



mHEALTH intervention to improve breast cancer prevention and early detection: A literature review

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ABSTRACT

Breast cancer is the leading cause of death among Indonesian women. Early detection is believed to increase survival and reduce mortality from breast cancer. Mobile Health (mHealth) intervention is considered the best strategy to increase health knowledge and behavior. Therefore, this literature review aims to provide an overview of mHealth's effectiveness in improving breast cancer prevention and early detection. The literature search used the Science Direct, Pubmed, DOAJ, Online Wiley library, Sage, and Cochrane databases. The inclusion criteria were randomized controlled trials or quasi-experimental studies published in English between 2013 and 2022. Eligible studies were those that investigated the effect of mHealth on improving breast cancer prevention and early detection. PRISMA was used to analyze the obtained data. The mHealth interventions used in the ten research articles reviewed are specifically designed short messages and a breast cancer mobile application. Overall, mHealth intervention can increase knowledge of breast cancer prevention, encourage early detection, increase breast cancer awareness, improve BSE behavior, as well as increase adherence and mammogram attendance. This literature review shows that mHealth intervention has significantly improved breast cancer prevention and early detection.

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ABSTRAK

Kanker payudara merupakan penyebab utama kematian wanita Indonesia. Deteksi dini diyakini dapat meningkatkan kelangsungan hidup dan menurunkan angka kematian akibat kanker payudara. Intervensi Mobile Health (mHealth) dianggap sebagai strategi terbaik untuk meningkatkan pengetahuan dan perilaku kesehatan. Oleh karena itu, kajian literatur ini bertujuan untuk memberikan gambaran tentang efektivitas mHealth dalam meningkatkan pencegahan dan deteksi dini kanker payudara. Pencarian literatur menggunakan database Science Direct, Pubmed, DOAJ, Online Wiley library, Sage, dan Cochrane. Kriteria inklusi adalah uji coba terkontrol secara acak atau studi kuasi-eksperimental yang diterbitkan dalam bahasa Inggris antara 2013 dan 2022. Studi yang memenuhi syarat adalah studi yang menyelidiki efek mHealth dalam meningkatkan pencegahan dan deteksi dini kanker payudara. PRISMA digunakan untuk menganalisis data yang diperoleh. Intervensi mHealth yang digunakan dalam sepuluh artikel penelitian yang ditinjau adalah pesan singkat dan aplikasi seluler kanker payudara yang dirancang khusus untuk intervensi. Secara keseluruhan, intervensi mHealth dapat meningkatkan pengetahuan pencegahan kanker payudara, mendorong deteksi dini, meningkatkan kesadaran kanker payudara, meningkatkan perilaku SADARI, serta meningkatkan kepatuhan dan kehadiran mammogram. Tinjauan literatur ini menunjukkan bahwa intervensi mHealth telah meningkatkan pencegahan dan deteksi dini kanker payudara secara signifikan.

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INTRODUCTION

Breast cancer is the most common disease diagnosed in women globally and the leading cause of death for women in both developed and developing countries, including Indonesia (Lestari & Wulansari, 2019; Solikhah et al., 2019). The incidence of breast cancer cannot be prevented, but its adverse effects, such as poor quality of life or death, can be prevented (Shakery et al., 2021). The poor quality of life in breast cancer patients is caused by high levels of morbidity, the patient's inability to carry out daily activities, high anxiety levels, a feeling of helplessness, metastases, as well as facing the adverse effects of surgery and chemotherapy (Osmiałowska et al., 2021). Breast cancer patients who seek health services are, on average (60-70%) at the advanced stage III-IV of the disease (Lestari & Wulansari, 2019). This adverse effect is due to the delay in realizing the signs and symptoms of breast cancer, resulting in delayed treatment (Schliemann et al., 2022).

