Unveiling the Potential of Mobile Applications in Breast Cancer Detection: A Systematic Review

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Abstract

Background: Breast cancer is the most common cancer among women, and every female is at risk of developing it. The rates of breast cancer are on the rise, leading to both disability and mortality. Health technology greatly contributes to the prevention and recovery of women who are at risk and affected by breast cancer. Aim: The aim of the study was to the impact utilization of mobile health application for the detection of breast cancer. Methods and Material: the study was women at risk of or with breast cancer, the year used was 2019-2023, and the research design used all types of quantitative research using mobile health application, The language used is English. Results: This study's search results is shown a total of 11 articles. Based on the study that there were all articles regarding health technology related to breast cancer consisting of mobile health applications. Conclusions: Utilization of the use of technology has a positive effect on all women who are at risk of or affected by breast cancer. Data shows that the use of smartphone applications, mobile health application is needed because it can support women to increase self-awareness to routinely check their breasts.

Keywords: breast cancer, detection, mobile health application, utilization, women.

Breast cancer is the most prevalent cancer affecting women globally, constituting a significant portion of all female malignancies (Breen et al., 2021). Over two million new cases of breast cancer are diagnosed annually (Breen et al., 2022). According to studies, breast cancer accounts for roughly 25% of all cancer incidences worldwide, and it is responsible for approximately 15% of cancer-related deaths in women (Y. Wu et al., 2020). An estimated 2.1 million women worldwide are affected by breast cancer annually, resulting in a substantial number of deaths (Vanlalhmangaihsanga et al., 2023).

Factors contributing to breast cancer include genetic factors, accounting for 5-10% of cases, while 80-85% are associated with behavior and endocrine risk factors influenced by cultural, educational, and income variations (Aziz & Zangana, 2020). Risk factors for breast cancer

encompass non-modifiable factors like age, sex, and genetic predisposition, as well as modifiable factors such as reproductive history, hormone replacement therapy, and lifestyle choices (Semiarty et al., 2019). Additionally, factors like mammographic breast density (Lim et al., 2019), hormonal contraception (Huang et al., 2022), and family history (Ye et al., 2019) play significant roles in breast cancer development. Early detection is one strategy for lowering the risk of breast cancer.

Early identification of breast cancer is crucial to improving patient outcomes and lowering mortality rates. Research consistently emphasizes the critical role of early diagnosis in enhancing the chances of recovery and survival for individuals with breast cancer (Shah et al., 2020). Mammography is a widely recognized method for early detection that can lead to a decrease in breast cancer mortality and morbidity (Ittannavar, 2019). Furthermore, modern technologies such as MRI and machine learning approaches have showed promise in supporting early detection efforts to minimize the mortality rate associated with breast cancer (Ahmed, 2020; Rao et al., 2019). In addition to these methods, breast cancer detection methods can use mobile applications.

The SDG's 2023 agenda highlights the spread of information, communication, and global interconnection technology that has great potential to accelerate progress toward achieving SDGs in the health sector (SDG, 2023). Digital transformations in the healthcare sector, such as virtualised care, blockchain, Artificial Intelligence (AI), and mobile applications, play an important role in improving various aspects of medical services. These technologies are used to improve medical diagnostics, data-driven treatments, digital therapies, as well as the efficiency of clinical trials. In addition, technology enables better self-care management for patients, and encourages person-centred care by customising healthcare services to each person's unique needs (WHO, 2021). The rapid advancement of digital health technologies, including mobile applications and artificial intelligence, has paved the way for transformative changes in healthcare delivery (Landers, 2024).

The development of technology in the health sector shows many innovations such as mobile applications for breast cancer detection. This mobile application offers personalized rehabilitation, support during chemotherapy, and aid in managing treatment-related symptoms (F. O. de A. M. da Cruz et al., 2021). According to studies, mobile health applications for women with breast cancer are well-received and can improve patient well-being by offering essential information and support (Rezaee et al., 2022). However, there has been no research that synthesizes information about the impact utilization of mobile-health application for the detection of breast cancer.

The current state of mobile health (mHealth) applications designed for breast cancer detection reflects a growing trend towards integrating technology into healthcare. One significant development in mHealth for breast cancer detection is the introduction of applications that automate and enhance diagnostic processes. For instance, the SmartIHC-Analyzer app automates the scoring of Ki-67, a protein associated with cell proliferation in cancer, thereby improving the accuracy of assessments during cancer progression (Houghton et al., 2019). Similarly, the Pixel Picker app has been designed to facilitate the rapid detection of breast cancer cells, showcasing the potential of mobile technology to streamline diagnostic procedures (Houghton et al., 2019). These innovations highlight the role of mHealth in not only improving detection rates but also in enhancing the efficiency of existing diagnostic methods. Furthermore, the integration of artificial intelligence (AI) into mHealth applications is emerging as a promising avenue for enhancing breast cancer detection. For instance, AI-driven mobile applications utilizing convolutional neural networks (CNNs) have shown potential in automating the analysis of MRI images for breast

cancer detection, thereby improving diagnostic accuracy and accessibility (Hamis & Bhalalusesa, 2022).

Multiple studies have shown that mHealth interventions can greatly impact women's knowledge, attitudes, and behaviors related to breast cancer screening, thereby facilitating earlier detection. One of the primary ways mHealth applications improve early detection is through education and awareness. Studies suggest that mobile interventions can successfully enhance awareness of breast cancer and the significance of screening. For instance, a randomized controlled trial demonstrated that mobile text messaging significantly improved women's knowledge about breast self-examination (BSE) and increased their self-efficacy in performing these examinations (Labrague et al., 2020). This educational component is crucial, as increased awareness directly correlates with higher screening rates, which are essential for early detection (Nayyar et al., 2023). Furthermore, mobile mammography programs have shown promising results in increasing screening rates among populations that are often underserved. A study analyzing a mobile mammography initiative in New York City reported that the program successfully engaged over 32,000 women, leading to a notable increase in screening uptake (Van Bruele et al., 2022).

The key features and functionalities of effective mHealth applications for breast cancer detection are enhancing user engagement, improving health outcomes, and facilitating early detection by integrating several key features. A user-friendly interface is critical, particularly for older adults, as seen in the BENECA application (Altmannshofer, 2024a; Lozano-Lozano et al., 2019). Comprehensive educational resources, such as those offered by Mammopad, empower patients by enhancing understanding of breast cancer and its management (Schliemann et al., 2022; Zhu, Ebert, Liu, et al., 2018). Symptom tracking and monitoring functionalities enable early detection and timely communication with healthcare providers, improving outcomes (F. O. de Cruz et al., 2019; W. Wu, 2024). Reminders and alerts promote adherence to screenings and treatment regimens (Vergani et al., 2019; W. Wu, 2024), while community support features provide emotional assistance and reduce isolation (Zhu, Ebert, Guo, et al., 2018; Zhu, Ebert, Liu, et al., 2018). Integration with healthcare providers ensures real-time data sharing for personalized care (Lu et al., 2021), and personalization enhances user engagement and satisfaction, improving health outcomes (Lim et al., 2023).

