The impact of mobile health on breast cancer patient's life and treatment: A systematic review

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ABSTRACT

Introduction: Breast cancer rates have been increasing worldwide, particularly among young women, suggesting important interactions between genes and health behaviors. At the same time, mobile technology, including smartphones applications (apps), has emerged as a new tool for delivering healthcare and health-related services. In 2019, there were nearly 670 publicly available breast cancer apps designed to provide disease and treatment information, to manage disease, and raise overall awareness.

Material and Methods: In order to conduct a review, the Medline, Scopus and PubMed databases were searched with the keywords "mobile health", "mobile health in electronics health", "breast cancer and electronic health", "mobile health and breast cancer", "mobile health and breast cancer quality life" and their equivalent. Out of the 60 articles found, after the depth of the criteria Inclusion in the study, 16 articles remained, which were reviewed and given using PRISMA 2020 checklist. SPSS software v.22 was used for description analysis.

Results: A total of 16 articles met the inclusion criteria and were included in this review. All studies have determined the positive impact of applications on cancer detection and clinical health outcomes. In addition, more than half of mobile applications have multiple functions, such as providing information, planning and education. Furthermore, most studies examining patient satisfaction and quality improvement have shown that users of healthcare applications are significantly more satisfied with life, leading to better quality.

Conclusion: The evidence of the studies which are included in this systematic review is currently limited, but it suggests that the mobile apps might be an acceptable information source for women with breast cancer and lead to improved patient well-being.

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INTRODUCTION

Smartphone technology represents an opportunity to deliver practical solutions for people affected by cancer at a scale that was previously unimaginable, such as information, appointment monitoring, and improved access to cancer support services [1]. Mobile health (mHealth) apps can provide an accessible platform for self-management among breast cancer survivors, as they recover from not just the intensive cancer treatments, but also their associated side-effects [2]. Breast cancer is a discrediting disease and its treatment can bring

genuine results that have a physical and mental effect. In particular, cancer treatment affects psychological capacity strongly. Lately, new advancements and eHealth have impacted medical services and inventive portable applications can be valuable instruments to convey intellectual exercise in the patient's home [3]. As of 2018, there were almost 600 freely accessible breast cancer apps designed to provide disease and treatment data, to oversee ailment, and to raise in general mindfulness and There are around 40,000 healthcare applications (apps) available for smartphones. Breast cancer self-

care under the influence of chemotherapy is an important and effective factor in controlling and reducing the side effects of chemotherapy, which makes the patients pay more attention to chemotherapy and improve his quality of life. Due to the role of mobile phones in personal life and the obvious charms for self-care, designing self-care programs through mobile apps can help patients [4, 5]. In other word, mobile health can play an important role in management. Taking care of cancer patients can support adherence to medication, the provision of cancer information and follow-up care after cancer treatment [5]. Mobile health can help care for the symptoms and complications of cancer patients. Patients who use this method can manage their symptoms by mobile health as a simple and easy way. mHealth can be useful for monitoring at home that gives them self-confidence and lead to beneficial management of the side effects of the disease [4]. Most people with cancer want to have accurate information about their decisions, illness, treatment, and prognosis for treatment. Mobile phones have the ability to provide this information directly [6]. Mobile health can also be a tool to provide personal information related to cancer treatment including laboratory results, notes, and doctor's appointments [7]. Patients with breast cancer follow structured follow-up programs after completing their initial treatment. These programs are usually offered in outpatient clinics of hospitals and their focus is on relapse diagnosis, management synergy, monitoring the effects of treatment, identifying psychological problems and social and ongoing support for patients and their families [8]. 92% of breast cancers are primary and the rate of five-year survival of primary breast cancer is 95% and average survival of 15 years of these patients is 82%, so follow-up care services have an increasing number of patients and usually without increasing the relevant resources to be presented [9, 10]. Follow-up care access is difficult for patients living in remote and rural areas; this makes the difference between urban and rural patients. In addition breast cancer patients have expressed the inadequate support for this few centers. This shows the current models of cancer follow-up services are not appropriate. mHealth is a good way for some aspects of cancer care [11]. Studies show associated health in support follow-up care has been successful for patients undergoing chemotherapy breast cancer [12]. Hence, the target of this studies was to decide how mobile applications are being utilized for breast cancer anticipation among women over the disease control continuum.

