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USE OF SMARTPHONE APPLICATIONS IN POST-MASTECTOMY BREAST CANCER PATIENTS: A LITERATURE REVIEW

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ABSTRACT
Post-mastectomy breast cancer patients frequently experience physical and psychological symptoms, including pain, fatigue, limited mobility, body image disturbance, and emotional distress that negatively affect quality of life. Smartphone applications have emerged as digital strategies to support symptom management and patient engagement during recovery. This study aimed to analyze the use of smartphone applications among post-mastectomy breast cancer patients through a literature review. Articles were retrieved from PubMed, Scopus, ScienceDirect, SAGE, and Google Scholar. A total of 342 articles were found during the search, with publication years ranging from 2021 to 2025. Of these, 11 studies that met the inclusion criteria were analyzed based on research design and symptom-related outcomes. The findings indicate that smartphone applications improve symptom monitoring through electronic patient-reported outcomes (ePRO), enhance self-efficacy, and reduce psychological distress and anxiety. Several studies also reported improvements in quality of life and adherence to rehabilitation programs. However, evidence regarding long-term physical symptom improvement remains inconsistent. In conclusion, smartphone applications serve as effective supportive interventions for symptom management and recovery among post-mastectomy breast cancer patients, although further standardized and long-term studies.

Keywords: breast cancer; post-mastectomy; quality of life; smartphone applications; symptom management

INTRODUCTION
Breast cancer is now the most commonly diagnosed type of cancer and the fifth leading cause of cancer death worldwide, with a predicted 2.3 million cases and 685,000 deaths in 2020. This figure is expected to increase to 4.4 million cases by 2070. Among women, breast cancer accounts for approximately 24.5% of all cancer cases and 15.5% of cancer deaths, making it the most common and deadliest type of cancer in many countries in 2020 (Lei et al., 2021).

In Indonesia, breast cancer is the most common cancer among women, with an incidence rate of 42.1 per 100,000 women and a mortality rate of 16.6 per 100,000 women in 2020 (Globocan, 2022). Breast cancer is the leading cause of cancer death in women, with over 670,000 deaths reported in the same year (World Health Organization, 2024). These figures underscore the urgent need for effective interventions to address breast cancer in the country, where health care disparities and cultural barriers often hinder early detection and treatment (Osborne et al., 2025).

Mastectomy is a breast removal procedure that is often the primary treatment option for advanced breast cancer. A mastectomy is a surgical procedure designed to remove all breast tissue, primarily as a treatment for breast cancer or as a preventative measure (National Center for Biotechnology Information, 2021). Although this procedure can save the patient's life, the recovery process after a mastectomy is often marked by significant physical and psychological problems. Common physical symptoms include fatigue , pain, sleep disturbances, nausea/vomiting, mucositis, neuropathy, changes in body shape and arm function, lymphedema, and decreased physical and cognitive capacity (Nardo et al., 2022). Additionally, patients may experience anxiety, depression, stress, fear of cancer recurrence , body image disturbance, and sexual problems. These conditions can impact patients' quality of life and ability to manage their health independently (Yang et al., 2025).

Mastectomy has a higher rate of postoperative medical and surgical complications than BCS. Serious postoperative complications are associated with poorer survival after mastectomy (Boniface et al., 2023) . However, in practice, inadequate insurance, cost, and housing instability hinder follow-up visits and therapy (Vangsness et al., 2024)

The rapid development of information technology has had a major impact on the world of health, including nursing. For nurses, keeping up with these technological changes is crucial to providing high-quality care. Digital health technologies, such as telemedicine, mobile health apps, electronic medical records (EMD), and remote patient monitoring (MPM), enable nurses to provide more personalized, efficient, and effective care (Hamzah et al., 2024). Digital communication tools have shown significant potential to improve health literacy, ultimately leading to better health outcomes (Fitzpatrick, 2023).