The adoption of mHealth applications for breast cancer detection faces challenges in technical, individual, and systemic areas. Technical barriers, such as poor internet connectivity and device compatibility, hinder usability (Alanzi, 2022; Zakerabasali et al., 2021). Individual barriers include low digital literacy and privacy concerns, especially among older adults or those with limited tech skills (Alanzi, 2022; Hengst, 2023). Healthcare system issues, like inadequate integration and lack of reimbursement models, further limit adoption (Jongerius et al., 2019; Subramanian et al., 2021). Socioeconomic factors restrict access for lower-income individuals, while cultural resistance also affects adoption (Quintiliani et al., 2016; Schliemann et al., 2022). Additionally, sustaining user engagement and overcoming the issue of "Pilotitis," where projects fail to scale up, are key challenges (Baseman et al., 2017; Lee et al., 2017).

This systematic review aims to thoroughly assess the available evidence on the effects of adopting mHealth apps for breast cancer screening. This review aims to discover the type of mhealth apps for the detection of breast cancer, the use of mhealth apps for the prevention and improvement of breast cancer conditions, the key features and functionalities of effective mHealth apps for breast cancer detection, and the barriers and difficulties associated with the adoption and use of mobile health applications. Exploring these topics will

provide valuable insights into the efficacy of mobile health applications in breast cancer screening, identify information gaps, and drive future interventions and policy.

METHODS AND MATERIALS

Data Sources

This study employed a systematic review approach, sourcing articles from scientific databases including Scopus, PubMed Central, PubMed, and ClinicalKey Nursing, published between 2019 and 2023. The analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021).

Search Strategy

The search equations used were "Mobile-health Application OR Mobile-phone OR OR e-Health OR Health Technology AND Early Detection OR SCREENING AND Cancer Breast Self- Examination OR Breast Cancer OR Breast Neoplasma". PICO is used to search populations, interventions, comparisons, and outcomes.

Selection of Studies

The inclusion criteria of the study were women at risk of or with breast cancer, the year used was 2019-2023, and the research design used all types of quantitative research using one of the technologies such as smartphone apps, mammography, or other information technology, English, journal of research or regarding of the technology for breast cancer. The study excluded certain criteria and selected relevant papers based on their titles and abstracts, which were meticulously reviewed by three experts. Table 1 presents the selection of the relevant papers.

RESULTS

Type of Studies

The eligible articles for this study searches resulted are shown a total of 238 articles. After going through a selection process based on titles and abstracts, the researchers found 7 duplicate articles. Articles were removed from the 231 selected articles, then selected to produce 21 articles, and finally get 11 articles. Furthermore, the researcher reread the full text of the articles. The article has found five that did not meet the criteria. The reason for the article being excluded is because it describes not only breast cancer but colorectal cancer, does not suit the person, and is related to complications of other diseases that are not only breast cancer.

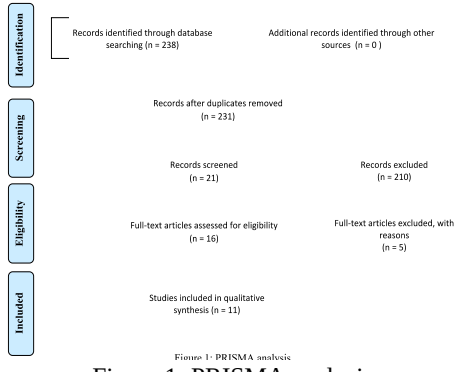

Figure 1: PRISMA analysis

Author, Year, Title, DOI, Publisher	Study Design	Sample	Aim	Results	Conclusions
(Błajda et al., 2022) Poland. "Application of Personalized Education in the Mobile Medical App for Breast Self-Examination." https://doi.org/10.3390/ijerph19084482 Scopus	A Quasi-experimental study	A total of 500 women were randomly assigned to two groups: Group I, consisting of 250 participants in the study group, and Group II, which included 250 control participants.	The study aims to evaluate the effectiveness of personalized education delivered through algorithms in a mobile medical app for smartphones running on the Android system, which provides Internet access for breast self-examination.	It was determined that the areas of the breast marked in both test groups were exclusively influenced by the women's knowledge of breast cancer.	mobile medical apps are essential to enhance these apps' capabilities for breast self-examination by incorporating features that assess the skills required for the three-stage compression of the examined breast.
(Shakery et al., 2021). Iran "The effect of a smartphone application on women's	A Quasi-experimental study	150 women referring to therapeutic clinics	To investigate the influence of a smartphone app on women's performance and health beliefs about BSE.	Following the intervention, the intervention group showed significantly	Access to the smartphone application improved participants' performance and health beliefs related to

