Differences in the Use Characteristics of a Mobile App to Assess Dietary Behavior and Physical Activity Lifestyle Parameters in Two Different Age Groups of Breast Cancer Survivors: A Pilot Cross-Sectional Study

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Master´s Programme in Nutrition, 60 credits
Nutrition Degree Project, 30 credits
Course Code: 3NT004

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Date: 2022-05-22

Abstract

***Background*:** While breast cancer survivorship is increasing globally, mobile health (mHealth) interventions are used to promote the patients' health. However, considering the digital divide among older individuals, there is a lack of knowledge regarding the mHealth use characteristics in different age groups of patients to design efficient health technology tools. ***Aim*:** To compare the use characteristics of the REBBECA mobile app between younger and older breast cancer survivors. ***Methods*:** 24 breast cancer survivors residing in Stockholm were enrolled in this pilot cross-sectional study to use the REBECCA app for one week. 12 participants were recruited in each group (≤60 and >60 years old). The primary outcome was the level of app usage measured through the app logging mechanisms. User evaluation metrics were assessed with the system usability scale and user experience questionnaires completed after one week of the app usage. Also, the app's most and least liked features were qualified using open-ended questions. ***Results*:** There was no statistically significant difference between younger and older patients regarding the REBECCA app usage and its perceived user experience. Participants liked several app features, such as ease of use, built-in camera function, and simplicity. Moreover, the highlighted improvement areas were the annotation choices when registering food and stressors, and the presentation of stored data. ***Conclusion*:** The REBECCA app use characteristics were not significantly different between younger and older breast cancer survivors. Nevertheless, long-term research with a larger and more representative sample is required to investigate the link between patients' age and this app's use.

Introduction

In 2020, 2.3 million women were diagnosed with breast cancer throughout the world (1). It was also reported as the most common cancer globally (1) and in Sweden (2). Moreover, the breast cancer survivorship rate is rising worldwide, and it is expected to increase due to the significant advances in treatments and early diagnosis (3). However, this growing rate of survivorship results in increased disability-adjusted life-years, which are linked with considerable medical costs, reduced productivity, and other long-term health impacts (4). Therefore, apart from the survivorship, quality of life has now become a noteworthy disease outcome that is assessed in research investigating breast cancer and its survivorship (5). In this pilot, breast cancer survivor refers to women previously diagnosed with breast cancer who have successfully finished their primary treatments, such as surgery, radiation therapy, chemotherapy, hormone therapy, and immunotherapy (6).

The leading cancer organizations have stated several lifestyle recommendations for breast cancer survivors to increase their quality of life, such as maintaining healthy body weight, having regular physical activity, and consuming a mostly plant-based diet. However, adherence to such recommendations is usually low among this population (7). Therefore, several methods are used to assess patients' lifestyle parameters, such as diet and physical activity, to increase adherence to these recommendations. Despite the extensive use of the established assessment methodologies, such as accelerometry, direct observation, daily records, and 24-hour dietary recall in various populations (8), these traditional approaches include several limitations, such as being costly, time-consuming, burdensome for respondents, and dependent on the patient's memory (9). Hence, there is still a need for better assessment methods that are precise and accurate, user-friendly, time- and cost-efficient for both researchers and participants, and without the demand for specialists' presence. These tools are necessary to offer objective and meaningful information: (a) to the survivors themselves, (b) to the supervising health professionals, and (c) to relevant clinical researchers.

Suitable alternatives for the traditional interventions could be Mobile health (mHealth) applications (10). The World Health Organization has defined mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices" (11). These technologies offer numerous benefits such as immediate and individualized feedback, self-directing data collection, and low cost (8). Additionally, smartphones are likely to be used in health interventions and sizable monitoring due to their omnipresence in society (12). Statista reports a global penetration rate of 78.05% for smartphones in 2020 (13). Also, in Sweden, the monthly active smartphone use rate is reported as 90%, and this percentage is expected to reach 96% by 2025 (14).

To date, mHealth and eHealth technologies have been used in several studies for data collection or lifestyle promotion in different populations (12, 15, 16). Some studies have shown the influence of sociodemographic factors such as age on the use of health apps among adults. These studies reported that younger individuals were more likely to use mHealth apps than older individuals (17, 18). Similar findings have been reported for cancer survivors (19, 20). Correspondingly, two survey-based studies, one in the United States (19) and one in Sweden (20), reported a lower health-related internet use among older cancer survivors compared to younger patients. Although mHealth technology has been used in several interventions to promote breast cancer survivors' health, the age-specific use of these tools was not assessed in these studies (21-24). Only in one of these interventions, participants who declined to participate were significantly older than those who accepted to participate (24).

Furthermore, older breast cancer survivors experience both adverse treatment effects and health issues related to aging (25). Therefore, considering the large and increasing proportion of this population, their special needs (25), and the lower technology use among older adults (17, 18), research is warranted to design relevant and effective mHealth tools for this population. To the best of our knowledge, less is known about the differences in the use characteristics of mHealth technology in different age groups of breast cancer survivors. Acquiring more understanding in this area will provide helpful information for designing mHealth tools based on the specific needs of patients of all ages. This could result in more efficient mHealth interventions by bridging the digital divide in the older population using this mobile application and similar mHealth tools.

We used and evaluated the REBECCA app, a custom-built mobile application, for data collection in this pilot. It is part of the REBECCA system, a monitoring platform that uses smartphones to collect real-world data (RDW). This is a European Union (EU)-funded project that will provide a combination of clinical data and RWD describing women's physical activity, eating habits, and self-report measurements to promote breast cancer survivors' health.

This pilot aims to investigate the differences in using the REBBECA mobile app for lifestyle monitoring in two age groups of breast cancer survivors (below and above 60 years of age). The goal of the pilot is to identify possible barriers in the specific mobile app, potentially relevant for younger or older patients, to support optimized app versions in the future. This study aims to determine whether older breast cancer survivors differ from younger patients regarding the REBECCA *app usage*. The secondary aims were to specify the differences in the user evaluation metrics of the REBBECA app in the younger vs. the older patients, and the other secondary aim was to obtain an insight into the users' most and least liked features of the REBECCA app.

Methods and Materials

Study Design and Setting

A cross-sectional single-center pilot study was conducted to investigate the differences in using the REBECCA mobile app for monitoring dietary behaviors and physical activity lifestyle parameters in 2 different age groups of breast cancer survivors (≤60 and >60 years old). This study was the 2nd Phase of a REBECCA study conducted from April to May 2022 in collaboration with AMAZONA's locale, the oldest and largest local breast cancer association in Stockholm County. The data collection was performed remotely through the REBECCA mobile app for one week. This study was approved by the Swedish Etikprövningsmyndigheten prior to the recruitment of participants. Dnr: 2021-03982.

Participants and Recruitment

The sample included breast cancer survivors residing in Stockholm, Sweden, who were members of the AMAZONA breast cancer patient association. Based on the eligibility criteria for inclusion in the study, patients had to: i) be 18 years of age or older; ii) be able to speak and read Swedish; iii) have finished their primary breast cancer treatment within the previous 10 years (self-reported); iv) own an Android or iOS smartphone, and v) have daily access to the internet. Exclusion criteria for participation were: i) current cancer recurrence; ii) the presence of medical conditions such as dementia, anorexia, or any other condition that might independently affect the use of the REBECCA mobile app. Finally, iii) those who self-reported limited technological and mHealth literacy to use the app were also excluded. Study participants were mainly recruited from breast cancer survivors involved in the previous phase of the REBECCA study (Phase 1). During Phase 1 (conducted Nov-Dec 2021), the patients visited the AMAZONA locale, where they provided data to support the online behavior analytics of the REBECCA system. While Phase 1 supported the recruitment for this effort, it is not relevant to the present report and is not further expanded upon here. All participants in the Phase 1 REBECCA data collection were contacted again via email in April 2022. Out of the 25 previous participants, 22 agreed to participate in this data collection phase (Phase 2). Also, 2 new individuals, who could not participate in the previous part due to late response, were recruited for this part. Participants were recruited into two age groups, breast cancer survivors younger or equal to 60 years of age (n=13) and breast cancer survivors older than 60 years of age (n=11).

