Mobile Health[Title/Abstract] Complication*, Obstetric Labor [Title/Abstract] OR Labor Complication*, Obstetric[Title/Abstract] |
| Embase | "pregnant woman"/exp Telemedicine:ab,ti OR mHealth:ab,ti OR telehealth :ab,ti Complication*, Obstetric Labor [Title/Abstract] OR Labor Complication*, Obstetric[Title/Abstract] |
| Scopus | TITLE-ABS-KEY ((pregnant w/0 woman) OR (pregnant w/0 women) TITLE-ABS-KEY (Telemedicine OR (Mobile W/0 Health) OR mHealth OR Telehealth OR eHealth OR "Virtual Medicine") ((complication* W/1 labor) OR (complication* W/0 pregnan*) OR (adverse W/0 "birth outcome*") OR (Disorder* W/0 Puerperal) |
| Proquest | ("Pregnant Women") (MESH.EXACT("Telemedicine") OR MAINSUBJECT. EXACT("Telemedicine") ("Pregnancy Complications") OR AINSUBJECT.EXACT("Pregnancy complications") OR MESH.EXACT("Puerperal Disorders") |
| Science Direct | Pregnant woman AND telemedicine or mobile health or telehealth or mHealth and complication pregnant woman and telemedicine or mobile health or telehealth and labor complication or pregnancy complication |

### *Criteria for inclusion of the literature in the study*

The articles chosen for this study met the modified inclusion criteria as of August 4, 2022. PubMed, Scopus, ScienceDirect, ProQuest (A Psy-article; Coronavirus; Health and Medicine), and Embase were some of the article's sources. These publications were sought out using the academic journal search technique, and the articles focusing on pregnant women with difficulties and suitable therapies were reviewed in the process. All the articles cited in this evaluation were research papers that employed technology to identify obstetrical issues early on. The articles were written in English. The following requirements had to be met in order for an article to be included: (a) it had to discuss telemedicine-based applications related to obstetric complications, pregnant people, telemedicine, and obstetric complications (pregnancy complications or labor complications); (b) it had to be published in an academic journal; (c) it had to be written in English only; (d) it had to be free to access; (e) it had to be readily available; and (f) it had to be published through the area of public health. Articles that do not discuss pregnant women, systematic protocol and gray literature publications, and proceedings are all excluded from the study.

### *Procedure for analyzing the data*

In conducting data analysis, all articles were reviewed. Then, a summary and quick reading were carried out to extract the data based on the year of publication, type of articles, country, sample, and results found in all articles related to the use of applications in prevention occur complications.

### *Screening*

The articles were screened based on the name of researchers, titles, abstracts, and full text.

### *Data Extraction*

The data extraction process is shown in Figure 1.

## Results

The purpose of this study, which resulted in 45 articles after the screening, was to determine the extent to which digital technology has contributed to the early identification of risk factors for obstetric complications. In several peer-reviewed articles, it was revealed that pregnant women were monitored on a technology basis and by gathering all pregnant women with the aim of detecting pregnant women to prevent various pregnancy complications. The digital technology mobile-based obstetric services can help patients in early detection of complaints that occur during pregnancy, including several ongoing applications in providing services in detecting symptoms of depression, monitoring pregnant women's blood pressure, controlling glucose, and monitoring complications during pregnancy, where technology is being developed in control the condition of mother during pregnancy. Mobile phone cameras are used to detect hemolysis in blood.

According to a summary of the findings, 45 articles that addressed telemedicine-based applications for obstetric complications, pregnant people, telemedicine, obstetric complications (pregnancy complications or labor complications), academic journals, research findings in English only, free full-text academic journals, and accessibility of documents and publications in the field of public health all met the inclusion criteria. The gathered articles were examined and analyzed, and the results are shown in Table 2. A total of 45 articles were derived from original articles. Some of the articles were reviews of random control trials; they were published between 2014 and 2022, and the writers' research included findings from studies in Australia, USA, India, China, UK, Spain, Iran, Japan, Norway, Austria, New Zealand, Kenya, Belgium, Sweden, and Ireland. Pregnant mothers and mothers who encountered obstetric problems were the subjects of 45 articles. There were two articles that examined responders from a wide range of perspectives; they observed responses from medical professionals, nursing staff, and the public regarding the consequences of utilizing the program. While 31 publications highlighted ways to manage pregnant people so as not to increase issues experienced by pregnant women, 15 of the papers collected discussed early complications suffered by pregnant women.

The most common reason for maternal deaths was shown to be complications during pregnancy; in this instance, the mother had complications.