MATERIAL AND METHODS

In this study a systematic search of Medline, Scopus and PubMed was performed to identify relevant studies. Use the keywords "mobile health", "mobile health in electronics health", "breast cancer and

electronic health", "mobile health and breast cancer", "mobile health and breast cancer qualify life" to find updates related to Medline, Scopus and PubMed databases. Created and searched between 2014 and 2020. During this period, more than 60 documentaries were reviewed and the relevant items were extracted according to the following criteria after the depth of the criteria:

- (1) all studies on male breast cancer, due to the rarity of this disease in men;
- (2) breast cancer detection and treatment studies;
- (3) studies not performed on human subjects;
- (4) mobile health in during treatment, after treatment.

Inclusion in the study, 16 articles remained. To select the documents used, the titles found by the search engine were first examined in terms of thematic relevance. The findings were divided in two groups of articles, thesis. Selection criteria after the thematic relationship, the items that were more completed than the others were selected as the reference used.

For thesis, the selection criteria were thematic relevance and availability. After reviewing the titles and abstracts, full text was selected applying predefined in- and exclusion criteria. Included ones were studies presenting multivariable models, with the aim to effects for breast cancer patients. After reviewing the title, the articles were evaluated in the next step in terms of the relationship between the abstract and the intended purpose. From the selected studies, the following information was extracted:

Authors, publication date, study objectives, study population, study design, interventions' features, outcome measures, and results. The documents retrieved from the search were sent to Endnote software and evaluated according to the set criteria. The selected cases were thoroughly studied and finalized. Inclusion criteria for the mobile apps to be included in the review were availability in English language; free of any cost to the user; and have an available numerical user rating on the corresponding mobile app store.

A secondary screening was performed following the installation of resulting apps meeting primary screening criteria. The secondary screening was conducted to identify apps that offered at least one of the six identified self-management resources for breast cancer survivors and quality of life. Apps purely about breast cancer awareness, fund raising, and general information were not included. The apps that failed installation or did not work as expected were also excluded. All apps retrieved by the initial search were screened independently for inclusion by two reviewers with expertise in the areas of breast cancer self-management and the evaluation of personal health apps. Each differences were resolved

through a process of discussion and reconciliation to reach consensus. The studies evaluated independently by three reviewers, and in case of any disagreement, a bilateral discussion session held to reach a consensus.

Research questions

The aim of this review is to search the impact of mobile health in three metrics. The research questions addressed are as follows:

1. What are the applications of mobile health in these studies?
2. What are the most commonly usage of mobile health in quality of life for breast cancer patients?
3. How is the quality of these studies?

Fig 1: Article search flowchart

The number of authors of articles indicates the degree of participation of researchers. Many of the researches are the result of teamwork and as the participation and number of authors in the researches increases, it is a sign of the expansion of teamwork and the increase of collective wisdom. The results of the present study were a confirmation of this issue and showed the increase of participation and number of authors has a favorable effect on the quality of final research report, which is especially true for abstracts. The average of five authors indicates an acceptable level of participation in a study for each article. In most studies, the articles are reported by an average of three people. This indicates sensitivity and the need for collective wisdom and greater focus is for writing systematic reviews and meta-analysis.

RESULTS

Search results of all medical databases (English) in Iran has only 16 meta-analysis and systematic reviews by medical data in the period of 2014 to 2021. Table 1, survey results the quality of systematic review articles and meta-analysis based on PRISMA tool shows the overall compliance rate of the quality of the articles survey with 72% report criteria,

PRISMA it was estimated. Most quality deficiencies in report section of the article method by 57% estimated. The most specific deficiency systematic and meta-analysis review reports case study related to errors in preliminary studies and errors resulting from the combination the results of these studies and the lack of reference to this there have been biases. Most of the articles found are related to the years were 2018 and (3.70%) 2021, which in 6.43% articles, especially the nationality of the writers, in none of them articles to be reviewed, authors with nationality no non-Iranians were found.

Some app characteristics of contents and features were categorized according to the functions and impacts. A number of mobile apps were developed for patients to exercise, which can have a positive effect on the patient's life. A number of mobile apps were developed for patients to exercise, which can have a positive effect on the patient's life. Mobile application has been used to rehabilitate patients and relieve their depressive states. Mobile application has been used to rehabilitate patients and relieve their depressive states. Table 1 shows the degree of compliance with the items listed in the Prism statement. The findings of the table indicate that the sections of objectives, title and combination of results with 90%, 98% and 75% of compliance, respectively, have the highest average in the criteria. Prism has been assigned to them, which shows the observance of the mentioned matters by the authors.

