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Breast cancer-related apps in Google Play and App store: evaluate their functionality and quality

Aydanur Aydin[1] · **Ayla Gursoy**[2]

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Abstract

Aim This study aimed to evaluate the functionality and quality of breast cancer apps that can be accessed from Turkey.

Methods In this study, a systematic search strategy was used to identify free mobile apps on breast cancer available in the App and Google Play stores. According to the study's PRISMA flowchart, 707 apps met the inclusion criteria. The Mobile App Rating Scale (MARS) assessed the quality of the apps.

Results Mobile apps focused on the categories of communication, education, and treatment order/plan. The mean MARS quality score for all apps was 3.4, and according to the mean score of the subscales, they were categorized as functionality, aesthetics, information quality, and participation. In addition, the mean scores of the subscales were listed on MARS as functionality, aesthetics, knowledge quality, and participation.

Conclusion Nowadays, "e-health" apps are attracting attention in the treatment of health problems. While the apps in download stores appear to provide basic information about breast cancer, they offer limited and personalized problem management related to prevention, early detection, and screening. Support from healthcare professionals and further efforts can be made to develop innovative technologies and apps that include evidence-based informational content about breast cancer.

Implications for Cancer Survivors In the process of breast cancer information, survivors can be encouraged to manage this process using e-health services.

Keywords e-Health · Mobile health · Mobile apps · Store analysis · Breast cancer

Introduction

The use of technology in healthcare is preferred as a powerful method for maintaining patient follow-up, care, and information [1, 2]. The development of technology in mobile devices is reflected in health services, and many medical mobile applications (apps) that contain health information are easily installed on phones [3]. Mobile apps are used by healthy people to gain awareness and even to provide nutrition and exercise recommendations in daily life [4]. Additionally, the Turkish Ministry of Health ensures that the health service is supported by technological tools by making the physician appointment system available to the public through the phone app [5]. In a study, it was pointed out that if easy access to mobile apps is provided, a better quality of health services can be managed [6]. In another study, it is stated that mobile apps in healthcare have increased at a level acceptable to society [7]. Based on this information, it is thought that the mobile app can be a useful tool in managing the problems that may occur in a non-clinical environment, ensuring their participation in their care, and receiving consultancy services.

E-health, which is the use of electronic information and communication technology in the execution of health apps, is expressed as having a high potential for economic savings and integration into health systems worldwide [8]. Mobile health services are rapidly finding a place in healthcare [9]. Besides its use in maintaining health, it provides convenience in various fields such as patient follow-up and home patient care [10]. In recent years, individuals have had access to information and prefer the internet and mobile apps rather than printed media

✉ Aydanur Aydin
aydanuraydin_88@hotmail.com; aydin.aydanur@hotmail.com

[1] Faculty of Health Sciences, Nursing Department, Gumushane University, Gumushane, Turkey

[2] Faculty of Health Sciences, Nursing Department, Antalya Bilim University, Antalya, Turkey

such as brochures and books [11]. These apps facilitate access to information and interest, increasing reading and practice [7, 12]. In a study conducted with patients with breast cancer, it was observed that the mobile app developed to report symptoms and cooperate with the hospital contributed positively to the acceptance and process of the disease in patients [13]. Patients experience postoperative problems, and training methods such as brochures, consultancy, and booklets are used besides verbal expression to cope with these problems [14, 15]. It is reported that after training, women frequently used the internet (22.5–45%) to get information after breast cancer surgery [16, 17]. Based on this information, bringing evidence-based information together with the ease of use of mobile apps to the service of society will be one of the most important services that can be provided to these individuals. There are many websites on breast cancer organized by different individuals or institutions. However, studies investigating the functions and quality of existing sites are limited. This study aims to determine the functionality and quality of breast cancer apps available in the App and Google Play stores.

Methods

This research includes a systematic review of mobile applications. In this context, the PRISMA method was used to determine the applications and make the eliminations. The first author searched English and Turkish apps about BC from January 2018 to 2019. All the apps in the App and Google Play stores about BC within the defined time horizon were included in the study.

