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Designing more engaging computer-tailored physical activity behaviour change interventions for breast cancer survivors: lessons from the iMove More for Life study

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Abstract

Background: Participating in regular physical activity is a recommended cancer recovery strategy for breast cancer survivors. However, tailored support services are not widely available and most survivors are insufficiently active to obtain health benefits. Delivering tailored programs via the internet offers one promising approach. However, recent evaluations of such programs suggest that major improvements are needed to ensure programs meet the needs of users and are delivered in an engaging way. Understanding participants' experiences with current programs can help to inform the next generation of systems. **Purpose:** To explore breast cancer survivor's perspectives of and experiences using a novel computer-tailored intervention and describe recommendations for future iterations. **Methods:** Qualitative data from a sub-sample of iMove More for Life study participants were analysed thematically to identify key themes. Participants long-term goals for participating in the program were explored by analysing open-ended data extracted from action plans completed during the intervention (n = 370). Participants negative and positive perceptions of the website and recommendations for improvement were explored using data extracted from open-ended survey items collected at the immediate intervention follow-up (n = 156). **Results:** The majority of participants reported multi-faceted goals, consisting of two or more outcomes they hoped to achieve within a year. While clear themes were identified (eg., "being satisfied with body weight"), there was considerable variability in the scope of the goal (e.g., desired weight loss ranged from 2kg to 30kg). Participants' perceptions of the website were mixed, but clear indications were provided of how intervention content and structure could be improved. **Conclusions:** This study provides insight into how to better accommodate breast cancer survivors in the future and ultimately design more engaging computer-tailored interventions.

Keywords: breast cancer survivor, computer-tailor, intervention, physical activity, qualitative

Introduction

Many breast cancer survivors suffer from adverse treatment related side effects well beyond the time of treatment, reducing quality of life [1]. In addition, compared to their age-matched counterparts, breast cancer survivors are more likely to suffer from other chronic conditions and have a lower life expectancy [2]. There is strong evidence that participating in regular physical activity can ameliorate treatment-related side-effects and help breast cancer survivors to improve and sustain good health [3,4]. On this basis, regular physical activity is recommended as an important cancer recovery strategy [5-7]. Nonetheless, specialised physical activity support is not routinely available to breast cancer survivors and most are considered insufficiently active to obtain health benefits [8].

Internet-based applications have been put forth as one promising strategy to support physical activity behaviour change among breast cancer survivors [9,10]. The Internet is ubiquitous and capable of providing personalised and interactive support in an on-going manner. This allows for a wide-reach at a low cost, while still providing a high level of tailored support. Online delivery also circumnavigates many of the barriers of attending traditional face-to-face programs, such as inflexible program times and travel requirements [11]. As such, it is not surprising that many survivors cite a preference for receiving lifestyle support online compared to other delivery modes [9]. However, there are some limitations that need to be addressed if Internet-based interventions are to have a real world impact on public health. The development of such interventions is a complex process and can be resource intensive in terms of time and/or money. Further, evaluations of internet-based interventions suggest that few users engage with the intervention as intended [12]. This likely explains, at least in part, the small effect sizes observed in internet-based physical activity interventions and has been largely attributed to sub-optimal intervention design and delivery [13,14]. Evidence and theory related to user engagement suggests that engagement is optimal

when interventions are well matched to individual's characteristics in terms of goals, needs, skills and circumstances [13]. This is the case in terms of both intervention content (e.g., feedback, social support features) and delivery factors (e.g., ease of use, interactivity, complexity) [15,13]. When interventions are well matched the user experience is more positive, which leads to greater persuasion and intervention usage and ultimately greater behaviour change [15-17]. While a considerable amount of research has been conducted to determine what intervention strategies are associated with increased effects [18], few studies have provided practical insights into how to implement these strategies in a way that provides a more positive user experience and more deeply engages users in the behaviour change process. To combat this, qualitative research aiming to help intervention developers better understand and accommodate the perspectives of intervention users has been recommended [19].

We have previously reported on the outcomes of a randomised trial [20] examining the effects of theory-based computer-tailored online interventions for improving physical activity behaviour among breast cancer survivors. The intervention was adapted from a previously evaluated print-based intervention [21], which was developed based on extensive qualitative and quantitative formative research [22,23]. Our findings suggest that computer-tailored online interventions have utility in this group for supporting clinically relevant changes to both aerobic and resistance-based activity [20], however improvements to the intervention design were clearly needed. Similar to other studies [12,18], usage of our intervention platform steadily decreased over time and we had difficulty retaining participants. Further, acceptability ratings were mixed. The current qualitative study aims to provide insight into the perspectives of our users and how to better accommodate them by exploring their goals for participating, what design features may have contributed to negative and positive experiences, and how the intervention could be improved based on participant

recommendations. The decision to analyse participants' long-term goals was made post-hoc, based on the growing recognition that interventions need to be more person-centred, and in doing so consider the perspectives and desires of the target audience [19]. Given that our intervention utilised two gold-standard intervention techniques consistently associated with increased effect sizes among other populations (i.e., computer-tailoring and action planning [24,25]), this research is timely, and likely to serve as a useful guide to intervention developers wishing to implement these techniques in way that holistically accommodates breast cancer survivors and better engages them in the behaviour change process.

