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ORIGINAL RESEARCH

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Development, usability and quality evaluation of the resilient mobile application for women with breast cancer

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Abstract

Introduction: Mental health problems as a consequence of cancer lower the quality of life of cancer patients. Despite increasing studies of breast cancer-focused mobile health applications (m-Health apps), there is less research on breast cancer patients' quality of life or well-being. The purpose of this study is to develop and evaluate the usability and quality of an educational m-Health app aimed at improving the resilience of breast cancer in women.

Methods: This study was conducted in four phases. It included extracting the requirements of the app through the nominal group technique. Based on these results, an m-Health app was developed and evaluated in terms of usability and quality by two scales, System Usability Scale and Mobile App Rating Scale questionnaires, respectively. Finally, the role of patients' age and educational backgrounds in the use of the app was assessed. The relationship between learnability and usability of the app was measured by the T-Test.

Results: The app was developed with three user interfaces. Its usability developed from the patient's point of view scored a remarkable score of 83.20 with a 95% confidence interval. This value was too indicative of high satisfaction with the usefulness and the possibility of recommending it to other cancer survivors. The results of the quality evaluation from an expert's point of view showed that this app had good functionality. Evaluation of the role of demographic information in the use of the app showed that it can be used for all age groups with different levels of education. The app did not differ significantly between learnability and usability.

Conclusion: The development of m-Health apps, based on usability principles that are suitable for all age groups with different levels of education, is welcomed by cancer patients.

KEYWORDS

breast cancer, Mobile App Rating Scale, mobile health, psychological resilience, System Usability Scale, Usability

1 | INTRODUCTION

Despite advances in medical science, cancer is still one of the most crucial life-threatening causes.[1] According to the World Health Organization (WHO), after cardiovascular disease, cancer is the second cause of death in developed countries and the third cause of death in developing countries.[2] Among cancers, breast cancer is the most prevalent malignancy and the main cause of death in women. This cancer has the highest diagnosis among women in the world and includes one in four cases of cancer.[3] For many people, cancer survival means living with a complex and chronic condition. Surviving and living with cancer or beyond requires long-term management of the disease and having a significant need for active rehabilitation of patients.[4]

The results of studies show that technologies have an effective role in improving the health status of breast cancer patients.[5] M-Health apps are increasingly being developed in oncology care as potential tools to support cancer patients.[6] Evidence from studies shows that mobile health applications (m-Health apps) for women with breast cancer are an acceptable source of information that can improve patient well-being.

M-health apps affect health services and care in a variety of ways.[7] M-Health services include patient participation in self-care,[8] clinical decisions support,[9] empowering patients with education,[10,11] improving patients' access to treatment and counseling,[12] improving treatment process management,[13] diagnosing and monitoring disease,[14] promoting mental health, and public health services.[15]

The WHO has made mental health a global development priority in recent years.[16] Evidence shows that providing mental health-related services forces a heavy financial burden on health and care systems. The use of information and communication technologies (ICT) can make mental health services cost-effective economically.[17,18] Due to the simplicity of access to mobile devices and mobile apps, cancer patients can communicate effectively with healthcare providers.[7,19] So m-Health apps had been evaluated to be useful in identifying and managing mental problems and stress after a cancer diagnosis.[20–22]

Improving mental health is the most important factor of resilience in women with breast cancer and interventions related to improving mental health can improve resilience.[23] Resilience is a process that provides the possibility of improvement or adaptation to problems[24] and helps the person to improve their mental and physical performance encountering challenges and difficulties.[25] Factors such as spirituality, personality factors, coping strategies, and social support affect the resilience of cancer patients and improve their mental health. Promoting resilience through targeted interventions should be an essential component of cancer care that lead to positive results.[26]

Mobile apps are recognized as an innovative way with the goal of relaxation and mindfulness interventions for cancer patients.[20] The results of the use of m-Health apps in the field of cancer for active participation of patients in self-management, improving the psycho-emotional status, and understanding of the disease show improvement in the process of treatment and clinical care.[4] Crico et al. developed the online platform Horizon 2020 European project to manage cancer to empower cancer patients, their results showed improved resilience in these patients.[27] Zhou et al. developed an m-Health app called Cyclic Adjustment Training (CAT) to provide home rehabilitation care for patients after surgery to reduce depressive symptoms. The results of this intervention showed positive effects on resilience and reduction of symptoms of depression and anxiety in patients after cancer surgery.[28]

Studies have shown that about 30%–40% of cancer patients suffer from mental health problems. Emotional distress in cancer patients is associated with lower quality of life.[6] Improving the quality of life of breast cancer patients can be improved by using m-Health apps.[29,30]

Since the quality of life of these patients is affected by resilience, so providing mobile-based educational apps as an available platform with a high penetration rate among cancer patients, can play an effective role in improving their quality of life. In this direction, the purpose of this study is to develop, usability, and quality evaluation of an m-Health app to provide appropriate educational content that can improve resilience and quality of life in breast cancer patients.