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performance and health beliefs about breast self-examination: a quasi-experimental study." https://doi.org/10.1186/s2911-021-01609-4 PubMed Central				higher levels of perceived susceptibility, self-efficacy regarding Breast Self-Examination (BSE), and health motivation compared to the control group. However, there was no significant difference between the two groups in terms of perceived severity and BSE benefits.	Breast Self-Examination (BSE), particularly in the areas of perceived susceptibility, self-efficacy, and health motivation.
(Johnson et al., 2021). "The New Normal? Patient Satisfaction and Usability of Telemedicine in Breast Cancer Care" https://doi.org/10.1245/s10434-021-10448-6 PubMed Central	A cross-sectional study	203 adults who had a telemedicine visit at a single academic institution	To measure patient satisfaction and telemedicine usability in breast cancer care.	Patient satisfaction using telemedicine.	Breast cancer patients expressed satisfaction with telemedicine and considered it user-friendly. The satisfaction of patients and the usability of telemedicine should encourage its continued use in post-pandemic breast cancer care.
(Baik et al., 2020). United States. "Patterns of Use of Smartphone-Based Interventions Among Latina Breast Cancer Survivors: Secondary Analysis of a Pilot Randomized Controlled Trial" http://dx.doi.org/10.2196/17538 PubMed	A Quasi-experimental study	80 women	Our study sought to evaluate how Latina breast cancer survivors used the My Guide intervention app and the My Health attention-control app.	Latina breast cancer survivors utilized the smartphone app, My Health. Participants accessed links or webpages related to the study within the app, focusing on areas such as Diet and Nutrition, as well as exercise for preventing diabetes and heart disease.	Latina breast cancer survivors utilized the smartphone app, My Health. Participants accessed links or webpages related to the study within the app, focusing on areas such as Diet and Nutrition, as well as exercise for preventing diabetes and heart disease.
(Buscemi et al., 2020). USA. "My Health Smartphone Intervention Decreases Daily Fat Sources among Latina Breast Cancer Survivors." doi:10.1007/s10865-020-00136-3 PubMed	A Quasi-experimental study	80 women	to compare the effects of two smartphone-delivered programs, My Health, which targeted food and physical activity, and My Guide, which focused on psychosocial functioning, on nutritional and physical activity outcomes.	There was a significant interaction between time and condition in terms of daily fat sources and servings of fruits and vegetables. There was no interaction found between time and condition for walking, moderate physical activity, sitting, vigorous physical activity, or physical activity categorization.	These initial findings indicate that eHealth interventions designed to enhance lifestyle factors could positively affect nutritional intake and physical activity.
(Çınar et al., 2021). Turkey. "Effect of mobile phone app-based training on the quality of life for women with breast cancer." https://doi.org/10.1016/j.ejon.2021.101960 ClinicalKey Nursing	A randomized pre-posttest design	64 Women with breast cancer.	The study sought to determine the influence of a mobile phone app-based training program on the QoL of women with breast cancer receiving adjuvant endocrine hormone therapy for supportive care.	The treatment group's quality of life (QoL) increased following the intervention, and their level of distress was lower than the control group, with these results being statistically significant. Most patients reported that the mobile application was "informative and useful."	The smartphone app is a useful tool for providing supportive care to women with breast cancer.
Arryana Nasution, Azlina Yusuf, Segera Lean Keng, Nur Syahmina Rasudin, Yulita Hanum PIskandar, Imi Sairi Ab Hadi. (2021). Malaysia "Mobile App Development for Breast Examination Awareness Using Health Confidence Model: A Qualitative Study."	The qualitative approach uses semi-structuredin-depth interviews	37 women	to determine the necessary elements for creating mobile applications that raise awareness about breast screening, using components of the Health Belief Model (HBM) for integration into health promotion strategies.	The analysis revealed themes such as vulnerability, forecasting, reactiveness, influence, outcomes, and barriers. The findings included sub-themes that align with Health Belief	The research findings could inform future app development by public health professionals, content creators, and software experts. This information will be utilized to create a mobile app focused on breast exam

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https://doi.org/10.1016/j.ejon.2021.101960 PMC				Model (HBM) components, highlighting requirements such as infographics on risk factors, videos covering symptoms and self-examination, and information related to metastasis, survival, and screening.	awareness that incorporates health theory.
Adhikari, B., Marasini, A., Mohebtash, M., & Farha, M. J. (2023). "Implementation of a secure mobile application to improve care of patients with breast cancer: Experience from a medically underserved area." https://doi.org/10.1200/JCO.2023.41.16_suppl.e18701 ascopubs.org.	The study used a feasibility pilot approach, providing a HIPAA-compliant mobile application to newly diagnosed breast cancer patients and gathering qualitative data via surveys.	The sample consisted of 26 newly diagnosed breast cancer patients, with 25 consenting to use the mobile application.	The study aimed to evaluate the feasibility of utilizing a secure mobile application, MyCureTeam, to enhance communication and care coordination for breast cancer patients in a medically underserved region.	Results showed that 94% of patients found the app easy to use, 75% preferred it over patient portals, and 96% adoption was noted in a largely elderly, African-American population.	The study concluded that a mobile application is feasible for enhancing communication and support in breast cancer care, particularly in underserved populations.
Ahmadi, M., Shahrokhi, S. N., (2022). "Development of a mobile-based self-care application for patients with breast cancer-related lymphedema in Iran." https://doi.org/10.1055/s-0042-1757295 Applied Clinical Informatics	The study employed a two-stage design: first, a needs assessment and content development phase, followed by the design and usability evaluation of the mobile application among patients	The study involved 30 patients with breast cancer-related lymphedema (BCRL) and 30 experts, including healthcare professionals such as surgeons, oncologists, and physiotherapists	The aims of the study were to develop a mobile-based self-care application for patients with BCRL in Iran, focusing on enhancing self-management, providing necessary information, and improving the overall quality of life for these patients	The results indicated that the mobile application was effective in improving patients' self-management of lymphedema symptoms, with high usability scores and positive feedback from users regarding its features and functionality	The study concluded that the mobile-based self-care application is a valuable tool for managing breast cancer-related lymphedema, enhancing patient self-care and quality of life
Alabdullatif, N., Arrieta, A., Dlugasch, L., & Hu, N. (2022). "The Impact of IT-Based Healthcare Communication on Mammography Screening Utilization Among Women in the United States: National Health Interview Survey (2011–2018)." https://doi.org/10.3390/ijerph191912737 In International Journal of Environmental Research and Public Health.	The study employed a cross-sectional design using multiple logistic regression models to analyze data from the National Health Interview Survey (NHIS).	The study utilized data from NHIS spanning 2011 to 2018	The study aimed to investigate the effect of IT-based healthcare communication on mammography screening utilization among women in the United States and to identify the factors that influence this relationship.	The study revealed significantly enhanced mammography utilization among women aged 40 and older, with particularly notable benefits for White women and those aged 50 and above.	The study concluded that emphasizing the importance of enhancing access and education for women aged 40 and older.
Altmannshofer, S. (2024). "A Content-Based Review of Mobile Health Applications for Breast Cancer Prevention and Education: Characteristics, Quality and Functionality Analysis." https://doi.org/10.1177/20552076241234627 Digital Health	The study employed a systematic search and evaluation of mobile health apps for breast cancer prevention, using the Mobile Application Rating Scale (MARS) for quality assessment	The study found 19 apps in the Google Play Store and 7 in the Apple App Store that matched the inclusion criteria for breast cancer prevention and education.	The aims of the study were to analyze and review mHealth apps focused on breast cancer prevention and education, assessing their characteristics, quality, and functionality available on the German Google Play and Apple App Store	The review found that most apps provided features like tutorials for breast self-examination and reminders, but many scored just above the minimum acceptability level on the MARS scale, indicating a need for improvement in quality and trustworthiness	The study concluded that most breast cancer prevention apps lack comprehensive, trustworthy information and personalization, highlighting the need for improved quality and healthcare professional involvement in their development
Baek, S. Y. (2022). "Effects of Mobile Healthcare Applications on the Lifestyle of Patients With Breast Cancer: A Protocol for a Randomized Clinical Trial." https://doi.org/10.4048/jbc.2022.25.e42 Journal of Breast Cancer, 25(5), 425–435.	The study design is a randomized controlled trial with four groups: three intervention groups using different mobile health apps and one control group	The study will include a total of 320 participants, with 80 participants in each of the four groups being tested	The objectives of the study are to assess the effects of mobile healthcare applications on health-related quality of life (HRQOL), physical activity, and metabolic health outcomes in breast cancer patients, and to perform a cost-utility	The results will compare health-related quality of life, body measurements, distress levels, side effects of therapy, and metabolic health outcomes between the intervention and control groups at 6 and 12 months	The conclusions of this study demonstrate the potential of mobile health applications in improving the quality of life of breast cancer patients.