Many women diagnosed with advanced breast cancer had insufficient knowledge and awareness about the early symptoms of breast cancer (Solikhah et al., 2019). Studies have shown that early detection and prevention efforts for breast cancer can improve the patient's quality of life, increase their survival, and reduce their mortality from breast cancer (Schliemann et al., 2022; Solikhah et al., 2019). Moreover, the early detection of breast cancer can increase survival by 80% (Sun et al., 2017) and reduce mortality by 20% (Lestari & Wulansari, 2019). Early detection can be done by conducting a breast self-examination (BSE), clinical breast examination (CBE), or mammogram screening (Wöckel et al., 2018). However, some women do not do mammographies due to poor knowledge and negative perceptions about breast cancer (Schliemann et al., 2022).

Low knowledge and negative perceptions includes fear of cancer diagnosis, embarrassment because of the presence of male radiographers/technicians, low trust with radiologists/radiographers in detecting abnormalities, low coping skills in dealing with abnormal results, anticipating pain during procedures and side effects. procedural side, and women's perception that breast screening tests are not needed if they are in good health status (Aidalina & Syed Mohamed, 2018). Additionally, the patient's level of knowledge about breast cancer is significantly correlated with their Breast Self Examination (BSE) behavior (Guilford et al., 2017) and mammography compliance (Schliemann et al., 2022). Therefore, it is important to improve women's knowledge of the early detection of breast cancer. One method to do so is through a mobile health (mHealth) intervention (Subramanian et al., 2021).

Chronic disease is considered the most important target for mHealth applications (Scholz & Teetz, 2022). mHealth is a comprehensive health information system accessible through mobile devices (Catalani et al., 2013). It can promote health, support health practices, improve access to services, and be used as a continuous health monitoring tool. mHealth applications are commonly used in education and behavioral change in the form of Short Message Service (SMS), Multimedia Messaging Service (MMS), Interactive Voice Response (IVR), audio, video, and images (Tokosi et al., 2017). The mHealth application can be an alternative method for developing promotive care without time and place limitations (Qureshi et al., 2019).

mHealth is effective in delivering educational content, encourages participants to follow instructions, to read and think about the content carefully, and is a cost-effective approach to reducing the burden of cancer (Alanzi et al.,

2018; Subramanian et al., 2021). The mHealth application can provide patient education and training, behavior change, data collection and reporting, registration of health services, tracking important events, electronic health records. mHealth interventions have a positive impact on clinical outcomes, medication and care adherence, health behavior change, disease management, and primary care attendance rates with respect to various diseases. mHealth in cancer treatment also has a positive impact on improving sleep quality, weight loss management, reducing fatigue, stress, and pain in cancer (Schliemann et al., 2022). Moreover, mHealth's advantages are its simple features, ease of connectivity, relative affordability, and sound, image, and video features. There has also been rising community enthusiasm for using mHealth, as it is used in high-income areas as well as low- and middle-income areas (Catalani et al., 2013).

However, there is still limited clinical evidence in the form of a literature review regarding mHealth interventions that can improve breast cancer prevention and early detection. A similar literature study called "mHealth Interventions to Improve Cancer Screening and Early Detection: Scoping Review by Schliemann et al. (2022) reviewed articles published from 2012 to 2022. This article reviews the effectiveness of mHealth against cancer in general and the papers included are reviews of any type. Therefore, the authors aim to include newer findings in the discussion and further evaluation of the effectiveness of mHealth interventions in increasing the prevention and early detection of breast cancer.

This literature review aims to provide an overview of the effectiveness of mHealth, which has been found in previous studies to improve the prevention and early detection of breast cancer. This literature review is expected to provide new understanding and knowledge for nurses about the effect of mobile health interventions in increasing the prevention and early detection of breast cancer in women. With this knowledge, nurses can provide holistic and effective patient services based on evidence-based practice.

METHOD

The literature search was conducted in September 2022 using the patient, intervention, control, and outcome (PICO) framework. The data were then analyzed using the Preferred Reporting Items for Literature Review and Meta-Analyses (PRISMA) framework.