2 | METHODS

This development-applied study was conducted in four phases. The first phase involved identifying and confirming requirements. Based on the results of the first phase, a mobile app was developed to measure and improve the resilience of women with breast cancer. In the third phase, the app was evaluated in terms of usability and user satisfaction. Statistical analyses were used to evaluate the role of demographic information in the use of the app and the relationship between learnability and usability in the last phase. At length, these phases are as follows:

1) **The first phase—Identifying and confirming educational requirements, measurement, and improving resilience, and functionality requirements for the mobile app**: To review resilience studies and mobile applications in the field of cancer and international resilience guidelines, PubMed Databases, Scopus, Google Scholar search engine, and google play market with keywords related to cancer and resilience and mobile health without time constraints were examined. The results of this step were reviewed in an expert panel session by four experts including one medical informatics specialist, one hematology and oncology specialist, one medical education specialist, and one cognitive neuroscience specialist who had at least three years of experience at Shiraz University of Medical Sciences. Their research areas were e-Health, health educational content production, and resilience, respectively. The nominal group technique (NGT) was used to evaluate search results. It allows stakeholders to directly produce items for needs assessment surveys.[31] Our goal was to use NGT discussions to develop survey items on[1] resilience education content and[2] preferences for patient support services. Two NGT group was conducted. Participants generated lists of educational content and services according to the search results and their

experiences. Participants shared items, and a master list was compiled, then reviewed by participants to remove or merge overlapping items. Once a final list was generated, participants independently rated them on a scale from 1 to 10. Lists generated in the NGT discussions were subsequently reviewed and integrated into a single list by research team members.

2) **The second phase—Development**: The resilience mobile app was developed based on confirmed requirements. This app had three user interfaces (UI) for the patient, doctors, and admin. It was developed with the component-based programming approach.[32] This approach is one of the software development methods that provide more capabilities in the areas of reuse, flexibility, and the ability to maintain and support software.[33] The web-based admin user interface was developed via ASP.net programming language and the patient and physician user interface was developed within the Android Studio environment. Also, in designing the UI, since the mobile app in this study was a type of patient-engagement app, color psychology appropriate to the type of app was used.[34] Also, the resilience questionnaire was placed in the app environment to measure patients' resilience scores. The developed mobile app is named **CaRA**. It means useful in the Persian language.
3) **The third phase—Usability and quality evaluation**: For the app evaluation, two methods of expert evaluation and end-user evaluation were used. The participation of each group is as follows:

- **Patient participant**: Usability assessment was performed from patients' perspectives. The following steps were performed to invite patients:

One of the members of this study (SA) was stationed in Motahari hospital and Amir Oncology hospital in Shiraz city of Fars province for 2 months from July 13 to September 13, 2021. She talked to patients or their companions about the conditions for participating in the study. All women with breast cancer during this time were invited to use the developed mobile app.

Patients were included in the study through convenience sampling of women with breast cancer who were referred to these two centers according to the inclusion criteria.

2.1 | Inclusion criteria

1) Having an Android-based smartphone.
2) Being in the age range of 30–60 years.
3) Being on Stage 1–3 cancer disease.

2.2 | Exclusion criteria

1) The patient's unwillingness to continue participating.

In addition to inviting the patient to participate in the **CaRA** app evaluation process, the purpose and benefits of this study were also explained. The **CaRA** app was installed on the participants' mobile phones and the instruction for using the app in form of an educational video was sent to them. After confirmation that the app was successfully installed on their smartphone, were asked patients to use the app for 5 weeks. To encourage participants to use the app, a message was sent daily with the following content along with motivational sentences: "Please use the **CaRA** app," also, for more assurance, were called with patients every 2 weeks. At time intervals that patients went to the hospitals for treatment, SA reminded them of the use of the app. After 5 weeks, SA asked them to answer the questions of the System Usability Scale (SUS) standard questionnaire. The online survey link was sent to patients. The results were collected after 5 weeks. Studies have shown that SUS is a reliable tool for measuring usability.[35] It consists of a 10-item questionnaire with five response options for respondents (Table 2). Each statement has a scoring scale (*) from 1 (strongly disagree) to 5 (strongly agree). To calculate the converted SUS score (**), for the odd-numbered questions 1, 3, 5, 7, and 9 the converted score was obtained by subtraction one unit from the average score, and for the even numbers questions 2, 4, 6, 8, and 10 the converted score was obtained by subtraction 5 number from the average score. Multiplying the sum of converted scores by 2.5 was obtained the total SUS value. Value of SUS = 80.3 or higher means that the mobile app is good, people like your app and recommend it to their friends. A value of SUS = 68 or higher means that this app is also considered a good app but needs to be improved and finally, the value of SUS < 68 means that the app is weak.[35]

- **Expert participant**: The expert's evaluation was done through the Mobile App Rating Scale (MARS) scale. This scale investigates the quality of m-Health apps from a point of expert that according to studies, this evaluation is performed by at least three experts.[36] For evaluation of the **CaRA** app, altogether three experts including one health information management, one medical informatics, and one software computer engineering answered 29 questions in six parts of the MARS scale. Their research areas were e-health, evaluation healthcare systems, and mobile app development, respectively. They had at least 3 years of relevant work experience. The MARS uses six sections: Engagement, functionality, esthetics, information, subjective quality, and app-specific for assessing app quality. The **CaRA** app quality means the score was obtained from the total scores of four categories of engagement, functionality, esthetics, and information.