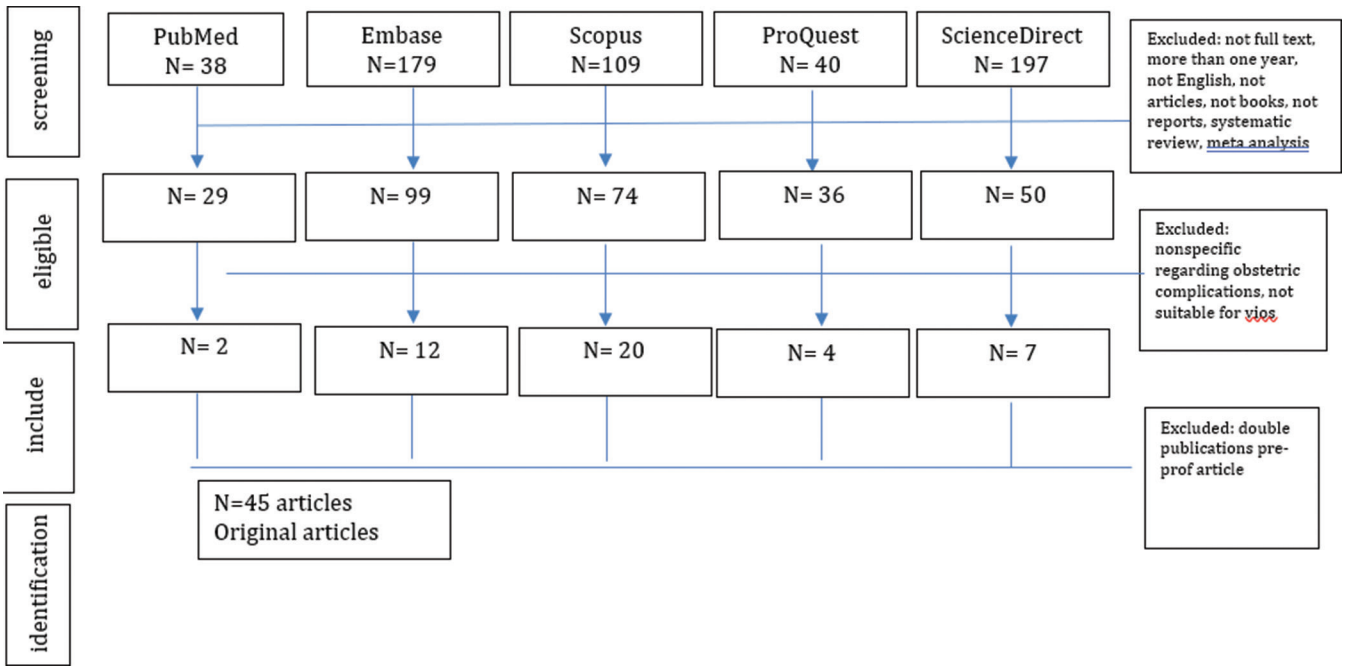


*Figure 1: Summary of literature search strategy*

**Table 2: Article characteristic**

| S. No | Author/Year | Study Period | Types of articles | Country | Sample Size | Main findings | Developed Technology | The role of digital technology | Digital Technology Acceptance |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (Holmes *et al*, 2020) Scopus | October 2017-October 2018 | Review articles (Random Control trials) | USA | 83 | The short service intervention for pregnant woman had no effect on excessive weight gain . | Short Message Service | The program participation barriers for low-income women, particularly vulnerable to overweight, obesity, and excessive GWG, were addressed as part of this trial to avoid excessive GWG. | - |
| 2 | (Thomas *et al*, 2022) ProQuest | Mei 2017-mei 2018 | Review articles (a mixed methods: Random Control trials) | USA | 68 | The experimental mHealth lifestyle intervention encouraged self-monitoring and was extremely feasible. To successfully affect PA and GWG among pregnant patients, overweight or obese, sophisticated interventions are required | mHealth technology | For pregnant patients who are overweight or obese, mHealth technology is appropriate for delivering a theory-based lifestyle intervention. | 88% (29/33) of them rated the program “good to excellent |
| 3 | (Downs *et al*, 2021) Scopus | | This study was a two-arm, feasibility randomized control trial | USA | 31 | 65 percent of the eligible women were randomly assigned; 87% of them finished the study; 10% of them only partially did; and 15 percent dropped out. 3%. Intervention women attended > 90% of education/ counseling sessions and 68-93% of step-up dosage sessions, and compliance with using the mHealth tools for intensive data collection varied from 77 to 97%. The GWG in the intervention group (6.9 kg) was 21% lower than in the control group (8.8 kg), but this difference was not statistically significant. | MyFitnessPal phone app; | Instructions for using the mobile health (mHealth) devices, such as the Wi-Fi scale, fitness monitor, Use the MyFitnessPal mobile software to track your weight, PA, and EI. Because self-reported dietary intake data is inaccurate, MyFitnessPal was used to gather information on diet quality for dietary guidance throughout the intervention. | - |
| 4 | (Gonzalez-plaza *et al*, 2022) ProQuest | June 2018-October 2020 | Review article (a mixed methods: Random Control trials) | Spain | 150 | 61% (36/59) of the pregnant women in the intervention group regularly wore the smart band, and 75% (44/59) thought the Mi Fit app’s usability was outstanding. | complex digital health intervention smart band (Mi Band 2) linked to the app Mi Fit | The intervention was carried out using a smart band (Mi Band 2) connected to the apps Mi Fit and Hangouts, which allowed the midwife to receive personal health information and assess PA. | evaluated the usability of the Mi Fit app as excellent. |