Inclusion criteria

Studies were eligible for inclusion if they met the following criteria:

- *Category*: "medicine," "health fitness," and "reference."
- *Type of cancer*: breast cancer
- *Application language*: Turkish and English

Exclusion criteria

Applications containing congress presentations, applications that introduce a company, device, or expert, and applications that require additional hardware (applications whose content cannot be accessed without access to virtual reality glasses, etc.) were not included in the research.

Search and selection strategy

This review was completed using the Primary Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [18]. PRISMA facilitated a systematic approach to the selection of mobile apps. The selection of mobile apps related to different subspecialties was searched in both the App and the Google Play stores. The sub-categories screened are "medicine," "health fitness," and "reference." The keywords used were "cancer," "oncology," "breast cancer," and "breast" in both Turkish and English. In total, 1683 English and Turkish apps were included.

App selection process

First phase All apps reached by keywords in the specified categories were recorded. Data for each app was categorized according to the app name and version number, the cost of the app (if applicable), and the presence of in-app purchases. Apps were selected according to the inclusion criteria of the study. These criteria it was in Turkish/English, free (with or without in-app purchase), designed for breast cancer, and containing information on early diagnosis or treatment. Registered apps were selected according to these criteria (Fig. 1). These criteria were decided in line with the literature [19, 20].

Second phase The apps to be included in the research were downloaded to the Apple iPhone X in the app store, and the ones in the Google Play store were downloaded to the Samsung Galaxy S5 by the first author (AA). A total of 707 apps were included, which were in 356 Google Play stores and 351 App stores (Fig. 1).

Third phase A checklist critically evaluated the apps. An Excel sheet was designed for data extraction because of the wide variation in the included apps. The first part of the datasheet is general information about the app and publication year. The second part included the number of downloads, star rating given by users, number of reviews, available for free, and developer ID. Finally, the third part of it is composed of BC early diagnostic methods, treatment options, and cancer prevalence. We extracted the following data: developer, user rating, available for free, BC education, BC treatment, and BC communication. The BC education included cancer information, a guide, lecture notes, and scientific journals. If in the treatment section were breast cancer symptoms, laboratory values, nutrition in cancer, and drug use, the other section contains communication, radiotherapy session, and patient-physician follow-up.