4) **The fourth phase—Statistical analysis**: At this stage, the relationship between learnability and usability in the CaRA app was measured. The SUS questions consisted of learnability and usability parts. Using the T-Test, the app usability was analyzed

in two parts: learnability and usability, also education groups. Using the analysis of variance (ANOVA) test, the app usability was analyzed in age groups. ANOVA is a statistical test for detecting differences in group means when there is one parametric dependent variable between more than two independent groups. A statistically significant ANOVA is typically followed up with a multiple comparison procedure to identify which group means differ from each other.[37] In this study, the dependent variable is the usability of the application and the independent variable is the age group. All analyses were performed with SPSS.23 software.

2.3 | Ethical considerations

Ethics approval (IR.SUMS.REC.1399.1333) was obtained from the ethics committee of Shiraz University of Medical Sciences. The participation of women with breast cancer was voluntary and they could withdraw from the study at any time. Informed consent was obtained from patients for participation. For all patients, the use of the **CaRA** app was free during the evaluation process. Data collected from breast cancer patients were used without identifying their personal information.

3 | RESULTS

3.1 | The first phase

The experts selected "Resilience—A key skill for education and work (duration 12/2012–11/2014)"[38] as the most comprehensive tool for the educational content requirements in the app. This guideline has been designed with the support of the European Commission to increase resilience and teach resilience solutions to different people. Understanding and awareness, life control, emotional support, optimism about the future, the purposefulness of life, importance for self and life, and self-confidence are selected as resilience dimensions to produce app content according to the experts' point of view. The results of resilience educational content are shown in Table 1.

Creating an account, questions, exercises, and evaluations, sharing experiences, capability audio of exercises, and downloading and uploading files are selected as the major functional requirements and support services that are described in the second phase.

3.2 | The second phase

Based on the requirements extracted from the first phase, the mobile app was developed. The UI functionality of the users is as follows:

- **Patient UI**: The patients can be logged in to the app through an account created by the physician for them. At first, patients answer the questions on the resilience questionnaire. After answering the questions, patients go to the exercises section. After doing exercises on each dimension of resilience, there is an evaluation to assess resilience in breast cancer patients. In this section, phrases are displayed for the patients and they had to diagnose between right and wrong phrases. Figure 1 shows how the patients use the **CaRA** app. At First, the patients answer the questions, and if accountability is full to them, they are transferred to the exercises section, and if unaccountability to the questions, they will be transferred to the questions section again. In the exercises section, if the patients do not perform an exercise, they are not allowed to access the next exercise and the exercise is not activated for them. If doing exercises, their feedback will be displayed for them. After showing feedback, the next exercise will be activated for the patients. After doing all exercises for each resilience dimension, the patients go to the evaluation section, and if they complete the evaluation questions, the next dimension exercises will be active for them. If the evaluation is not done, they will be transferred to the evaluation section again and will not be allowed to access the next exercises. This cycle continues until all exercises and evaluations are completed.

Figure 2 shows the patient panel. The panel functionalities are as follows:

- **Measurement resilience score**: The patients by answering the questions can measure their resilience level and according to the

TABLE 1 The educational requirements

Dimensions of resilience	Individual/group exercise	Exercise topic	Having /not having Educator
Understanding and awareness	Individual	Stress control, Illustration in mind	Having educator
Life control	Individual	Illustration in mind, yoga	Having educator
Emotional support	Individual	Illustration in mind	Having educator
Optimism to future	Individual	Illustration in mind, relaxation	Having educator
Purposefulness of life	Individual	Illustration in mind, yoga	Having educator
Importance for self and life	Individual	Relaxation, stress control	Having educator
Self-confidence	Individual	Illustration in mind	Having educator