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**Table 2:** ***(Continued)***

| S. No | Author/Year | Study Period | Types of articles | Country | Sample Size | Main findings | Developed Technology | The role of digital technology | Digital Technology Acceptance |
|---|---|---|---|---|---|---|---|---|---|
| 5 | (Graham *et al*, 2014) Scopus | February 2021 | Formative research in the form of intercept interviews, in-depth interviews, and focus groups | USA | reviews = 110 RCT= 1689 | Tools for tracking and establishing goals for diet and exercise. In total, 80% of women used a tool or function on the website at least twice while logged in. 70% of participants in the intervention group utilized the only 40% of participants used the instruments for dietary and exercise goal-setting. | e-Moms Roc | Prevent weight gain | |
| 6 | (Harrison *et al*, 2017) ScienceDirect | 2014-2015 | Mix-methods | USA | 70 Participant | Effective telemedicine implementation approach with GDM | telemedicine | telemedicine offers a potential solution to reduce the time and cost burden of prenatal care for women with GDM. | |
| 7 | (Ghasemi, Vakilian and Khalajinia, 2021) ScienceDirect | January 2018 – january2019 | RCT | Iran | 126 | The results revealed a substantial difference in self-care and quality of life between the three groups (p=0.001). Additionally, there was a significant disparity between the three groups' fasting blood sugar levels following the intervention (p=0.005). | Social application, i.e., WhatsApp, on self-care and quality of life of women with gestational diabetes. | Self-care and Quality of life DM | |
| 8 | (Hasmi *et al*, 2022) ScienceDirect | 16 September 2019 | Randomizes control trial | Australia | 15 | A retention rate of 60.0% (n=9) of the fifteen women who were randomly chosen to participate in the research consented to do so. Two weekly motivational texts were sent to all subjects during the intervention trial, and 40.0% (n=6) of the participants dropped out. The participants recognized 68.1% of these. | SEESPA | Motivation for pregnant women | SEESPA useful, effective and there are feel satisfied. |
| 9 | (Tian *et al*, 2020) ScienceDirect | June-December 2019 | Randomizes control trial | China | 309 | Online management did demonstrate some potential advantages, such as lowering the influence of patients' self-judgment on SMBG, encouraging quick BG control, and keeping a high BG control rate. | Online management | Self-monitoring of blood glucose in pregnant women | |
| 10 | (Yee *et al*, 2020) PubMed | Focus pada patient August 2017-June 2018 | Qualitative | USA | pregnant 16 nurse 29 | Sweet mama a new educational and motivational mHealth tool for pregnancy for prenatal with diabetes, is considered a helpful educational tool and easy for low-income women to use during the trial two weeks of use. | theory-driven mHealth tool called Sweet Mama | Special health care needs | Sweet Mama users had largely positive feedback about the mHealth tool's appeal, content, and functionality. |
| 11 | (Musyola, thiga and Muketha, 2019) ScienceDirect | 2019 | Randomizes control trial | Kenya | 30 pregnant | Preeclampsia management in antenatal care presents a unique problem that has been identified. The results support any preconceived notions [19]. The 24-h ambulatory blood pressure monitoring device was created using this architectural design as a blueprint. | a smartwatch | using a smartwatch in conjunction with a mobile and cloud based application. | 100 % Satisfied with the system |
| 12 | (Archibong *et al*, 2017) ScienceDirect | | | USA | | This approach significantly reduced the errors associated with subjective visual methods and shortened the analysis time relative required by standard automated techniques. | Samsung Galaxy Nexus 19,250 and Nokia Lumia 520 cellphone were utilized as the prototype platform. | Measuring blood plasma color. To detect hemolysis. | |