Method

The iMove More for Life Study

A detailed description of the iMove More for Life study has been published previously[20]. In brief, 492 Australian breast cancer survivors were recruited online. Participants were generally representative of the breast cancer survivor population in terms of age, weight status, cancer stage, fatigue and physical activity, however they were more likely to have a university degree and reside in rural/regional areas than would be expected based on Australian population-based data [1,20]. Participants were randomised into one of three intervention arms: (1) a three-module computer-tailored intervention delivered monthly, (2) a three-module computer-tailored intervention delivered weekly or (3) a single module computer-tailored intervention.

The interventions all aimed to influence key social cognitive [26] determinants of physical activity over a 12week period to increase participation in both aerobic and resistance-based physical activity. As well as computer-tailored feedback and advice, each intervention condition also contained access to an action planning tool and a library page containing information on resistance-training exercises and stretches that could be done at home, strategies for incorporating physical activity into daily life, and suggestions on how to

make physical activity fun. The computer-tailored content provided in each condition was almost identical, with exception of the additional physical activity feedback provided to individuals receiving the multiple-module interventions (see [20]).

Retention at the primary time-point of interest (i.e., immediately post-intervention) was 35% (n = 156). Analysis of observed data [20] indicated that participation in aerobic and resistance-based physical activity increased significantly across all groups, and that perceived website acceptability (M = 22.20 out of 36, SD = 5.98) and usability (M = 69.16 out of 100, SD = 17.06) were fair to above average, respectively. Those allocated to the monthly module group rated the acceptability of the intervention 2.27 (95 % CI = 0.02 to 4.53) points higher on average than those allocated to the single module intervention group (p = 0.048). Likewise, incidence of resistance-training among participants allocated to the monthly module group was 1.88 times higher than participants allocated to the single module intervention group (p = 0.01). There were no other effects of group.

Ethics approval was obtained from the Central Queensland University's Human Research Ethics Committee (EC00158). The trial is registered with the Australian and New Zealand Clinical Trials Registry (registration number: ACTRN12613001220752).

Measures

Participants' long-term goals

All participants were encouraged to complete an action planning task on the website at the beginning of the intervention. As part of this activity, participants were prompted to enter their long-term physical activity goal. This was defined as what they would like to achieve in one year's time. Participants were instructed the goal could be anything they liked, as long as it met the SMART (specific, measurable, attainable, realistic, time-based) goal principles. Response options were open-ended with no character limit enforced.

Participants' perceptions of the website

Participant's perceptions of using the website and the website content was assessed using four open-ended items at the immediate post-intervention follow-up. Participants were instructed to answer as honestly and as completely as possible and were informed that their responses would help us to improve the website. The following two items were used to assess positive perceptions: "What did you like about using the website?" and "What did you like about the information/advice on the website". Negative perceptions were assessed using "What did you NOT like about using the website" and "What did you NOT like about the information and advice on the website?" Response options were open-ended with no character limit enforced.

Participant's' recommendations for improving the website

Participants' recommendations for improving the website were assessed at the immediate post-intervention follow-up with the following two items "Do you have any recommendations for improving the information/advice available on the website?" and 'Do you have any other recommendations to improve the website?"

Data analysis

All qualitative data were analysed using an inductive thematic analysis approach [27]. This approach is data-driven, and involves becoming familiar with the data, generating initial codes, searching for themes among codes and refining themes to better fit the data. For the analysis of participants' long-term goals, codes were generated and listed alongside individual responses. The prevalence of the themes and how often participants' responses mapped to more than one theme was then explored. As participants' goals were not expected

to be influenced by group assignment, the influence of group on themes was not explored for this data. Whereas, as group allocation may have influenced participants' experiences and perceptions of the website, responses to these items were organised thematically into a tabular format with separate columns for each intervention group. Possible differences based on group were then explored when reflecting and refining themes. Once themes were refined, quantitative survey data (demographics, perceived website acceptability [possible range 0-36] and usability [possible range 0-100][20]) were noted alongside participant responses to provide additional context and illustrative quotes were selected to represent each theme. All data analyses were conducted by CES, who holds a PhD in behavioural science and was the lead intervention developer for this study. All co-authors reviewed each theme and agreed that the selected quotes were appropriate. Examination of participant characteristics was conducted in STATA 11 [28] using descriptive statistics and independent t-tests.