REBACCA App Description

REBECCA is a lifestyle monitoring mobile app developed by a technical team at the Aristotle University of Thessaloniki. This app was used and evaluated in this study to collect data from breast cancer survivors. Prior to the data collection, the study staff performed the app's technical test in 2 phases. In the first phase, severe problems with the app and generic feedback to improve the app's usability were reported to the technical team. In addition, during the second phase, the quality of the collected data was tested. The app consists of several basic components. The main screen includes a graph showing the amount of the user's data contribution, a manual sync button, a button to capture and annotate photos, and a menu bar (Figure 1A). Once a user installs the app, an anonymous random nickname is suggested to them as their username. The app collects continuous GPS locations from the mobile, intending to use them to evaluate the user's lifestyle habits. On the main screen, the data contribution graph displays the number of the user's photos, questionnaires, and location sessions uploaded to the server. The data is either automatically or manually synced with the server in the presence of the internet. In addition, participants can capture and annotate their

meal/drink/environmental stressors by clicking on the photo button and selecting a category (e.g., meal: breakfast, lunch, dinner, snack). After choosing the photo categories, users can capture the photo, retake/save it, and provide annotations for it. For example, if a user uploads a picture of fruits and nuts, they can select "meal">> "snack">> "fruit/salad" and "legumes or nuts">> "finish" (Figure 1B). In the menu bar, there is a “questionnaire” section (Figure 1C), offering several questionnaires related to patients’ reported outcomes measures (e.g., fatigue questionnaire).

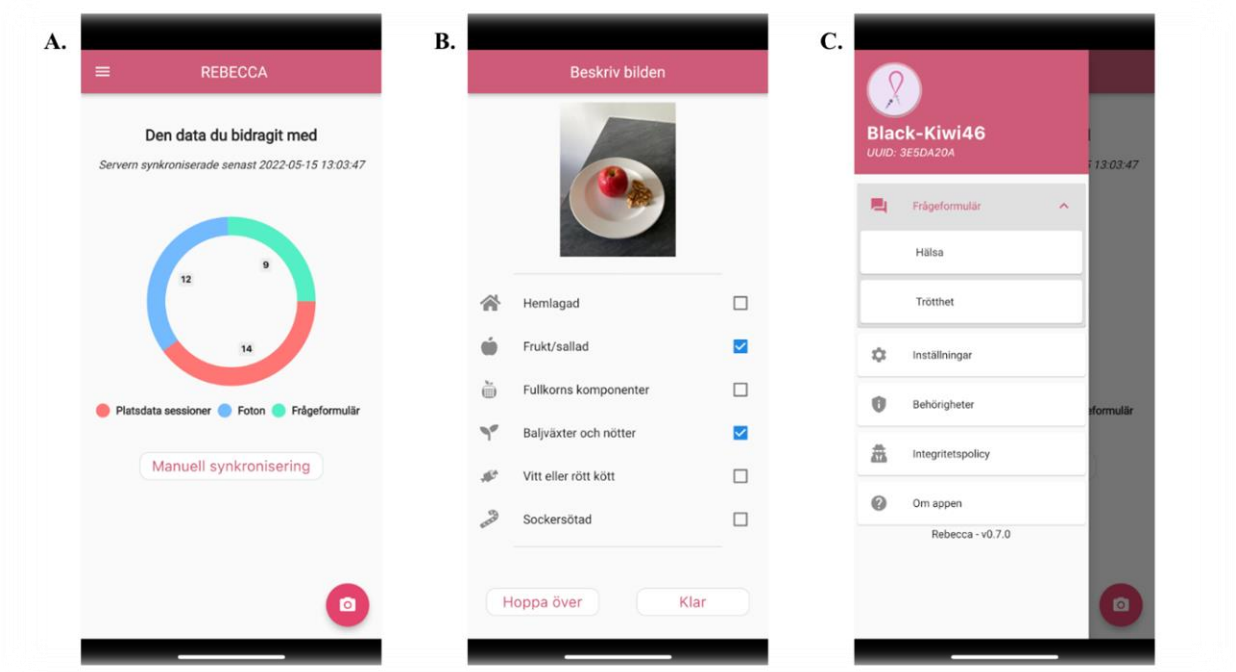

Figure 1. A. The REBECCA's main screen including the user contribution graph, manual sync button, photo button, and menu bar, B. An example of a meal photo annotation, and C. The menu bar including questionnaires, setting, permissions, privacy policy and information about the app

Instruments and Outcome Measures

Demographic characteristics: Participants’ age, education, and the time since their latest breast cancer diagnosis were assessed using a short online questionnaire built-in Redcap. Participants in Phase 1 REBECCA data collection had already completed this questionnaire in November 2021, and their previous data was used. However, the new participants were asked to complete the same questionnaire at the beginning of their participation.

The REBECCA app usage (primary outcome): It was assessed through the active user-app interaction and the volume of recorded GPS data, using automated mobile app logging mechanisms. The active user-app interaction was quantified through the summation of picture-taking instances, and the answers to daily questionnaires after one week of using the REBECCA mobile app. The volume of recorded GPS data in the REBBECA app was quantified by the number of GPS points recorded by the app per week. These parameters were compared between the two age groups. These data were also compared with subjectively collected data through the patients' self-report after the evaluation process. This was estimated by assessing the patients' answers to a question by asking how many times per day they interacted with the app.

User evaluation metrics about the REBECCA app (secondary outcome): This was measured and compared between the groups using system usability scale (SUS) and user experience questionnaire (UEQ). Both questionnaires were embedded in a form named Feedback questionnaire, built through the Redcap web application. The Feedback questionnaire was electronically distributed and completed by the participants. SUS questionnaire was used to measure the usability of the REBECCA app. It consists of 10-item with five response options, ranging from "Strongly agree" to "Strongly disagree". A SUS score of more than 68 is considered above average, while anything less than 68 is considered below average (26). The UEQ includes 26 items and assesses the app's user experience using six scales: *Attractiveness; Perspicuity; Efficiency; Dependability; Stimulation;* and *Novelty*. Each item consists of a 7-point scale, labeled at the two extremes (e.g., boring vs. exciting) (27). It is available in 21 languages, and its Swedish version has been used in this study. The participants' overall evaluation of each item determined the analysis outcomes. While the values of -0.8 and 0.8 for an item demonstrate a neutral response, values below -0.8 and above 0.8, respectively, indicate the users' negative and positive evaluation of that item (27).

Most and least liked features of the REBBECCA app (secondary outcome): Two open-ended questions were embedded at the end of the Feedback questionnaire, asking about at least 2 of the REBECCA app's features that the participants liked or thought needed further improvement.

Data Collection

Following the recruitment, patients assigned to participate in both age groups were invited in groups of 2 to 4 for a 1 hour informational and study setup meeting at AMAZONA's locale. There, participants downloaded the app by scanning a QR code and finally got access to it with a password given to them. They also received written and oral instructions on using it during data collection. Additionally, they signed a new informed consent covering their participation and the use of data for Phase 2, specifically. During the data collection period, the app constantly captured the users' GPS signal, allowing the automatic estimation of lifestyle mobility (e.g., time at home vs. time outside). In addition, the participants were asked to record their meals and drinks using the inbuilt picture-taking feature, which also incorporated simple meal/drink annotations, inspired by UK's recommendations for a better diet for cancer patients (28). They were asked to upload and annotate at least five meal/drink pictures (e.g., lunch, dinner, snack, drink) per day and at least five environmental stressors per week. Environmental stressors were explained to them as everything in their environment that affect them negatively (e.g., a crowded bus, a busy road, barking dogs, a queue in the grocery store). Participants were also asked to answer a short questionnaire once a day which they were reminded of with a push notification every evening. Moreover, to avoid missing data due to technical problems with auto-syncing, participants were asked to sync the app manually with the server every day at noon. During the data collection, participants could contact the study staff to receive technical support or ask questions regarding the use of the app. After one week, all participants who completed the data collection took part in 1-hour follow-up meetings in groups of 3 to 4. Meetings were arranged either in person or via Zoom based on the participants' preferences. After completing the online Feedback questionnaire during these meetings, participants expressed their verbal feedback about their experiences using the REBECCA app. After one week of data collection and completing the follow-up session, participants were asked to continue using the app for two more weeks. Analysis of the data from the additional two weeks of the app usage and verbal feedback of the users in the follow-up meetings is ongoing in the REBECCA project and is not included in this report.