Search strategy

The Science Direct, Pubmed, DOAJ, Online Wiley library, Sage, and Cochrane databases were used in the literature search. The keywords used to search for evidence-based research were "mHealth" OR "mobile health" AND "breast cancer" AND "Randomized control trial" AND "prevention" AND "early detection" OR "screening."

Inclusion and Exclusion Criteria

The inclusion criteria were randomized controlled trials (RCT) or quasi-experimental studies published in English between 2013 and 2022. The eligible article results were studies that investigated the effects of mHealth in improving the prevention and early detection of breast cancer. The exclusion criterium were non-open access journals.

Assessment of Article Quality

The selected articles were then assessed for quality by using the Critical Appraisal Checklist (CAP) from the Joanna Briggs Institute (JBI) in 2020. The questionnaire assessed the quality of the methodology, determined any possible bias in the design, and evaluated behavior and analysis. There are many types of JBI questionnaires for various types of

research designs. In this case, the JBI questionnaire used was for experimental research designs, such as the Randomized Controlled Trial (RCT) and Quasi-Experimental (non-randomized) designs. Articles with good assessment results are deemed good quality articles that were selected for review. The ratings of the RCT and quasi-experimental articles are shown in Table 1 and Table 2, respectively.

Table 1
Randomized Controlled Trial Article Assessment Questions

No	Items	Article quality assessment						
		Ginsburg et al., 2014	De Jesus et al., 2021	Chung et al., 2015	Kerrison et al., 2015	Pagkatipunan, 2018	Nanda et al., 2022	Blajda et al., 2022
1	Did the study address a clearly focused research question?	Y	Y	Y	Y	Y	Y	Y
2	Was the assignment of participants to interventions randomized?	Y	Y	N	Y	Y	Y	Y
3	Were all participants who entered the study accounted for at its conclusion?	Y	Y	Y	Y	Y	Y	Y
4	Were the participants 'blind' to the intervention they were given?	N	N	N	N	N	N	N
5	Were the investigators 'blind' to the intervention they gave participants?	Y	Y	N	Y	Y	Y	Y
6	Would the experimental intervention provide greater value to the people in your care than any existing interventions?	N	N	Y	N	N	N	N
7	Were the people assessing/analyzing outcome/s 'blinded' ?	Y	Y	Y	Y	Y	Y	Y
8	Were the study groups similar at the start of the randomized controlled trial?	Y	Y	Y	Y	Y	Y	Y
9	Apart from the experimental intervention, did each study group receive the same level of care (were they treated equally)?	Y	Y	Y	Y	Y	Y	Y
10	Were the effects of the intervention reported comprehensively?	Y	Y	Y	Y	Y	Y	Y
11	Was the precision of the estimated intervention or treatment effect reported?	Y	Y	Y	Y	Y	Y	Y
12	Do the benefits of the experimental intervention outweigh the harms and costs?	Y	Y	Y	Y	Y	Y	Y
13	Can the results be applied to your local population/in your context?	Y	Y	Y	Y	Y	Y	Y

Notes: Yes (Y), No (N), Unclear (U), and Not Applicable (NA)

Table 2
Quasi-Experimental Article Assessment Questions

No	Items	Article quality assessment		
		Shakery et al., 2021	Vidal et al., 2014	Yusuf et al., 2022
1	Is it clear in the study what is the "cause" and what is the "effect" (i.e., there is no confusion about which variable comes first)?	Y	Y	Y
2	Were the participants included in any of the comparisons similar to each other?	Y	Y	Y
3	Were the participants included in any comparisons received similar treatment/care other than the exposure or intervention of interest?	Y	Y	Y
4	Was there a control group?	Y	Y	N
5	Were there multiple measurements of the outcome, both pre-and post-intervention/exposure?	Y	Y	Y
6	Was the follow-up complete, and if not, were there differences between groups regarding their follow-up in terms of adequate descriptions and analysis?	Y	Y	Y
7	Were the participant outcomes included in comparisons measured the same way?	Y	Y	Y
8	Were the outcomes measured reliably?	Y	Y	Y
9	Was appropriate statistical analysis used?	Y	Y	Y

Notes: Yes (Y), No (N), Unclear (U), and Not Applicable (NA)

RESULTS AND DISCUSSION

The article search was conducting using the Preferred Reporting Items for Literature Review and Meta-Analyses (PRISMA) framework. In total, the researchers obtained ten

articles of good quality. A summary of the selected articles is shown in Table 3. The articles studied were published between 2013 and 2022. The article search flow based on the PRISMA method is shown in Figure 1.