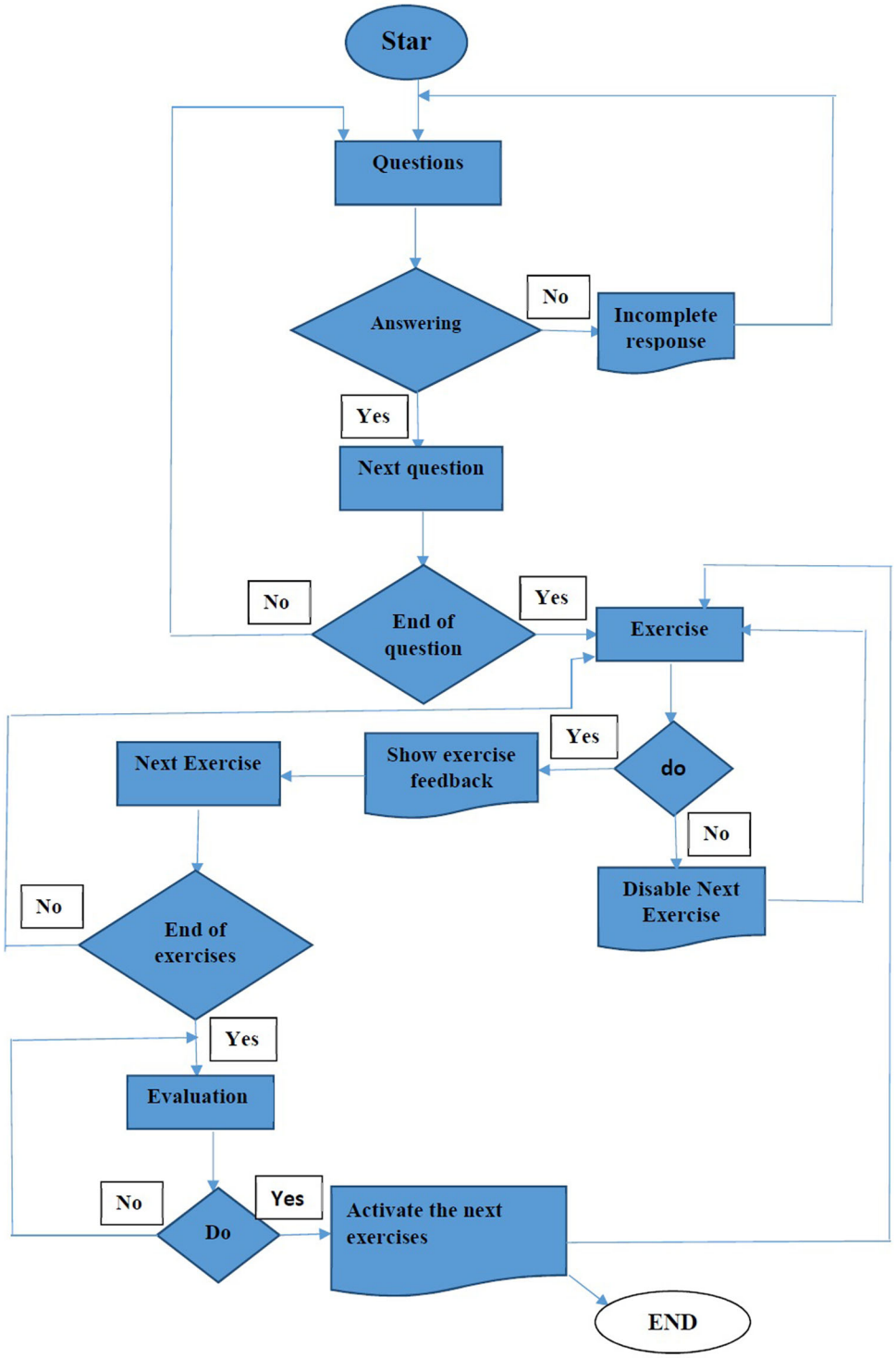

FIGURE 1 Flowchart of how the patient uses the **CaRA** app.

scores do appropriate exercises. They could see their status and resilience score in emoji format. Low, medium, and high resilience levels were displayed with sad, half sad, and happy emojis respectively. Each dimension has three questions and the score of each question is from 1 to 10. If the total score is < =10 (low resilience) if the total score is between 11 and 20 (medium resilience), and If the total score is > =21 (high resilience).

- **Doing exercises**: In the exercises section, patients can observe the exercises, do them, and answer the exercises questions. Also, they can receive feedback from the exercise section after answering the questions.

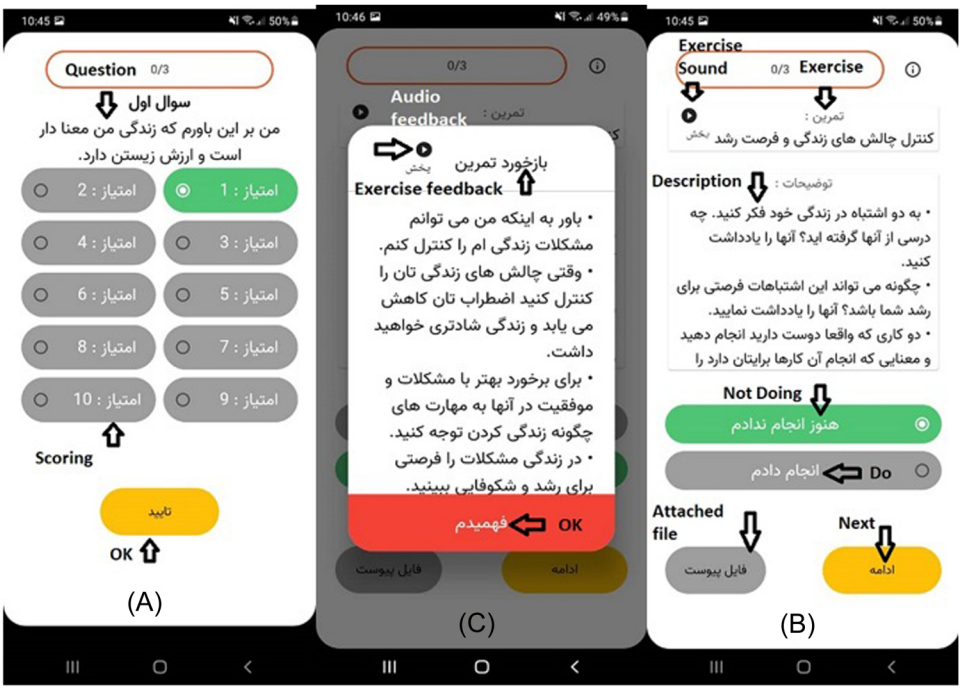

FIGURE 2 Patient panel functionalities. (A) Questions, (B) Exercises, (C) Exercise feedback.