Results

Participants

Of the 492 participants enrolled in the iMove More for Life study, 370 (75%) specified their long-term ('1-year from today') physical activity goal. On average, those who specified a goal had finished their primary treatment for cancer more recently than those that did not (mean difference = 0.95 years, 95% CI = 0.13, 1.77). Just under one third of all iMove More for Life study participants (n = 156; 32%) provided information on what they liked and did not like about the website. These participants had higher baseline resistance-training scores (calculated by multiplying number of sessions by number of exercises) compared to non-responders (mean difference = 1.21, 95% CI = 0.20, 2.22). They also utilised the intervention more, however non-usage attrition was still observed. Approximately 20% of participants who had access to three modules did not completed them all, and less

than two percent completed all available action plans. Participants in the current study were otherwise representative of the iMove More for Life study population [20].

Participants' long-term goals (n = 370)

The majority of participants (60%) reported multi-faceted goals, consisting of two or more outcomes they would like to achieve (e.g., “Losing 10kg, walk for 30 minutes every day, and being able to walk around Singapore during our holidays”). Overall, the most common goals related to having a regular exercise routine, being satisfied with body weight or image, increasing fitness and strength and improving current health issues. A more detailed overview relating to each of these themes is summarised below. Illustrative quotes are presented in Table 1.

Regular exercise routine

The majority of participants (60%) aimed to have a regular or “fixed” exercise routine, and specified the frequency, time and type of exercise they hoped to do. The frequency and time mentioned were generally in line with the physical activity guidelines (which they had been presented with), however some did aim to achieve a lower amount, and others aimed to achieve more. Walking was the most commonly mentioned activity. Running, yoga, Pilates, swimming, cycling, ‘gym sessions’, tennis, aqua aerobics, resistance-training and boxing were also mentioned. Overall, most participants’ goals related to aerobic activities, with about a quarter also referring to resistance-based activities. Very few participants specified the intensity of the activity they aimed to do, though some did mention walking “briskly” and others indicated the distance or number of steps they would like to achieve within a particular time-frame (e.g., 5km in 45 minutes).

Body weight and body image

Just over half of participants (56%) had a goal relating to their body. The vast majority of these were aiming to reduce their current weight. Most women specified how much they would like to lose in kilograms (kg), ranging from 2-30kg, with an average of 10kg. Others indicated what clothes size they would like to be, where they would like to lose weight from (e.g., “excess fat around my hips”), the “ideal” weight they are aiming for or how many centimetres they’d like to lose from their waist line. A small proportion of women indicated that their main goal was maintaining their current weight. There were also a few participants who reported that their goal was to feel better about their body.

Increasing fitness and strength

One quarter of participants had a fitness related goal. This typically involved being able to do a specific activity without needing to stop or without feeling too much out of breathe. Some participants also had a special event in mind (e.g., a holiday or a competition or an activity they used to do) that they wanted to be fit enough to participate in. A small number of participants also had more general goals relating to “increasing strength” or “core muscles” or being “fitter and stronger” than before.

Improving health

One-quarter of participants had a health-related goal. For most, this centred on restoring physical functioning, and reducing pain and fatigue after cancer treatment. For some, it also involved managing other health issues, such as diabetes, high cholesterol, knee replacements or poor mental health.

Table 1 – illustrative quotes relating to participants goals

Participant's perceptions of the website (n = 156)

The majority of participants reported both aspects they liked and disliked about the website, with a moderately positive tone overall. However, there were some participants that provided only negative or only positive feedback. For example, some participants said comments like “nothing”, “not a thing” and “not applicable” in reference to what they liked about the website. Whereas others reported there was nothing that they disliked (e.g., I liked it all!). Analysing themes and illustrative quotes based on group assignment did not reveal any unique insights or trends, with all themes being equally prevalent across groups and defined by similar participant quotes. Given this, themes are presented independent of study group.

The most common positive perceptions of the website related to the content being considered easy to understand, interesting, pragmatic, non-judgemental, encouraging, relevant, informative and helpful. However, some strongly felt that the advice was not tailored adequately to fit their circumstances, and in particular their health issue (e.g., fatigue) or their age group. Others felt that they did not learn anything new from the information, that too much information was provided at once, and even that participating was de-motivating for them.

