

Breast cancer survivors' preferences for social support features in technology-supported physical activity interventions: findings from a mixed methods evaluation

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Abstract

Incorporating peer and professional social support features into remotely delivered, technology-supported physical activity interventions may increase their effectiveness. However, very little is known about survivors' preferences for potential social features. This study explored breast cancer survivors' preferences for both traditional (e.g., coaching calls and peer support) and innovative (i.e., message boards and competitions) social support features within remotely delivered, technology-supported physical activity interventions. Survivors [$N = 96$; $Mean = 55.8$ ($SD = 10.2$)] self-reported demographic and disease characteristics and physical activity. A subset ($n = 28$) completed semistructured phone interviews. Transcribed interviews were evaluated using a thematic content analysis approach and consensus review. Following interviews, the full sample self-reported preferences for social features for remotely delivered physical activity interventions via online questionnaires. Questionnaire data were analyzed using descriptive statistics. Four themes emerged from interview data: (a) technology increases social connectedness; (b) interest in professional involvement/support; (c) connecting with similar survivors; and (d) apprehension regarding competitive social features. Quantitative data indicated that most survivors were interested in social features including a coach (77.1 per cent), team (66.7 per cent), and exercise buddy (57.3 per cent). Survivors endorsed sharing their activity data with their team (80.0 per cent) and buddy (76.6 per cent), but opinions were mixed regarding a progress board ranking their activity in relation to other participants' progress. Survivors were interested in using a message board to share strategies to increase activity (74.5 per cent) and motivational comments (73.4 per cent). Social features are of overall interest to breast cancer survivors, yet preferences for specific social support features varied. Engaging survivors in developing and implementing remotely delivered, technology-supported social features may enhance their effectiveness.

Keywords

Technology, Social support, Physical activity, Remotely delivered interventions

INTRODUCTION

Approximately 3.5 million breast cancer survivors live in the USA today, and this number is projected to increase to nearly 4.5 million by 2026 [1].

Implications

Practice: Breast cancer survivors are interested in incorporating peer and professional social support features into remotely delivered, technology-supported physical activity interventions.

Policy: Policymakers who want to increase physical activity in breast cancer survivors should consider technology-supported peer and professional social support features and work with survivors to determine which features may be most appropriate.

Research: Future research is warranted to test which technology-supported social support features, or combinations of features, are most effective for increasing and maintaining physical activity in breast cancer survivors.

Although these statistics are promising, many breast cancer survivors experience chronic, negative side effects that impair quality of life [2]. Increased physical activity is consistently associated with improved physiological (e.g., mobility and muscle strength), psychological (e.g., quality of life), and social (e.g., interpersonal relationships) functioning among survivors [3–8] as well as better disease outcomes (i.e., cancer recurrence, cancer-specific mortality, and all-cause mortality) [5, 9–12]. Despite the benefits of physical activity, up to 70 per cent of breast cancer survivors do not meet aerobic physical activity recommendations (i.e., 150 min of moderate or 75 min of vigorous intensity physical activity per week) [13] and few accessible physical activity interventions exist for this population [14, 15]. Remotely delivered, technology-supported (e.g., mobile phones and wearable trackers) physical activity interventions may offer a scalable solution given their efficacy in other populations [16]. Incorporating peer and professional social support features into these

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programs may increase their effectiveness, but little is known about survivors' interest in and preferences for these features.

Social support is a key component of several health behavior-change theories and has been defined as attempts to aid and reinforce someone's own efforts to positively change his/her health behavior [17]. Higher levels of social support are associated with increased physical activity participation among breast cancer survivors [18] and reduced risk of all-cause and breast cancer-specific mortality [19]. Breast cancer survivors view adequate social support as a facilitator of physical activity maintenance and inadequate support as a barrier to physical activity engagement [20]. To date, social support has been implemented in physical activity promotion interventions for cancer survivors at three levels: professional (e.g., phone calls and emails from study staff), peer (e.g., group workshops and message boards), and personal (e.g., engaging participants' friends or spouse). Although professional support is typically structured (e.g., regular phone calls from study staff [21]), peer and personal support may be operationalized both formally (e.g., moderated Facebook groups [22] and enrolling romantic partners [23]) and informally (e.g., instructing participants to find supportive peers) [24]. However, few physical activity interventions for breast cancer survivors have included remotely delivered (i.e., no in-person contact) social support features, and, of those that exist, technology was primarily limited to Facebook, phone calls, or email [14, 25].

