

Perspectives on Messaging-Based Interventions for Improving Sleep and Physical Activity among Breast Cancer Survivors: Insights from Focus Group and Individual Interviews

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Abstract

Background: Sleep disturbances and low physical activity are common among breast cancer (BC) survivors and are associated with increased morbidity and mortality. Given the increased access to technological devices and the growing popularity of conversational agents (CA), such as chatbots, in recent years, these tools have the potential to address both sleep disturbances and low physical activity in scalable and cost-effective manners. To understand and make effective use of these tools, it is important to explore the preferences and needs of BC survivors with sleep disturbances, including how a chatbot could interact on the topics of physical activity and sleep hygiene.

Objective: The objectives of this study were to explore the perspectives and preferences of BC survivors regarding technology-based interventions, especially CA, to address sleep disturbances.

Methods: Three focus groups (n=13) and three individual interviews (n=3) were conducted from May 2020 to March 2021 with 16 BC survivors (mean age = 59.3 years) currently experiencing sleep disturbance. The interview questions focused on their experiences with poor sleep and preferences for technology-based interventions. Thematic analysis was applied to the de-identified transcription of audio recordings.

Results: Three themes were identified: (1) attitudes toward health interventions delivered via messages, (2) specific user needs, and (3) technology usage habits and preferences. Most participants reported a positive attitude toward the possibility of using technology to help improve their sleep and increase their physical activity, and endorsed a high level of acceptance toward some technologies, such as text messages and mobile applications, but not others, such as voice interactions. In terms of desired features, reminders and accountability features, such as meeting physical activity goals, were mentioned most frequently. In addition, incorporating bedtime and relaxation exercise reminders were thought to be helpful. Regarding time and frequency, a daily reminder and an hour before bedtime was found to be acceptable.

Conclusions: The insights will be used to guide the development of a tool for improving sleep and physical activity in BC survivors. Future research will focus on developing an intervention addressing these health behaviors and validating its acceptability.

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Conclusions: The insights will be used to guide the development of a tool for improving sleep and physical activity in BC survivors. Future research will focus on developing an intervention addressing these health behaviors and validating its acceptability.

Keywords: Breast cancer; sleep disturbance; physical activity; technology preference; thematic analysis.

Introduction

More than 4 million breast cancer (BC) survivors currently reside in the United States [1]. In recent years, BC survival rates have substantially improved due to advancements in early detection and treatment [2]. However, BC survivors experience a variety of challenges following treatment. Sleep disturbances, defined as subjective difficulty with initiating or maintaining sleep, are one of the common challenges, as more than half of BC survivors report experiencing sleep disturbances [3–6]. Compared with a healthy population, BC survivors experience poorer sleep quality [7]. Sleep disturbances following BC diagnosis have been associated with mental health problems, such as anxiety and depression [8–10]. In addition, poor sleep quality is recognized to be related to poor quality of life of BC survivors [11,12]. Therefore, it is crucial to develop effective interventions that

specifically address sleep disturbances in this population.

To effectively alleviate these sleep disturbances, several non-pharmacological interventions have been suggested in prior research, such as cognitive behavioral therapy for insomnia (CBTi) and physical activity [13]. CBTi is a multi-component intervention that is recommended as the first-line treatment for chronic insomnia disorder [14]. Standard treatment of CBTi consists of 6 to 8 sessions, typically conducted weekly or biweekly in person or through telehealth, and may be held individually or in groups [14]. However, due to a shortage of skilled and trained CBTi providers, this treatment is underutilized [15]. Internet-based CBTi interventions have been developed and evaluated in several randomized controlled trials (RCTs), including those targeting BC survivors, demonstrating encouraging results [16–18]. However, when comparing different CBTi formats, asynchronous or self-help interventions may still be less effective than synchronous CBTi formats (e.g., face-to-face and telehealth) [19]. The challenges include high attrition and lack of synchronous support [19]. Technology-based tools such as chatbots are increasingly utilized in healthcare and hold some potential for addressing these difficulties by providing adaptive feedback and real-time interaction [15]. However, there is limited research on technology preferences among BC survivors and their views on the development of sleep-related technologies, such as CAs, which include chatbots.