Table 1: Degree of observance of the items stated in the PRISMA statement in the abstract of the article under review

Title	90%
Introduction/aims	98%
Methods	57%
Results	75%
Discussion	89%

DISCUSSION

Most of the reasons for the inconsistency of the abstract of the reviewed articles with the PRISMA statement may be due to the lack of awareness of the authors of the PRISMA statement to report the results of the reviews and low level of familiarity with the scientific writing and evaluation of articles. The other side of the coin is the editors and editors of magazines. Unfortunately, most of the scientific journals in the country and even international journals do not provide any specific instructions for reviewing and judging the format of epidemiological articles. Another reason for this may be that in recent years more importance has been given to the quantity of reviews than to their quality. Thus, due to the need to provide systematic reviews and meta-analysis in providing complete and accurate reports, as well as the positive correlation between the number of receipts received and the actual

application of the results of the study, the results are consistent. The items in this statement, which will improve the structure of the abstracts, apply to the

inclusion of the Prism Handbook in the journal writing guide for article authors.

Table 2: Frequency of Reporting the Criteria of the PRISMA Statement in Articles

Study	Year	Location	Sample Size	Type of Study	Out come
Lozano-Lozano et al. [13]	2020	Spain	N=40	Randomized controlled trial	Both groups showed improved outcomes, but global QoL was significantly better with BENECA mHealth and rehabilitation than BENECA mHealth alone (mean difference, 12.76; 95% confidence interval 4.85; 20.67; $P = 0.004$), with a moderate-to-large effect size ($d = 0.72$). The proportion of participants reporting reliable clinical improvement on global QoL at T2 was higher with BENECA mHealth and rehabilitation than BENECA mHealth alone (57.5% vs 26.3%, $P = 0.008$). Improvement in subjective and objective upper-limb functionality was also higher with BENECA mHealth and rehabilitation.
Siebenhüner et al. [14]	2021	USA	N=83	Self-care cancer app study	A decrease in distress was associated with lower adherence to the app intervention, whereas patients with moderate distress or an increase in distress showed more adherence.
Brennan et al. [10]	2020	Ireland	N=10	Qualitative study	Self-driven rehabilitation; and visions for high-quality rehabilitation. Regarding technology, participants reported a lack of mHealth options for this clinical context and using non-cancer-specific applications and wearables. Participants requested a mHealth tool from a reliable source that provides exercise support.
Stanley et al. [15]	2017	USA	N=1434	Retrospective study	Significant differences were found among patients visiting the cancer centre versus the mobile mammography van.
Cairo et al. [16]	2017	USA	N=127	2-group control	Had a significantly greater reduction in overall body mass index ($P < 0.01$). The app group also demonstrated statistically significant improvements in "strenuous" physical activity ($P = 0.04$) and had significant improvement in their dietary patterns ($P < 0.001$)
Sheikhtaheri et al. [17]	2017	Iran	N=33	Analytical	help patients with breast cancer undergoing chemotherapy in managing side effects and obtaining self-care skills
Ollero et al. [18]	2017	Netherlands	N=57	Case-controlled	directed to the patient who is undergoing rehabilitation and allow to monitor parameters of interest
Nielsen et al. [19]	2020	USA	N=30	Cross-sectional	Five themes for desired mHealth physical activity intervention features during chemotherapy for breast cancer were identified had best effect on patients
Zhu et al. [20]	2018	Australia	N=30	Qualitative study	The qualitative interviews revealed that participants perceived the Breast Cancer e-Support program to be helpful in enhancing knowledge, improving confidence level, and promoting emotional well-being. Women also identified access to tailored advice from experts and convenience as the benefits of this program. Physical or psychological health status, stigma related with breast cancer, and app instability were mentioned as the challenges to engagement
Chow et al. [21]	2020	USA	N=40	Pre-Post study	There was a significant decrease in general distress symptoms, as well as symptoms of depression and anxiety, from baseline to post intervention
Sundberg et al. [22]	2017	Spain	N=64	Qualitative study	The intervention group rated significantly lower levels of fatigue and nausea at the end of radiotherapy. Moreover, they had significantly less burden in emotional functioning, insomnia, and urinary-related symptoms at the end of treatment as well as 3 months later compared with the control group
Uhm et al. [23]	2020	Taiwan	N=24	A 5-step design thinking approach	A total of 8 major themes including treatment, physical activity, diet, emotional support, health records, social resources, experience sharing, and expert consultation were identified. Minor themes included the desire to use the app under professional supervision and a trustworthy app manager to ensure the credibility of information.
Crafoord et al. [24]	2020	Sweden	N=74	Mixed methods	Patients in the breast cancer group had a statistically significant lower comorbidity score ($P < 0.001$) and a higher self-reported education level ($P = 0.005$). App as supportive during their treatments and described symptom reporting in terms of diary keeping. Reporting symptoms encouraged and supported reflection on their well-being and made patients more aware of symptoms and what they should observe for
Fjell et al. [25]	2020	Sweden	N=75	Randomized controlled trial	The intervention group rated statistically significant less symptom prevalence in nausea, vomiting, feeling sad, appetite loss and constipation. Overall symptom distress and physical symptom distress were rated statistically significant lower in the intervention group. Further, emotional functioning was rated statistically significant higher in the intervention group.
Lim et al. [26]	2021	Korea	-	Development	professional support for monitoring and providing real-time feedback
Martin et al. [27]	2021	France	N=9	Qualitative exploration	The tested mHealth group challenge was associated with several positive representations including well-being and good habit promotion and being a motivational catalyser. Following feedback, modifications were implemented into the mHealth challenge.