Physical activity interventions that are delivered remotely offer an opportunity to implement innovative social support features that can be accessed anywhere and anytime. Such features can be used in combination with more traditional, remotely delivered strategies (i.e., calls and emails), stand alone, or be integrated as part of a mobile application (app) with wearable activity trackers [26], social media integration, message boards, and competitions [27]. Preliminary qualitative evidence suggests variation in survivors' preferences for technology-enabled social features [28]. Furthermore, potential unintended, adverse effects (i.e., fear of bullying and negative social comparison) and variation in engagement (i.e., mega users vs. observers) should be carefully considered [29]. Given the significant resources required to program and develop remotely delivered social support features, additional research is needed prior to implementation to better understand breast cancer survivors' preferences, prevent unintended consequences, and maximize intervention effectiveness [30].

Thus, the purpose of the present study is to use a sequential mixed methods approach to quantitatively and qualitatively evaluate breast cancer survivors' opinions and preferences regarding social support features within technology-supported,

remotely delivered physical activity interventions to inform future intervention development.

METHODS

Recruitment and randomization

Study procedures were approved by the university's institutional review board. Women were recruited through an "e-blast" sent to members of the Army of Women, an online directory that connects researchers with survivors interested in breast cancer-related research. Interested women received an e-mail describing the study's purpose and eligibility criteria, which included age ≥ 18 years, diagnosed with stage I-III breast cancer within the last 5 years, ≥ 3 months postprimary treatment (i.e., surgery, chemotherapy, and radiation therapy), able to read, write, and speak English, own a smartphone, and have access to a computer with Internet. No restrictions were placed on body mass index or exercise frequency. At the end of the email, women could click on a personalized link to open the online screening tool. Women meeting eligibility criteria were automatically redirected to an online consent form. Participation was limited to 100 women due to budgetary constraints. Using a prepopulated computer algorithm, a subsample of participants ($n = 35$) was randomly selected for a phone interview [31].

Data collection

This study was part of a larger study exploring breast cancer survivors' interests in remotely delivered, technology-supported interventions. Our previous findings [32] and the broader literature informed interview questions assessing survivors' interests in specific, remotely delivered, social support features (Table 1). We used a sequential mixed methods approach. First, the subset of consented participants randomly selected for a phone interview-completed interviews. They received up to three reminders to schedule an interview. After the interviews were complete, we developed the questionnaires based on previous findings and findings from the interviews. All consented participants were emailed a secure, personalized link to the study questionnaire. Participants received up to three reminders to complete the questionnaires.

Measures

Interviews

Interviews, conducted by an expert in physical activity and cancer survivorship (SMP), followed a semistructured guide developed by the research team. Questions assessed survivors' beliefs about how technology can facilitate or hinder regular physical activity and the types of technologies (i.e., Fitbits, online webinars, and messaging capabilities)

Table 1 | Social features interview guide

Topics	Questions
Use of Tech to Increase Physical Activity	“How do think technology could be used to help facilitate or motivate you and other breast cancer survivors to start and continue to be more physically active?”
General Intervention Features	“What types of features (i.e., social component, tracking, games, and feedback) would you want a smart-phone application to have to help you become more physically active?”
Social Features of Interest	<p>“What types of social components do you think would be helpful?”</p> <p>Specific components described to and discussed with participants:</p> <p>(1) Online Group Webinars: Webinars would be hosted by study staff and focus on behavior change techniques. The format of the webinars could be live, allowing participants to chat or ask questions, or pre-recorded, so all participants could view the video at a convenient time</p> <p>(2) Coach: A study staff member would serve as your behavioral coach and check-in with you via telephone support calls</p> <p>(3) Teams: Participants would be assigned to a team of 4–5 women in the intervention. Potential team features include the options of viewing other team members’ physical activity progress (i.e., steps and minutes of activity) on a team progress board, team message board where a member can communicate with one another, and competitions (see below)</p> <p>(4) Buddy: This could involve matching participants to a “virtual” buddy in the intervention or asking them to choose an individual from their personal life (i.e., friend, spouse, family member, and coworker) to help them become more active</p> <p>(5) Competitions: These may be interpersonal (one participant challenges another participant) or team-based (one team challenges another team). Example competitions include competition for the most weekly minutes, steps, or participation</p>
Final Thoughts	“Any final thoughts on what technology-supported physical activity intervention features would be useful to help you and other breast cancer survivors be more physically active?”

they would find helpful as part of a physical activity intervention. Items relevant to the present study are presented in Table 1. All interviews were audio-recorded and professionally transcribed.

Online questionnaire

After consent, all survivors reported on demographic and disease characteristics. Current physical activity was assessed by asking participants to indicate the number of times per week that they engage in moderate to vigorous intensity exercise and the number of minutes, on average, they exercise each time. Total minutes of moderate to vigorous physical activity was calculated by multiplying the number of times per week by average number of minutes per session.