Author, Year, Title, DOI, Publisher	Study Design	Sample	Aim	Results	Conclusions
			analysis of the interventions.		
Benjumea, J. (2019). "Privacy in mobile health applications for breast cancer patients." https://doi.org/10.1109/CBMS.2019.00131 Proceedings - IEEE Symposium on Computer-Based Medical Systems, 2019, 634–639.	The study employed a privacy assessment scale based on GDPR items to evaluate the privacy policies of selected mHealth applications for breast cancer self-management	The study analyzed a sample of 8 mobile health applications for breast cancer patients	The objectives of the study are to examine the privacy policies of mobile health applications for breast cancer patients and evaluate their adherence to the General Data Protection Regulation (GDPR) to ensure the safeguarding of sensitive personal data.	The results showed low GDPR compliance among the analyzed apps, with only 3 out of 7 scoring 50% or higher on privacy policy assessments	The study found a notable deficiency in GDPR compliance among breast cancer mHealth applications, underscoring the necessity for developers to enhance privacy practices.
Blinder, V. S., Patil, S., Finik, J., Makower, D., Muppidi, M. R., Lichtenthal, W. G., Parker, P. A., Claros, M., Suarez, J., Narang, B., & Gany, F. (2022). "An Interactive Mobile Application Versus an Educational Booklet to Promote Job Retention in Women Undergoing Adjuvant Chemotherapy for Breast Cancer: A Randomized Controlled Trial." https://doi.org/10.1186/s13063-022-06580-7 BMC – Trials	The study design is a multicenter, randomized controlled trial comparing a mobile app to an informational booklet	The study samples consist of English- and Spanish-speaking women who were employed before their diagnosis and are currently receiving or planning to receive adjuvant chemotherapy for breast cancer.	The study aims to refine the TEAMWork app, evaluate its impact on job retention, assess confidence in requesting accommodations, and measure communication efficacy with healthcare providers	The results will assess job retention rates, confidence in requesting accommodations, communication efficacy with providers, and self-reported symptom burden among participants using the app compared to those receiving the booklet	The mobile app is expected to enhance job retention and support for women undergoing chemotherapy compared to the educational booklet
Choi, J. H., Park, S. J., Kwon, H., (2020). "Application and evaluation of mobile nutrition management service for breast cancer patients." https://synapse.koreamed.org/articles/1143043 Journal of Nutrition and Health	The study employed a randomized controlled trial design, with participants assigned to either a treatment group using a mobile nutrition app or a control group maintaining their usual lifestyle.	The study included 50 breast cancer survivors aged 30 years and older.	The aim of the study was to evaluate the effectiveness of a mobile nutrition management service for breast cancer patients, focusing on improving their dietary habits and nutritional status.	The treatment group experienced a significant decrease in waist-hip ratio and an increase in Nutrition Quotients, while the control group showed a decrease in Nutrition Quotients. Weight change was not significant.	The mobile nutrition management application effectively improved dietary habits and obesity management in breast cancer patients.
Dewi, I., Widianti, A. T., Fatmawati, A., Wulandari, S., & ... (2023). "The predictors need for complementary interventions using mobile application technology in women with breast cancer." https://e-journal.unair.ac.id/JNERS/article/download/45799/25431 Jurnal Ners	The researchers employed a cross-sectional survey approach to investigate determinants of the need for mobile-app supplemental therapies among women with breast cancer.	The study included 112 women with breast cancer, selected through simple random sampling from a population of 1,433 at a teaching hospital in Bandung, Indonesia	The study aimed to examine the need for mobile-app supplemental therapies in Indonesian women with breast cancer and identify critical factors influencing this requirement.	The study identified key factors influencing the need for mobile-app complementary interventions, highlighting significant psycho-social stress and limited use of such technologies among breast cancer patients	The research concluded that an effective mobile-app-based supplementary intervention paradigm should be established, focusing on psychosocial and spiritual well-being to improve the quality of life for women with breast cancer
Goldzahl, L. (2020). "Health Information Provision, Health Knowledge and Health Behaviours: Evidence From Breast Cancer Screening." https://doi.org/10.1016/j.socscimed.2020.113505 In Social Science & Medicine.	The study uses a difference-in-differences design to investigate the effect of structured breast cancer screening programs on health knowledge and mammography use.	The study uses data from 10,610 European women collected in the Eurobarometer survey during 1997/1998.	The objectives of the study are to explore the causal effect of health information provision on health knowledge and to examine how changes in health knowledge influence breast cancer screening behaviors, particularly focusing on variations by educational attainment.	The results indicate that higher health knowledge is associated with increased participation in breast cancer screening, with significant variations observed based on educational levels.	The study concludes that while health information provision improves knowledge, it has minimal impact on changing health behaviors, particularly mammography utilization.
Liang, X., You, M., Wen, C., Hou, F., Kang, J., Lv, Z., & Tian, J. (2022). "Self-administration of complex decongestive therapy facilitated	The study employed a two-phase design: a 5-day intensive CDT therapy followed	The study recruited 88 patients with breast cancer-related lymphedema (BCRL), of which 61 completed	The study aimed to assess the effectiveness of self-administered complex decongestive therapy (CDT) supported by the	The results showed a significant reduction in excess arm volume (EAV) and improvement in lymphatic symptoms	The self-administered CDT model via WeChat significantly improved arm volume, lymphedema symptoms, and quality of