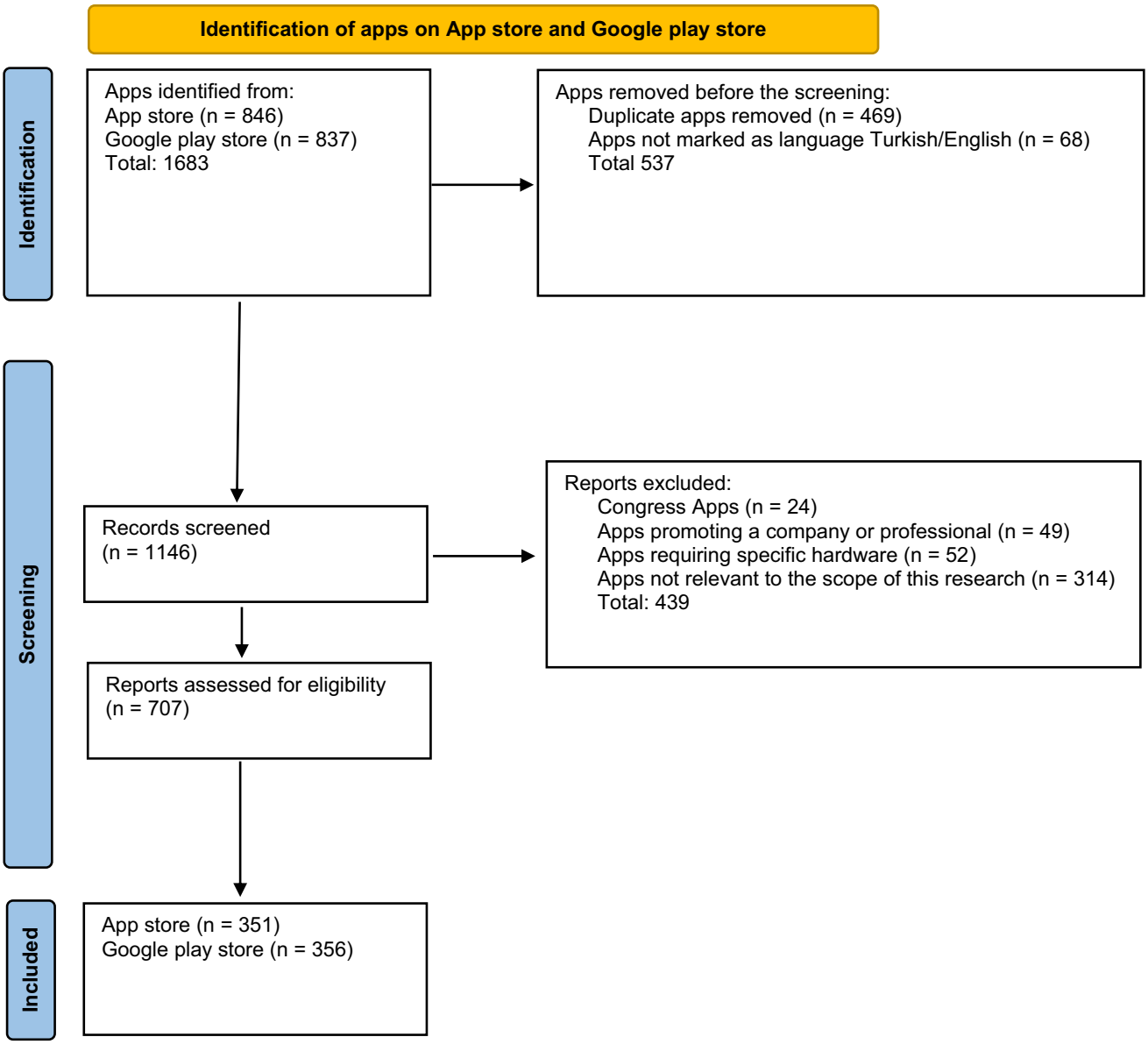

Fig. 1 Primary Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart for app selection

Fourth phase Evaluated all apps. The "Mobile Application Rating Scale" (MARS) scale evaluates the quality of apps. Developed by [21], the MARS measurement tool evaluates the qualities of the app in four sub-categories: (1) participation (entertainment, interest, customization, interaction, and target group), (2) functionality (performance, ease of use, navigation, gestural design), (3) aesthetics (layout, graphics, visual appeal), and (4) information quality (accuracy of app description, objectives, quality and quantity of information, visual information, reliability, evidence base). Each item is evaluated on a 5-point scale (1-inadequate, 2-poor, 3-acceptable, 4-good, 5-excellent). Overall quality score comprises of the mean scores of the interaction, functionality, aesthetics, and information quality subscales. Each app was evaluated with the MARS scale independently by two authors. If the authors gave different points to the same app, the average of the two authors' scores was accepted as the MARS scale score for that app. MARS score was given with standard deviation (SD) and 95% confidence interval (CI). The authors chose this method because it is used in similar application evaluations [22, 23].

Quality assessment

MARS section scores are calculated by taking the arithmetic mean of each item score in the section, while the

overall score is the arithmetic mean of the section scores (excluding subjective quality). Overall and department scores were shown as mean and range for each app. Apps were ranked according to their average MARS score. Both researchers scored the apps separately and the scores of both researchers were averaged and their differences were examined. It was seen that this difference did not create a significant difference between the raters.

Results

Characteristics of the selected apps

All apps were classified according to "education," "treatment order/plan," and "communication" in terms of their content. In the stores, it was determined that there were 71.2% apps for education, 25.2% apps for treatment, and 3.6% apps for communication. Of the apps in both stores, 38.2% of the app's content required internet access, and 17.1% access all the app's content required a purchase. The remaining apps allowed access to all their content when downloaded to the phone. Some of the apps do not have a user rating of 33.9%. There were 64.3% of apps developed by the corporation and most of the apps 51.0% received at least 4 stars (max: 5, Table 1).