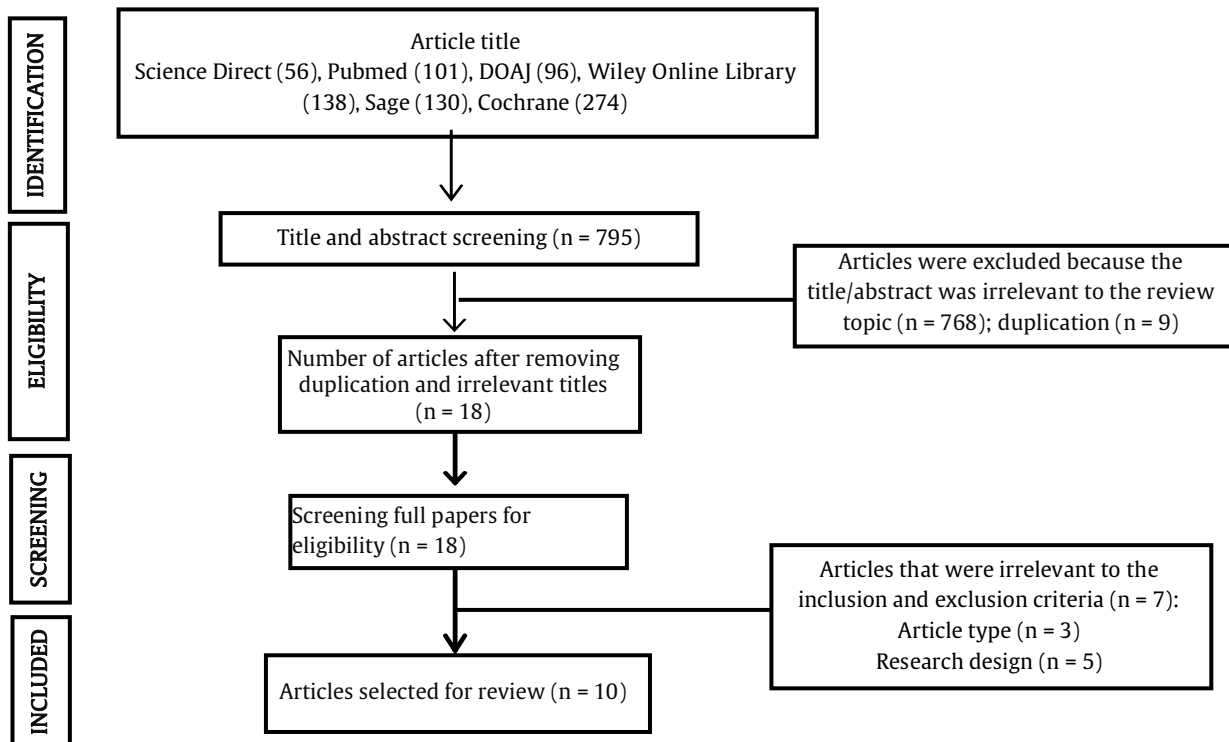


Figure 1
Flow of article search using PRISMA

Table 3
Article Summary

Title of article, researcher, and year of publication	Research methods/design	Intervention	Samples and sample techniques	Measured output	Results
Ginsburg et al., 2014 An mHealth Model to Increase Clinic Attendance for Breast Symptoms in Rural Bangladesh: Can Bridging the Digital Divide Help Close the Cancer Divide?	RCT	A smartphone-empowered community health worker (CHW) model of care for breast health promotion, clinical breast examination (CBE), and patient navigation.	The sample was 22,337 women aged 25 years and over. The sample was randomly determined with a ratio of 1:2 (control group/ intervention group).	Adherence of women with abnormal CBE to clinic attendance.	Attendance for treatment group B was 63% and (43%) for group A. Women in group B were significantly more present for treatment than group A who were without navigation 0.0001.
De Jesus et al., 2021 A Mobile Health Breast Cancer Educational and Screening Intervention Tailored for Low-Income, Uninsured Latina Immigrants.	RCT	Automated cell phone voicemail, automated text message, or control (mail).	The sample was 256 women aged 40 years and over. The random sampling distribution was performed with a computer system that divided the sample into 2 intervention groups and 1 control group.	Knowledge about breast cancer and breast cancer prevention, as well as adherence to mammography screening.	The group that received the intervention via email had the greatest adherence to screening (67.4%). Adherence to mammography screening in all groups was 62.9%. There is a difference in knowledge between pre-intervention and post-intervention (p<0.001).
Chung et al., 2015 Effect of short message	RCT	Short message service (SMS)	The sample was 202 women aged between 20 and 65	BSE adherence and the frequency of BSE	The compliance rate of the texting group was compared with the control

service as a reminder on breast self-examination in breast cancer patients: a randomized controlled trial.			years. The sampling technique was randomized by nurses who did not participate in the study. They made random numbers and divided them into the intervention and the control groups.	over 6 months.	group at month three (71.2% vs. 28.6%, $p < 0.001$) and at month six (76.3% vs. 31.0%, $p < 0.001$). The frequency of BSE in the last six months was significantly higher in the intervention group than in the control group.
Kerrison et al., 2015 Text-message reminders increase uptake of routine breast screening appointments: a randomized controlled trial in a hard-to-reach population.	RCT	Intervention with reminder text messages containing time, date, and rescheduling if they are unable to attend 48 hours prior to the appointment.	The sample was 2,240 women aged between 47 and 53 years. Using a computerized pseudorandom method, the participants were randomly divided into a control group and an intervention group.	Attendance at breast screening	Attendance at the first breast screening appointment was significantly higher in the text message reminder group than in the control group, (64.35 % and 59.12 %, OR 1.26 and P 0.01). Attendance at the appointment 60 days after the first breast screening was significantly higher in the intervention group than in the control group (67.65% and 62.88, OR 1.23 P 0.02).