In addition to CBTi, physical activity interventions, such as yoga [20] or endurance training combined with resistance training [21] are common strategies for reducing sleep disturbances or improving sleep quality. Beyond improving sleep, studies have also linked physical activity to improved survival and quality of life in BC survivors [22]. A previous study reported that the majority of survivors were unable to maintain adequate levels of physical activity 10 years after diagnosis [22]. Hence, several studies examined preferences toward technology-based interventions in this population to explore potential and effective strategies. For example, BC survivors exhibited high acceptability toward remotely delivered exercise programs and wearable activity trackers, valuing personalized feedback and self-monitoring features [23,24]. However, few studies have explored the application of CAs in physical activity programs targeting BC survivors, particularly in settings aimed at using physical activity as a strategy for improved sleep, particularly in settings aimed at using physical activity as a strategy for improved sleep. Therefore, the aim of this study was to explore the perspectives and user preferences of BC survivors on the acceptability of using technology-based interventions, especially CAs, to address sleep disturbances, incorporating physical activity as one of the strategies.

Methods

Participants

Participants were recruited via social media advertisements and completed an online screening survey to assess eligibility. Following the completion of the online screening survey, research staff contacted potential participants by telephone. Inclusion criteria required that participants: (1) were ≥ 18 years; (2) had a prior diagnosis of stage I-IV invasive breast cancer; (3) self-reported poor sleep defined as >4 global score on the Shortened Pittsburgh Sleep Quality Index (sPSQI) [25]; and (4) an Eastern Cooperative Oncology Group (ECOG) Performance Status of 0-2 (indicating the ability to perform activities of daily living) [26]. The exclusion criteria were: (1) a prior diagnosis of restless legs syndrome, periodic leg movement disorder, narcolepsy, REM sleep behavior disorder, or sleep-related breathing disorder; (2) or active receipt of chemotherapy or radiation (endocrine therapy permitted). Sixty-four individuals filled out the initial screener. Of these, 22 participants provided consent, while 4 declined participations, 7 were found ineligible, and 31 were lost to follow-up. Among those who consented, 2 participants withdrew after enrollment and

4 could not be scheduled for focus groups or interviews. Ultimately, a total of 16 BC survivors experiencing current sleep disturbances were included. This sample size was considered sufficient to capture a range of viewpoints while approaching data saturation. All participants provided verbal informed consent as the written informed consent was waived by the University of Washington Institutional Review Board.

Data Collection

Three online focus groups (FGs) and three individual online interviews were conducted from May 2020 to March 2021. Two groups consisted of four participants each, while the third group comprised five participants. Individual interviews were conducted with three participants who had difficulty scheduling focus group time. All discussions were conducted and recorded via Zoom and each discussion lasted approximately 60 minutes.

The FGs were led by two authors (KR and WS), and the interviews were conducted by WS. Group discussions were framed by semi-structured subject guides (Table 1). The first section of each FG and individual interview explored participants' experiences with sleep disturbances and their coping strategies. Next, participants were asked about their preferences regarding potential features of sleep- and physical activity- related technology interventions.

Table 1. Semi-structured subject guides

Topic	Questions
Current sleep information	<ul style="list-style-type: none"> • Did you have sleep difficulties before breast cancer therapy, or did they start with breast cancer therapy? • What strategies have you used in the past to deal with insomnia? • What are some things you wish you had known earlier when you first started having sleep difficulties? • What barriers do you experience in getting help with your sleep?
Technology Preferences	<ul style="list-style-type: none"> • What do you like about texting? What don't you like? • Do you ever have any challenges with sending or writing text messages? • How do you feel about receiving text messages related to your health? • In general, how do you feel about text-messaging? • How do you feel about the following format and features. Which might you prefer? <ul style="list-style-type: none"> ○ App on your phone that you proactively access to receive information ○ Text message system that reaches out to you with information ○ Going to a website and reading information • Would you be willing to use an app or text-based intervention for 6 weeks? • How comfortable are you discussing something personally difficult or distressing over text message?