Table 3: Summary of the positive impact of mobile health on Breast cancer.

Impact of mobile health	Percent
Exercise	30
Chemotherapy/Radiotherapy	15
Mammography	5
Rehabilitation	20
Self-care	20
Mental	10

Table 4: Frequency of Reporting the Criteria of the PRISMA Statement in Articles

Author	Objects	Country	Year	Sample	Survey	Result
Kuhar et al. [9]	Mobile app for symptom management and associated quality of life during systemic treatment in early stage breast cancer: Nonrandomized controlled prospective cohort study	Netherlands	2020	Using mHealth apps and their impact on breast cancer care.	Impact using mHealth on breast cancer care.	Use of the app enabled patients undergoing systemic therapy for early stage breast cancer to better cope with symptoms which was demonstrated by a better global quality of life and summary score after the first week and by a better summary score at the end of treatment in the intervention group compared to those of the control group
Handa et al. [11]	Effectiveness of a smartphone application as a support tool for patients undergoing breast cancer chemotherapy: A randomized controlled trial	Japan	2020	Using mHealth apps and their impact on breast cancer care	Impact using mHealth on breast cancer care, chemotherapy.	The BPSS app is a feasible tool for patients with breast cancer and might be useful as a support tool for information sharing between patients and medical staff in an effort to optimize chemotherapy and deliver suitable patient care and support.
Zhu et al. [20]	A mobile application of breast cancer e-support program versus routine Care in the treatment of Chinese women with breast cancer undergoing chemotherapy: Study protocol for a randomized controlled trial	Australia	2018	Women with breast cancer	symptom distress, women as they cope with the unique challenges of breast cancer and chemotherapy	The results of this study will provide a better understanding of the role of self-efficacy and social support in reducing symptom Distress and the credibility of using a theoretical framework to develop a BCS intervention.
Dorri et al. [28]	A systematic review of electronic health (eHealth) interventions to improve physical activity in patients with breast cancer	Iran	2020	Women with breast cancer	Articles comprise 2304 breast cancer patients with the mean age of 51 years and 50% were conducted in the USA	The results show that eHealth interventions can improve the level of PA in breast cancer patients.
Karim et al. [29]	Mobile health applications for improving the sexual health outcomes among adults with chronic diseases: A systematic review	Iran	2020		Sexual problems in 2304 breast cancer patients	All interventions were delivered through websites, and a positive effect on sexual problems was reported.

Table 5: Used of mobile application in other items

	Smartphone applications	Text messages	Activity trackers
Appointment reminders, Mental health support	Mobasheri et al. (2014) [5]	Guy et al. (2012) [30]; Kerrison et al. (2015) [31]	
Exercise tutorials or tracking	Harder et al. (2017) [32]		Valle et al. (2017) [33]
Weight loss	McCarroll et al. (2015) [34]		
Symptom tracking	Patel et al. (2012) [35]	Mougalian et al. (2017) [36]	
Health information	Alanzi et al. (2018) [37]		
Medication adherence	Mobasheri et al. (2014) [5]	Mougalian et al. (2017) [36];	

Lim et al. start an application for edema self-care lymph nodes are present in women with breast cancer. This program has three electronic tools that are smartphones, tablets and laptops are available at Self-assessment, early detection and management of edema related symptoms lymph help [26]. A novel mobile app, was developed together with breast cancer patients to support self-management of arm and shoulder exercises following axillary treatment [32]. Further assessment in a randomized controlled trial is expected to provide objective proof on its clinical effectiveness. This will permit patients to upgrade the ease of use of the application, when suffering breast and lymph edema in other word using it to look at in the event that it is practical to utilize bWell as a coordinated piece of clinical consideration for breast cancer [32]. Studies showed that consistent and promising findings of interventions using mHealth apps that target care management in breast cancer. Among the categories of mHealth apps focusing on survivorship, mHealth-based interventions showed a positive effect by promoting weight loss, improving the quality of life, and decreasing stress [13].