After the interviews were complete, the research team developed the online questionnaire. Participants indicated their interest in the specific social support features that were positively perceived during the phone interviews (i.e., teams, a “virtual” buddy, and a coach) to refine preferences for component features and implementation as they were the most likely candidates for inclusion in future interventions. First, survivors indicated whether they liked the idea of being assigned to a team and their interest in potential team features including a progress board and a message board. Survivors then indicated whether they liked the idea of being assigned a “virtual” exercise buddy from the intervention, the potential content they may message their buddy, and their willingness to share their physical activity progress with their buddy. Finally,

survivors indicated their interest in a behavioral coach and their preferred modality for receiving coaching. Components endorsed less positively by survivors during the interviews (i.e., competitions) were not assessed on the online questionnaire.

Data analysis

For interview data, key themes were identified through thematic text analysis using an inductive approach [33, 34]. Two research team members (S.M.P. and G.R.L.) independently read through interview transcripts to identify shared responses and iteratively develop a coding scheme (i.e., code names and meanings), which was reviewed by the larger research team to achieve consensus. Three independent coders (G.R.L., A.V.C., and S.L.) read transcripts and assigned codes to relevant content. Discrepancies in coding were resolved through discussion with the larger research team. The larger team met to organize codes into larger thematic categories based on conceptual similarities and a priori research questions. Consensus was reached through discussion. NVivo 11.0 [35] was used to organize narrative content within thematic categories. Two team members (G.R.L. and S.A.H.) independently reviewed the narrative content within each thematic category, summarized findings, and identified illustrative quotes. The pair reviewed any inconsistencies, and discrepancies were resolved through iterative consensus.

Descriptive statistics (e.g., means and frequencies) were calculated for self-reported questionnaire data including demographic and disease characteristics,

weekly minutes of physical activity, and preferences for social support features within technology-supported physical activity interventions. All analyses were conducted in SPSS V.22 [36]. Logistic regression was used to determine whether participant characteristics including race (White vs. non-White), ethnicity (Hispanic/Latina vs. Non-Hispanic/Latina), employment status (employed vs. not employed), age (continuous), education (\geq college degree vs. $<$ college degree), time since treatment (continuous), disease stage (continuous), treatments received (i.e., chemotherapy, radiation, and endocrine/hormone therapy; yes vs. no), health status (continuous), or meeting MVPA guidelines (yes vs. no) influenced social support preferences. Questions with three response items were recoded into two categories (Yes and No/Not sure) to create binary variables.

RESULTS

Participants

Initially, 259 women expressed interest in participating. Recruitment was halted once the study goal ($n = 100$) was met. A total of 104 breast cancer survivors were eligible and consented to participate. Of these, 96 completed the survey. Of the 35 women

randomly selected for an interview, 28 completed the interview. On average, survivors were 55.8 ($SD = 10.2$) years of age. The majority were White (92.7 per cent), non-Hispanic/Latina (92.7 per cent), highly educated (83.7 per cent \geq college degree), and working at least part-time (70.7 per cent). Approximately half were diagnosed with Stage I disease (53.3 per cent). Nearly all had surgery (95.8 per cent), whereas 56.3 per cent received chemotherapy, 61.5 per cent received radiation, and 66.7 per cent received hormone therapy. On average, survivors were 27.5 ($SD = 15.7$) months post-treatment. Survivors self-reported participating in 140.8 ($SD = 123.6$) min of moderate to vigorous physical activity per week with 41 per cent meeting the aerobic physical activity guidelines [13]. Demographic and disease characteristics are presented in Table 2.

Phone interviews

Four main themes emerged from interview data: (a) technology increases social connectedness; (b) interest in professional involvement/support; (c) desire to connect with other survivors; and (d) apprehension regarding competitive social features. Interview questions are presented in Table 1 and illustrative quotes are provided in Table 3.

Table 2 | Sample demographic and disease characteristics

Factor	Interview participant subsample ($n = 28$) Frequency (%)	Survey participant subsample ($n = 96$) Frequency (%)
Age (M, SD)	53.39 (10.1)	55.8 (10.2)
Race—White	92.9	92.7
Ethnicity—Not Hispanic/Latina	96.4	92.7
Education		
$<$ College Degree	10.7	16.3
\geq College Degree	89.3	83.7
Employment Status		
Not Working	25.0	29.4
Working at least Part-time	75.0	70.7
Overall Health Status		
Fair	11.1	10.8
Good/Very Good	74.0	77.4
Excellent	14.8	11.8
Disease Stage		
Stage I	67.9	53.3
Stage II	21.4	34.8
Stage III	10.7	12.0
Treatment Type		
Chemotherapy	50.0	56.3
Radiation	57.1	61.5
Surgery	100	95.8
Hormone Therapy	57.1	66.7
Currently Receiving Hormone Therapy	59.3	76.9
Months Since Treatment (M, SD)	21.8 (15.1)	27.5 (15.7)
Weekly Minutes of Physical Activity (M, SD)	172.6 (129.2)	140.8 (123.6)