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**Table 2:** ***(Continued)***

| S. No | Author/Year | Study Period | Types of articles | Country | Sample Size | Main findings | Developed Technology | The role of digital technology | Digital Technology Acceptance |
|---|---|---|---|---|---|---|---|---|---|
| 13 | (Lanssens *et al*, 2018) Scient direct | 1 January 2015 and 31 December 2016 | retrospective study | Belgium | 320 pregnant | Pre-natal care | remote monitoring/ cellphones | The various interventions included: [1] expectant management; [2] blood sampling; [3] adjusting antihypertensive therapy and/or physical exercise; [4] admission to the prenatal ward; and [5] inducing labor. The therapy approaches were built on regional management techniques. | |
| 14 | (Wernimont *et al*,2020) Embase | November 2015 to July 2017 | cohort study | USA | 45 pregnant | Use of cellular-enabled glucometers as part of a perinatal diabetes program enhances glucose control at delivery with timely transmission of accurate readings throughout gestation for pregnancies complicated by insulin-requiring diabetes. | Cellular-enabled glucometers | a cohort of insulin-dependent pregnant women participating in a telemedicine diabetes program can better manage their blood sugar levels. | |
| 15 | (Garnweidner-Holme *et al*, 2020) Embase | October 2015 and April 2017 | RCT | Norway | 238 pregnant | The food frequency questionnaire was finished by 193 (81.1%) of the 238 women at baseline and around gestational week 36. | Smartphone | smartphone app with targeted dietary information and blood glucose monitoring influenced the dietary behavior of women with GDM | |
| 16 | (Parameswaran *et al*., 2022) Embase | | Qualitative | USA | 47 pregnant women | experiences of the video conference intervention including positive experiences, negative experiences, suggestions and ideas, and screening as well as communication. | Telehealth: video conference | Mental health services to increase the access for treatment and to overcome the covid 19 pandemic | Enjoying and interested in the application. |
| 17 | (Yang *et al*, 2018) Embase | March-August 2016 | mix-method | China | 107 people | WeChat platform treatment could improve pregnancy outcomes | Smartphone-based Telemedicine | Self-monitoring of glucose levels (to control blood glucose) | |
| 18 | (Zhu *et al*., 2019) Embase | October 2012 and September 2016 | retrospective | China | 93465 pregnant | the number of prenatal visits increased significantly in the telemedicine group. | Telemedicine | to carry out antenatal visits on time, which is one of the important factors to improve the outcome of high-risk pregnancy. | |
| 19 | (Skar *et al*., 2018) Embase | October 2016 and February 2017. | Interpretive phenomenology | Norway | 17 pregnant | The results imply that a smartphone app may have potential to assist ladies with GDM, especially in managing their blood sugar. | smart phone | c controlling their blood glucose values and receiving health and nutrition information using a smartphone app | More information about glucose |
| 20 | (bircher *et al*., 2022) ProQuest | October 2021 and February 2022 | - | UK | 429 pregnant | Feedback alluded to feelings of increased safety, comfort, and ease with the technology. | Flexible maternity virtual ward (MVW | Identifying clinical leaders, triage criteria, technology, alarm selection, and creating adaptable escalation paths for disease patterns that can change. | |
| 21 | (Musabyimana *et al*, 2018) ProQuest | | qualitative | USA | 28 pregnant women | 90% of mothers who were interviewed were willing to receive SMS devices | Rapid SMS | for clinical appointments, deliveries, and postpartum care visits with increased attendance at antenatal care | Rapid SMS was well received by the community |
| 22 | (Heuvel *et al*, 2020) [1], [20] PubMed | - | qualitative | - | 42 women | Four major themes emerged from both participant groups: [1] care experiences, [2] emotions during pregnancy, [3] privacy, and [4] impacts on daily life | telemonitoring | Telemonitoring of a high-risk pregnancy provides an innovative manner to monitor fetal and maternal condition from home | |
| 23 | (Coleman *et al*., 2017) Scopus | 1 April 2013 – 18 August | retrofit | USA | 235 pregnant women infected with HIV | 40% of mothers following visits and text message interventions with an increase in the number of births | mHealth (sms) mama | Providing information regarding maternal health such as healthy eating, ANC reminders, psychosocial support, birth planning | |
| 24 | (Jenifer Felder, John Neuhaus, Andree, 2020) Scopus | 23 November 2016 to 22 May 2018 | RCT | USA | 2258 women | Changes in the severity of insomnia symptoms were measured by the insomnia severity index. Qualitative results: sleep efficiency, sleep duration, sleep quality, severity of depressive symptoms, severity of anxiety symptoms. | Digital for Insomnia | In this trial, digital CBT was an effective, scalable, safe, and acceptable intervention for overcoming insomnia symptoms during pregnancy. | |