	<ul style="list-style-type: none"> o Would you feel comfortable bringing this up with a bot (software program)?
Data privacy concerns	<ul style="list-style-type: none"> • Do you have any privacy concerns about receiving information via text message about your health? • Do you have concerns about sharing health information over text? • How do you feel about automatic data collection that happens in the “background”?
Specific feature questions related to prototype of a chatbot	<ul style="list-style-type: none"> • Would you be willing to answer questions each day about your sleep, if it will help the app make recommendations?

Data Analysis

The characteristics and medical history of the participants were analyzed using descriptive analyses. The audio recordings were transcribed verbatim and analyzed using thematic analysis, adhering to the six-step process outlined by Braun and Clarke [27]. ATLAS.ti 23, a qualitative data analysis software developed by ATLAS.ti Scientific Software Development GmbH, was used to analyze qualitative data. The authors, CT and HL, acquainted themselves with the data through multiple readings of the group data. CT and HL conducted thematic analysis on a subset of the transcripts to create an initial coding framework. Discrepancies were resolved through discussion and agreement or by consulting with KR to finalize the themes and subthemes. Intercoder reliability was evaluated on a data subset, resulting in 93.2% inter-coder agreement between coders (CT and HL), signifying a high level of consistency. The final set of themes and report was then shared with other co-authors for feedback.

Ethical consideration

The study was reviewed and approved by the University of Washington Institutional Review Board (Approval #9642).

Results

Three FGs and three individual interviews were conducted with a total of 16 BC survivors with sleep disturbances. The characteristics of the participants are summarized in Table 2. The participants were aged between 41 and 72; the average age was 59.3 ± 8.9 years. Most of the participants were White (14/16, 87.5%), and the remainder were Black (2/16, 12.5%). Participants had varying levels of education with 68.8% (11/16) having a bachelor's degree or higher; had varying stages of BC with 50% (8/16) diagnosed with Stage II BC; and the majority had received chemotherapy, radiation, and/or hormone therapy.

Three themes emerged from the analysis: (1) attitudes toward CAs use for promoting sleep and physical activity; (2) specific user needs for future technology-based interventions; and (3) technology usage habits and preferences. Table 3 provides an outline of the themes, sub-themes, and the definition of the theme.

Table 2. Participants demographic characteristics and medical history (N =16)

Characteristics	N (%)
Race	
Black	2 (12.5)
White	14 (87.5)

Ethnicity	
Not Hispanic or Latino	16 (100)
Hispanic or Latino	0 (0)
Education	
GED or high school degree	1 (6.25)
Some college, no degree	3 (18.8)
Associate's degree	1 (6.25)
Bachelor's degree	8 (50)
Master's degree	3 (18.8)
Work status	
Unable to work	2 (12.5)
Retired	5 (31.2)
Working full-time	8 (50.0)
Other	1 (6.25)
Marital status	
Divorced	3 (18.8)
Domestic partnership	1 (6.2)
Married	10 (62.5)
Never married	2 (12.5)
Do you have a caregiver?	
Yes	2 (12.5)
No	14 (87.5)
Breast cancer stage at diagnosis	
Stage 1	4 (25)
Stage 2	8 (50)
Stage 3	4 (25)
Received surgery related to breast cancer	
Yes	16 (100)
No	0 (0)
Received radiation therapy	
Yes	14 (87.5)
No	2 (12.6)
Received endocrine therapy	
Yes	11 (68.8)
No	5 (31.2)
Received Herceptin (HER2) treatment	
Yes	2 (12.5)
No	14 (87.5)
History of breast cancer recurrence	
No	11 (68.8)
Yes	5 (31.2)

Table 3. Outline of the themes, sub-themes, and the definition of the theme.