FIGURE 3 Admin panel functionalities.

- **Doing assessment**: At the end of exercises in each resilience dimension, an assessment will be performed to assure that patients perform the exercise correctly. This evaluation consists of correct and incorrect phrases, and the patients can diagnose correct and incorrect phrases after doing exercise.
- **Sharing experiences**: in this section, patients can share their experiences and memories with other patients. When a patient shares an experience if the physician confirms that, it will be displayed to other patients otherwise, the experience remained inactive in the physician's panel.

- **Admin UI**: The **CaRA** app has an admin panel to manage different parts of the app. There are functionalities such as creating an account for the patient and the physician and uploading exercise

files, questions, and evaluation phrases. Also, the admin can set motivational sentences and reminders in the form of notifications in this panel (Figure 3). These functionalities are as follows:

- **Registration module**: Creating an account for patients and physicians is done by this module.
- **Exercise module**: Adding a new exercise, editing, and deleting the exercise is done by this module.
- **Question module**: Adding a new question in the questionnaire, editing and deleting the question is done by this module.
- **Evaluation module**: Adding a new phrase, editing, and deleting the phrase is done by this module.
- **Notification setting module**: In this module it is possible to set the time and date, add, edit and delete motivational and reminder messages. The patients receive the notification set by the admin on the date and time pacified.
- **Category module**: In this module, there is possible to add, edit, and delete resilience dimensions.

- **Physician UI**: After logging into this panel, the physician can observe the patient's health status. When patients respond to the exercises, the physician can check them and can refer them to a psychologist if necessary. Also, can confirm patients' experiences to be displayed to others (Figure 4). The physician panel functionalities are as follows:
  - **Follow-up of patients' status**: In this section, the physicians can observe and evaluate the patients' status and if necessary, refer them to a psychologist. Reference to a psychologist could be done face to face or by phone.
  - **Sharing experiences**: In this section, the physician can check the patient's experiences.

3.3 | Third phase—Evaluation

- **Usability evaluation from the patient's point of view**: After sampling and applying inclusion and exclusion criteria to the study, Twenty-five women with breast cancer were included in the study. All of them agreed to participate in the end-user usability evaluation (100% of participants). The results of this evaluation have been presented in Table 2. It shows that the value of SUS = 83.20 (maximum possible score = 100) indicates high satisfaction with the usefulness and the probability of recommending it to other cancer survivors. The mean score of SUS for the **CaRA** app (95% CI) is significantly higher than the normative mean of SUS = 68 (p value <0001). Analysis of subscales showed that the mean SUS (95%CI) learnability domain was 84.80 (94.14–75.45), the standard deviation (SD) equal to 7.52, and the standard deviation error (Std. error) 3.36. The mean (95% CI) usability domain was 81.60 (86.04–77.15), Standard deviation equal to

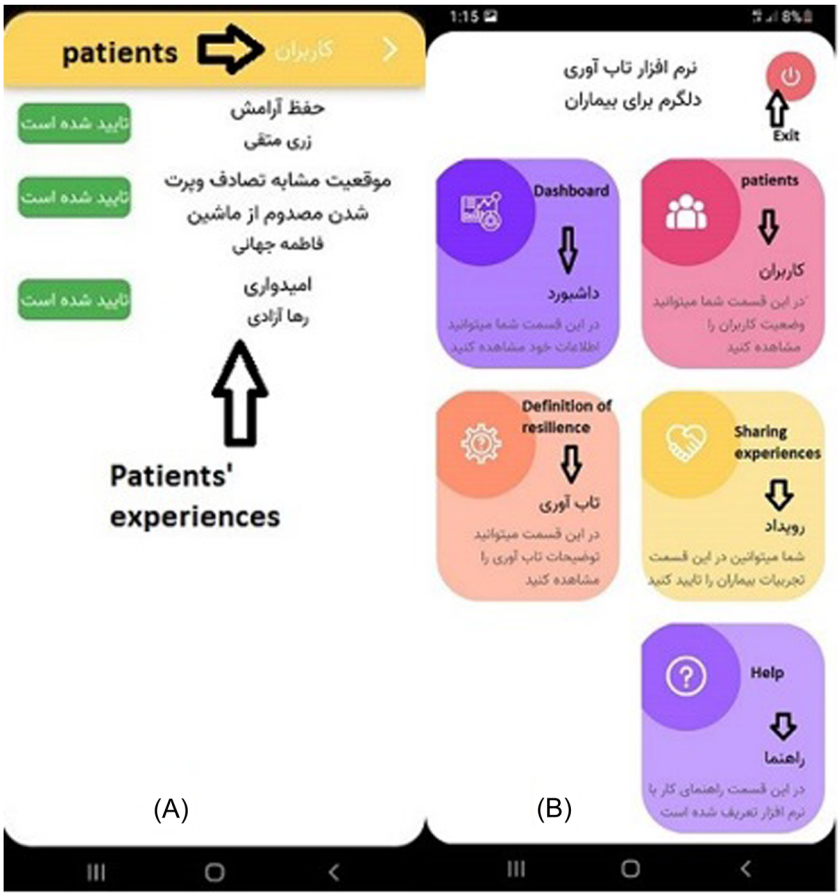

FIGURE 4 The physician panel functionalities. (A) Confirmation of patients' experiences, (B) physician dashboard.