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**Table 2:** ***(Continued)***

| S. No | Author/Year | Study Period | Types of articles | Country | Sample Size | Main findings | Developed Technology | The role of digital technology | Digital Technology Acceptance |
|---|---|---|---|---|---|---|---|---|---|
| 25 | (Ngo *et al*., 2022) Scopus | 2019-2020 | RCT | Norwey | 268 | Improve quality of life | cellular minsafestar (MSS) | To better understand how pregnant women use the app and how to maximize its utility within maternity care, future studies should include a process assessment. | For quality of life |
| 26 | (Forsell *et al*., 2017) Scopus | | RCT | Swedia | 42 | It is possible, acceptable, and effective to treat antenatal melancholy with ICBT tailored for pregnancy. To confirm these encouraging results, more extensive trials must repeat these results. | Cognitive behavior | depletion | |
| 27 | (Olson *et al*., 2018) Scopus | Mei 2011-July 2012 | Double blind | USA | 1689 | Cognitive, the results were not altered in several sensitivity analyses. | Intervening online | informational placebo control did not result in a difference in the proportion of women with excessive total GWG compared to the placebo control | |
| 28 | (Latendres *et al*.,2021) Scopus | | | USA | 47 | These observational results are promising, suggesting further study of effectiveness for women with symptoms of perinatal depression, as well as for women at high risk for developing perinatal depression. | Conference video | Perinatal depression. | |
| 29 | (Downs *et al*, 2021) Scopus | | RCT | USA | 31 | Adaptive behavioral interventions affected on maternal weight | mHealth | Losing weight | 97% of the patients were obedient |
| 30 | (Jennifer n felder zindel segal arne, corodao nancy sherwood, 2017) Embase | April 2013 to December 2013 | Qualitative | USA | 37 | Women who experienced depression did not show a significant relapse with the implementation of this program | Web-based mindfulness cognitive therapy | Reducing depression relapse | Mmb deserves to be accepted as a solution to the depression problem. |
| 31 | (Zhang Zhou and li, 2019) Embase | December 2015 to December 2017 | Random | China | 124 patients | Patient compliance in controlling blood sugar thereby reducing complications in pregnancy | mHealth: mobile medical application | Advanced mobile medical technology for patients' and doctors' communication to improve medical outcomes | |
| 32 | (Graham *et al*., 2017) | | RCT | USA | 1335 patients | Observing the weight at the first pregnancy and the weight at the last pregnancy | mHealth: presenting blogs, articles, frequently asked questions | Reducing weight | |
| 33 | (Willcox *et al*., 2017) Embase | | RCT | Australia | 100 | Ninety-one women completed the study. Delivery to protocol provides evidence of program feasibility. Weight participant 7,8 kg | mHealth | It is feasible to implement an intervention that intended to deliver healthy eating, physical exercise, and GWG guidance using cutting-edge technology and produce positive results. Vigorous exercise and GWG results. | |
| 34 | (Kojima *et al*., 2017) Embase | 2008 - 2011 | RCT | India | Pregnant, nurses, community | There were 22 (0.6%) cases of HIV, 19 (0.5%) cases of hepatitis B, 2 (0.1%) cases of syphilis, and 250 (7.1%) cases of BV, which were identified and treated. | mobile health | Pregnant people visiting mobile medical clinics in large numbers demonstrate that antenatal care and PMTCT services were accepted and used. Additionally, the initiative created and trained health professionals who still work in those | Patient-centered mobile medical clinics are feasible, successful, and acceptable |
| 35 | (Yee *et al*., 2020) Scopus | August 2017 to March 2019 | RCT | Norwest ran | 45 | An educational tool to help and facilitate pregnant women | mHealth cellular | providing motivation and information | Patients showed positive acceptance of the appeal, content, and function of mHealth. |
| 36 | (Nakagawa *et al*., 2020) | March 4 to April 2, 2020. | retrospective | Japan | 67 | A total of 67 telemedicine interventions were given to 44 pregnant mothers. 22 primiparas (50%) and 32 pregnant women (73%) had problems. | telemedicine | Maternal telemedicine can be safely conducted in pregnant women who are at risk of having an underlying disorder or fetal abnormality 1 month following the start of the attempt | |