In post-mastectomy breast cancer patients, smartphone applications can improve physical activity, function, muscle strength, cardiorespiratory capacity, pain, fatigue, and quality of life, with the majority reporting positive results and high satisfaction (Keikha et al., 2022) . Furthermore, A CBT-based stress management app for cancer survivors (Stress Proffen) reduces stress and improves several domains of quality of life by emphasizing easy access and self-paced exercises that encourage sustained engagement (Borosund et al., 2020)

Research shows that cancer apps found that app-based interventions overall increased self-efficacy and decreased anxiety, depression, and distress (Qin et al., 2022) . A systematic review of digital counseling for chronic illnesses showed that many app/web programs improved self-efficacy and treatment adherence, especially when they included quality educational materials, personalized feedback, and self-monitoring (Paalim et al., 2022). Although various studies have been conducted on the use of smartphone applications in cancer patients, studies that specifically focus on the post-mastectomy breast cancer patient population are still limited and spread across various research designs. Few studies have systematically identified the types of apps used, the most effective features, the clinical and psychosocial outcomes measured, and barriers to implementation in the context of post-mastectomy care. Based on this description, a comprehensive literature study is needed to identify, analyze, and synthesize scientific evidence related to the use of smartphone applications in post-mastectomy breast cancer patients. The aim of this study is to evaluate the effectiveness of smartphone applications in symptom management, improving quality of life, and supporting recovery for post-mastectomy patients.

METHOD

This study used a literature review design to summarize and evaluate relevant scientific evidence regarding the use of smartphone apps in post-mastectomy breast cancer patients. The review approach was systematic to identify, examine, and synthesize scientific articles relevant to the study topic. The literature search strategy was conducted through electronic searches of several major international and national scientific databases, namely PubMed, Scopus, ScienceDirect, Sage, and Google Scholar. The keywords used in the search process included a combination of terms in English and Indonesian, including: 'breast cancer', 'post mastectomy', 'smartphone application', 'mobile health', 'mHealth', 'mobile app', 'rehabilitation', 'self-management', and 'quality of life'. The use of Boolean operators AND and OR was applied to expand and focus the search results according to the objectives of the study. The articles selected for inclusion were published between 2021 and 2025.

Inclusion criteria for this literature review included original research articles and review articles discussing the use of smartphone-based applications or mobile health (mHealth) interventions in post-mastectomy breast cancer patients. The selected articles were published within the last five years to ensure the scientific evidence used reflects the most recent findings. Furthermore, the

included articles were written in English and available in full-text form. Exclusion criteria included articles that did not specifically examine post-mastectomy breast cancer patients, including studies with mixed populations without separate analyses for post-mastectomy patients. Studies using interventions other than smartphone-based applications were also excluded from this review. Furthermore, articles that did not report measurable research outcomes were not included in the analysis.

The article selection process involved several stages, starting with initial identification of articles based on electronic search results, duplication screening, title and abstract review, and full-text review to determine compliance with inclusion and exclusion criteria. Data extraction from selected articles included information on authors and year of publication, study design, sample characteristics, type of smartphone application/intervention used, and key findings related to clinical outcomes, rehabilitation, and other aspects relevant to the patient's condition. Data analysis was conducted using descriptive narrative to describe and synthesize the findings from the selected articles, thus providing a comprehensive overview of smartphone app use in post-mastectomy breast cancer patients, including benefits, challenges, and clinical implications. The study results are then presented in tabulated and narrative form, integrated according to the scope of the study.