Pagkatipunan 2018 Peer leader and phone prompts: implications in the practice of breast care among college students.	RCT	Traditional health program (THEP), peer group leader-phone recommended health education program (PPHEP)	The sample was 10 schools. They were then randomized and divided into 3 groups - control group - THEP group - PPHEP group	Knowledge and attitude towards breast care, practice of BSE, and physical activity	Students in the THEP group were 7.13 times more likely to perform BSE than the control group. The PPHEP group did more physical exercise than the control group by 8.24%.
Nanda et al., 2022 Text-Based Intervention Increases Mammography Uptake at an Urban Safety-Net Hospital	RCT	A text reminder with specific scheduling options, a text reminder with open-ended scheduling options or usual care	The sample was 1277 women aged between 50 and 65 years. The groups were divided by using a random number generator. Intervention group 1 had 423 participants, the intervention 2 group had 420, and the control group had 434.	Mammography uptake at 3 months	A higher number of participants scheduled their mammograms within 3 months when given text-based reminders compared to the control group $p = 0.03$. Of the 1277 participants, 63.2% of them attended and received mammograms. Compliance between specific scheduling and open scheduling after 3 months of intervention did not differ, at 10.16% vs. 10.2% (special vs. open).
Bajda et al., 2021 Application of Personalized Education in the Mobile Medical App for Breast Self-Examination	RCT	Mobile medical app for breast self-examination with personalized education based on the algorithm	The sample was 500 women aged 18 years and over. The distribution of participants was randomized, where participants with an odd number sequence were the target of the intervention, and participants with an even number were the target of the control group.	Ability to perform breast self-examination and knowledge about breast cancer.	The application of the intervention significantly increased the application user's ability to perform breast self-examination. Data analysis revealed a statistically significant correlation between the level of knowledge and the number of points marked in the tactile test in both Tests I and II.
Shakery et al., 2021 The Effect of a	Quasi Experiments	The BSE smartphone application	The sample was 150 women aged between 18 and 60	Women's performance and health	There was no significant difference between the two groups regarding BSE