Table 3 | Qualitative findings on social preferences

Theme	Social component ideas	Illustrative quotes
Technology Increases Social Connectedness	Social media integration	<p>“I know that’s something that motivates me, when I get done with a workout, I either log on to Facebook and post it up there because I have a special group of friends that are just people that workout, so we share all our workouts together. That, for me, is what motivates me, is just to stay in touch with other people that are similar, that have gone through a similar journey as I have.” (p. 238)</p> <p>“The biggest thing ... Facebook pages, Facebook groups, tend ... seem to work really, really well. Especially if someone involved in the study posts something out there, every day. Posts a question, or ‘Tell us how you’re doing today? Marie is having this issue. Give her encouragement.’” (p. 56)</p>
Professional Involvement and Support	Study Staff (coaching calls and texting)	<p>“I think it [behavioral coach] could be extremely, extremely valuable because I think that so many people struggle with it. They [survivors] don’t know what to do. They don’t know how to do it. They don’t know how much to do, so having someone that’s kind of helping them through that or again the app that kind of lays out a plan but then the coach checks in with them to say, ‘How are you doing? What are you struggling with? What can I help you get through?’” (p. 247)</p> <p>“I think to start out something like that, a weekly call would be helpful to help hold people accountable and then gradually scale off to maybe once a month or something as such.” (p. 42)</p> <p>“Maybe a message just ... like, ‘Just checking in. Do you need any help? I’m available at this time today,’ or something. I guess that would be the best for me. Even if they weren’t available at that time, ‘Just send me a text if you have any questions,’ or whatever if you’re not available at those hours.” (p. 101)</p>
	Staff Facilitated Sessions (webinars)	<p>“If you guys are really looking for the interaction between the participants, then I would think you would want a set time that everybody logs in together and has an open chat or whatever.”</p> <p>“It makes it very complicated but I would feel totally cheated out if I missed these. If you do a combination of both, that would be awesome so I could watch it on my own time but if you had a forum or something like that to pop in and do questions, that would be awesome and if you had it live, that would be awesome for the people that could catch it live.” (p. 238)</p>
Connecting with Similar Survivors	General comment on closed group	<p>“I think that if there was this study, and if there is this app, and if there is this common thread through all of its participants, hey we’ve all had breast cancer, it feels safe at that level. I think that could be engaging to me. I would do that, whereas with the Jawbone, I have no idea whether I’m talking with someone in India or Canada or California. Not that any of those places, I wouldn’t want to communicate with those people, but I just feel that the motivations of people within this safe app would be an environment that would be trusted.” (p. 125)</p>
	In App Features that facilitate “Connectedness” (message boards and sharing progress)	<p>“I think where you can post questions and say, you know, I’m really having a tough time today can anybody help me through this? That type of thing so they can give encouragement to one another.” (p. 174)</p> <p>“I like sharing my experiences with people, if it means that it will help them. I’m sure that you’d find a lot of survivors are like that. Maybe I’m wrong, but my idea is that well, we’ve all gone through something and we’ve all made it through it so let’s give it our best shot to make sure it never comes back again. I could see how this could be very useful.” (p. 238)</p>
	Team Assignment	<p>“...I think of teams and having a progress report where people could see they did this many steps in one day or they walked this many miles or whatever, you got the visual aspect to it, people like seeing that and routing for their team and stuff like that. They might go the extra five hundred steps just to win that day or whatever, whatever that may be. I’d say the social aspect is really, really important. It could really work well.” (p. 238)</p> <p>“I like the teams aspect because that gives you an interaction with a few people that are the same level you are, the same age maybe or close to the same age, same level of breast cancer. That type of thing that you’re working with on a weekly basis, maybe, with something going on.” (p. 174)</p>

(Continued)