Statistical Analysis

Regarding SUS results, the scores were interpreted by converting participants' scores for each question to a new number, adding them together, and multiplying them to 2.5 to achieve 0-100 scores (26). The data from UEQ was primarily processed using a data analysis tool in an excel sheet provided by the UEQ team (29). The patients' sociodemographic characteristics were compared between two age groups using Chi-squared tests with frequencies and percentages. The normality of the data was controlled using descriptive statistics. Non-parametric tests were used for comparisons due to the non-normality in the data distribution. Mann-Whitney U tests were performed to compare the REBECCA *app usage* and the user evaluation metrics of the app between the two independent groups. A Wilcoxon signed ranked test was carried out to compare the level of interactions between the first and last two days of the data collection period. In addition, thematic analysis was performed using the Braun and Clarkes guidelines (30) for the open-ended questions. P-values less than 0.05 were considered statistically significant, and all analyses were performed using IBM SPSS version 27.0 for Mac.

Results

Demographic characteristics

The demographic characteristics of both younger (n=11) and older patients (n=11) who completed the data collection are presented in Table 1. The proportion of higher-educated participants was equal in the younger and older group (7 in each group; 63.6%). 90% of the younger participants and 73.7% of the older participants received their latest breast cancer diagnosis within the last five years. No significant differences between the age groups for having higher education (p=1.00) and receiving a breast cancer diagnosis within the last five years (p=0.26) were observed. All recruited participants received instructions on how to use the REBECCA app. One participant decided to leave the study due to the lack of time. One dropped out of the study due to the technical issues related to downloading the app. The objective data of two participants were missing because of a technical problem disrupting the synchronization of their data to the server. Two participants did not attend the second meeting to complete the Feedback questionnaire. The study flow chart is presented in Figure 2.

Table 1. Demographic characteristics of the patients by age

Characteristics	Total (n=22)	Younger (n=11, 50%)	Older (n=11, 50%)	χ^2	p-value[3]
Having higher education[1], n (%)	14 (63.6%)	7 (63.6%)	7 (63.6%)	0.00	1.00
Received diagnosis within the last 5 years[2], n (%)	18 (81.8%)	10 (90.9%)	8 (73.7%)	1.22	0.26

n, Number of participants

[1] refers to any university degree

[2] with reference to the year 2022

[3] The statistical comparisons were performed using Chi-square tests

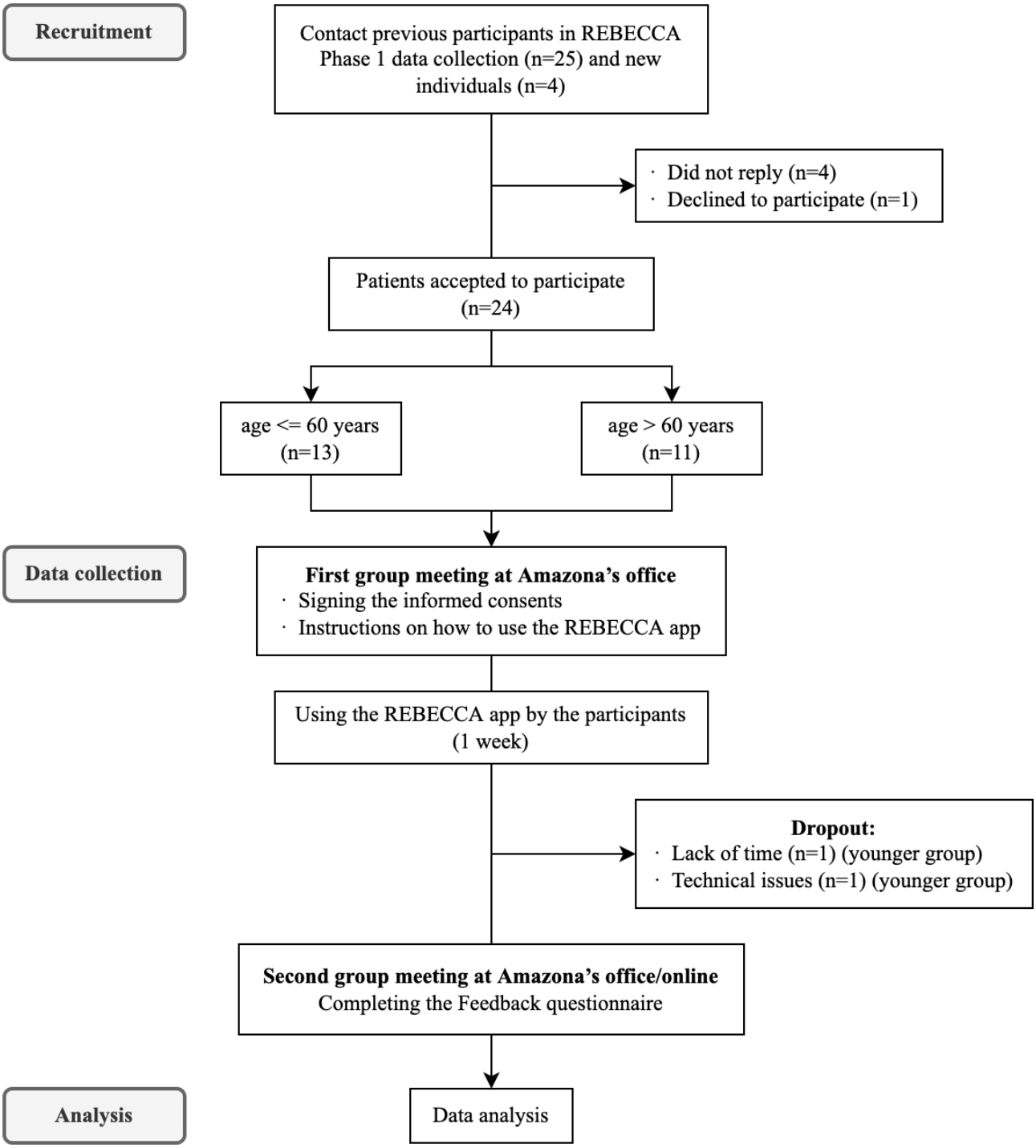

Figure 2. The study flow chart

The REBECCA app usage

Table 2 provides results comparing the REBECCA *app usage* during the one week of the REBECCA app use between the two age groups. No significant difference was found between the level of active interaction per week (i.e., the number of reported questionnaires and photos) with the REBECCA app for the younger compared to the older group (58.6 ± 22.86 vs. 46 ± 18.45 interactions/week, p=0.4). Also, the volume of recorded GPS data for one week of the app use was not significantly different between the younger and the older patients (10512.29 ± 7938.8 vs. 17792.78 ± 18959.9 recorded GPS points/week, p=0.63).