Smartphone Application on Women's Performance and Health Beliefs About Breast Self-Examination: A Quasi-Experimental Study			years. Participants were randomized by block randomization using a random allocation software (block size four) into the intervention and control groups. An unknowing expert in the study group performed this division.	beliefs regarding BSE	performance before the intervention ($p = 0.089$). After the intervention, BSE's performance significantly increased in the intervention group compared to the control group ($p = 0.001$). After the intervention, the difference in mean scores of perceived vulnerability, self-efficacy, motivational health, and BSE inhibition was significantly higher in the intervention group compared with the control group ($p < 0.05$).
Vidal et al., 2014 Use of Text-Message Reminders to Improve Participation in a Population-Based Breast Cancer Screening Program	Quasi Experiments	Short Message Service (SMS) Reminder	The sample was 100,000 women divided into 2: an intervention group (47,979) and a control group (47,480).	Attendance at the mammogram screening appointment	Appointment attendance in the intervention group was 74.9%, and the control group was 65.0% (OR=1.63). As much as 8.3% of the intervention group rescheduled and 7% of the control group rescheduled (OR=1.20). Appointment attendance after rescheduling in the intervention group was 74.2%, and the control group was 80.7% (OR = 0.69).
Yusuf et al., 2022 Breast Awareness Mobile Apps for Health Education and Promotion for Breast Cancer	Quasi Experiments	BrAware application	Participants were 41 women aged 18 years and over. The non-probability sampling method used social media, such as Facebook and WhatsApp groups, between October 1 st to December 1 st , 2021.	Level of knowledge about risk factors for breast cancer, awareness about signs and symptoms of breast cancer, and confidence in performing BSE.	BC warning sign knowledge scores were different before and after using BrAware at a significance level of <0.001 (70.62% vs. 79.83%). BSE knowledge scores before and after using the application increased by 9.75 ($p 0.007$). The knowledge score about BC risk factors changed before and after giving the BrAware application intervention at a significant level of 0.005 (65.79% vs. 77.07%).

The articles' research locations are Bangladesh (1 article), the United States (1 article), Korea (1 article), England (1 article), the Philippines (1 article), Kansas (1 article), Poland (1 article), Iran (1 article), Spain (1 article), Malaysia (1 article). The research design method used were RCTs (70%) and quasi-experimental designs (30%). The mHealth interventions applied were text messages (60%) and a breast cancer mobile application specifically designed for the intervention (40%).

Based on the reviewed articles, the participants were between 18 and 65 years old. This aligns with the recommendations for breast screening in Indonesia, as the right age to reduce mortality from breast cancer is between 50 and 75 years. However, according to research in Indonesia, most women over 50 do not perform breast screening (Solikhah, 2019). Studies have shown that BSE intervention has been conducted in Indonesia on women of childbearing age (20 to 49 years) (Lestari & Wulansari, 2019). In contrast, the German national mammography screening

program stated that women who participate in the screening should be within the age range of 50 to 69 years (Wöckel et al., 2018). In America, women are recommended to do a mammography examination before 40 because it is reported that deaths from breast cancer at the age of 40 and above are 99.3% (Sun et al., 2017). Overall, women aged 35 to 50 years face risks for breast cancer. However, this risk increases at over 50 due to various factors (Ceber et al., 2013).