Table 3 | Continued

Theme	Social component ideas	Illustrative quotes
	Buddy Assignment	<p>“My gut reaction is, if I did have a buddy, I would want it to be someone from the app, another survivor. I think that would create that camaraderie, and sisterhood...and can more understand each other's experience. Maybe understand each other's challenge, and the relative uniqueness of being a survivor, and having to deal with some of the after-effects of treatment ... versus a family member.” (p. 56)</p> <p>“I like the idea of having a battle buddy. Somebody who maybe I'm assigned one person I could go back and forth with...Then, it's a little more personalized, and intimate, and you get to know each other over time, and motivate each other over time. You're all competing together against yourself, you know what I mean?” (p. 63)</p> <p>“In twelve weeks I don't know how close you could get to somebody that might be not as effective as someone you know, who knows your history, who knows the importance of staying active to keep cancer away. So I would yes, a buddy, and someone you know.” (p. 204)</p> <p>“The second piece in having it be a spouse, a family member, what have you, the biggest thing that I see there is that it's so much easier to do something and stick with it if you have the support at home and you have others doing it with you.” (p. 247)</p>
Apprehension Regarding Competitive Social Features	Team Competitions	<p>“...if I'm comparing myself to others and I am falling short, that's going to make me really depressed...I don't want to be in a forum where I am competing and comparing. That's not going to help me. It's not useful to me. I'd be less likely to use the social aspects of it.” (p. 118)</p> <p>“I never thought of teams in competition. I guess when I think of social interaction I tend to think of cooperation and encouragement rather than competing. I guess personally I probably wouldn't find competition, that model to be particularly helpful. Just personally. I probably wouldn't respond to that as much as knowing that I was doing something or trying to do something that a lot of other people were trying to do as well.” (p. 170)</p> <p>“I think so as long it [team competitions] was fostering positive progress and I don't think anybody wants survivor trash talking or anything. I think that would be cool. Otherwise just to have a time that isn't competitive that that would also be for like you say the sense of community, that would be equally as good I think.” (p. 220)</p>
	One-on-One Competitions	<p>“...the little feature where you can challenge other people and kind of see how you're stacking up against your family and your friends. I think that's kind of motivating too.” (p. 168)</p>

Theme 1: technology increases social connectedness

Reasons cited for how technology could increase social connectedness within a physical activity intervention included the following: technology creates communities, eases communication, heightens visibility, and allows for social comparisons and competitions. Some believed sharing physical activity data (i.e., posting goals and progress to social media, using Fitbits to challenge others) increases accountability, fosters encouragement, and would ultimately help them successfully increase their physical activity. In terms of social media integration, most survivors supported using Facebook to join a closed study group, whereas a few endorsed posting study-related content to their personal accounts. Survivors preferred Facebook over other social media apps because it is frequently used, has chat features, and posted content is “front and center,” enabling members to easily view it, share, and respond.

Theme 2: professional involvement and support

Survivors believed a coach would increase their expertise, motivation, and accountability, especially

when feeling overwhelmed or discouraged. They liked the idea of knowing they could ask questions to a knowledgeable professional who cared about them. A few were uncertain about a coach because they felt that they would be intrinsically motivated, motivated by technology alone (e.g., app or wearable tracker), or previously had poor experiences with coaches. Survivors preferred increased contact with a coach at the intervention's start, which would taper with progress. Survivors emphasized a desire for flexible coaching, suggesting a mix of scheduled calls, access to a coach during open office hours, and the ability to text questions anytime with answers returned within 24–48 hr. Many survivors preferred texting over calls for convenience (i.e., express their questions/concerns as they occurred). When asked about their interest in on-line group webinars facilitated by study staff, survivors liked the idea, viewing webinars as an opportunity to connect with fellow participants, access study staff, and address questions. Survivors preferred a live webinar format that would be recorded and shared with

participants, so they could access it later if unable to attend live. Concerns regarding on-line group webinars related to poor attendance and receiving redundant information.

Theme 3: connecting with similar survivors

Participants indicated that a physical activity app that connected them to other survivors would be highly motivating. Many emphasized the desire for social connectedness with other survivors due to their shared experiences and feelings of isolation. Several survivors indicated that they would use social features in an app exclusive to breast cancer survivors, though they typically would not use social features in other apps. Survivors were most interested in supportive, encouraging, and positive social features. Message boards were highly regarded for their potential to increase interaction through posting questions, giving and receiving feedback, and sharing ideas. Similarly, survivors believed that sharing physical activity data (e.g., steps and minutes) on a progress board would help formalize goals, create a sense of accountability, and facilitate an understanding of their achievements relative to their peers.

Survivors were mixed in their preferences for team and buddy assignments. Many liked teams because they felt that teams would encourage connection, fun, support, and accountability. Some thought women should be assigned to teams based on some similarity (i.e., age and exercise goals). Those not in favor of teams cited concerns about members feeling excluded and difficulty encouraging survivors they have never met. Nearly all sources believed that an exercise buddy would be helpful. Many endorsed the idea of being matched virtually with another participant citing their shared cancer experience. However, some preferred choosing a buddy from their personal life for both in-person support and the perceived challenge of connecting with others via an app. Those who disliked buddies mentioned the possibility of feeling nagged, difficulties coordinating exercise sessions, or concerns over compatibility if matched.