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**Table 2:** ***(Continued)***

| S. No | Author/Year | Study Period | Types of articles | Country | Sample Size | Main findings | Developed Technology | The role of digital technology | Digital Technology Acceptance |
|---|---|---|---|---|---|---|---|---|---|
| 37 | (Ann *et al*., 2022) Scopus | | RCT | USA | 162 | This trial will support the implementation of an underutilized resource-an evidence-based mobile health tool-to decrease EGWG and PPWR among pregnant women with overweight and obese BMIs. | Mhealth | improved diet quality among people who enter pregnancy with overweight or obese BMIs to help them achieve appropriate GWG. | |
| 38 | (Kennelly *et al*., 2022) Scopus | March 2013-August 2016 | RCT | UK | 406 | The PEARS intervention did not influence maternal C3 or CRP concentrations in pregnancy. | Pregnancy Exercise And Nutrition Research Study (PEARS) | a lifestyle intervention, and adverse pregnancy, birth, and metabolic outcomes | |
| 39 | (Williamson *et al*., 2018) Embase | 2016-2017 | Discuss paper | UK | 402 | This recruitment approach generated 402 engagements but only seven respondents for questionnaire 1 and zero respondents for questionnaire 2, despite 55,700 Twitter impressions in a 76-day span during the winter of 2016–2017. | Situs web tweet dan Facebook | management of asthma during pregnancy, | Aspects of communications theory and They have been enthusiastically embraced |
| 40 | (Von Dadelszen *et al*., 2015) Scopus | | qualitative | USA | Pregnant women, nurses, doctors | Identified the health of pregnant women, babies, and facility-based care | Pre-EMPT Piers on the move application screen shoot | Identify individuals step-by-step regarding the risks associated with the condition | |
| 41 | (Hantsoo *et al*., 2017) Scopus | | quantitative | USA | 111 | Panic, stress, and anxiety disorders were treated with an analysis of p=0.02 | Computer-based depression screening with video telehealth therapy (VTT), computer assisted therapy (CAT) and online self-therapy (SGO) | Computer-based psychotherapy treatment could identify the needs of pregnant women's mental health barriers | Computer-based therapy is acceptable to some pregnant women |
| 42 | (Kennelly *et al*., 2016) Scopus | 2012 | RCT | Ireland | 253 | behavior modification, including individualized low GI dietary counseling and a daily exercise regimen prescribed before 18 weeks of pregnancy | mHealth smart technology | smart phone technology-assisted targeted healthy lifestyle intervention, which is grounded in behavior change theories and techniques, to support antenatal | |
| 43 | (Kingston *et al*, 2017) Scopus | August 2013 to January 2015 | RCT | Canada | 675 | for conducting mental health screenings in bustling medical offices. To assist women in using the Web-based screening link on the computer tablets, clinic and hospital personnel would need to receive minimal training. | E screening | to reveal mental health problems | Mental health e-screening was feasible and acceptable to pregnant women |
| 44 | (Zhu *et al*., 2019) Scopus | October 2012 to September 2016 | retrospective | China | 93465 pregnant women with high-risk pregnancy and 134884 pregnant women with telemedicine | Telemedicine could encourage mothers to manage antenatal care visits. Maternal mortality decreased after using telemedicine (p value <0.05) | telemedicine | management of high-risk pregnancy | |
| 45 | (Alam Banwell and Lokuge, 2020) Scopus | 2014 | retrospective | Australia | 459 | Consuming nutritious food p=0.03 following the procedure for taking medication = 0.01 | Text or voice messages | Changes in pregnancy care behavior Results related to service satisfaction, ability to remember services, identify danger signs of pregnancy, skilled preferences, blood donation arrangements for childbirth and complications of pregnancy, maternal nutrition, use of drinking water. | high satisfaction |

To provide pregnant women with the right care, an internet-based application was created [21]. Telemedicine or telehealth was defined in 45 articles as technology tools and services that enable virtual communication between medical professionals, patients, and service consumers using mobile health. These articles discussed changes in application behavior, disease management, and promotions in the health sector. The use of mobile devices like smartphones and tablets was also discussed in the articles. The community would have 24 h, anytime,

anywhere access to all health-related information through a web-based application. The public has access to all information on preventing pregnancy issues, allowing for better monitoring of the mother's health and welfare during her pregnancy. To save time and establish long-distance contact, the usage of telemedicine would make it easier for the community to communicate in real time, such as between doctors and patients one-on-one. As a result, it offers enormous potential for cost savings and remote access to a huge audience.

Mobile-based obstetric services can help patients in the early detection of complaints that occur during pregnancy, including several ongoing applications in providing services in detecting symptoms of depression, monitoring pregnant women's blood pressure, controlling glucose, monitoring the condition of the fetus, and monitoring complications during pregnancy where technology is being developed in control the condition of the mother during pregnancy. Mobile phone cameras are used in detecting hemolysis in blood.