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by the mobile application WeChat improves lymphedema and quality of life in breast cancer survivors: an observational study." https://doi.org/10.21037/atm-21-6662 Annuals of Translational Medicine, 10(3), 146.	by 3 weeks of self-administration with online instructions, and a lifelong maintenance phase with weekly online support	the protocols and were analyzed	WeChat application in enhancing symptoms and quality of life for patients with BCRL.	and quality of life after treatment, with EAV decreasing by 50.90% after 3 months	life in patients
Munoz-Zuluaga, C., Sardi, A., Orozco-Urdaneta, M., & ... (2018). "Amate: A mobile application to improve access to early breast and cervical cancer detection." https://doi.org/10.1200/JGO.18.10290 ascopubs.org.	The study involved advertising the Amate app in a healthcare facility, using educational and risk assessment questions to engage women and identify those needing screening	A total of 4,553 women were contacted, with 830 downloading the Amate app and 131 identified as at risk for breast and/or cervical cancer	The purpose of the Amate app is to educate women about breast and cervical cancer while directing them to national screening programs, thereby enhancing early detection and access to care.	24% of at-risk patients successfully completed their recommended screening tests, and barriers to enrollment included limited appointments and health care coverage issues	Amate is a low-cost tool that identifies at-risk women and highlights barriers to early cancer detection, with potential benefits for underserved populations
Öztürk, E. S., & Kutlutürkan, S. (2021). "The Effect of the Mobile Application-Based Symptom Monitoring Process on the Symptom Control and Quality of Life in Breast Cancer Patients." https://doi.org/10.1016/j.soncn.2021.151161 Seminars in Oncology Nursing, 37(3), 151161.	The study was structured as a single-center, randomized controlled trial involving two parallel groups.	The study comprised 70 breast cancer patients.	The study sought to determine the effect of a mobile app-based symptom monitoring system on symptom management and QoL in breast cancer patients receiving chemotherapy.	The results indicated that the mobile apps for symptom monitoring did not significantly improve symptom control, as the intervention group's symptom scores were not statistically different from the control group's scores	The study concluded that the mobile app-based symptom monitoring process was not effective in improving symptom control in breast cancer patients
Rezaee, R., Asadi, S., Yazdani, A., Rezvani, A., & Mani, A. (2022). "Development, Usability and Quality Evaluation of the Resilient Mobile Application for Women With Breast Cancer." https://doi.org/10.1002/hsr2.708 Health Science Reports.	The study employed a development-applied design conducted in four phases, including requirement extraction, app development, usability valuation, and statistical analysis of demographic impacts	The samples consisted of women with breast cancer who were invited to participate from Motahari and Amir Oncology hospitals in Shiraz, using convenience sampling	The study sought to develop and assess a mobile app designed to measure and enhance resilience in women with breast cancer, emphasizing usability and user satisfaction among various demographic groups.	The results indicated high usability and learnability of the mobile app, with 84% of participants expressing a desire to use it frequently and 88% finding it easy to use	The conclusion highlighted that the m-Health app is suitable for all age groups and education levels, demonstrating high usability and user satisfaction among breast cancer patients
Richardson, D., Zhan, L., Mahtani, R., McRoy, L., (2021) "A prospective observational study of patient-reported functioning and quality of life in advanced and metastatic breast cancer utilizing a novel mobile application" https://doi.org/10.1007/s10549-020-06082-7 Breast Cancer Research	The study utilized a prospective observational design, collecting patient-reported outcomes via a mobile application throughout treatment cycles.	The study involved women with hormone receptor-positive, human epidermal growth factor receptor 2-negative advanced or metastatic breast cancer who were receiving combination therapy with palbociclib.	The objectives of the study were to evaluate patient-reported functioning and QoL in individuals with advanced and metastatic breast cancer through the use of a new mobile app.	Patients consistently reported low levels of pain and fatigue, stable overall health, and a good QoL during the first six months of treatment, despite experiencing episodes of neutropenia.	Palbociclib-treated patients experienced low pain and fatigue levels, stable quality of life, and neutropenia did not impact their quality of life.
Romero-Ayuso, D., García-López, R., (2023). "Usability of a mobile phone application to enhance activities of daily living in occupational therapy services for breast cancer survivors." https://doi.org/10.1177/15691861231206489 Hong Kong Journal	The study utilized a cross-sectional usability design, employing an online questionnaire to gather data on participants' experiences with the MAIA app	The sample consisted of 29 women diagnosed with breast cancer, recruited from two associations in Spain	The study aimed to develop the MAIA app to assist breast cancer survivors in enhancing their occupational performance and improving their quality of life through personalized monitoring and communication with therapists.	The study found that breast cancer survivors experienced difficulties in daily life performance, with the MAIA app showing potential as a useful resource in occupational therapy for rehabilitation	The MAIA app effectively addresses the occupational needs of breast cancer survivors, enhancing their daily living activities and supporting rehabilitation efforts
Seo, S. J., Nho, J. H., & Park, Y. (2021). "The development of a lifestyle modification mobile application,	The study utilized a methodological design to develop and assess the	The study involved 20 breast cancer survivors recruited from a breast cancer outpatient clinic	The aims of the mobile application "Health for You" are to support lifestyle modifications for	The results indicated that most participants were unaware of lifestyle education and	The developed mobile application demonstrated satisfactory usability and can effectively support

Author, Year, Title, DOI, Publisher	Study Design	Sample	Aim	Results	Conclusions
"Health for You" for overweight and obese breast cancer survivors in Korea." https://synapse.koreamed.org/articles/1147794 Korean Journal of Women Health	usability of a mobile application for lifestyle modification aimed at overweight and obese breast cancer survivors, adhering to the ADDIE model.	in Jeonju, Korea.	overweight and obese breast cancer survivors by promoting healthy behaviors, enhancing physical activity, and improving dietary habits.	expressed a strong desire for mobile application-based education on lifestyle modifications, with high interest in using the app for support.	lifestyle modifications for overweight and obese breast cancer survivors.
Tsangaris, E., Edelen, M., Means, J., Gregorowitsch, M., O'Gorman, J., Pattanaik, R., Dominici, L., Hassett, M., Witkowski, M. L., Schrieber, K., Frank, E., Carnie, M., & Pusic, A. (2022). "User-centered design and agile development of a novel mobile health application and clinician dashboard to support the collection and reporting of patient-reported outcomes for breast cancer care." https://doi.org/10.1136/bmjsit-2021-000119 BMJ Surgery, Interventions, & Health Technologies, 4(1).	The study employed a user-centered design (UCD) approach combined with agile development (AD) to iteratively develop and refine the mobile health application and clinician dashboard based on stakeholder feedback	The study involved a clinical sample of 28 breast cancer patients for qualitative interviews and two focus groups with 17 members of the DF/HCC Breast Cancer Advisory Group	The study aimed to create a user-centered mobile health application and clinician dashboard to facilitate the collection and reporting of patient-reported outcomes (PRO) in breast cancer care, thereby enhancing patient engagement and improving the delivery of care.	The results indicated a strong preference among participants for features such as inspirational quotes, easy-to-interpret graphs for tracking recovery, tailored feedback on PRO scores, and access to trusted educational resources and support networks	The study concluded that a user-centered mobile health application and clinician dashboard can effectively support breast cancer care by addressing patient needs and enhancing communication among care providers
Uddin, K. M. M., Biswas, N., Rikta, S. T., & ... (2023). "XML-LightGBMDroid: A self-driven interactive mobile application utilizing explainable machine learning for breast cancer diagnosis." https://doi.org/10.1002/eng2.12666 Engineering Reports	The study employed an experimental design that involved data preparation, application of various machine learning algorithms, and the development of a mobile app for breast cancer prediction	The study utilized a dataset comprising 780 breast ultrasound images from 600 female patients.	The aims of the research are to develop an interactive mobile application that utilizes explainable machine learning to enhance the accuracy and transparency of breast cancer diagnosis	The best model achieved an accuracy of 99% using LightGBM after various machine learning techniques were applied	The study concluded that explainable machine learning can improve breast cancer diagnosis accuracy and user trust, while highlighting the need for further research to enhance model reliability and applicability
Wright, A. (2021). "Evaluation of two mobile health apps for patients with breast cancer using the Mobile Application Rating Scale." https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8572758/ Mhealth	The study employed a qualitative evaluation using the Mobile Application Rating Scale (MARS) to assess two mobile health apps for breast cancer patients.	The study evaluated two mobile health apps, Becca and OWise, as samples for assessing their functionality and user experience for breast cancer patients.	The aims of the study are to evaluate two mobile health apps, Becca and OWise, for their effectiveness in meeting the informational needs of breast cancer patients during and after treatment, using the MARS framework.	Both apps received high ratings on the MARS, with Becca excelling in accessibility and OWise in functionality, but both lacked sufficient clinical evidence and had data privacy concerns.	Both Becca and OWise effectively, but require more clinical evidence and improved data privacy measures.