Table 2. The REBECCA app usage comparison between the two age groups

	Total	Younger	Older	Z	p-value[5]
	Mean ± SD	Mean ± SD	Mean ± SD		
User-app active interactions/week[1]	52.3 ± 21.23 (n=20[3])	58.6 ± 22.86 (n=10)	46 ± 18.45 (n=10)	-0.83	0.4
Photos/week	41.05 ± 20.02	47.8 ± 22.86	34.3 ± 14.94		
Questionnaires/week	11.25 ± 3.86	10.8 ± 2.61	11.7 ± 4.92		
Volume of recorded GPS data/week[2]	14607.56 ± 15193.59 (n=16[4])	10512.29 ± 7938.8 (n=7)	17792.78 ± 18959.9 (n=9)	-0.47	0.63

n, Number of participants; SD, Standard deviation

[1] The number of recorded photos and questionnaires per week

[2] The number of recorded GPS data per week

[3] Data from 2 participants was missing due to technical issues related to synchronization

[4] Data from 6 participants was missing due to the technical issues in their phones disrupting the GPS data capturing

[5] The statistical comparisons were performed using Mann-Whitney U tests

User app's evaluation metrics

The SUS scores for the REBECCA app, calculated by the SUS formula, are presented in Table 3 and Figure 3, by age group. The overall SUS score of the whole sample (n=20) was 68.12 out of 100, indicating an "average" usability for the app (26). The SUS score for the younger users did not significantly differ from the older users' ratings (70.35 vs. 65.9, p=0.82). The overall results of the UEQ for the whole sample (n=20) are presented in Figure 4 and Table 3. Among all the items, *Perspicuity* had the highest average score (1.2 ± 1.12). Figure 4A shows the relative results of the UEQ compared to the UEQ benchmark dataset, comparing the results of the REBECCA app to the other products (31). The overall average of *Attractiveness* score was 0.2 ± 0.93; *Efficiency* 0.43 ± 0.99; *Dependability* 0.3 ± 0.69; *Stimulation* -0.02 ± 0.93, and *Novelty* 0.2 ± 1.02 (Table 3). Table 3 also compares the results of each UEQ item for the REBECCA by age group. No statistically significant difference was shown for any of the UEQ items' value (*Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation* scale, and *Novelty*) between the groups (p= 0.7; 0.93; 0.25; 0.42; 0.37; 0.97). Figure 4B shows the overall UEQ results by grouping the UEQ scales into 3 categories: *Attractiveness*, *Pragmatic quality* (*Perspicuity*, *Efficiency*, and *Dependability*) describing the quality aspects of the app, and *Hedonic quality* (*Stimulation* and *Originality*) describing the non-task related quality aspects.

Table 3. The comparison of the REBECCA app' use metric evaluation between the two age groups

	Total (n=20[1])	Younger (n=10)	Older (n=10)	Z	p-value[2]
	Mean ± SD	Mean ± SD	Mean ± SD		
SUS score	68.12 ± 31.9	70.35 ± 27.8	65.9 ± 36.94	-0.22	0.82
UEQ score					
Attractiveness	0.2 ± 0.93	0.26 ± 0.79	0.13 ± 1.09	-0.38	0.7
Perspicuity	1.2 ± 1.12	1.22 ± 1.21	1.17 ± 1.09	-0.07	0.93
Efficiency	0.43 ± 0.99	0.7 ± 1.01	0.17 ± 0.95	-1.14	0.25
Dependability	0.3 ± 0.69	0.42 ± 0.68	0.17 ± 0.7	-0.8	0.42
Stimulation	-0.02 ± 0.93	-0.17 ± 0.79	0.12 ± 1.08	-0.88	0.37
Novelty	0.2 ± 1.02	0.17 ± 0.95	0.22 ± 1.13	-0.03	0.97

n, Number of participants; SD: Standard deviation; SUS: System usability scale; UEQ: User experience questionnaire

[1] Data from 2 participants was missing due to uncompleted questionnaires

[2] The statistical comparisons were performed using Mann-Whitney U tests

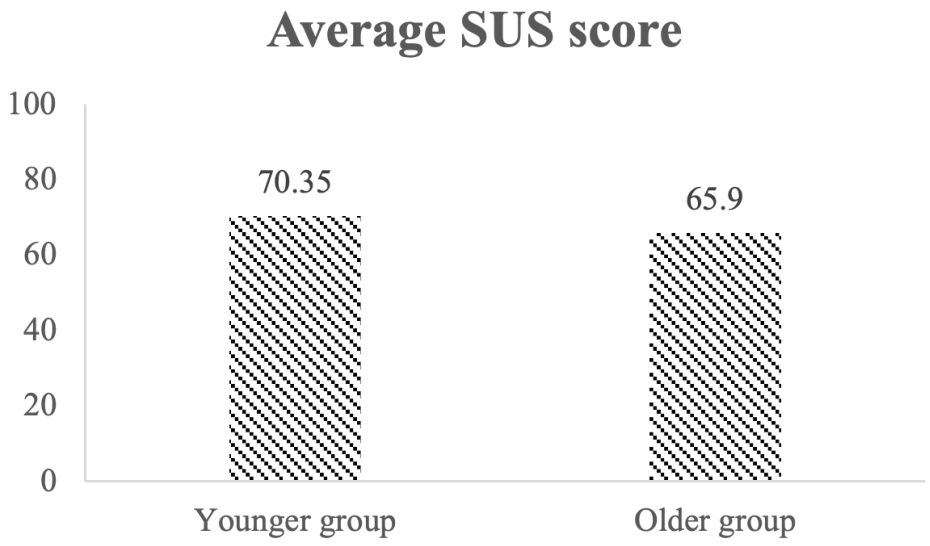

Figure 3. The average SUS scores for the REBECCA app by age group

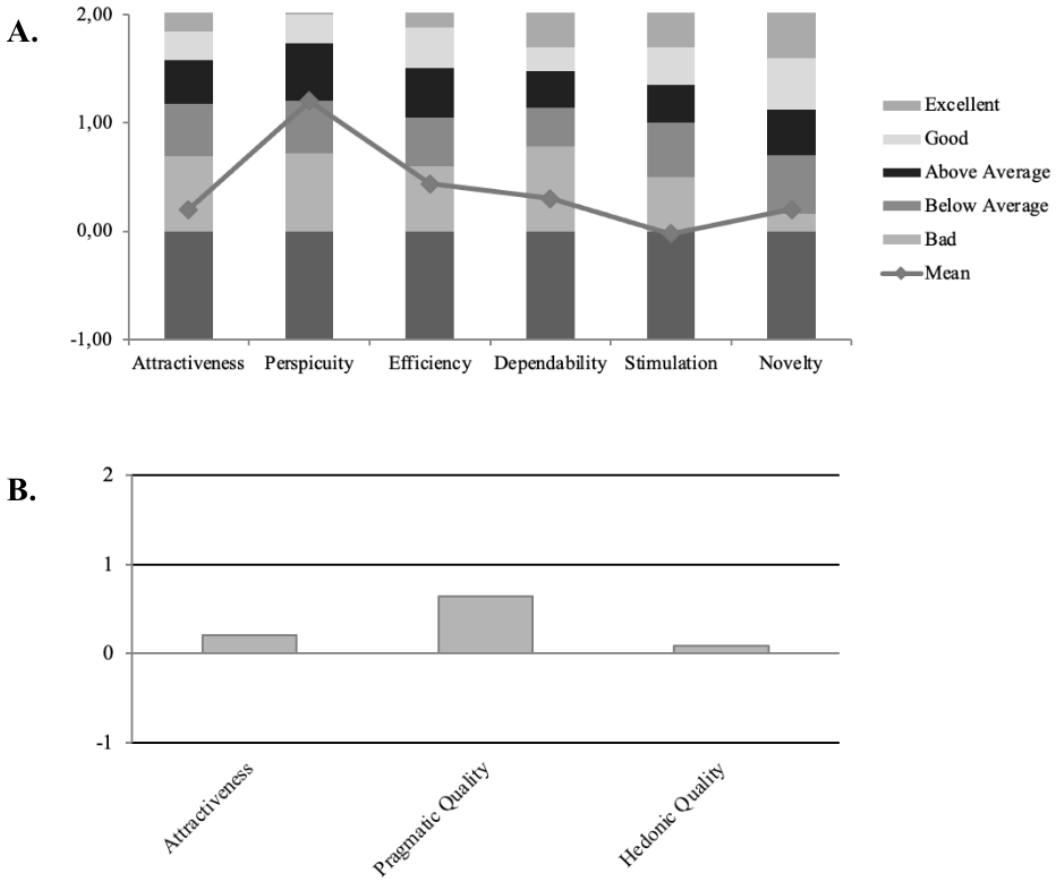

Figure 4. Results of the UEQ scale, A. The value of each UEQ item for the whole sample compared to the UEQ benchmark dataset, B. the overall UEQ results by grouping the UEQ scales into 3 categories: Pragmatic quality; Hedonic quality; Attractiveness

Most and least liked features of the REBBECCA app

Table 4 presents the three most frequently mentioned features of the REBECCA app that the users appreciated and, similarly, those they wished to be improved, as mentioned in the two open-ended questions included in the Feedback questionnaire. Ease of use, the photo capturing function in the app, and simplicity (mentioned 8, 6, and 5 times, respectively) were the most appreciated app characteristics by the participants. The most frequently mentioned aspects that should be improved were: "lack of appropriate alternatives for food annotations (8 times)", "lack of appropriate alternatives for stressor annotations (8 times)", and "lack of the ability to see the history of their logged data (4 times)".