Changes in lifestyle are always the cause of complications in pregnant women. A review of the literature identified several issues that can occur in expectant mothers, including 15 articles talked about obesity, 12 articles talked about gestational diabetes, three articles talked about pregnant women who had high blood pressure, seven articles talked about prenatal depression, three articles talked about HIV, four articles talked about high-risk pregnancies for complications, and one article revealed mothers who had COVID. The remainder of the discussion focused on mothers who experienced hemolysis, sleeplessness, asthma, nausea, and vomiting. Most articles on complications related to diabetes mellitus patients highlighted how, in some pregnancies, pregnant women's blood sugar levels rose. Some sources found several pregnant women who experienced stress and even depression. Anxiety that appears was a common symptom that might occur in mothers. If we leave the mother in a state of stress and pressure, this will have a negative impact on the development of the baby, increasing the risk of postpartum depression.

In addition, there were also some articles discussed about short-massage service applications, mHealth technology [12], [19], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], Telemedicine [3], [20], [32], [33], [34], the use of applications [35], [36], [37], MyFitnessPal phone app [23], Mi Fit app [38], e-Moms Roc [16], WhatsApp social application [39], [40], SEESPA [41], RapidSMS [42], E screening [43], [44], PEARS [28], [45], and Cellular-enabled glucometers [46]. Others were about watch-based applications and video conferencing like using a smartwatch [47], Telehealth: video conference [45], [48], [49], flexible maternity virtual ward services [50], internet-based [24], [51], website Williamson [52], and Text or voice message [53].

A group of people had experienced in using telemedicine in high-risk pregnant groups and admitted that this application provided convenience and was innovative. Several studies have shown that those applications were functioned to monitor the condition of the fetus and mother from a distance. For example, studies by [12], [16], [23], [26] discussed about the decrease in mother's weight and changes behavior of pregnant cares. Outcomes related to service satisfactions, the ability to remember services and to identify danger signs of pregnancy, the use of registration features for diet, weight, and physical activity in the Healthy Moms were found by [54]. Then, studies on self-care and quality of life of diabetes patients were conducted by [32] [39], [40], [41], [47]. Others discussed about providing motivation during pregnancy [21], [42], measuring the color of blood plasma, detecting hemolysis [20], increasing access to care [49], providing clinical health-care remotely [3], monitoring oxygen saturation (SpO2), respiratory rate, pulse, movement, and skin temperature, and integrated with a blood pressure cuff, axillary temperature patch, and spirometer [51].

Furthermore, studies on clinical appointments, delivery, and postpartum care visits by increasing attendance at antenatal care were conducted by [27], [20], [42]. Besides [22] analyzed insomnia occurred to pregnant woman, while [42], [46] investigated an independent of conditions related to health to nausea, vomiting, and quality of life. Moreover, studies related to depression were performed by [50], [52], [55] the uncover mental health problems by [44], the medical check-up, blood pressure check, and body weight by [35]. After that, the Pregnancy Exercise and Nutrition Research Study (PEARS) discussed about lifestyle intervention and adverse pregnancy, birth, and metabolic outcomes, as well as monitoring patients with asthma. To address the needs of mothers throughout pregnancy, health care for high-risk pregnant women must be provided due to the rising demand for such services. Pregnant women are increasingly using websites to get information, track people, check fetal development, and provide them confidence.

Various applications through the mobile health program are widely used in addressing maternal and child health problems in low- and middle-income countries. As many as, 16 articles evaluated the acceptance of programs felt by users and the beneficiaries of telemedicine applied to pregnant women. All the programs were created to increase access to antenatal, postnatal care, childbirth, and emergency obstetric care, and respondents were satisfied with the applications used [44], [48], [54]. The applications were accepted in the community, as reported by [43], [53], [55]. Some of the applications got positive community acceptance [21], some were successful [27], adhere to application implementation [14], and gave impacts [37]. Some respondents wanted more information [36], enjoyed

all applications [49], and another acceptance said excellence [39].

## Discussion

This study of the literature an early detection, monitoring, and assurance of maternal management during pregnancy were provided through web-based antenatal care assessments [51]. Telemedicine is the practice of delivering clinical health-care remotely through the use of communications and informatics technology. There are numerous telemedicine applications in use today, including teleconsultation, telediagnosis, tele-education, telecare, and telemedicine. Most pregnant women research options and try to live healthily. Numerous preventative and health promotion strategies are based on the recent development of telehealth [3].