Text messages

The text messages in the reviewed articles were automatically designed and sent through various methods: using a computer telephony system called Healthwave Phonetree (De Jesus et al., 2021), through website services (Chung et al., 2015), by Iplato patient care messaging (PCM) service (Kerrison et al., 2015), by a punctual message system connected to EMR (Nanda et al., 2022), through the ALHORA solution company (Vidal et al., 2014), and by sending a peer

leader assistance manual (Pagkatipunan, 2018). As much as 20% of the text messages were breast cancer educational messages. A total of 8 educational messages were sent (De Jesus et al., 2021), and on the fifteenth day, the participants were given information about breast cancer (Chung et al., 2015). Text message interventions containing information related to breast cancer can also increase breast cancer knowledge, breast cancer prevention knowledge, and improve attitudes toward the early detection of breast cancer (Chung et al., 2015; De Jesus et al., 2021).

Of the sent messages, 20% were Breast Self Examination (BSE) reminder messages, and 40% were mammography reminders. Text message reminders were sent to reduce the forgetting factor that is often reported to be why the participants do not conduct BSE or fail to attend screening mammograms (Chung et al., 2015; Kerrison et al., 2015; Pagkatipunan, 2018). Text messaging is also a cost-effective way for healthcare providers to reach women whose addresses have changed (Kerrison et al., 2015; Vidal et al., 2014).

This type of intervention has been widely used in many studies. Previous studies also support the reviewed articles because text messages can serve as appointment reminders, provide cancer-related information, or information related to cancer screening (Schliemann et al., 2022). Text messages can also improve health behavior (Armanasco et al., 2017) and increase TB treatment adherence (Mahwati, 2022). Moreover, text messaging interventions effectively increase attendance and adherence (Guy et al., 2012). This aligns with the results of interventions in the reviewed articles, where 70% of text messages can increase attendance and adherence in early detection, such as through BSE and mammography.

Based on the reviewed articles, each would have different text message-sending frequencies. These messages vary from two weekly messages sent per month ($n = 8$) (De Jesus et al., 2021), two monthly messages sent per 6 months ($n = 12$) (Chung et al., 2015), one message sent 48 hours before the appointment ($n = 1$) (Kerrison et al., 2015), monthly messages sent per 3 months ($n = 3$) (Pagkatipunan, 2018), messages sent one week before the appointment of different quantities ($n = 1$, $n = 2$, $n = 3$) (Nanda et al., 2022), and one message sent three days before the appointment ($n = 1$) (Vidal et al., 2014). Of the text messages sent, 40% were one-way communication, and 20% were two-way.

Applications that provided a question-and-answer space allowed participants to clarify the misunderstood materials (Alanzi et al., 2018). The frequency of short messages twice a day on the same topic is considered repetitive, suggesting that only one message per day or three messages per week is ideal. This aligns with the reviewed articles, as in most studies, only one short message is sent per day, and other messages are given at different times.

The reported advantages of text messages are that they are more efficient, relatively affordable, and easy to use compared to other interventions (Lionita et al., 2017). Moreover, many people agreed to be sent SMS and are satisfied with this service (Kannisto et al., 2014). Reminder text messages to increase screening uptake are expected to be informative, brief, and simple (Schliemann et al., 2022). The drawbacks of text messaging are an inconvenience for older participants, lack of texting skills, difficulties in texting, concerns that the message content is not well-understood, and security, such as lost cell phones. Some women were also worried that negative results would be sent via SMS and read by someone else with access to their cell phone (Schliemann et al., 2022; Kannisto et al., 2014).

Breast cancer mobile app specially designed for the intervention

Some of the reviewed articles used a specially designed breast cancer application that uses internet access and is downloadable on a smartphone. The application, with the help of a Community Health Worker (CHW), is in the form of a motivational video with a duration of 3.5 minutes emphasizing the importance of maintaining health. The use of this application has been proven to increase the number of women doing clinical breast examinations and finding signs of breast cancer symptoms. After using the application, women who found abnormalities in their breasts would present the issue to a healthcare center for examination (Ginsburg et al., 2014). The CHW and navigation services in mHealth interventions can also facilitate participants, especially older adults, to support the participants' needs, and convey information such as examination results (Schliemann et al., 2022).