Table 4. Most and least liked features of the REBECCA app

Most liked features	Mentions	Least liked features	Mentions
Ease of use	8	Lacking stressor annotation alternatives	8
The photo capturing function	6	Lacking food annotation alternatives	8
Simplicity	5	Lacking logged data history	4

Descriptive app use characteristics across the whole sample

Figure 5A represents a graph of the trend of active interactions with the app at the beginning vs. end of the data collection period (one week) across the whole sample. There was no statistically significant difference in the level of active user-app interaction between the first and the last two days of data collection in the Wilcoxon signed-rank sum test (14.5 vs. 12.45 interactions/2 days, $p=0.16$). The time distribution of interactions during a week of use of the REBECCA app across the whole sample is visualized in Figure 5B. The active interactions with the app were lower in the morning (14%) compared to the rest of the day (28-29%). Figure 5C shows the proportion of each photo category captured across the whole sample during one week of data collection. The proportion of reported snacks (38%) was higher than the other photo categories, which included: breakfasts (13%), lunches (11%), dinners (14%), drinks (13%), and stressors (11%)). In addition, according to the self-reported data, 17 out of 20 participants, regardless of their group, answered that they interacted with the REBECCA app 4-6 times per day. This number is slightly lower than the level of active interaction measured objectively (7.4 interactions/day) through the app's logging mechanisms.

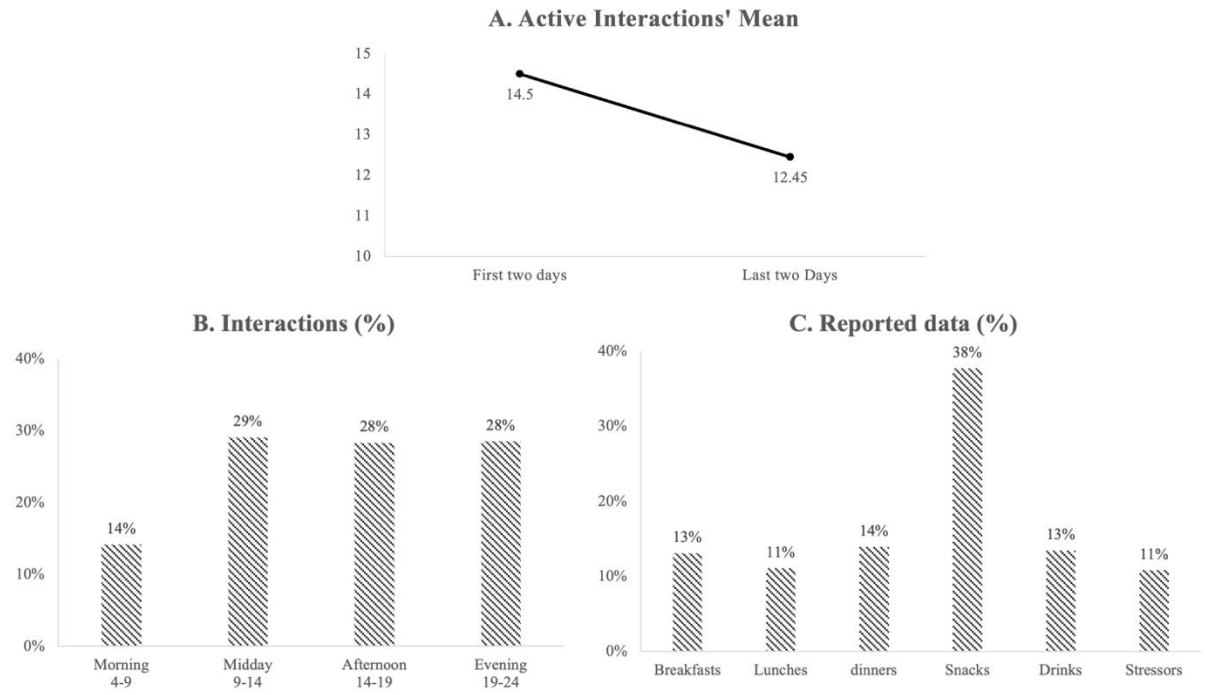

Figure 5. Descriptive app use characteristics across all the participants, A. The trend of active interactions with the app at the beginning vs. end of the data collection period (average interactions/2 days), B. The time distribution of interactions during the week of use of the REBECCA app (%), C. The proportion of each type of photo captured by participants during one week of data collection (%)

Discussion

Principal findings

This master thesis investigated the differences between younger and older breast cancer survivors regarding the REBECCA app use characteristics. This report indicates no significant difference between younger and older breast cancer survivors in the REBECCA *app usage* and the patients' perceptions of the app's user experience. In addition, regarding the most and least liked app features, the ease of use, the simplicity, and the inbuilt picture-taking functionality were the features that the users liked about the REBECCA app. Moreover, three requested improvements for the app were to add more relevant and comprehensive alternatives for food and stressor picture annotations and the presentation of the user's data-logged history. Furthermore, our study shows no significant difference between the level of active interaction with the REBECCA app at the beginning and end of the one week of app usage. Regarding the distribution of user-app interaction, the participants had the lowest interaction with the app in the morning (until 9 AM), while the most uploaded type of photographic data was in the "snack" category. Moreover, the objective measured number of interactions per day was more than the amount that the participants perceived.

Relation to current and relevant literature in the field

REBECCA app usage

We found that there was no significant difference between younger and older breast cancer survivors in the REBECCA *app usage*. This is in line with the results of the previous randomized control trials investigating the use of mHealth and eHealth in cancer survivors, where no significant association

between their age and *app usage* was observed (32, 33). These studies used a similar approach to measure *app usage* (i.e., using the user's logs on the server). On the other hand, these findings contrast with the majority of previous research that looked at the influence of age on mHealth/eHealth tool usage (18, 34, 35). Commonly those indicate a lower health technology use among seniors than younger adults (18, 34, 35). However, most of these studies used self-reported rather than objectively collected data, which might introduce sources of self-reporting bias in their findings (9).

Potentially explaining these discrepancies, Jiang et al. (36) have previously reported that the difference in using mHealth between younger and older patients with cardiovascular diseases was due to the technology literacy, not due to the age of the users. The important role of technology literacy in using health apps could explain our results, as our sample was relatively well educated (63.6% had higher-level education) and probably had relatively high levels of technology skills. Indeed, in a previous, non-published effort by the REBECCA project, when 511 AMAZONA members participated in a technology literacy survey, 94% reported daily internet usage. Since the Amazona members were this study's main recruitment pool, it is expected that our sample shared these characteristics.

Moreover, an additional previously indicated factor for the lower rate of app adoption in older adults has been the lower rate of mobile device ownership in that age group (37). A national survey-based study investigating age differences in health technology use (37) indicated a lower rate of health *app usage* among older adults in the United States. However, adjusting the analysis for the ownership of technology devices revealed the critical influence of technology device ownership on the link between age and health technology use (37). Thus, the increasing proportion of older individuals living in Sweden who have access to the internet at home (38) and the high rate of smartphone user penetration in this country (14) could justify the similarity in the mHealth use between younger and older patients in our results.

Finally, the type of mHealth technology and specific design characteristics for older people are two additional potential explanations for this population's lower use of health technology. Although some studies agree on the association between age and health app use (18, 34, 35), this association varies for different types of mobile apps (17). For instance, while the users of fitness apps tend to be younger, the usual users of self-care and vital apps tend to be older (17). This variation of mHealth tool characteristics can also be viewed as the underlying reason for the inconsistent reports about the association between age and mHealth *app usage* in the domain.