Theme	Sub-theme	Definition
Theme 1: Attitudes	1.1 Acceptance of new	1.1 The willingness of individuals to use new

toward CAs use for promoting sleep and physical activity	technology-based tools/strategies 1.2 Concern about technology interfering with sleep 1.3 Data privacy	technology-based tools or strategies to improve sleep and physical activity. 1.2 Individuals' worries or hesitations regarding the utilization of sleep-related technology. 1.3 Individuals' perspectives on sharing personal sleep- and physical activity-related data.
Theme 2: Specific user needs for future technology-based intervention	2.1 Features 2.2 Time and frequency 2.3 Motivation for engagement	2.1 The functionalities and attributes that users look for in sleep- and physical activity-related technology. 2.2 Users' preferences regarding when and how often they would engage with sleep- and physical activity-related technology. 2.3 The factors or functionalities that motivate users to regularly engage with sleep- and physical activity-related technology.
Theme 3: Technology usage habits and preferences	3.1 Technology usage habits 3.2 Preferred delivery modes	3.1 Users' general behaviors and routines related to technology usage. 3.2 The preferences for certain types of sleep- and physical activity-related technologies.

Theme one: Attitudes toward CAs use for promoting sleep and physical activity

Subtheme 1-1: Acceptance of new technology-based tools/strategies

Most participants (13/16, 81.3%) expressed willingness to try new strategies to address their sleep problems. When asked whether they were interested in technology-based interventions for sleep, such as chatbots, most participants expressed a positive attitude. One participant mentioned that she had tried technology-based tools to improve sleep before without success, but she remained willing to try something new:

“I would be interested. [...]. And I think if the chatbot also had some aspect of meditation. I think that that would be really useful too. I would love to try those. Those aren't things that I've tried to have helped. But those are things that I would love to try.” – Participant 106, FG 2

In terms of physical activity, most participants expressed a positive attitude. In FG 1, the interviewers and the participants discussed the willingness to participate in online exercise classes, and all participants demonstrated a positive willingness. The interviewer invited participants to reflect on the chat messages. One participant noted that the messages could provide motivation by serving as reminders to engage in exercise.

Subtheme 1-2: Concern about technology interfering with sleep

Although most believed that developing such a tool has potential, one participant expressed concerns about the effectiveness of using phones and electronics to improve sleep.

“Checking phones and electronics right before bed probably doesn't help sleep or relaxation. I don't know.” – Participant 113, FG 3

Subtheme 1-3: Data privacy

When utilizing technology-based interventions, users may be required to input their sleep and health conditions. Therefore, concerning data privacy, the research staff asked participants about

their comfort with discussing personal health information over messaging apps or text message. Some participants agreed to share their personal experiences and conditions (4/16, 25%), while the rest did not express any opinion. None of them expressed opposition. Two participants answered:

“It's fine. Like I said, I mentor people who are about to go through the same thing, so I'm able to help them with it. This part is coming at this stage of the chemo, and this is coming at that. And here's, what's going to happen at radiation so that they aren't blindsided.” – Participant 202, Interview 2

“I like sharing similar situations. I think it's helpful for me to talk about it. I think it's helpful for me to hear other people's similarities or things that are is they're getting help with.” – 110, FG 3

One FG participant stated that the decision to share data relies on who is keeping it and the reason for keeping it, but generally, they would not oppose sharing.

“I guess it would depend on who's keeping it and why. I normally don't have a problem sharing.” – Participant 113, FG 3

Theme two: Specific user needs for future technology-based interventions

Subtheme 2-1: Features

The FGs and interviews discussed the needs and features that participants thought should be included in the development of a technology-based tool related to sleep and physical activity. Among these, reminder features were the most frequently mentioned (5/16, 31.3%). This feature could be used to remind users of the bedtime routine or meditation.

“If there was a bedtime routine, there's something a sleep routine that would help with my sleep patterns, that would be great.” – Participant 102, FG 1

“I think maybe a reminder now it's time to put down your device and do some relaxing activity or meditation or relaxation exercise.” – Participant 103, FG 1

“I use reminders at work all the time because I have so many things that I have to can't forget to do. And sometimes when you get busy you don't stop to make sure. So, I need reminders. So, to me, this would be very useful.” – Participant 104, FG 1

Meditation or relaxing exercises were mentioned as commonly used strategies for improving sleep. Therefore, several participants (3/16, 18.8%) expressed a desire for the tool to include features that assist them in performing meditation or relaxing exercises.