Article Screening

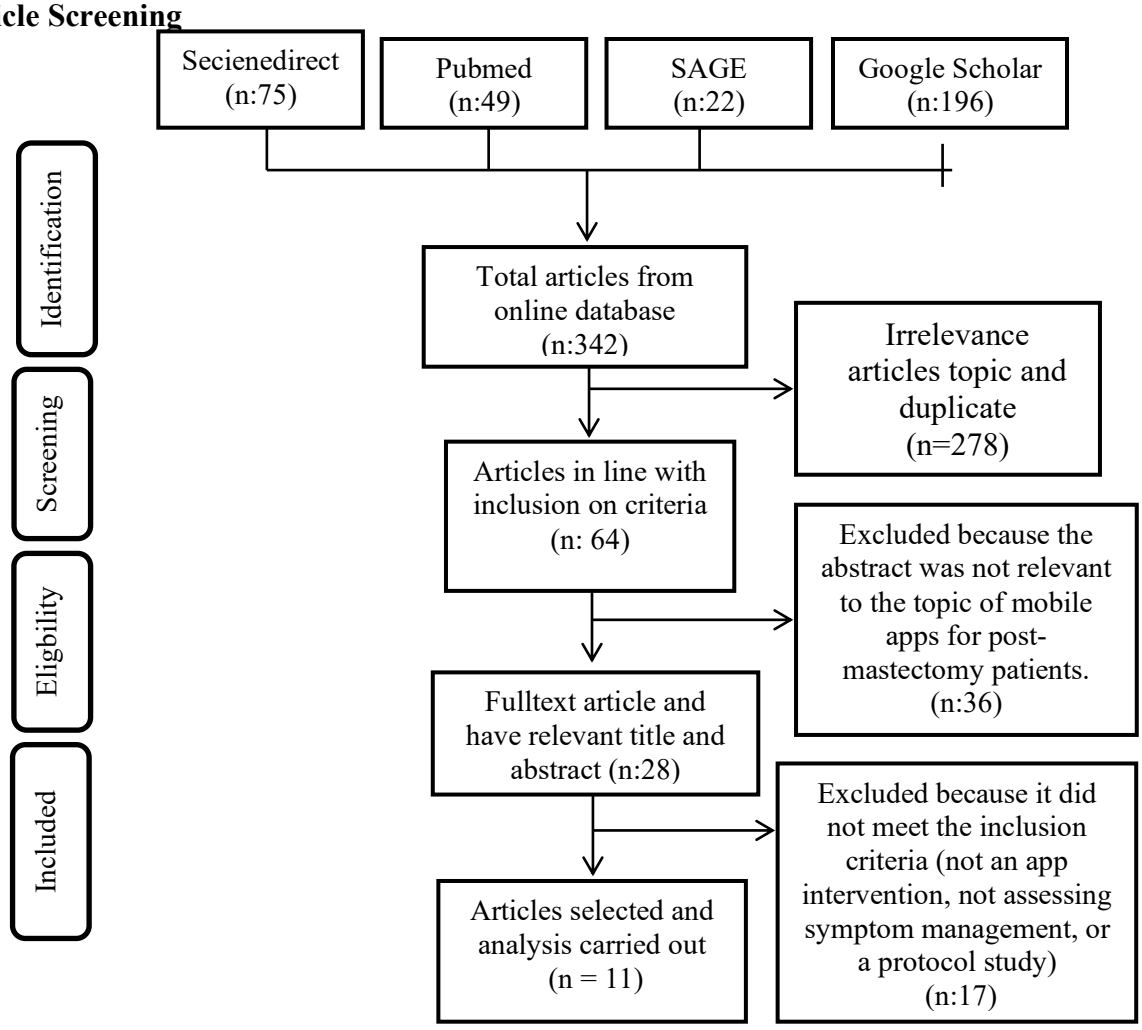

Figure 1: Literature Selection Flow

RESULT

Based on the results of literature searches from various databases such as PubMed, Science Direct, SAGE and Google Scholar, ten articles were obtained that met the inclusion criteria which can be seen in the following table:

Table 1.
Analysis Article

Outhor	Title	Method	Results
Akingbade et al. (2024)	Development and feasibility of an mHealth intervention for psychoeducational support of Nigerian women diagnosed with breast cancer undergoing chemotherapy: A pilot randomized controlled trial	Pilot RCT; development and initial evaluation of an mHealth intervention in women with breast cancer in Nigeria .	The mHealth intervention was deemed feasible and well-accepted. Participants reported the benefits of psychoeducation and emotional support for symptom management during chemotherapy; further large-scale trials are recommended.
Grażyna Suchodolska & Elżbieta Senkus (2022)	Mobile applications for early breast cancer chemotherapy-related symptoms reporting and management: A scoping review	Scoping review to identify and review studies evaluating mobile applications used for symptom reporting and chemotherapy side effect management in adult patients with early-stage breast cancer.	Four of the six mobile apps recognized in this review were shown to have interventional value for managing chemotherapy-related side effects. Clinical outcomes achieved among mobile app users included improved quality of life, lower symptom prevalence, and symptom burden.
Shi et al., 2023	Mobile health application-based interventions to improve self-management of chemotherapy-related symptoms among people with breast cancer who are undergoing chemotherapy	A systematic review of RCTs examining mHealth apps for symptom self-management in breast cancer patients undergoing chemotherapy; included RCTs were published between 2010 and 2021; data were categorized using the Omaha System and Bandura's self-efficacy theory .	The search identified 1,668 records. Full-text screening was performed on 44 articles, and 5 randomized controlled trials (n = 537 participants) were included. Self-monitoring in the “Treatments and procedures” domain was the most frequently used mHealth intervention to improve symptom self-management in breast cancer patients undergoing chemotherapy. Most mHealth apps employed a variety of “mastery experience” strategies, including reminders, self-care suggestions, videos, and learning forums.
Lee et al., 2025	Impact of a 24-Week Mobile App–Based Human Coaching Program on Body Composition and Lipid Metabolism in Breast Cancer Survivors With Overweight or Obesity	Prospective single-arm cohort study: 130 breast cancer survivors (BMI ≥25) participated in a 24-week Noom app-based coaching program; weight, BMI, lipid profile, bioimpedance, and quality of life were evaluated at baseline, 6 months, and 12 months.	The program demonstrated significant weight and BMI reductions in the hyperactive group (≥16 weeks of use). Triglycerides decreased significantly , and several bioimpedance components showed positive changes. Several quality-of-life aspects (nausea/vomiting, constipation, body image, arm and breast symptoms) also improved at 6-month follow-up.
Kim et al., 2025	Evaluating the Effectiveness of a Mobile App for Breast Cancer Self-Management on Self-Efficacy: Nonrandomized Intervention Trial	Nonrandomized controlled intervention trial : n=66 breast cancer patients were divided into CAMA (mobile app) and control (treatment-as-usual) groups. Groups were allocated based on availability and smartphone compatibility; the intervention duration was 12 weeks. Outcomes were measured using self-efficacy, quality of life (WHOQOL-BREF), mental adjustment (K-Mini-MAC), PHQ-9 (depression), GAD-7 (anxiety), and the menopause emotional symptoms questionnaire (MESQ).	Use of the CAMA app proved feasible and demonstrated significant increases in self-efficacy (seeking help and support), psychological well-being, and improvements in positive attitudes toward cancer. Furthermore, there were significant decreases in anxiety, depression, and emotional symptoms of menopause compared to controls. User satisfaction surveys indicated positive impacts and areas for improvement (e.g., communication and content).
Jiang et al., 2024	Effects of the “AI-TA” Mobile App With Intelligent Design on Psychological and Related Symptoms of Young Survivors of Breast Cancer	Randomized controlled trial (RCT): Young women (18–45 years) with breast cancer were randomly assigned to either the intervention (AI-TA app) or control group. The intervention included the “AI-TA” app with bidirectional web follow-up every 2 weeks, with psychosocial measurements at 1 and 3 months.	app intervention demonstrated significant increases in self-efficacy (measured by the CBI-Brief) compared to controls at 1 and 3 months. Social support increased significantly at 3 months, and all groups (including controls) demonstrated improved quality of life (FACT-Breast), which was maintained through 3 months. The app has demonstrated potential for reducing psychological and cancer-related symptoms in young survivors.