Theme 4: apprehension regarding competitive social features

Survivors' beliefs about competitive social features were discrepant. Common reasons cited against competitions were survivors' beliefs that they were not personally competitive individuals and fear that competitions may induce feelings of failure. Some preferred individual competitions (i.e., compete against oneself) over one-on-one competitions against others. In contrast, others believed that competitions would motivate them, provide additional accountability, and facilitate connectedness. Responses were also mixed for team competitions. Some believed that competitions would be motivating as team members could encourage each other

without individual comparisons. Others were concerned that team competitions may lead to "trash talking" and create unequal pressure resulting from differing abilities or progress rates. Instead, survivors preferred teams to function as support groups, not competing forces. Survivors who liked individual or team competitions were more likely to have had positive experiences with previous competitions (i.e., Fitbit challenges).

Online questionnaire

Data on survivors' preferences for social support features are presented in [Table 4](#).

Teams

The majority of survivors liked the idea of assigned teams with a message board for communication among members (66.7 per cent). Most were interested in posting effective strategies for increasing physical activity (74.5 per cent) and motivational comments (73.4 per cent) on the team message board. Additionally, most survivors were willing to share their physical activity data with team members (80.0 per cent) and were interested in seeing team members' physical activity data (76.8 per cent). Although almost half (44.8 per cent) liked the idea of a progress board where their individual physical activity data were ranked against team members, another one-quarter were unsure (27.2 per cent) or did not like this idea (28.1 per cent). Findings were similar with regard to a progress board that ranked (a) individual physical activity data against their team's average or (b) their team's activity against other team's activity data.

Exercise buddy

Most survivors (57.3 per cent) liked the idea of a program-assigned exercise buddy whom they could message. They were most interested in messaging effective strategies (77.3 per cent), motivational comments (73.9 per cent), and barriers they encountered (71.6 per cent). The majority of survivors were interested in sharing (76.6 per cent) and comparing (62.8 per cent) their activity data with their buddy.

Overall, survivors believed both a team and a buddy would be most helpful for staying motivated (38.2 per cent), when compared with only a team (29.2 per cent) or only a buddy (11.2 per cent), whereas 21.3 per cent had no preference.

Coach

Most survivors (77.1 per cent) liked the idea of a coach. The preferred mode of communication with the coach was text message (48.9 per cent), whereas weekly office hours were least preferred (7.4 per cent). Finally, survivors indicated an exercise specialist (54.7 per cent) or a study team member (37.9 per cent) should be the coach.

Table 4 | Breast cancer survivors' preferences for social features (n = 96)

Question	Frequency (%)
Interest and preferences for "Teams"	
What are your thoughts on a being assigned to a team of others in the intervention?	
I like this idea	66.7
Not sure	22.9
I don't like this idea	10.4
If you were assigned to a team and there was a team message board, what would you be interested in posting to the message board? (Mark all that apply)	
Effective strategies	74.5
Motivational comments	73.4
Links to websites or articles	68.1
Barriers you are having	60.6
Pictures	33.0
If you were assigned to a team, would you be interested/willing to share your activity data with others on your team?	
Yes	80.0
Not Sure	11.6
No	8.4
If you were assigned to a team, would you be interested in seeing other team members' activity data?	
Yes	76.8
No	12.6
Not Sure	10.5
What are your thoughts on a progress board where your activity is ranked in relation to other individual team members' activity data?	
I like this idea	44.8
I don't like this idea	28.1
Not sure	27.1
What are your thoughts on a progress board where your activity data is ranked in relation to the average activity data for all other team members?	
I like this idea	58.3
I don't like this idea	24.4
Not sure	17.7
What are your thoughts on a progress board where your team's activity data is ranked in relation to activity data from other teams?	
I like this idea	53.7
I don't like this idea	23.2
Not sure	23.2
Exercise Buddy	
What are your thoughts on being assigned an exercise buddy who is similar to you in the program?	
I like this idea	57.3
Not sure	22.9
I don't like this idea	19.8
If you were assigned a buddy, what would you be interested in messaging about? (Mark all that apply)	
Effective strategies	77.3
Motivational comments	73.9
Barriers you are having	71.6
Links to websites or articles	64.8
Pictures	35.2
If you were assigned a buddy, would you be interested/willing to share your physical activity data with your buddy?	
Yes	76.6
Not Sure	14.9
No	8.5
If you were assigned to a buddy would you be interested in seeing your activity data in relation to your buddy's activity data?	
Yes	62.8
Not Sure	23.4

(Continued)