DISCUSSION

The Type of Mobile Health Application for the Detection of Breast Cancer

Based on the study, there were all articles regarding health technology related to breast cancer consist of mobile medical application or smartphone that supports the Android system with internet access for Breast Self-Examination (BSE) of women, IT-based healthcare communication, platforms, Facebook (FB), Instagram, email, telemedicine and mammography screening, implementation of the Tai Chi program combined with FB and telemedicine. One articled stated that the use of the Cancer Screening Algorithm (BCA) is carried out before mammogram screening for women with breast cancer (Alabdullatif et al.,

2022; Błajda et al., 2022; Buscemi et al., 2020; Gao et al., 2022). Six articles stated smartphones and the internet, and three articles in this study described smartphones and the internet.

Mobile applications have become valuable tools in the field of breast cancer detection and management. These applications address various aspects of breast cancer care, including symptom management, lifestyle adjustments, and early detection. For example, the "Manage My Surgery (MMS)" app was created to support patients undergoing elective breast cancer surgery by offering planning, outcomes, and analytics-based assistance (Ponder et al., 2021). Similarly, the "MAIA" app was developed to improve daily activities for breast cancer survivors based on their perceived needs (Romero-Ayuso et al., 2023). These applications highlight the significance of tailored support and empowerment for individuals navigating breast cancer treatment and recovery.

Moreover, mobile applications have played a crucial role in monitoring symptoms and promoting self-management among breast cancer patients. Research has shown that mobile application-based interventions can positively impact symptom control, quality of life, and chemotherapy-related symptoms in these patients (Buscemi et al., 2020; Öztürk & Kutlutürkan, 2021; Shi et al., 2023). These apps not only help in symptom tracking but also enhance overall well-being and treatment experiences. By utilizing mobile technology, healthcare providers can deliver more personalized and effective care to individuals undergoing breast cancer treatment.

Additionally, mobile applications contribute to mental health and well-being among breast cancer patients. Psychological mobile health interventions have been recognized as beneficial for enhancing the mental health of breast cancer survivors during follow-up care (Horn, 2023). These interventions offer comprehensive care by addressing emotional and psychological aspects, ultimately improving patients' quality of life. By incorporating mental health assistance into mobile apps, healthcare professionals can satisfy the different requirements of breast cancer patients beyond physical symptoms. Furthermore, mobile applications support lifestyle modifications and healthy behaviors in breast cancer survivors. For instance, the "My Health" app aims to encourage healthy lifestyle behaviors among Latina breast cancer survivors to enhance their quality of life and reduce symptom burden (Baik et al., 2020). Similarly, the "Health for You" app targets overweight breast cancer survivors in Korea, focusing on lifestyle changes to improve well-being (Seo et al., 2021). These applications emphasize the importance of holistic care that considers not only medical treatment but also lifestyle factors affecting patients' health outcomes.

Moreover, mobile applications are utilized for patient education, awareness, and self-care practices in breast cancer contexts. The "BECA" app, for example, focuses on breast examination for cancer awareness to educate users on self-examination practices and early detection strategies (Adiyasa, 2023). Additionally, mobile apps have been instrumental in improving access to early breast cancer detection in underserved communities, highlighting technology's role in enhancing screening and care coordination (C. A. Munoz-Zuluaga, 2021). In addition, there is a mobile application "Amate" that can be used to increase access to early detection of breast cancer and cervical cancer (C. Munoz-Zuluaga et al., 2018). By empowering patients with knowledge and resources, these applications promote proactive health management and early intervention in breast cancer care.

Another application developed using machine learning for breast cancer diagnosis is an interactive mobile application called XML-LightGBMDroid (Uddin et al., 2023). The app is designed to improve understanding of cancer and aid in treatment selection and diagnosis. This application can also help with the early detection and diagnosis of breast cancer. In addition, the application developed by (Adhikari et al., 2023) is a safe mobile apps to improve the treatment of

patients with breast cancer. The app enables patients to contact with their healthcare providers, monitor tumor profiles, and schedule appointments and treatments. This shows that mobile applications can be an effective tool in facilitating communication between patients and healthcare providers, as well as monitoring the development of the disease.

In addition, the application developed by (Seven et al., 2022) is also worth highlighting. They developed a mobile app for symptom management in breast cancer patients. This app is designed to help patients prevent and manage their own symptoms.

In conclusion, mobile applications have transformed breast cancer care by offering innovative solutions for symptom management, mental health support, lifestyle modifications, patient education, and early detection. These apps empower patients, improve their quality of life, and enhance treatment outcomes. By leveraging mobile technology, healthcare providers can provide personalized, accessible, and comprehensive care to individuals affected by breast cancer. The evolving role of mobile applications in breast cancer care demonstrates technology's potential to optimize the patient experience in oncology settings.

Utilization of Mobile Health Application for Prevention and Improvement of Conditions from Breast Cancer

Based on this study found six articles utilization of health technology for mental health programs by application but not physical health and stress; scheduled medical appointments online, and ten percent engaging with a healthcare professional via email (Alabdullatif et al., 2022; Gao et al., 2022). BSE barriers, self-efficacy, and health motivation (Shakery et al., 2021).