“Maybe even suggest a — I don't know if that's possible but — just some type of something you could do to help it, like a breathing exercise or giving you a place to go to find something that can [help] you get to sleep.” – Participant 101, FG 1

“Any kind of activity for relaxation prior to bedtime would be really helpful.” – Participant 102, FG 1

The capacity to analyze data for tracking and monitoring progress was one of the most frequently mentioned design features. Several participants (3/16, 18.8%) wanted to track their sleep progress and assess any improvements in their sleep quality.

“I really like that. Especially if you want to see — I like seeing my own improvement or the difference, you know, month over month, week over week.” – Participant 201, Interview 1

In FG 3, some participants mentioned the desire for social features to connect with others in similar situations and support each other.

“I like sharing similar situations; I think it's helpful for me to talk about them. I think it's helpful for me to hear other people's similarities or things that they're getting help with.” – Participant 110, FG3

However, one participant mentioned that she prefers to be on her own and does not need such a feature.

“I'm much more of a go it alone person, so that wouldn't be a thing for me.” – Participant 109, FG3

Two participants mentioned that they prefer having human experts available to provide guidance and interaction.

“I think that would be really important, especially if you know you're sharing, because your answer may not be cookie-cutter. So, to know that someone can decipher the nuances would be really good.” – Participant 201, Interview 1

Subtheme 2-2: Time and frequency

Given that reminders are among the most proposed features, research staff further investigated how often users would like to be reminded and what the most appropriate times for these reminders. Summarizing their opinions, daily and an hour before bedtime would be appropriate.

“I think daily would be fine.” – Participant 103, FG 1

“An hour before bedtime or something like that. If they were talking about sleep-related, right? Maybe configurable, maybe start out every night and [see] if it's too much.” – Participant 113, FG 3

However, one participant indicated that receiving related information daily would make her feel stressed. She stated:

“No, I don't want it every day. That would get on my nerves. I can't stand people like that.” – Participant 203, Interview 03

Subtheme 2-3: Motivation for Engagement

For some participants, some features, such as tracking, reminders, sign-up, and goal setting, could help motivate their engagement. One participant shared her experience with a wearable device as an example, noting the ongoing comparison of her progress serves as motivation for improvement.

My son got me a FitBit, one that would track, you know, steps and sleep. It was fascinating. I love it. It was motivating for me to see that every day, [...] I like that, looking back, I just see I'm kind of competitive with myself. It's like a contest. Like, oh, how well did I sleep, or what motivated me to do better? So tracking sticks out to me [...]. – Participant 105, FG 2

In interview 1, participant 201 identified personal motivation as the primary barrier to sustaining regular physical activity. To address this, participant 201 endorsed accountability mechanisms and progress feedback. Some participants expressed that assistance with setting goals around sleep and physical would also be advantageous. One participant said:

[...] It is important, at least for me, to have goals and to stick with them. – Participant 107, FG 2

Another participant believed assistance with establishing and maintaining daily routines, as well as providing motivation during periods of inactivity, would be helpful for sustaining regular lifestyle habits.

Maybe some short meditation too. Those are things that are hard to motivate yourself to do. But if it were a reminder, or it was on Zoom, and you could sign up for it, I think I would definitely do it. – Participant 103, FG 1

If there's somebody there to help you work through that and what it is, I think that would be helpful. [Both] at that moment, and then also motivate you if you haven't been working out, say for a few days. Get you to think about, maybe I need to go do some exercise. And I think that would be helpful. – Participant 103, FG 1

Theme three: Technology usage habits and preferences

Subtheme 3-1: Technology usage habits

The research staff asked participants about their phone usage habits, specifically focusing on text messaging. The majority of participants said that they frequently use this feature.