Table 1 Characteristics of the breast cancer-related mobile app

Characteristics	App store ($n=351$) n (%)	Google Play store ($n=356$) n (%)
Education	235 (66.9)	268 (75.2)
Cancer information	53 (22.7)	88 (39.0)
Guide	72 (30.6)	53 (19.7)
Lecture notes	64 (27.2)	55 (20.5)
Scientific journals	46 (19.5)	56 (20.8)
Treatment	102 (29.1)	76 (21.3)
Breast cancer symptoms	31 (30.3)	22 (28.9)
Laboratory values	26 (25.5)	21 (27.6)
Nutrition in cancer	24 (23.7)	15 (19.9)
Drug use	21 (20.5)	18 (23.6)
Communication	14 (4.0)	12 (3.5)
Radiotherapy session follow-up	8 (57.1)	9 (75.0)
Patient-physician follow-up	6 (42.9)	3 (25.0)
Developer		
Corporation	251 (57.3)	203 (57.1)
Individual developer	150 (42.7)	153 (42.9)
User rating (stars)		
0	4 (1.1)	1 (0.2)
1	10 (2.8)	11 (3.1)
2	13 (3.7)	14 (3.9)
3	25 (7.1)	28 (7.8)
4	91 (25.9)	92 (25.8)
5	89 (25.4)	89 (25.0)
Missing	119 (34.0)	121 (34.2)

Breast cancer-related app MARS scores

According to the MARS score, approximately 25% of breast cancer-related apps scored four or five (min: 0, max: 5). The mobile apps got a full MARS scale point of 14.3%. It was found that 61.3% of mobile apps scored between 3 and 4 on the MARS scale average (Fig. 2).

The mean score of the subscales of MARS for apps in both stores was determined as 3.4 ± 0.6 (CI: 3.38–3.72). Mobile app MARS scores were found to be in the order of functionality (4.05 ± 0.57), aesthetics (3.70 ± 0.7), information quality (3.23 ± 0.74), and participation (2.34 ± 0.56). The mean MARS score of the apps in the communication group was 3.65 (SD: 0.31; CI: 3.57–3.95), the education apps were 3.21 (SD: 0.16; CI: 3.13–3.63), and the treatment apps were found to be 3.32 (SD: 0.41; CI: 3.29–3.52).

It was observed that the year in which the mobile apps were published positively affected the MARS scale total score ($p=0.02$). It was determined that the star scores given to the apps by the users significantly affected the functionality sub-dimension score ($p=0.01$). It was seen that the apps available in the two stores did not make a significant difference in terms of the MARS total score average ($p=0.03$).

Discussion

The research includes a comprehensive review of the functionality and quality of breast cancer-related apps available in stores. It includes analyses made using MARS, a valid and reliable measurement tool that evaluates the features and evaluation results of these apps.

The average score of mobile apps in both stores on the MARS scale was rated below "good" in the scale evaluation. According to the scale evaluation, this score is between acceptable and good. The mean score of the scale is considered high in terms of functionality. In a study examining two breast cancer apps was reported that the MARS scale score was above 4, supporting the use of patient groups, but insufficient to ensure data confidentiality [24]. In another study, it is pointed out that there is no standard for creating health-related mobile app content, but it is emphasized that only the modification of the contents by app developers creates a limitation [19]. Existing mobile apps can be useful in providing health counseling to special patient groups such as breast cancer.

The functionality of the apps included in the research received the highest score from the MARS assessment tool sub-category. It was seen that the functionality sub-category

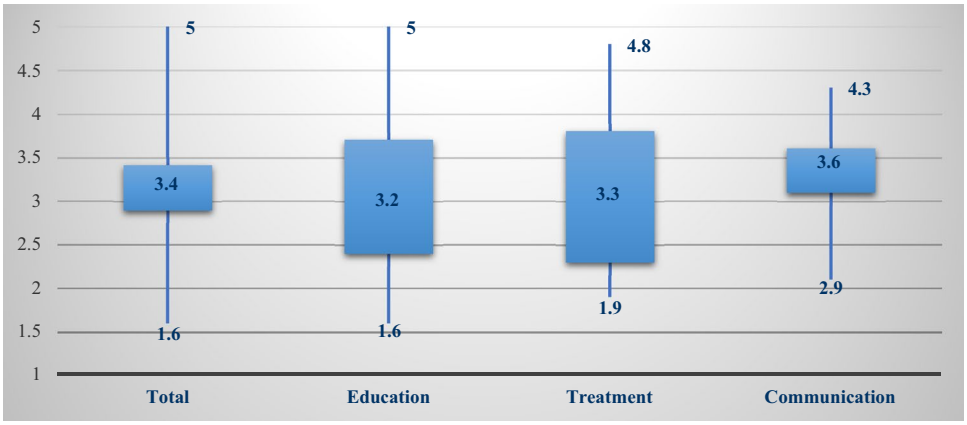

Fig. 2 The Mobile App Rating Scale overall and section-specific scores of the breast cancer-related apps ($n=707$). Note: The bottom and top edges of the boxes represent the first and third quartiles; the lines within the boxes represent the medians and the ends of the bottom and top whiskers represent the minimum and maximum values