Outhor	Title	Method	Results
Lv Tian et al., 2025	Effects of using app-based interventions on quality of life among breast cancer patients: a systematic review with meta-analysis	Systematic review + meta-analysis of 16 RCTs evaluating the effects of app-based interventions in breast cancer patients; searches were conducted in PubMed, Web of Science, Scopus, Cochrane Library, and EMBASE until October 2024. Quality evaluation was carried out using Cochrane Risk of Bias, and effect analysis was carried out using RevMan.	A meta-analysis showed that, compared with usual care, app-based interventions significantly improved the quality of life of breast cancer patients (14 studies, SMD = 0.84; $p < 0.00005$). Furthermore, the apps significantly reduced physical pain and anxiety. However, the interventions showed no significant differences for fatigue and depression .
Lim et al., 2021	A Modular Mobile Health App for Personalized Rehabilitation Throughout the Breast Cancer Care Continuum: Development Study	Development study: Design and development of a modular mHealth application containing various functions to assist the rehabilitation of breast cancer patients throughout the care continuum. The process involved a team of experts, the formulation of evidence-based content and modules, the classification of user information for personalization algorithms, and the development of a platform and digital device connectivity.	The mHealth application was successfully developed with 11 core functions, including self-monitoring, personalized health information, physical exercise, and diet management, tailored based on the user's medical information. Personalization algorithms were created based on criteria such as surgery type, therapy use, and post-operative medication changes.
Grasič Kuhar et al., 2025	Patients' Daily Reporting of Symptoms via Mobile Application Reveals a Significant Difference Between Patients' Perceptions and Doctors' Interpretations	Prospective cohort study : 46 early breast cancer patients receiving (neo)adjuvant chemotherapy recorded daily symptoms using an Android application (m-app OnkoVed). Daily data were compared with physician notes in electronic health records (EHR) and with the EORTC QLQ-C30 & BR23 quality of life questionnaire every 3 months. Usability and satisfaction with the application were also evaluated by patients and physicians.	Patients reported nearly twice as many symptom types through the app as through physician notes (75 vs. 49), with significantly higher symptom frequency and intensity ($p<0.001$). The most frequently reported symptoms were fatigue, insomnia, and dry mouth , with insomnia and dry mouth being underreported by physicians. QoL assessments showed declines in physical, social, and cognitive functioning, as well as increases in fatigue, systemic therapy side effects, and dyspnea after 3 months. The app received a usability score of 4.5/5 from patients, but some physicians expressed concerns that the ePRO increased the burden of clinical management.
Cahyono et al., 2022	The effect of Benson relaxation application ('Bens app') on reducing fatigue in patients with breast cancer undergoing chemotherapy	A quasi-experimental pretest-posttest with comparison group (56 breast cancer patients undergoing chemotherapy). Participants were divided into an experimental group that performed Benson relaxation using the Benson app twice daily for 7 days, and a control group that performed the same technique using a guide booklet. Fatigue was measured using the Brief Fatigue Inventory before and after the intervention.	Both groups showed a significant reduction in fatigue after the intervention ($p=0.001$ in the app group and $p=0.015$ in the booklet group). However, the reduction in fatigue was greater in the Bens app group than in the control group, suggesting that mobile apps can be an effective alternative in helping patients practice relaxation techniques to reduce fatigue during chemotherapy.
Shi et al., 2024	Feasibility of a mobile health app-based self-management program for Chinese patients with breast cancer receiving chemotherapy	A randomized controlled pilot study: 96 breast cancer patients receiving chemotherapy were divided into an intervention group (mHealth self-management app plus nurse-led support) and a control group (routine care + placebo app). Evaluation was conducted over 6 weeks, measuring app usage, adherence, symptoms, quality of life, and self-efficacy.	The mHealth program is feasible for BC chemotherapy patients, with an increase in app compliance from 4.8% (week 3) to 51.2% (week 6). The intervention group showed significantly lower symptom burden ($p=0.042$) and better physical well-being ($p=0.024$) compared to the control group at week 6. Both groups showed a decrease in physiological efficacy scores compared to baseline. The results support the feasibility and positive initial effects of the mHealth application in symptom self-management during chemotherapy.

DISCUSSION

Based on the literature search results of 11 articles that met the inclusion criteria, a variety of research designs were obtained, including randomized controlled trials (RCTs), pilot RCTs, quasi-experimental studies, prospective cohort studies, systematic reviews, meta-analyses , and development studies . Most of the studies were conducted in the context of mobile health (mHealth)-based interventions for breast cancer patients undergoing chemotherapy or breast cancer survivors. The most widely studied outcomes include self-efficacy , quality of life, psychological distress, anxiety, depression, fatigue, and symptom burden during therapy.