Text messaging is one of the very few things I can do. – Participant 111, FG 3

For everything, like I texting, I still do work emails on it. – Participant 201, Interview 1

One participant said that they would use text messaging but would encounter some minor limitations. When the researchers asked participants if they had been challenged with sending or receiving text messages, one participant responded:

I do. We have a second home in a very remote part of Canada, so that becomes a challenge. But otherwise, bring it on! – 112, FG 03

Two participants stated that they use this feature less frequently or use their phones less often in certain situations.

I don't carry my phone with me when I'm working. It'll be in my office. So, um, I don't always have it on my person. – Participant 110, FG 3

The reason I don't do texting is there are people on my phone who don't do texting. But in the past I loved to text because I don't have time to call. – Participant 203, Interview 3

Some individuals mentioned the utilization of technology-based tools, such as apps and wearable devices, to facilitate the implementation of these strategies. As noted in Participant 105's quote in Subtheme 2-3, using Fitbit that tracked steps, and sleep was described as fascinating and motivating.

The nice thing about Minute is that it's an app on my phone, so I can have it anywhere we are in the world and have my meditation if I have the issues. It works out really good. – Participant 107, FG 2

While many participants reported ownership of wearable devices and have a certain level of acceptance, one individual indicated that she cannot use them due to allergies to nickel and plastic.

Subtheme 3-2: Preferred delivery modes

The FG discussions included a conversation about the preferred type of technology-based intervention, such as text or app, four participants preferred using text, four participants preferred an app, and three were open to all of them. Two participants were neutral or uninterested in using text messages but did not oppose it.

I like text. I think it's easy, and you don't have to open up your email on your phone if you don't want to. – Participant 101, FG 1

Text is best for me. And just to be able to access those relaxation techniques whenever I wanted them or needed them. – Participant 102, FG 1

I think the app would be good because on that app, then you could have little things like relaxation tips or meditation, or you could have little things like that that people could then hit and follow. – Participant 103, FG 1

I'd be open to all of them, but my number one preference would be the app. – Participant 106, FG 2

Discussion

Principal Findings

We conducted FG and individual interviews to explore BC survivors' perspectives on technology-based interventions, especially CAs, designed to improve sleep, including CBTi the use of physical activity as one of the strategies. The analysis was designed to inform the development of technology-based interventions to address sleep disturbances in BC population. Three areas were focused upon in this study: attitude, technology preference, and specific user needs.

To address sleep disturbances and improve physical activities, participants stated the need for an efficient intervention and expressed a positive attitude toward trying new approaches. Some participants mentioned that they were still seeking effective strategies. These findings highlighted the significance that participants attributed to sleep health and emphasized the need for suitable sleep-related interventions. Most participants exhibited a high level of acceptance toward technology, such as text messages and mobile applications, and they incorporated it into their daily lives. Prior studies showed that smartphone ownership among older adults increased significantly from 18% in 2013 to 83% for individuals aged 50–64 and 61% for those aged 65 and older in 2021 [28]. A survey from American Association of Retired Persons (AARP) in 2023 revealed that 94% of adults aged 50 and above in the U.S. use text messaging to maintain social connections[29]. This finding aligns with the usage habits reported by most of our interview participants. In combination with commonly used devices (e.g., smartphone) and communication habits, this suggests that designing conversational interventions, such as interactive text messaging or chatbots, is potentially feasible across in this population.

As for the features, incorporating a reminder related to sleep and physical activity was mentioned most frequently. A systematic review reported that personalized push reminders can positively influence users' adherence [30]. Participants proposed that incorporating bedtime and relaxation exercise reminders could be helpful and that daily reminders, or notifications an hour before bed, would be acceptable. A systematic review paper regarding electronic health interventions in BC patients indicates that users exhibited the most engagement with supportive features, including text messages, chat functions, and health reminders [31]. On the other hand, a significant decline in user engagement over time is also a common phenomenon [31]. Another research focused on older patients with cancer suggests that features such as ignore reminders and omit responses, which give users more control, might be helpful [32]. Consequently, when developing reminder features, user control and customization options should be considered fundamental components. Mindfulness meditation may be effective in enhancing sleep quality [33,34]. Furthermore, a study implemented a meditation app to improve sleep in adults with sleep disturbance, resulting in significant reductions in pre-sleep arousal and improvements in depression and anxiety [35]. Additionally, a previous qualitative study demonstrated a mobile meditation tool to improve sleep quality is acceptable.