Table 4 | Continued

Question	Frequency (%)
No	13.8
Team versus Exercise Buddy	
Which of the following do you think would be more helpful for motivating you and keeping you on track?	
Both	38.2
Team	29.2
No Preference	21.3
Exercise Buddy	11.2
Behavioral Coach	
What are your thoughts on a behavioral coach?	
I like this idea	77.1
Not sure	18.8
I don't like this idea	4.2
If you were to be provided with a behavioral coach, how would you like this relationship to be structured?	
Text messaging to check in	48.9
On demand where I could reach out and the coach will get back to me	20.2
Scheduled 10–15 min phone calls	14.9
Weekly or biweekly office hours when I know the coach is available	7.4
No preference	7.4
Other	1.1
If you were to be provided with a behavioral coach, who do you think the coach should be?	
Cancer exercise specialist	54.7
Trained study staff (male or female)	29.5
Trained study staff (female only)	8.4
Other breast cancer survivors	6.3
Other	1.1

Preferences and participant characteristics

Preferences for specific features in relation to demographic and disease characteristics are presented in Table 5. Survivors who received chemotherapy were more likely to endorse teams than those who did not ($\beta = 2.0$; $p = .004$). Women who received

radiation therapy were more likely to endorse a buddy than those who had not ($\beta = 1.26$; $p = .03$). Women with lower health status ($\beta = -0.90$; $p = .02$) were more likely to indicate that they liked the idea of a coach. No characteristics assessed were significantly associated with progress boards.

Table 5 | Participant characteristics and preferences for social features ($n = 96$)

Characteristic (Reference)	Social Support Feature			
	Team β (SE)	Buddy β (SE)	Coach β (SE)	Progress Board β (SE)
Race (White)	0.56 (1.88)	-20.97 (27478.72)	-1.54 (1.92)	18.32 (28396.03)
Ethnicity (Not Hispanic/Latina)	24.01 (40192.97)	0.47 (48688.34)	20.70 (40192.97)	42.43 (49211.88)
Employment (Full/Part Time)	-0.41 (0.60)	-0.43 (0.58)	1.33 (0.79)	1.78 (0.82)
Age	-0.05 (0.03)	-0.02 (0.03)	-0.058 (0.40)	-0.06 (0.03)
Education (\geq college degree)	0.26 (0.71)	-0.40 (0.65)	-0.28 (0.76)	-0.11 (0.73)
Time Since Treatment	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	-0.01 (0.02)
Disease Stage	0.93 (0.48)	-0.01 (0.43)	0.24 (0.49)	-0.08 (0.47)
Received Chemotherapy (Yes)	2.01 (0.70)**	0.57 (0.61)	1.29 (0.74)	0.74 (0.66)
Received Radiation (Yes)	-0.13 (0.61)	1.26 (0.59)*	0.00 (0.67)	-1.03 (0.63)
Received Endocrine/hormonal therapy (Yes)	-0.57 (0.57)	-0.40 (0.56)	1.37 (0.76)	0.90 (0.67)
Health Status	-0.47 (0.35)	-0.51 (0.33)	-0.90 (0.39)*	0.57 (0.38)
Meet MVPA Guidelines	0.26 (0.53)	-0.43 (0.52)	-0.38 (0.61)	-0.41(0.59)

Values in bold indicate that the factor is statistically significant. Progress board variable represents interest in any type of progress board.

* indicates significant at $p < .05$; ** indicates significant at $p < .01$.

DISCUSSION

The present study utilized a sequential mixed methods approach to evaluate breast cancer survivors' preferences for social support features within technology-supported, remotely delivered physical activity interventions. Overall, qualitative and quantitative findings were congruent: survivors believed that social support is an important intervention component and expressed interest in a variety of both traditional (i.e., weekly calls) and innovative (i.e., "virtual" buddies) social support features that connect study staff, fellow participants, and those in their personal life. Survivors were most interested in encouraging features accessible to study participants only. Data indicate preferences varied as to which specific features should be implemented and how, especially with regard to competitive features. Data also suggest that participant characteristics may be associated with social support preferences. These findings should be considered when designing remotely delivered, technology-supported interventions for breast cancer survivors.

Because remotely delivered interventions do not allow face-to-face support, technology must foster social connectedness in creative ways acceptable and useful to survivors. Survivors endorsed both traditional and innovative technology-supported social features that could be conveniently accessed anywhere at any time. With regard to more traditional, remotely delivered social features, most believed a coach and study-staff moderated webinars would help them increase their physical activity through encouragement and greater accountability. Additionally, survivors' preferences for more innovative social support features varied, which is consistent with previous findings [32, 37]. Many survivors qualified that the purpose of social features should be to foster encouragement and support rather than social comparison and negative competition. Competitive features received mixed support, which may be attributable to participant characteristics not assessed in the present study (i.e., being competitive, Fitbit use). Some survivors' concerns are consistent with previous research describing how physical activity as a means to compete with friends was not well received [28].