User app's evaluation metrics

The patient-reported subjective evaluations of the app were performed using two standardized user questionnaires specifically designed for digital tool evaluations.The overall SUS score was 68.12, indicating average usability for the REBECCA app. However, the significant standard deviation (31.9) from the mean SUS score across the whole sample (i.e., the high coefficient variation) reveals the low agreement among the users on this evaluation metric. Regarding age, no significant difference in perceived app usability between younger and older patients was observed. This finding is similar to those reported by Jaana et al. (39), where the older adults and the general adult population were not significantly different regarding user satisfaction with a self-tracking mHealth app (39).

Similarly, the results of the UEQ evaluation did not vary based on patients' age groups. According to the overall UEQ results, the REBECCA app, in general, was not attractive to the participants. Although the app needs improvements in both pragmatic and hedonic aspects, its overall pragmatic quality was rated higher than the hedonic quality. These results are not surprising as the app was in its initial development stage. In addition, considering the UEQ results of the whole sample, perspicuity was the highest-rated dimension of the app. This indicates that learning how to use the app easily is the best aspect of its perceived user experience. However, our findings are difficult to compare with others in the field, since the analysis outcomes are related to the particular eHealth/mHealth tools and each user group's specific characteristics and needs. Also, the lack of studies for young vs. older users, especially in the domain of breast cancer, is a limiting factor to the comparison of this study's outcomes to other reports. Overall, there is still room for improvement in the REBECCA app regarding its user experience and usability. It is expected that improving these characteristics will, in the future, result in a higher usage rate of the app.

The most and least liked features of the REBECCA app

The open-ended questions revealed the potential factors influencing the REBECCA app's weak user experience evaluation. Participants mentioned the app's ease of use, built-in camera function, and simplicity as the most liked features. Similarly, in one study investigating breast cancer survivors' preferences for mHealth intervention features, the users mentioned the importance of an app being easy to use (40). In addition, one literature review reported the importance of ease of use and using visual materials for apps designed for patients with chronic diseases (34). These results were not unexpected since ease of use is one of the crucial factors for the acceptability of mHealth technology (41). Additionally, the low burden related to the image-based dietary assessment (IBDA) (42) for the patients compared to the other dietary assessment methods such as weighted food records and 24-hours food recalls could be the reason for the popularity of the built-in camera function. This dietary assessment method also has some advantages for the researchers, such as quick and easy data collection and a lower risk of recall bias (42).

REBECCA app users also mentioned a lack of appropriate alternatives for annotating stressors and food in the app. While some nutrition apps using the IBDA method demand the users' written or voice descriptions to support the app in identifying the food items in the pictures (43), the idea for the design of the REBECCA app's dietary assessment feature was to provide quick and straightforward annotations to describe the food images. This design reduces the users' burden and is more likely to be used for a long period of time. Therefore, we used a limited number of food annotations relevant to several food components (e.g., whole grain components, white and red meat, fruit/salad). In addition, one aspect that breast cancer survivors believed needed improvement in mental health apps was the lack of tailoring the technology to the specific needs of the patients, as the tested tool was not perceived as relevant, specifically to breast cancer (44). The authors note that it is important to tailor health technologies considering the end-users need to increase engagement with the app (44). In general, it has been noted that tailoring apps to the patient's requirements can also improve health care delivery to patients with different cultures and characteristics (45). For instance, adding more annotation alternatives for stressors relevant to breast cancer survivors living in Sweden could improve the usability outcomes for the REBECCA app. Also, regarding food logs, a comprehensive list of food annotations that covers all food groups and is relevant to the socio-cultural characteristics of the target group is crucial.

Finally, the patients' request to be able to look back on their logged history was also mentioned in another study investigating breast cancer survivors' preferences for mHealth (40). A report from Lee K et al. (46) evaluating a personal health record app also indicates that using the self-monitoring feature in the mHealth apps is associated with the long-term use of those apps (46). This feature also improves the individuals' dietary habits by informing them about their usual dietary intake (47). Thus, adding this feature to the mHealth apps could promote both the technical and clinical feasibility of the apps.

Descriptive app use characteristics across the whole sample

Due to the short data collection period, we did not compare the compliance to use the app between the two groups. Nevertheless, one study on a health app collecting self-reporting data in breast cancer patients (48) indicates no significant association between age and compliance to using the app. Also, regarding the overall compliance, the average mean reporting data in the app had a decreasing trend over 90 days in the mentioned report (48). However, this is not to be compared with our results as we only measured this metric in one week.

Regarding the daily *app usage* pattern, our results differed from another study investigating the patterns of mental health *app usage*, which reports these health *app usage* peaks in the morning and evening (49). However, this pattern could differ considering the type of the app and the participants' characteristics. For example, performing tasks such as optional food reporting in the REBECCA app may be more prone to be forgotten compared to the apps that provide instant services to the users, such as mindfulness apps. Also, individuals based on their characteristics, eat their meals at different times of the day. For instance, in our results, the lower rate of *app usage* was reported in the morning (until 9 AM), while the number of reported lunch (11%) meals was lower than breakfasts (13%). This indicates that our sample may have started their days late and reported breakfast after 9 AM. Overall, these data help detect the actual times of the day that the specific app users need to be reminded to report data. Accordingly, sending push notifications during these times may improve the *app usage*. Furthermore, reporting the "snack" category as the most reported data could be due to the participants' cultural characteristics. In Swedish culture, it is very common to have multiple breaks during a day, called "Fika", for drinking coffee and having snacks together with friends or family. This cultural characteristic may explain our results, and it might be different in the other settings.

Strengths, limitations, and generalizability

Our study has several strengths. First, we used the REBECCA app logging data to assess the app use characteristics. This objective method is free of self-reporting biases such as recall and social desirability biases (50). Second, to ensure that the app is ready to be tested by the target group, the study staff carried out an internal technical validation prior to the recruitment. Following the technical test, some bugs were fixed, and several changes were made to make it easier to work with the app. Third, the active involvement of AMAZONA in this project resulted in a safe and friendly research environment, allowing participants to feel involved in the study and express their actual feedback regarding the app. Furthermore, we used open-ended questions to support and clarify the user experience quantitative data. This will give the researchers a better insight into the facilitators and barriers in using the REBECCA app. Finally, this pilot study is helpful to detect and solve possible practical issues in the methodological design before the main study, since performing a pilot study enhances the chance of success of the main research; nevertheless, it does not ensure it (51).

While the study was carried out successfully, there were some limitations. The first issue was the study's small sample size which reduces the statistical power. In addition, concerning the study's cross-sectional design and the short-term evaluation of the *app usage*, we could not evaluate the behavior changes both in the app's use and lifestyle over time. Nevertheless, this pilot still provides evidence for the technical feasibility of the REBECCA app in further, larger-scale research actions, and the mentioned outcomes will be investigated in a more extended period with an appropriate sample size further in the main study. Also, some technical problems with the app were not diagnosed before the study (e.g., issues with GPS data collection in some devices), which may have affected our results. Nonetheless, technical issues are not rare in such studies, and one of the aims of this pilot was to detect and fix these technical problems to be solved for the main study. Moreover, the participants were sourced from a single breast cancer association in Stockholm. This recruitment strategy may limit the generalizability of our findings to the breast cancer survivors living in other settings. However, considering the findings of this study as country-specific, the results apply to the target population living in Sweden. The reason is that the proportion of women residing in Stockholm who have access to the internet at home and use mobile apps is very similar to that of other Swedish regions (52). One more concern regarding the representativeness of this sample for the target population was their high motivation to help. However, patients with certain conditions are more likely to participate in these research types than the general population (21). Thus, our sample characteristics may have potential relevance to the target group of future clinical trials.