Tracking features were also discussed in FG interviews. The tracking feature can assist users in adhering to their goals, evaluating their progress, and motivating them to maintain healthy habits. In previous studies on technology-based interventions related to physical activity for the BC population, tracking features have often been mentioned or incorporated [36,37]. Although there is a lack of studies specifically on the tracking features of sleep-related interventions for the breast cancer population, evidence from other clinical populations suggests potential benefits. A study on multiple sclerosis patients has shown that self-tracking tools may help clarify patterns related to symptoms, physical activity, and sleep quality, and had a motivational effect on changing behavior as well [38]. Another research study focused on the general population indicated that routine self-tracking is more likely to provide positive modifications in health management strategies compared to event-triggered tracking [39]. In addition, the mindsets of users may influence the evaluation of self-tracking performance and affect the dynamics of the relationship formed with the tool [40]. If future studies incorporate self-tracking features into sleep-related interventions, researchers could evaluate their potential to enhance users' motivation for lifestyle modifications and subsequently improve sleep quality. Of note, most of our participants self-reported as being White, and additional tailoring specific to other racial and ethnic groups may be needed to ensure broader acceptability [41]. Future research could investigate the usage preferences and viewpoints of more diverse ethnic and racial groups.

In terms of technology preferences, both text messaging and applications were mentioned as acceptable choices, with a shared consensus that mobile phones are the most convenient tool. According to prior studies, several sleep-related applications have been developed. These applications include features like personalized sleep feedback, a sleep diary, and reminders [42]. However, there has been a lack of interventions delivered via text messages with interactive features, especially in cancer survivors population. Participants who preferred text messaging thought texts to be easy to read and simple to operate, suggesting that this format holds potential as an effective intervention. A customized text-based CAs tailored to this population could provide targeted support in real-time, delivering reminders, relaxation exercises, or sleep hygiene tips that are particularly relevant to their lived experiences.

Increasing research has emphasized the potential of text-based CAs in clinical practice and psychotherapy [43,44]; however, the application of such technology in addressing sleep and physical activity among BC survivors remains limited. We also asked participants about their perspectives on

these developing technologies. Some participants expressed interest in using novel technologies such as text-based CAs for health interventions. Only one participant expressed concerns regarding the use of electronic devices before bed. Prior research showed that using smartphones in bed may negatively impact sleep quality, especially those games that overload certain memory and cognitive functions. Conversely, smartphones used outside of bed do not decrease sleep quality [45]. This aspect should be considered when designing sleep-related digital tools to avoid any potential negative impact of technology on sleep.

Strengths and Limitations

One limitation of this study is that the demographic composition of the sample mainly comprised older adults with higher levels of education, and the majority of participants self-identified as White. In addition, most participants were based in the U.S., with recruitment primarily targeted to Washington State. The lack of a diverse population included in this study may limit the generalizability of the findings to broader populations. Moreover, since the study was conducted virtually, most of the participants were likely to have a greater degree of knowledge and familiarity with using technology. The perspectives of groups less familiar with using technology were not included. However, the findings could still provide meaningful insights into the specific group perspectives and serve as a foundation for developing text-based CAs as an intervention to promote sleep and physical activity. We also recommend that future research expand to include more diverse populations to enhance the breadth of perspectives represented the findings.

Conclusions

We gathered perspectives from BC survivors on the design of a text-based CA, which incorporated common sleep-related interventions such as CBTi and physical activity. The participants showed positive attitude toward technology-based interventions and potential features, such as tracking and reminders. The preference for delivery modes, such as text messaging, could serve as a reference for tailoring interventions to this population. Future research will focus on the development of the intervention and the validation of its acceptability.

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Conflicts of Interest

None to declare.

Abbreviations

BC: breast cancer

CAs: conversational agents

CBTi: cognitive behavioral therapy for insomnia

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