The variability in survivors' preferences for social support features indicates that there may not be one feature or set of features that appeal to all survivors, and participant characteristics may predict preferences. Variability in preferences does not imply that these features would be ineffective; rather survivors may lack experience with these features. Conducting pilot work that exposes survivors to various social support features and allows them to test each feature is important in order to give survivors the needed experience to solidify their beliefs about which features they find most helpful. Thus, survivors should be engaged when developing and testing social

features to further vet them or tailor them to specific groups. Before implementation, it is important to consider not only which social features most effectively increase and maintain physical activity alone or in combination with other intervention strategies (i.e., self-monitoring), but also which features are most acceptable, cost-effective, and feasible, raising the fewest concerns. Additionally, researchers must consider how to monitor social features and encourage engagement throughout an intervention to ensure these features function as intended. Finally, although only treatment received and health status were significantly related to preferences, it is possible that these factors and other factors not assessed in the present study may affect preferences when assessed in larger, heterogeneous samples. Furthermore, other factors (e.g., education, motivation, and personality) that were not assessed may influence preferences, and it is possible that survivors with more or less exercise knowledge or experience may desire different social features. Therefore, future research in larger, heterogeneous samples is warranted to explore the relationship between factors explored in this study and additional physical (e.g., BMI and functional status), psychosocial (e.g., quality of life and fatigue), motivational (i.e., self-efficacy and outcome expectations), and personality factors as well as how knowledge regarding the potential benefits of social support may affect participant perceptions.

Study designs including A-B quasi-experimental designs [38], multiphase optimization strategy factorial experiments [39], sequential multiple assignment designs [39], and microrandomized trials [40] may be useful when identifying the most effective features, or feature sequences. Furthermore, these designs address questions about what works for whom, in what contexts, and for what outcomes [41]. Additionally, future work should test the feasibility and efficacy of a patient-centered, tailored approach [42] whereby survivors are provided with a "menu" of social support features to choose from in order to customize the intervention to their preferences. Finally, researchers may consider how to build off of existing online or telehealth survivorship programs when implementing social support features for remotely delivered, technology-supported physical activity interventions.

Results of this study should be interpreted within the context of its limitations. First, our sample largely consisted of fairly active, White, non-Hispanic, high-income survivors. Additionally, recruitment and data collection were conducted using the Internet; thus, our findings may not be representative of less technologically savvy individuals. Furthermore, our sample consisted of highly engaged survivors as they were members of the Army of Women and self-selected into the study. Future research should examine whether this

study's findings generalize to more diverse breast cancer survivors (i.e., Hispanic, more-advanced disease) at different times since diagnosis and with varying experiences with technology. Finally, this study involved a cross-sectional assessment of preferences for digital social features. Existing data from other populations suggest that long-term engagement with technology-supported interventions may be influenced by many features (i.e., content, appearance, and ease of use) that we did not assess. Future research should examine these characteristics before deciding on features and how to implement them.

Despite limitations, to the best of our knowledge, this is the first study to specifically examine breast cancer survivors' preferences for social support features within a technology-supported, remotely delivered physical activity intervention. When designing an intervention for breast cancer survivors, it is necessary to specifically query these patients, as their unique demographic and disease profile may result in different social needs compared with other survivor groups (i.e., peer support vs. spousal support). In our national sample of breast cancer survivors, we intentionally included both active and inactive survivors to learn what works for individuals with varying exercise experiences. Additionally, we utilized a mixed methods approach because qualitative analysis yields insight beyond what can be learned from survey responses, and our qualitative approach used multiple coders and team consensus to ensure that illustrative quotes were accurately sorted into representative, thematic content areas.

In conclusion, findings indicate that breast cancer survivors are interested in social support features as part of a remotely delivered, technology-supported physical activity intervention. These data highlight variability in survivors' preferences for specific features, indicating that survivors should be engaged in designing and implementing social features to increase their utility and efficacy. Future work is warranted to test which social support features, or combinations of features, are most effective for increasing and maintaining physical activity in breast cancer survivors.

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Compliance with Ethical Standards

Conflict of Interest: None declared.

Primary Data: This is an original manuscript, and it is not being simultaneously submitted elsewhere. The findings of this study have not been previously reported. The authors have full control of all primary data and agree to allow the journal to review their data if requested.

Authors' Contribution: All authors have contributed sufficiently to this scientific work and share collective responsibility and accountability for the results.

Ethical Approval: All procedures performed in this study involving human participants were in accordance with the ethical standards of institutional review board at Northwestern University Feinberg School of Medicine and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

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