Quality of Life is a smartphone app that provides patients with breast cancer education, a symptom diary, and lifestyle suggestions, Web-based management application reveals that the treatment increased, useful information, and the distress level was lower (Çınar et al., 2021). One article describes the physical and emotional symptoms of breast cancer survivors, as well as recommendations for nutrition and physical activity by My Guide (Baik, et al 2021). One article described telemedicine in Breast Cancer Care's influence on satisfaction and usability (Johnson et al., 2021).

There are two articles that discovered abnormal signs in the breast, where the applications can be useful in solving the public health problem related to breast cancer, and the effectiveness of Breast Self-Examination (Błajda et al., 2022). Breast cancer is a significant public health issue that can be addressed through educational mobile medical apps. It is also vital to broaden the possibilities of medical applications for BSE by validating elements of the investigated breast's three-stage compression skill (Błajda et al., 2022). Besides that, after the intervention had found that the performance of BSE and abnormal findings were related to the palpable breast mass and nipple retraction (Shakery et al., 2021).

Two articles were found in this study about the effect of age on information technology and mammography utilization for women who use health technology the most at the age of 40 years or more. The prevalence of mammography screening among women aged 50 and up versus those aged 40 to 49. Older women aged 50 years and above benefited more from all strategies (Alabdullatif et al., 2022). Women below the screening age were found to have significantly lower levels of breast cancer (Błajda et al., 2022). Except for work status in the My Health group, there were no significant sociodemographic or psychological factors associated with app use (Baik et al., 2020).

The development of technology in the health sector shows many various computer systems and applications that are used by the public for early detection of breast cancer such as BSE and treatment of breast cancer patients. Based on the study that there were all articles regarding health technology related to breast cancer consist of mobile medical application or smartphone that

supports the Android system with internet access for Breast Self- Examination (BSE) of women, IT-based healthcare communication, platforms, Facebook (FB), Instagram, email, telemedicine and mammography screening, implementation of the Tai Chi program combined with FB. Telemedicine. One of 11 articles stated that the use of the Cancer Screening Algorithm (BCA) is carried out before mammogram screening for women with breast cancer. (Alabdullatif et al., 2022; Błajda et al., 2022; Gao et al., 2022). Six of 11 in this study were about smartphones and the internet, 3 out of 11 in this study described smartphones and the internet.

The utilization of health technology for mental health programs by application but not for physical health and stress; planned medical appointments on the internet; and ten percent speaking with a healthcare professional via email (Alabdullatif et al., 2022; Gao et al., 2022).

One article described telemedicine in Breast Cancer Care's influence on satisfaction and usability (Johnson et al., 2021). There are two articles that discovered abnormal signs in the breast, where the applications can be useful in solving the public health problem related to breast cancer, and the effectiveness of Breast Self-Examination (Błajda et al., 2022). Educational mobile medical apps for breast cancer prevention can aid in the fight against this serious public health issue. BSE is critical for identifying lumps that may be breast cancer because early identification is the key to saving lives. BSE seeks to lower the death rate from breast cancer by 25–30%.

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The Key Features and Functionalities of Mobile Health Applications for Breast Cancer Detection

Mobile health applications (mHealth apps) have emerged as valuable tools in the realm of breast cancer detection and management, offering a range of features and functionalities to support patients throughout their journey. These apps cater to various aspects of breast cancer care, from survivorship and self-management to symptom monitoring and mental health support. Study by (Kapoor, 2020) highlight the significance of mHealth apps in aiding breast cancer survivors in managing not only the physical repercussions of cancer treatments but also the associated emotional and psychological challenges. Study emphasizes the role of mHealth apps in raising awareness about breast cancer prevention and promoting healthier lifestyle choices among women (Altmannshofer, 2024b). Moreover, other study underscored the acceptability and positive impact of mHealth apps on improving the well-being of women with breast cancer by providing them with valuable information and support (Rezaee et al., 2022).

In the context of symptom management, (Shi et al., 2023) discuss the increasing focus on using mHealth interventions to help patients with breast cancer better self-manage chemotherapy-related symptoms, especially in light of the COVID-19 pandemic. These apps offer a platform for patients to monitor and address their symptoms effectively. Other study conducted a scoping review on mobile health applications for

breast cancer care, shedding light on the diverse functionalities these apps offer to support patients through their treatment journey (Cai, 2021). Additionally, (Ponder et al., 2021) evaluated the feasibility of a mHealth app called Manage My Surgery (MMS) for patients undergoing breast cancer surgery, emphasizing the importance of tailored apps for specific stages of the cancer care continuum.

Furthermore, (Seven et al., 2022) discuss the development of a mobile apps specifically designed for symptom management in patients with breast cancer, showcasing the targeted approach of mHealth apps in addressing the unique needs of this patient population. A randomized controlled experiment was done to investigate the efficiency of an interactive mobile application in increasing job retention among women following adjuvant chemotherapy for breast cancer. The study highlighted the numerous benefits of mHealth apps beyond clinical care (Blinder et al., 2022). Study by (Salem, 2023) delves into the utilization of mobile apps by breast cancer patients, emphasizing the importance of leveraging technology to enhance patient experiences and outcomes.

Moreover, (Suchodolska, 2022) conducted a scoping review on mobile applications for early breast cancer chemotherapy-related symptom reporting and management, emphasizing the potential of these apps in improving symptom monitoring and management for patients undergoing treatment. Study outlined a protocol for a randomized clinical trial to evaluate the effects of mobile healthcare applications on the lifestyle of patients with breast cancer, highlighting the potential for these apps to positively impact patients' daily lives and behaviors (Baek, 2022). Other study by (Dewi et al., 2023) investigated factors for supplemental therapies using mobile app technology in women with breast cancer, emphasizing the necessity for tailored and complementary assistance using mobile platforms.

In addition, studied the impact of mobile application-based symptom monitoring on symptom control and QoL in breast cancer patients, demonstrating the potential of these apps to enhance patient outcomes and well-being (Öztürk & Kutlutürkan, 2021). Study by (Borjalilu, 2023) conducted a rapid review on mobile applications aimed at promoting mental health among breast cancer patients, highlighting the positive effects of these apps on various psychological aspects such as stress, depression, and coping mechanisms. Other study explored the determinants influencing the use of a mobile application focused on breast examination for cancer awareness, shedding light on factors that drive engagement with such health apps (Adiyasa, 2023).