Ethical considerations

This study was approved by the Swedish ethics review authority. All participants signed the informed consent after receiving verbal and written comprehensive information about the study itself, their involvement, and all the actions taken to protect their privacy. They were also ensured that participation in the research is entirely voluntary, declining to participate would not affect their membership at Amazona, and they have the right to leave the study or request to erase their personal data at any time without any explanation. Also, considering this study population as a vulnerable group, we could not conduct this research on other populations since the goal of this study was to identify the actual needs of the breast cancer survivors as the end-users of the REBECCA app. Accordingly, this population will benefit from the findings of this study which will provide them with better and more relevant post-cancer care in the future (53). Moreover, concerning confidentiality, each participant received a unique study identity (i.e., ADC_PRT_XX) that was used for all not-in-the-app logging of personal information. As an additional privacy measure, when a participant got registered in the app, they were randomly assigned anonymous nicknames that were not connected to their Study ID (i.e., Ciel_Starfish29). Moreover, study IDs and app nicknames were linked to the participants' real IDs externally to the system, in offline matching documents. These coding lists were stored separately from the collected data, and only the research coordinator and the AMAZONA study personnel had access to them. In addition, the de-identified data was transmitted to the research server using an encrypted web protocol during the data collection time. This data was stored in an encrypted web portal in the project server, allowing limited access to research team members. Also, in reference to GDPR (54) defined roles, the data controllers are KI and the other institutions participating in the REBECCA project that receive data for analysis.

Societal relevance and future perspectives

Given the increasing rates of breast cancer survivorship and the post-cancer health complications, there is a need for high-quality research to improve post-cancer care. REBECCA platform collects

RWD data from breast cancer survivors of all ages over time, providing further evidence of their post-cancer health challenges. The findings of this study will be used to improve further the REBECCA app, which is part of the larger REBECCA project. This app acts as an appropriate methodology for gathering sufficient data from this population and helps identify the patients' actual needs. This evidence in the field of breast cancer survivorship could aid investigators, public health practitioners, and other regulatory organizations across the EU in developing new guidelines and practices for post-cancer treatment. These implications will improve the quality of life of breast cancer survivors and reduce the financial burden of cancer survivorship. Additionally, this study can act as a valid guide for future developments of other similar mHealth tools, considering the patients' perceived user experience and feedback evaluated here. Nevertheless, additional long-term and high-quality evidence investigating the feasibility and effectiveness of the REBECCA app and similar mHealth tools in different age groups of breast cancer survivors in a larger sample and different settings are still required to confirm our findings. Also, further research on the use characteristics of similar mHealth tools in different age groups of patients with other chronic diseases could help lower the burden of these conditions by providing efficient health care based on the patients' actual needs and preferences.

Conclusions

In conclusion, the REBECCA app use characteristics were not significantly different between younger and older breast cancer survivors. However, these findings might differ in other populations. Thus, long-term research with a larger sample size and in different settings investigating the association between breast cancer survivors' age and the use characteristics of this app is needed to confirm our findings. In addition, there is still a considerable improvement space for the REBECCA app, such as solving technical issues and improving user experience. Further development in the app based on the findings of this study could contribute to future research that will use this app to collect dietary behaviors and physical activity lifestyle parameters data from breast cancer survivors of all ages. The findings of this study could also contribute to the design of the similar mHealth tools.

Acknowledgment

Firstly, I would like to express my deepest appreciation to my thesis supervisor, Dr. Ioannis Ioakeimidis, for his unwavering guidance through this project. I would like to extend my sincere thanks to AMAZONA's project manager, Matilda Ersson, for her active involvement in the data collection process and her moral support. Also, these efforts would not be possible without the involvement of the study's participants and the AMAZONA breast cancer association. Finally, words cannot express my appreciation to my partner, who always supported me during this process.

Author contribution

The REBECCA project team pre-arranged the protocol for the data collection. Z.A was involved in the planning phase of the data collection, data collection itself, and providing the preparatory results. Z.A also performed analysis, interpreted the results, and wrote the manuscript.

Reference:

1. World Health Organization. Breast cancer [Internet]. Geneva: World Health Organization; 2021. [cited 2022 Feb 4]. Available from: https://www.who.int/news-room/fact-sheets/detail/breast-cancer

2. Social Styrelsen (The Swedish national board of health and welfare). Statistics on Cancer Incidence 2019 [Internet]. Sweden; 2020. [cited 2022 Feb 4]. Available from: https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/artikelkatalog/statistik/2020-12-7133.pdf
3. Jeong SM, Park SM. Care for Breast Cancer Survivors. Adv Exp Med Biol. 2021;1187:511-24.
4. Lozano-Lozano M, Martín-Martín L, Galiano-Castillo N, Fernández-Lao C, Cantarero-Villanueva I, López-Barajas IB, et al. Mobile health and supervised rehabilitation versus mobile health alone in breast cancer survivors: Randomized controlled trial. Ann Phys Rehabil Med. 2020;63(4):316-24.
5. Mokhatri-Hesari P, Montazeri A. Health-related quality of life in breast cancer patients: review of reviews from 2008 to 2018. Health Qual Life Outcomes. 2020;18(1):338.
6. PDQ adult treatment editorial board. Breast cancer treatment (Adult) (PDQ®): Patient version. PDQ Cancer Information Summaries . Bethesda (MD): National cancer institute (US);2022.
7. Terranova CO, Lawler SP, Spathonis K, Eakin EG, Reeves MM. Breast cancer survivors' experience of making weight, dietary and physical activity changes during participation in a weight loss intervention. Support Care Cancer. 2017;25(5):1455-63.
8. Lozano-Lozano M, Galiano-Castillo N, Martín-Martín L, Pace-Bedetti N, Fernández-Lao C, Arroyo-Morales M, et al. Monitoring Energy Balance in Breast Cancer Survivors Using a Mobile App: Reliability Study. JMIR Mhealth Uhealth. 2018;6(3):e67.
9. Shim JS, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. Epidemiol Health. 2014;36:e2014009.
10. Yerrakalva D, Hajna S, Griffin S. Effects of Mobile Health App Interventions on Sedentary Time, Physical Activity, and Fitness in Older Adults: Systematic Review and Meta-Analysis. J Med Internet Res. 2019;21(11):e14343.
11. World Health Organization. New horizons for health through mobile technologies [Internet]. Geneva: World Health Organization; 2011 [cited 2022 Feb 14]. Available from: https://www.who.int/goe/publications/goe_mhealth_web.pdf
12. Amagasa S, Kojin H, Kamada M, Fukuoka Y, Inoue S. [Evaluation of physical activity using smartphones and wearable devices in healthcare: Current situation and future perspectives]. Nihon Koshu Eisei Zasshi. 2021;68(9):585-96.
13. Statista. Number of smartphones sold to end users worldwide from 2007 to 2021 [Internet]. Paris: Statista; 2021 [cited 2022 Feb 14]. Available from: https://www.statista.com/statistics/263437/global-smartphone-sales-to-end-users-since-2007/
14. Statista. Forecast of the smartphone user penetration rate in Sweden from 2018 to 2025 [Internet]. Paris: Statista; 2021 [cited 2022 Feb 14]. Available from: https://www.statista.com/statistics/568272/predicted-smartphone-user-penetration-rate-in-sweden/
15. Kouvari M, Mamalaki E, Bathrellou E, Poulimeneas D, Yannakoulia M, Panagiotakos DB. The validity of technology-based dietary assessment methods in childhood and adolescence: a systematic review. Crit Rev Food Sci Nutr. 2021;61(7):1065-80.
16. Duncan MJ, Fenton S, Brown WJ, Collins CE, Glozier N, Kolt GS, et al. Efficacy of a Multi-component m-Health Weight-loss Intervention in Overweight and Obese Adults: A Randomised Controlled Trial. Int J Environ Res Public Health. 2020;17(17).
17. Bol N, Helberger N, Weert JCM. Differences in mobile health app use: A source of new digital inequalities? The Information Society. 2018;34(3):183-93.