TABLE 2 Evaluation of SUS ($N = 25$)

No.	Statement	Average Score*	Converted Score**	Std. deviation
1	Like to use the application frequently	4.16	3.16	0.80
2	The application is unnecessarily complex	1.68	3.32	1.21
3	The application is easy to use	4.12	3.12	1.16
4	Need technical support to use the application	1.76	3.24	3.24
5	Various functions in this application are well integrated	4.48	3.48	0.71
6	Too much inconsistency in the application	1.40	3.60	0.70
7	Learn to use the application very quickly	3.96	2.96	0.97
8	The application is very cumbersome to use	1.28	3.72	0.73
9	Very confident using the application	4.44	3.44	0.71
10	Need to learn a lot before using the application	1.76	3.24	1.26
SUM			33.28	
SUS's value			83.20	

Abbreviation: SUS, System Usability Scale.

3.57 and a standard deviation error of 1.60. Also, in response to the SUS questionnaire, 84% of participants (21/25) expressed that they "would like to use **CaRA** frequently," 88% of participants (22/25) found "the use of **CaRA** easy" and 80% of the participants (20/25) believed in learning the app quickly. Analyzes were calculated to two decimal digits.

Table 3 shows the significance of the **CaRA** app in two domains of learnability and usability.

The p value in Table 3 shows that the **CaRA** app is not significantly different in the two domains of learnability and usability. Therefore, the app was designed in such a way that it considered both the amount of learnability and the amount of usability for patients and the patient could easily learn how to use the app and use it well. This lack of significance showed the balance of the app in these two domains.

Participants were divided into three age groups (Table 4) and two educational groups (Table 5).

The results of the relationship between age and participants' education levels in using the app have been presented in Table 6. A normalization test was performed for the data and all of them were evaluated as normal.

The p value in Tables 6 and 7 showed that there was no significant difference between the demographic characteristics and use of the app and it was evaluated as suitable for different age and educational groups.

- **Quality evaluation from the expert point of view**: The results of the MARS evaluation have been presented in Table 8. MARS also did pay subjective evaluation but did not help the overall mean score. The maximum score in each category was obtained 5.

TABLE 3 Significance test of learnability and usability with T-test

	F	Sig.	*t*	*df*	Sig. (2-tailed)
Equal variances assumed	2.76	0.13	−0.85	8	0.41

According to Table 8, the functionality category had the highest score with 89.80% and the engagement category had the lowest score with 69.20%. The app's subjective quality mean score obtained 3.42 evaluated the subjective quality of the app in terms of recommendation app to others, willingness to use the app frequently, rating, and paying for it. In the "App-specific mean score" section which included the evaluation of understood effects on knowledge, attitude, awareness, and behavior related to the disease, the average score was obtained 4.22.

4 | DISCUSSION

In this study, we developed and evaluated a mobile app to measure and improve resilience in women with breast cancer. The app usability from the patient's point of view scored a remarkable score of 83.20 with a 95% CI. This value was indicative of high satisfaction with the usefulness. Also, our developed mobile app had good functionality from an expert point of view. Evaluation of the role of demographic information in the use of the app showed that it can be used for all age groups with different levels of education. The app did not differ significantly between learnability and usability.

TABLE 4 Age range of participants

Group of ages	N	Mean	Std. deviation	Std. error
30–39	9	2.94	0.30	0.10
40–49	11	2.76	0.18	0.05
50–60	5	2.88	0.19	0.08
Total	25	2.85	0.24	0.04

TABLE 5 Participants' education levels

Education level	N	Mean	Std. deviation	Std. error
No university education	15	2.98	0.30	0.08
Has a university education	10	2.79	0.19	0.06
Total	25	2.90	0.28	0.05

TABLE 6 Significance test between age and use of application with ANOVA test

	Sum of Squares	df	Mean square	F	p value
Between groups	0.16	2	0.08	1.50	0.24
Within groups	1.21	22	0.05		
Total	1.38	24			

TABLE 7 Significance test between education and use of the application with *T*-test

	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	2.20	0.15	1.71	23	0.10

TABLE 8 Evaluation of MARS (*N* = 3)

	Mean score	Percent	Std. deviation
A: Engagement	3.46	69.20	0.40
B: Functionality	4.49	89.80	0.50
C: Esthetics	3.99	79.80	0.88
D: Information	4.10	82	0.61
E: Subjective quality	3.24	64.80	0.69
F: App-specific	4.22	84.40	1.08
App quality mean score	4.01	80.20	
App subjective quality mean score	3.08	64.80	
App-specific mean score	4.22	84.40	

Abbreviations: MARS: Mobile App Rating Scale.