Furthermore, (Choi et al., 2020) assessed the use and impact of a mobile nutrition management service for breast cancer patients, showcasing the potential of mobile apps in supporting patients with dietary management and overall wellness. Another study performed a comprehensive evaluation on the usefulness of mHealth apps on the mental health of breast cancer survivors, emphasizing the role of psychological interventions delivered through mobile platforms in enhancing survivors' well-being (Horn, 2023). The study focused on the usability of a mobile phone application meant to improve activities of daily living for breast cancer survivors, highlighting the importance of tailored apps in addressing specific needs and improving quality of life (Romero-Ayuso et al., 2023).

Finally, mHealth apps play a key role in assisting breast cancer patients throughout their journey, offering a wide array of features and functionalities to enhance self-management, symptom monitoring, mental health, and overall well-being. These apps have the potential to change breast cancer care by offering tailored assistance and encouraging patients to actively participate in their treatment and recovery process.

The barriers and Challenges Associated with the Adoption and Utilization of Mobile Health Applications

Adoption and use of mHealth apps provide both opportunities and obstacles in breast cancer care. These apps provide a practical platform for self-management among breast cancer survivors, aiding in their recovery from intensive treatments and managing associated side effects (Kapoor, 2020). However, privacy concerns related to these apps have been raised, emphasizing the need for robust privacy measures to protect sensitive health information (Benjumea, 2019).

Despite the potential benefits, challenges exist in ensuring the feasibility and usability of mHealth apps, as highlighted in studies evaluating specific applications like Manage My Surgery for patients undergoing breast cancer surgery (Ponder et al., 2021). Quality evaluation of mHealth apps targeted for breast cancer patients is critical since it improves their entire well-being and QoL (Rezaee et al., 2022). These apps, such as "Health for You," designed for overweight breast cancer survivors, play a role in increasing disease knowledge and facilitating better monitoring for chronic patients (Seo et al., 2021).

Implementing secure mobile applications in medically underserved areas has shown promise for improvement care delivery for breast cancer patients and addressing disparities in access to healthcare services (Adhikari et al., 2023). Moreover, content-based reviews of mHealth apps emphasize their potential in raising awareness for breast cancer prevention and promoting healthier lifestyle behaviors among women (Altmannshofer, 2024b). Research indicates that mHealth interventions can enhance self-management of chemotherapy-related symptoms in breast cancer patients, especially in the context of the COVID-19 pandemic (Shi et al., 2023).

Furthermore, mobile apps tailored for mental health support among breast cancer patients are gaining traction, highlighting the diverse applications of mHealth in addressing holistic patient needs (Borjalilu, 2023). Scoping reviews have outlined the landscape of mHealth apps for breast cancer care, emphasizing the need for comprehensive approaches to support patients throughout their treatment journey (Cai, 2021). Incorporating evidence-based strategies into mobile interventions is crucial for promoting behavior change among breast cancer survivors, such as self-monitoring, problem-solving, goal setting, and self-reward mechanisms (Buscemi et al., 2020).

Usability studies on mobile phone applications for improving daily living activities in occupational therapy services for breast cancer survivors highlight the potential of technology in helping rehabilitation and functional results (Romero-Ayuso et al., 2023). User-centered design approaches have led to the development of novel mHealth applications and clinician dashboards that revolutionize patient care delivery and outcomes monitoring (Tsangaris et al., 2022).

Telemedicine and interactive mobile applications have emerged as essential tools in breast cancer care, offering avenues for remote consultations, patient education, and symptom management (Johnson et al., 2021). Randomized controlled trials have demonstrated the efficacy of interactive mobile applications in promoting job retention and facilitating communication between patients and healthcare providers during cancer treatment (Blinder et al., 2022). Additionally, mobile-based self-care applications tailored for specific needs, such as breast cancer-related lymphedema management, showcase the potential for personalized digital interventions in improving patient outcomes (Ahmadi et al., 2022). Smartphone applications have been demonstrated to improve women's performance and health perceptions around breast self-examination, emphasizing the role of technology in promoting preventive healthcare practices (Shakery et al., 2021).

Predictive models utilizing mobile application technology can help identify breast

cancer treatment requires complementing therapies, especially in addressing mental and spiritual health aspects (Dewi et al., 2023). Evaluation frameworks like the Mobile Application Rating Scale are essential for assessing the quality and effectiveness of mHealth apps, ensuring their relevance and usability for patients (Wright, 2021). Scoping reviews focusing on early breast cancer chemotherapy-related symptom reporting and treatment highlight the diverse functionalities of mHealth apps in supporting treatment adherence and symptom monitoring (Suchodolska, 2022). Prospective observational studies utilizing mobile applications for patient-reported outcomes collection offer insights into patient functioning and quality of life, paving the way for personalized and data-driven cancer care approaches (Richardson et al., 2021).

Smartphone-based interventions tailored for specific populations, such as Latina breast cancer survivors, demonstrate the potential for targeted psychosocial support through digital platforms (Baik et al., 2020). Systematic evaluations on the usefulness of mHealth applications in improving mental health outcomes for breast cancer survivors underscore the importance of integrating psychological interventions into follow-up care strategies (Horn, 2023). The digital health era has revolutionized nursing practices, enabling efficient data management, trend identification, and personalized care delivery through mobile technologies (Barbosa et al., 2021). Innovative models of care delivery, such as self-administration of complex therapies facilitated by mobile applications, showcase the transformative potential of digital solutions in improving patient outcomes (Liang et al., 2022). IT-based healthcare communication has been instrumental in promoting mammography screening utilization among women, emphasizing the role of technology in enhancing preventive healthcare practices (Alabdullatif et al., 2022).

Mobile applications have been effective in removing barriers to early cancer detection in underprivileged communities, showcasing their potential in improving access to screening services and risk assessment tools (C. A. Munoz-Zuluaga, 2021). Health information provision through digital platforms plays a vital role in promoting breast cancer screening and preventive behaviors, contributing to improved health outcomes (Goldzahl, 2020).

In conclusion, the adoption and utilization of mobile health applications in breast cancer care present a dynamic landscape of opportunities and challenges. While these apps offer personalized support, symptom management, and health education for patients, ensuring privacy, usability, and quality remains paramount. Integrating evidence-based strategies, user-centered design principles, and robust evaluation frameworks are essential for maximizing the potential of mHealth apps in improving outcomes and enhancing the overall quality of care for breast cancer patients.

CONCLUSION

Mobile health applications positively impact women at risk of or affected by breast cancer by enhancing self-awareness, promoting routine breast examinations, and supporting symptom management. Utilizing mobile health technology has proven effective in increasing patient engagement, improving quality of life, and providing accessible health education. Future study should focus on overcoming barriers to general adoption and investigating the use of sophisticated technologies, such as AI, to improve the efficacy of mobile health applications in breast cancer care. Overall, the evidence demonstrates that mobile health apps are a valuable tool in the battle against breast cancer, providing individualized and scalable options for early identification and continuous management.

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