18. Carroll JK, Moorhead A, Bond R, LeBlanc WG, Petrella RJ, Fiscella K. Who Uses Mobile Phone Health Apps and Does Use Matter? A Secondary Data Analytics Approach. J Med Internet Res. 2017;19(4):e125.
19. Fareed N, Swoboda CM, Jonnalagadda P, Huerta TR. Persistent digital divide in health-related internet use among cancer survivors: findings from the Health Information National Trends Survey, 2003-2018. J Cancer Surviv. 2021;15(1):87-98.
20. Mattsson S, Olsson EMG, Johansson B, Carlsson M. Health-Related Internet Use in People With Cancer: Results From a Cross-Sectional Study in Two Outpatient Clinics in Sweden. J Med Internet Res. 2017;19(5):e163.
21. Lozano-Lozano M, Cantarero-Villanueva I, Martin-Martin L, Galiano-Castillo N, Sanchez MJ, Fernández-Lao C, et al. A Mobile System to Improve Quality of Life Via Energy Balance in Breast Cancer Survivors (BENECA mHealth): Prospective Test-Retest Quasiexperimental Feasibility Study. JMIR Mhealth Uhealth. 2019;7(6):e14136.
22. Quintiliani LM, Mann DM, Puputti M, Quinn E, Bowen DJ. Pilot and Feasibility Test of a Mobile Health-Supported Behavioral Counseling Intervention for Weight Management Among Breast Cancer Survivors. JMIR Cancer. 2016;2(1).
23. Martin E, Di Meglio A, Charles C, Ferreira A, Gbenou A, Blond M, et al. Use of mHealth to Increase Physical Activity Among Breast Cancer Survivors With Fatigue: Qualitative Exploration. JMIR Cancer. 2021;7(1):e23927.
24. Singleton AC, Raeside R, Partridge SR, Tat-Ko J, Che Mun Sum S, Hyun KK, et al. Supporting breast cancer survivors via text messages: reach, acceptability, and utility of EMPOWER-SMS. J Cancer Surviv. 2021:1-11.
25. Coughlin SS, Paxton RJ, Moore N, Stewart JL, Anglin J. Survivorship issues in older breast cancer survivors. Breast Cancer Res Treat. 2019;174(1):47-53.
26. services USdohah. System usability scale (SUS). Washington: U.S. Government Printing Office; 2006. Available from: https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html.
27. Schrepp M. User Experience Questionnaire Handbook [Handbook] [Internet]. 8th ed. 2019 [cited 2022 May 11]. Available from: https://www.ueq-online.org/Material/Handbook.pdf.
28. Cancer research UK. What is a healthy diet? [Internet]. England: Cancer Research UK; [cited 2022 13 May]. Available from: https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/diet-and-cancer/what-is-a-healthy-diet.
29. Schrepp M. User Experience Questionnaire (UEQ) [Internet]. [cited 2022 May 13]. Available from: https://www.ueq-online.org/.
30. Virginia Braun VC. Using thematic analysis in psychology. Taylor & Francis Online. 2008;3(2):77-101.
31. Martin Schrepp AH, Jörg Thomaschewski. Construction of a Benchmark for the User Experience Questionnaire (UEQ). International Journal of Interactive Multimedia and Artificial Intelligence. 2017;4(2).
32. Børøsund E, Cvancarova M, Ekstedt M, Moore SM, Ruland CM. How user characteristics affect use patterns in web-based illness management support for patients with breast and prostate cancer. J Med Internet Res. 2013;15(3):e34.
33. Ferrante JM, Devine KA, Bator A, Rodgers A, Ohman-Strickland PA, Bandera EV, et al. Feasibility and potential efficacy of commercial mHealth/eHealth tools for weight loss in African American breast cancer survivors: pilot randomized controlled trial. Transl Behav Med. 2020;10(4):938-48.

34. Reiners F, Sturm J, Bouw LJW, Wouters EJM. Sociodemographic Factors Influencing the Use of eHealth in People with Chronic Diseases. Int J Environ Res Public Health. 2019;16(4).
35. Onyeaka HK, Zambrano J, Longley RM, Celano CM, Naslund JA, Amonoo HL. Use of digital health tools for health promotion in cancer survivors. Psychooncology. 2021;30(8):1302-10.
36. Jiang J, Zhu Q, Zheng Y, Zhu Y, Li Y, Huo Y. Perceptions and Acceptance of mHealth in Patients With Cardiovascular Diseases: A Cross-Sectional Study. JMIR Mhealth Uhealth. 2019;7(2):e10117.
37. Onyeaka HK, Romero P, Healy BC, Celano CM. Age Differences in the Use of Health Information Technology Among Adults in the United States: An Analysis of the Health Information National Trends Survey. J Aging Health. 2021;33(1-2):147-54.
38. Statistics Sweden. Access to the Internet at home by sex and study domain. Year 2018 2020 [Internet]. Solna: Statistics Sweden, 2020 [cited 2022 May 18]. Available from: https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__LE__LE0108__LE0108D/LE0108T10/
39. Jaana M, Paré G. Comparison of Mobile Health Technology Use for Self-Tracking Between Older Adults and the General Adult Population in Canada: Cross-Sectional Survey. JMIR Mhealth Uhealth. 2020;8(11):e24718.
40. Phillips SM, Courneya KS, Welch WA, Gavin KL, Cottrell A, Nielsen A, et al. Breast cancer survivors' preferences for mHealth physical activity interventions: findings from a mixed methods study. J Cancer Surviv. 2019;13(2):292-305.
41. Duman-Lubberding S, van Uden-Kraan CF, Jansen F, Witte BI, van der Velden LA, Lacko M, et al. Feasibility of an eHealth application "OncoKompas" to improve personalized survivorship cancer care. Support Care Cancer. 2016;24(5):2163-71.
42. Naaman R, Parrett A, Bashawri D, Campo I, Fleming K, Nichols B, et al. Assessment of Dietary Intake Using Food Photography and Video Recording in Free-Living Young Adults: A Comparative Study. J Acad Nutr Diet. 2021;121(4):749-61 e1.
43. Ashman AM, Collins CE, Brown LJ, Rae KM, Rollo ME. Validation of a Smartphone Image-Based Dietary Assessment Method for Pregnant Women. Nutrients. 2017;9(1).
44. Chow PI, Showalter SL, Gerber M, Kennedy EM, Brenin D, Mohr DC, et al. Use of Mental Health Apps by Patients With Breast Cancer in the United States: Pilot Pre-Post Study. JMIR Cancer. 2020;6(1):e16476.
45. Cai T, Huang Y, Zhang Y, Lu Z, Huang Q, Yuan C. Mobile health applications for the care of patients with breast cancer: A scoping review. Int J Nurs Sci. 2021;8(4):470-6.
46. Lee K, Kwon H, Lee B, Lee G, Lee JH, Park YR, et al. Effect of self-monitoring on long-term patient engagement with mobile health applications. PLoS One. 2018;13(7):e0201166.
47. Hahn SL, Linxwiler AN, Huynh T, Rose KL, Bauer KW, Sonneville KR. Impacts of dietary self-monitoring via MyFitnessPal to undergraduate women: A qualitative study. Body Image. 2021;39:221-6.
48. Min YH, Lee JW, Shin YW, Jo MW, Sohn G, Lee JH, et al. Daily collection of self-reporting sleep disturbance data via a smartphone app in breast cancer patients receiving chemotherapy: a feasibility study. J Med Internet Res. 2014;16(5):e135.
49. Baumel A, Muench F, Edan S, Kane JM. Objective User Engagement With Mental Health Apps: Systematic Search and Panel-Based Usage Analysis. J Med Internet Res. 2019;21(9):e14567.
50. Althubaiti A. Information bias in health research: definition, pitfalls, and adjustment methods. J Multidiscip Healthc. 2016;9:211-7.
51. van Teijlingen E, Hundley V. The importance of pilot studies. Nurs Stand. 2002;16(40):33-6.

52. Statistics Sweden. Use of mobile phone and its apps by gender and accounting group. Year 2018 - 2020. Solna: Statistics Sweden, 2020 [cited 2022 May 18]. Available from: https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__LE__LE0108__LE0108J/LE0108T30/.
53. World Medical A. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4.
54. General Data Protection Regulation (GDPR) (Regulation (EU) 2016/679) [Internet]. Place of publication: Publisher [cited 2022 May 18]. Available from: https://gdpr-info.eu/