Pregnant women who are overweight will experience perinatal complications [39]. Being overweight makes pregnant women's already higher risk of perinatal problems worse. A risk factor for postpartum weight retention, which also contributes to weight growth, is excessive weight gain [56]. The patient's experience with pregnancy will inspire her to convert to a healthier lifestyle [29]. Holmes used message interventions to keep track of pregnant women's diets and exercise regimens [12]. Prenatal care is used to avoid obesity and includes information on recommendations, planning for weight increase, nutritious eating (calories throughout pregnancy, quality of diet), energy density, water consumption, and activity monitoring [16], [23]. Pregnancy complications involving gestational diabetes mellitus are the most prevalent [32], [36]. Premature birth, cesarean sections, neonatal hypoglycemia, and metabolic disease are just a few of the short- and long-term negative effects of gestational diabetes, a condition in which glucose resistance develops throughout pregnancy. Other risks arisen are health risks for pregnant women, cesarean delivery, hypertensive disorders, macrosomia, and neonatal metabolic complications [21]. Diet modification and blood glucose monitoring are the first line of treatment for women with gestational diabetes mellitus and should be made at diagnosis. Diabetes of any severity must be actively treated to prevent pregnancy complications [57]. Diet changes and blood glucose monitoring are the mainstays of gestational diabetes care [41]. Self-monitoring of glucose is necessary for effective control and is frequently done by pregnant women [47]. Most blood sugar measurements are made with gestational ages between 19 and 44 [58]. Therefore, it is crucial to check a pregnant woman's blood sugar level on the initial visit [40]. Pregnancy-related negative health effects for both the mother and the fetus can be avoided with a nutritious diet and stable blood sugar levels [38]. Diabetes education, food therapy, exercise, medication, and self-monitoring of blood glucose are methods for controlling blood sugar [34]. Other methods include facilitating communication and managing pregnancy-related activities [21].

Hypertension is another issue that affects pregnant women, according to the studies analyzed in this one. Pregnancy hypertension is a serious maternal and newborn disease [59]. Chronic hypertension, diabetes, obesity, renal disease, heart disease, and preeclampsia during pregnancy are all hazards for hypertension. These conditions begin during the $20^{th}$ week of pregnancy when the mother's blood pressure is high and there is protein in her urine. The mother's placenta, kidneys, liver, and brain may all be impacted by this occurrence [42]. Along with hypertension, other pregnancy-related problems include depression, which affects 20% of expectant mothers [17]. According to [49], depression affects 20% of pregnant women both during pregnancy and after giving birth [14] Following that, prenatal depression is a serious condition that requires close monitoring and early detection [52]. In America, a depression scale must be used for screening to detect maternal depression [20], [22], [49], [52]. HIV infection is the next pregnancy complication [22] Insomnia [46], hemolysis [20], nausea, vomiting, and infectious illnesses [27], [37].

The health services offered to high-risk pregnant women cannot keep up with the rising demand for these services, and the difficulties in providing care for high-risk pregnancies necessitate creative management techniques [20]. Numerous women try to pursue a healthy lifestyle while pregnant and preparing for motherhood by doing research and seeking out advice. The development of mobile health technology has led to an increase in the use of tools for interventions based on health promotion and prevention. Mobile applications are being used more and more by expectant mothers to access information, track health, monitor the fetus, and offer health insurance. E-health interventions have the advantages of being broad-reaching, interactive, personalized, and cost-effective. The interventions applied include cognitive, behavioral, and emotional changes [24]. Another development that was carried out with respondents, which was conducted by recording the behavior and asking open-ended questions through telephone interviews found that patients were satisfied with the applications used [42].

### *Limitations*

There are two limitations to this study. A search of the literature comes first. It contains up to 11 articles on pregnancy problems, which are particularly common in pregnant women who gain weight and have gestational diabetes. This topic includes both management and intervention articles for pregnant women who have problems. Therefore, there is a need to enhance early

pregnancy detection, particularly when using web-based detection. To ensure that the literature studies gathered are included in the review in accordance with the objectives associated with articles that are of high quality and represent the circumstances of pregnancy complications in different countries and parts of the world, the authors, however, adhered to the inclusion criteria set by the research when searching for articles.

## Conclusion

A literature review on the role of telemedicine in the detection of complications during pregnancy was selected in this study. This study outlined all roles of web-based mobile phones with applications that can be used and obtained patients who experienced complications during pregnancy and utilized the management and care of mothers during pregnancy remotely without the mother going to health services. Through the application, pregnant women can access information about pregnancy prevention. Therefore, it is important to develop applications for pregnant women so that complications can be detected before the mother experiences various problems in pregnancy.

### *Novelty*

The application of mHealth specifically as promotion in the areas of health, management of obstetric complications in the community, and behavior change is what makes this research new. Another novelty is that telemedicine may enhance pregnancy care by reducing pregnancy-related problems. This clarification has been updated to be clearer about identifying early pregnancy problems. The study's conclusions and suggestions state that the most popular application is a mobile one, and pregnant women can benefit from it.

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