The results of survey studies to access users' experiences in using m-Health apps have shown that cancer patients believe that this technology is useful to manage health care and they feel comfortable using mobile apps.[39] According to patients' views on the use of m-Health apps, research in this field usually uses survey studies to determine the user experience. Studies have shown that cancer patients are inclined to use mobile apps that are easy to use.[40] user acceptance is essential for the successful implementation of any m-Health app.[41] Usability can influence patients' adoption and acceptance of health information technology.[42] It is believed that evaluating usability among end users can provide insight into the redesign and successful implementation of the program.[43] We used the SUS scale to measure **CaRA** app usability from breast cancer patients ' views. The results showed that patients had satisfied with the use of the **CaRA** app. The high usability score in this study has matched with other m-Health apps scores in various types of cancer. compared to m-Health apps developed for cancer that had used the SUS scale, like the PCforMe app (SUS = 78.20),[44] LogPAL apps (SUS = 71.90),[45] TouchStream apps (SUS = 74.0),[46] Go-breath app (SUS = 79.43),[47] and app to reduce Sedentary Behavior (SB) before and after cancer surgery (SUS = 83.80),[48] **CaRA** app also showed high usability with a score of (83.20).

The **CaRA** app was provided to patients for an average of 35 days. Despite distributing the **CaRA** app among all the samples, we only could get feedback from 25 patients. Studies have shown that for evaluating educational mobile apps from the end users' view, the minimum time required to use the app is 5 weeks. But from a patient's view, feedback presentation about a breast cancer app may be a low priority during a stressful and uncertain period in their lives.[49] Therefore, for more participation, recommended considering a longer period to collect more feedback from cancer patients.

Despite the increase of m-Health apps, one of the major concerns is patients' access to apps with authentic content.[50] Health professionals have a leadership role in reviewing and confirming the contents of the mobile apps and selecting the appropriate patients to use the m- Health apps.[51] In this regard, in this study, to ensure the validity of the **CaRA** app, resilience content was developed based on the global resilience guideline and survey of experts.

One of the functionalities of m-Health apps that has been welcomed by breast cancer patients is the exchange of information with other patients.[52] The "Experiences Sharing" functionality in our app was also welcomed and 60% of patients used this capability during the intervention and stated that they felt pleasant while using this functionality.

Mobile apps that include social support, follow-up treatment, and health status are welcomed by cancer patients.[40] Determining motivations such as clear and attractive UI, receiving emotional support from peers and targeted recommendations are essential to encourage breast cancer patients to use m-Health apps.[53] In this regard, in the **CaRA** app with capabilities such as patients participating in the forum and receiving heartwarming messages, receiving advice and support from clinical counselors, receiving motivational notifications, and also receiving feedback with a positive

psychological load from the exercises, the required motivation for fidelity patients to exercises were created.

In our developed app, the physicians can monitor patients' mental health status and if needed, refer them to clinical counselors. Physician feedback based on collected patient data is a feature noteworthy in cancer-related mobile apps.[54] Display of daily patient reports in real-time and presentation of customized feedback,[29,55] has also been pointed as a noteworthy advantage in the mobile health-related studies in the field of cancer.[56] Both functionalities were considered in the **CaRA** app and patients were given feedback in the form of emoticons after answering questions.

Studies have shown that feedback that includes a face emoticon scale.[47] May facilitate user engagement.[57] The functionalities that respond to cancer patients' needs with other disabilities (such as vision disorder) have an important role in the usability of the app.[58] For this purpose, in designing the **CaRA** app, the capability to play exercises into voice and send voice feedback was provided.

To increase patient interaction with the app, they should after doing exercise, must answer questions based on the global resilience guideline. In this regard, they receive these questions in the form of downloadable attachment files or audio and text and send the answer in the form of text or voice. Events, photos, messages, and audio are some of the mechanisms that can increase the usability of apps and improve the information about the disease and treatment.[59] These functionalities are strengths in **CaRA** app design.

The apps that can be used on more than one device can provide the patients with more possibilities for testing.[57] The **CaRA** resilience app was developed for Android-based mobile phones and tablets.

Motivational feedback is considered a strength associated with cancer-related m-Health app. since the cancer patients have different functional statuses during the day depending on medical and chemotherapy treatments,[57,60] in this regard, motivational messages in the **CaRA** app provide the possibility to adjust messages to send at different intervals.