In general, study results indicate that mobile app-based interventions have a positive impact on improving patients' self-management and psychological well-being. A meta-analysis conducted by Tian et al. (2025) of 16 RCTs reported that app-based interventions significantly improved the quality of life of breast cancer patients compared to usual care. Furthermore, these interventions also demonstrated effects in reducing physical pain and anxiety, although no significant differences were found in fatigue and depression. These findings suggest that digital interventions have a more consistent impact on the psychosocial domain than the more complex physical domain.

These results align with an experimental study by Jiang et al. (2024) which found that the use of an artificial intelligence (AI-TA)-based application significantly increased self-efficacy and social support in young breast cancer survivors. Increased self-efficacy was also reported in a study by Kim et al. (2025), where a self-management application (CAMA) demonstrated a significant increase in patients' confidence in managing their health condition and a decrease in anxiety and depression compared to a control group. These findings reinforce the importance of self-efficacy as a mediator in health behavior change. A systematic review by Shi et al. (2023) identified that self-monitoring, reminders, evidence-based education, and interactive support were the most frequently used features in mHealth interventions for breast cancer patients. The study confirmed that apps that provide feedback and two-way interaction tend to be more effective than apps that are solely informative. This is in line with the Social Cognitive Theory which states that increasing the experience of success (mastery experience) and self-control plays a role in behavioral change.

In addition to psychological aspects, several studies also highlight the importance of symptom monitoring through electronic patient-reported outcomes (ePRO). A prospective study by Grasič Kuhar et al. (2025) showed that patients reported almost twice as many types of symptoms via the app as via physician notes in the electronic medical record. This indicates that app-based reporting is able to capture patients' subjective experiences more comprehensively and may aid in early detection of symptoms not identified in routine consultations. However, a study protocol by Hansen et al. (2022) showed that implementing ePROMs in healthcare systems still faces challenges related to system integration, healthcare worker readiness, and the potential for increased clinical workload. These findings suggest that mHealth effectiveness is determined not only by application design but also by the healthcare system's readiness to integrate the technology.

Several studies have also demonstrated the effectiveness of mHealth interventions on specific symptoms. Cahyono et al. (2022) reported that using the Benson relaxation app significantly reduced fatigue levels in breast cancer patients undergoing chemotherapy compared to conventional booklet-based methods. Meanwhile, a cohort study by Lee et al. (2025) showed that a 24-week app-based coaching program effectively reduced weight, BMI, and triglyceride levels in overweight or obese breast cancer survivors. These results suggest that mHealth interventions also have potential in the long-term management of metabolic risk factors.

In the context of digital psychological interventions, a pilot RCT by Zhang et al. (2025) demonstrated that asynchronous, internet-based Acceptance and Commitment Therapy (ACT) significantly reduced psychological distress and anxiety compared to a control group. Qualitative

analysis of the study revealed that flexibility of access and ease of use were important factors in increasing participants' acceptance of the intervention. Although most studies show positive results, there are some methodological limitations that need to be considered. Variations in intervention duration, relatively small sample sizes in some studies, and heterogeneity of application features present challenges in drawing more general conclusions. Shi et al. (2023) highlighted the lack of standardization in mHealth intervention components, making it difficult to directly compare effectiveness across studies.

CONCLUSION

Based on a literature review of 12 articles that met the inclusion criteria, it can be concluded that mobile health (mHealth)-based interventions have significant potential to improve self-management, self-efficacy, and quality of life in breast cancer patients. The majority of studies indicate that the use of digital applications can have a positive impact, especially on psychological aspects, such as reducing distress and anxiety, and increasing patients' confidence in managing their health condition. Effective mHealth interventions generally include self-monitoring, evidence-based education, reminders, and two-way communication or interactive support. These features contribute to strengthening patient self-control and increasing active engagement in the care process. Furthermore, the use of electronic patient-reported outcomes (ePRO) through apps has been shown to increase the sensitivity of symptom reporting compared to conventional clinical documentation. However, the effectiveness of mHealth interventions is still influenced by heterogeneity in application design, variations in intervention duration, and limited sample size in some studies. Furthermore, the integration of app systems with formal healthcare services remains a challenge that requires attention. Therefore, further research with large-scale randomized controlled trial designs, long-term follow-up, and a more standardized approach is needed to ensure the sustainability and clinical effectiveness of mHealth interventions in oncology practice.

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