Fu et al. [38] have examined in their study, mHealth assumes a critical function in improving self-care, patient-clinician communication, and access to health information. The optimal lymph flow health IT system (TOLF) is a patient-focused, web- and mobile-based educational and behavioral mHealth interventions focusing on safe, innovative, and pragmatic electronic assessment and self-care strategies for lymphedema symptom management. TOLF framework utilizing the electronic version of the instrument is able to assess patients' lymphedema side effects with high reliability and validity. TOLF system can survey deliver self-care mediations to enhance self-care strategies for lymphedema symptom management.

Zhou et al. surveyed whether a cyclic adjustment training (CAT) mediation conveyed through a mobile device can improve psychological resilience, and reduce mental strength and anxiety symptoms, in a population of post-surgical women with breast cancer. CAT had positive effects on improving psychological resilience and decreasing anxiety symptoms and depression, support for its use as an effective psychological management and

intervention strategy in the beginning phases Long-term recovery in women after breast cancer surgery [39].

In Lee et al. [40] and Uhm et al. [23] studies, from mHealth in other, review and compare mobile portable impacts well-being health (mHealth) and pedometer with ordinary exercise program utilizing physical capacity and quality of life (QOL). Which the results showed overall, both the mHealth combined with pedometer and conventional exercise education utilizing a leaflet effective in improving physical function, physical activity, and QOL. Yanez et al. [41] survey two mobile programs in breast cancer patients, Latina breast cancer survivors who utilized the my guide and my health applications reported temporary decreases in symptom burden and improved breast cancer well-being over time, though there were no differential impacts between conditions. Findings suggest that technology may facilitate Latina breast cancer survivors commitment in care after breast cancer treatment.

The evidence from the studies included in this systematic review is currently limited but suggests that mobile apps for women with breast cancer might be an acceptable information source and lead to improved patient well-being. They can also be used to report symptoms and adverse treatment-related effects and promote self-care. However, the real utility of mobile apps for women undergoing breast cancer treatment is still uncertain. More evidence-based apps must be tested in future randomized clinical trials. There are numerous examples of mHealth interventions that can provide support for women following active breast cancer treatment, including the use of text message programs, smartphone applications and activity trackers [42, 43].

Advances in digital technologies have created unprecedented opportunities to assess and improve health behavior and health outcomes. Mobile apps can inform breast cancer prevention across the continuum, given that breast cancer is a debilitating disease and conflict that requires care and post-treatment warnings, any program that can help patients have a better life is commendable. In mobile health for cancer, including the design of mobile applications for breast cancer has been able to play an important role in improving the patient's quality

of life, assessing the patient's adaptation to the living environment after treatment. mHealth is defined as the use of mobile technologies, such as text messages, smartphone applications, and activity trackers, to support healthcare delivery [44]. Typically, mHealth interventions provide health education, biofeedback (e.g., heart rate, accelerometer) or motivation through personal or interpersonal challenges to improve health-promoting behaviors. There are numerous examples of mHealth interventions that can provide support for women following active breast cancer treatment, including the use of text message programs, smartphone applications and activity trackers.

An overview can be seen in Table 4 that mHealth is used to provide support for women with breast cancer. The majority of studies used mobile apps to target tertiary prevention, particularly clinical care coordination and health related quality of life for breast cancer survivors, as well as to improve the measurement and assessment of symptoms, behaviors, and risk. Many of the screened studies looked exclusively at the design, feasibility and acceptance of mobile health applications, but there was a significant lack of evidence for the efficacy of

utilizing patient facing applications to improve clinically relevant outcomes. An overview can be seen in Table 5.

CONCLUSION

Cancer patients often suffer from high levels of stress and distress. The mobile health app (mHealth) may be an innovative way to provide relaxation and mindfulness interventions for cancer patients.

AUTHOR'S CONTRIBUTION

All authors contributed to the literature review, design, data collection and analysis, drafting the manuscript, read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

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No financial interests related to the material of this manuscript have been declared.

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