People suffering from cancer have to deal with rapid recurrences, bad prognosis,[54] side effects from cancer treatments, and psychological distress.[61] Also, they are a population that is interested in doing anything to improve their health,[54] so they welcome the use of apps that have been developed to improve their health. since the **CaRA** resilience app had been developed based on guidelines and experts' opinions, it will be a reliable tool for this group of patients and is expected to be welcomed after its release in the app stores because studies have shown that apps developed by educational institutions with the participation of physicians will be more acceptability among patients.[57]

Among the requirements of modern online software development can site high scalability and performance-oriented platforms. The importance of scalability is considered as a nonfunctional requirement equal to the functional requirements of systems. The ability to upgrade a system by increasing one or more functions with minimal effort is called functional scalability. In the field of health care, service-oriented architecture is generally used to create scalable architectures. This architecture in comparison with other software development architectures, to provide service to the consumer has received special attention.[62–64] The functional scalability of the **CaRA** app provides this capability that system administrators without changing the software infrastructure of the app can be to maintain the app to add more resilience exercises. The scalable service-oriented architecture of our developed app provides the capability to add other resilience metrics and the capability to use the app for other quality of life metrics.

When some researchers wanted to test a targeted app for cancer patients, they introduced the beta version.[55] The beta version of the **CaRA** app was also evaluated by the MARS tool and received an acceptable score. The beta version of the **CaRA** was implemented in cancer treatment centers, and the researchers preferred not to available it for download in the app stores before the investigation of its effectiveness was completed.

Studies have shown that evidence of clinical effectiveness is needed to support the use of m-Health apps.[65] However, during the intervention process, the participants constantly communicated their positive opinions about the **CaRA** app to the research team, which shows that it has partially met patients' needs and expectations.

The **CaRA** app focuses specifically on the mental health of breast cancer patients. Customization in cancer care is increasingly being promoted.[49] Our developed app has the capability presentation personal experiences to patients.

Despite good accessibility criteria, it obtained a low score for engagement and entertainment. All evaluators considered a score of 4 for engagement. Efficiency and ease of use as two features of functionality attracted the most attention of evaluators. In the esthetic section, the clarity and simplicity of the icons were considered by the evaluators and most evaluators evaluated the graphic quality of the app as intermediate. But they believed that the app enjoyed a high level of visual appeal. To improve interaction, we used color psychology special for patient-engagement apps, because an app should support the interaction between the users and the software, instill esthetics in them and use the appropriate color.[66]

The evaluators believed that the information inside the app is not enjoyed comprehensiveness and they are brief. This is because, in this version, the purpose of the **CaRA** app was to educate and measure resilience, and referring the patients from the app to resource-related resilience was not considered. So, in the next version, it seems that adding links to valid sources and information about resilience can help improve the quality of the **CaRA** app information.

Our developed app performed well in interactivity capabilities such as communicating with physicians, interacting with other patients, and sharing experiences. To improve the interactivity of this app, functionalities such as gamification or mood/symptom tracking can be used.

The goal of health apps implementation one or more behavior reform techniques to influence one specific health behavior,[49] so the **CaRA** app has been developed with the specific goal of measurement and improvement resilience.

Studies have shown that simple accessibility features should be considered in apps developed for cancer patients to ensure that they are comprehensive for different user groups.[49] Despite a great set of features such as voice feedback in sending and receiving exercises, the **CaRA** app neglected to include some simple accessibility features such as text magnification and zoom capability which had a negative effect on the interaction score (3.46 points), which should be corrected in the next version.

According to the evaluation results in the subjective quality section, the lowest score of the app was 4 and the highest score was 5, and most of the participants assigned an average rate (***) to the **CaRA** app. The app in all "App-specific" sections received on average agreement of all evaluators.

Studies emphasize that only user-friendly and certified apps should be offered to cancer patients. Therefore, according to the satisfactory evaluation results of this app, after solving detected problems, this app will be available to other breast cancer patients as a useful tool to download in the app stores.

This study has some limitations. In the **CaRA** app, the capability of Teleconsultation with psychologists is not considered and only if counseling is needed, physicians will refer patients to clinical mental health experts. The functionality that will be added in the next version of the app is Tele-consultation.

Due to the high popularity of the Android operating system, the primary version of the **CaRA** was developed on this platform, but the iOS version of the app should be released in the future.

The average age of people who were willing to participate in evaluating the usability of the app was 45 years, and we were not able to evaluate the opinions of people with higher average age. So, despite the app's high average user friendly, older people's views on user friendly and usability seem necessary.

Considering cancer patients are a vulnerable group, the study of the relationship between the uses of cancer-related apps in the field of oncology is prominent. Therefore, in future research, the impact of using our developed app in improving resilience will be reported.

5 | CONCLUSION

The **CaRA** is a usable m-Health app used to measure and improve the resilience of breast cancer patients. This app is supported by Shiraz University of Medical Sciences, but research is needed on how it has affected patients' resilience, so more research is being done to test its effectiveness and the results will be presented in a future study.

TRANSPARENCY STATEMENT

Azita Yazdani affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

AUTHOR CONTRIBUTIONS

Rita Rezaee: Conceptualization; formal analysis; funding acquisition; investigation; methodology; resources; supervision; validation; visualization; writing—original draft; writing—review & editing. **Sima Asadi**: Data curation; formal analysis; resources; software; validation; visualization; writing—original draft. **Azita Yazdani**: Conceptualization; methodology; project administration; software; supervision; validation; writing—original draft; writing—review & editing. **Alireza Rezvani**: Conceptualization; investigation; methodology; resources. **Arash Mani Kazeroon**: Conceptualization; methodology; resources; validation.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

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