was evaluated as "good." This result shows that the programs offer ease of use, performance, and navigation opportunities to the users and it is a very important feature for an app. In a study evaluating apps with a similar measurement tool in Australia, it was noted that the quality of weight management and health practices for children/adolescents was higher in functionality sub-category scores than others [25]. In a study examining pregnancy practices with a similar measurement tool, it was found that functionality scores were higher in MARS sub-categories than in others [20]. The lowest score of the information quality among other sub-categories of the MARS measurement tool is also similar to other studies [20, 25]. Besides these, it was observed in the study that the participation score was lower than in the other sub-categories. This shows that mobile app content is insufficient for entertainment, interest, personalization, and interactive features and needs improvement. It is seen that the features and effects offered to users by mobile apps produced in different cultures and languages are similar. In this context, it can be said that the features of mobile apps that need to be developed in the world are similar.

Mobile apps were not at the desired level in terms of information quality and participation, which are sub-categories of the MARS scale. Consulting a healthcare professional and having evidence-based information content are important parameters in evaluating mobile apps. Before using it, patients should make a risk calculation and pay attention to "predictability" [26]. In this situation, it is pointed out that it is possible to access non-evidence-aided, incomplete, or even incorrect information with mobile apps [27]. It can be said that the mobile app contents are in line with other research data and that experts evaluating the app contents and presenting them to the users in the stores will contribute to coping with these problems.

The mobile apps in both stores are evaluated as "acceptable" levels in terms of education, treatment, and communication. This section could not be discussed because there is no data on the sub-categories in the literature. However, it was observed that mobile apps in the communication section had a higher MARS score average than those in the education and treatment section. In the planning of mobile apps, although the apps in the education and treatment categories have high MARS scores in terms of functionality and aesthetics, it is seen that they are insufficient in terms of information quality and participation. In these categories, it is thought that the apps made by mobile app planners by paying attention to these sub-categories can achieve more successful results.

Mobile apps offer an extraordinary opportunity for patient follow-up, for a behavioral change in health because of their easy accessibility and high usability [28]. When mobile app contents are equipped with high evidence level information, they can turn into effective educational material. With the widespread use of mobile apps to be developed by healthcare professionals, transferring correct information will be easier [21]. Evaluating the MARS measurement tool in the production of health apps and deciding on the use of the app according to all sub-category scores may be behavior. In addition, this study is the first research in our country that includes the systematic process carried out to select apps and the use of the MARS measurement tool to evaluate the quality of its apps according to our knowledge.

Conclusion

Mobile health apps inevitably become widespread because of the advantages offered to patients and healthcare personnel. However, patients need mobile apps whose content is prepared with correct information. Only in this way can it be possible to manage different health problems that may occur. It has been determined that it is not a common practice for the app contents to be prepared by a healthcare profession. For an application to be prepared with health content, this situation should be changed and professional support from a health worker should be expanded. Examining previous

apps in the formation stages of an app, and determining the strengths and weaknesses in terms of both content and design will make contribute significantly to the researcher. There is a need for more researchers working in this field and apps prepared with the support of healthcare professionals for different patient groups.

Limitation

Our priority was to evaluate breast cancer and market-related functions to inform future app development. For this reason, all active practices related to breast cancer were included in the study. First, free apps were included in the research. These apps may be considered to providing basic information, but an in-app evaluation, functionality, participation, and aesthetic information were as important as the quality of information. For this reason, it can be stated that MARS measurement scores provide aim data. Second, although MARS has been validated with mHealth apps, its use for cancer-related apps has yet to be validated, particularly in terms of the quality of breast cancer information.

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Author contribution Study conception and design, AA; data collection, AA.

Data analysis and interpretation, AA and AG. Drafting of the article, AA and AG.

Critical revision of the article, AA and AG.

Data availability Not applicable.

Code availability Not applicable.

Declarations

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

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