Furthermore, applications with images, such as interactive tactile test applications, can effectively improve BSE practices (Bajda et al., 2022). Interventions with the BSE smartphone application include an alarm system, reminders (in the form of text messages), accurate BSE training video clips, four videos about breast cancer, and feedback to therapists for six months. These features have been shown to improve women's performance in performing BSE (Shakery et al., 2021). Moreover, a previous study found that when specially designed breast cancer mobile apps are combined with text message reminders, it will result in the participant's increased knowledge and increased screening uptake (Schliemann et al., 2022). The BrAware application also contains images and videos developed with simple and user-friendly sentences that have proven effective in increasing breast cancer awareness (Yusuf et al., 2022).

Applications containing videos are considered better because they can convey material more clearly compared to text messages. Videos are also entertaining, targeted to attract the individual's attention, allow for easier distribution, have better accessibility and portability, can be accessed at any time according to the user's wishes, and can easily notify other individuals on the topic. Conversely, there are several weaknesses of these applications, such as the small screens on smartphones making it difficult for individuals to read the subtitles on the video, poor internet connection, difficult download processes, and time-limited training for individuals who face difficulties in operating the application (Lee et al., 2018). Nevertheless, some women said that education with mobile applications in the form of videos about breast cancer could increase awareness of the importance of prevention and early detection, reduce anxiety, and increase knowledge (Alanzi et al., 2018; Lee et al., 2018). Such an application has also been developed in Indonesia to increase BSE knowledge and behavior by combining interesting texts, images, audio, and videos (Lestari & Wulansari, 2019).

Information about breast screening programs can increase health knowledge, change prevention behavior, and encourage patients to conduct mammographies (Eibich & Goldzahl, 2020). Based on the reviewed articles, the mHealth application can increase awareness about cancer (Alanzi et al., 2018). It has also been shown to increase knowledge regarding cancer prevention and screening (Subramanian et al., 2021). The weakness of the mHealth intervention in the reviewed articles is that it has not been possible to use the mHealth application for mammography examinations due to limited infrastructure or no access to mammography

services in Indonesia. The early detection of breast cancer method that is feasible in Indonesia is breast self-examination (BSE) (Solikhah, 2019).

LIMITATIONS TO THE STUDY

The limitations of this review are that the authors conducted the literature reviews, not in the form of meta-analyses. The articles analyzed were only randomized control trials and quasi-experimental studies published between 2013 and 2022. The limited number of studies may also limit the quality of the evidence found.

CONCLUSION AND RECOMMENDATIONS

The literature review of ten articles found that mobile health interventions can significantly increase breast cancer prevention and early detection through text messaging and specifically designed breast cancer mobile apps. The results of the mHealth intervention for the prevention and early detection of breast cancer are compliance and attendance to mammograms, BSE behavior, higher breast cancer and breast cancer prevention knowledge, increased BSE knowledge, knowledge of breast cancer risk factors and the signs of breast cancer symptoms, BSE beliefs, perceptions of vulnerability, self-efficacy, health motivation, and BSE barriers.

This intervention can be easily applied without side effects. Therefore, the mHealth interventions in the ten articles reviewed have had a positive impact and provided important findings regarding the prevention and early detection of breast cancer. Due to their rising usage, text messaging interventions are expected to be developed through other messaging applications such as WhatsApp, Facebook, Messenger, and WeChat. Text messages can also be combined with other application models to make educational videos, audio, graphics, and images easier to share. Finally, interventions with specially designed breast cancer mobile applications can also be combined with reminder text messages to increase screening uptake.

DECLARATION

Availability of Data and Material (ADM)

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

Competing interests

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Authors' contributions

Study conception and design: RNF, MDA
Literature review/analysis: RNF
Manuscript draft writing: RNF
Study supervision: RNF
Critical revisions for important intellectual content: MDA

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