The content most clearly valued by participants (including those who reported some negative perceptions) was the specific information provided about resistance-training exercises, and in particular the step-by-step instructions and diagrams. The instructions on goal setting and some components of the physical activity advice (e.g., benefits of physical activity relating to cancer survivorship) were also mentioned positively. While a few participants reported liking the action planning task, there were several negative perceptions related to these. It was clear that for many the lack of feedback provided on their plans once

created made the task feel pointless, as there was “nobody on the other side”. There was also disagreement with how the action planning tool was set up. Some found the response options inadequate or too inflexible (e.g., “not enough choices for exercise”), others found it to be too time-consuming and repetitive, which made it feel like a chore. Other usability issues were also noted, such as issues using the site on an iPad, issues trying to print the information sheets available in the library and a glitch in the reminder system that resulted in confusing emails being sent to participants about when they should complete modules and action plans. Illustrative quotes relating to participants’ positive and negative perceptions are summarised in Tables 2 and 3, respectively.

Table 2: Illustrative quotes relating to participants positive perceptions of the website

Table 3: Illustrative quotes relating to participants negative perceptions of the website

Participants’ recommendations for improving the website (n = 156)

Participants’ recommendations for improving the website predominantly addressed the components they disliked. For example, several women recommended that the physical activity advice could be more tailored so that it better addressed their level of capability given a particular health issue or their level of fitness. Other suggestions seemed more related to participants’ goals for participating or what they felt they needed to stay engaged with the website. For example, some participants reported that they wanted more prescriptive exercise plans to help keep them on track and others stated they wanted more regularly updated content to keep them interested. A summary of participants’ recommendations, alongside illustrative quotes, is presented in Table 4.

Table 4: Summary of participant's recommendations for improving the website with illustrative quotes

Discussion

Principal findings and comparison to previous research

Our findings relating to participants' long-term physical activity goals complement the existing literature exploring breast cancer survivor's motives for exercising [29,30]. Both motives and goal content provide insight into the outcomes that individuals are pursuing when engaging in physical activity [31]. In line with our findings, previous qualitative research has shown that weight loss, physical appearance, and health are key physical activity motivators among breast cancer survivors [29,32,30,33]. Our findings extend this work by providing more detailed information that is essential for person-centred intervention design. For example, we demonstrated that while weight loss is a key motivator, it is not the sole motivator, and the extent of weight loss desired and how it is defined is heterogeneous. This suggests not only that online systems targeting breast cancer survivors may benefit from incorporating weight loss content and tools (e.g., calorie counter), but that this needs to be flexible and sufficiently tailored to account for the differing degrees of weight loss desired, the weight loss metric of interest to participants (e.g., moving down a clothes sizes versus kilograms) and the other key outcomes participants want to achieve (e.g., developing a regular physical activity habit). In addition, compared to other studies, our findings are also in the context of what participants would like to achieve within one year. By prompting participants to be specific when setting their goals for this timeframe, our data is a useful resource for guiding the development of platforms aiming to achieve long term outcomes. To date, most physical activity interventions targeting breast cancer survivors have been for a 12 week period, as have most internet-based interventions targeting the general population

[34,35]. Our data suggests that this time period may provide inadequate support for many survivors (e.g., those aiming to lose over 20kg of weight). As such, it is recommended that alternative intervention designs, better suited to providing longer-term and more goal specific support are considered in the future. Given that previous research suggests that engagement in internet-based health applications is partly driven by how well the application is perceived to address personal goals [36,13] this is an important consideration.

Our research also provides insights into how to improve the implementation of computer-tailored feedback in web-based interventions targeting breast cancer survivors. Previous research has shown that computer-tailored interventions are more effective than interventions providing generic information and advice, which is primarily due to the increased personal relevance of the information [24,37]. The tailored advice presented to participants in the current study was adapted from a tailored-print intervention delivered to breast cancer survivors in 2012. Acceptability data suggested that the original advice was considered somewhat relevant to very relevant by most participants (with 90% retention, 73% responded '3 somewhat relevant to 5 very much relevant'; $M = 3.7$, $SD = 0.96$ [23]). This is comparable to what was reported in a recently conducted study examining the appreciation of tailored modules targeting early cancer survivors (mean relevance score for physical activity module = $3.5/5$, $SD = 0.7$ [38]). While these results are positive, they do suggest there is considerable room for improvement. Typically, module content in computer-tailored interventions is tailored based on demographics, psycho-social profiles and current health behaviour. Our findings indicate that perceived relevance could be enhanced in this population if content is more highly customised based on age, physical capabilities and level of fatigue. Factoring in participants' goals within this context should also be helpful. This is likely to especially be the case when summarising information on the physical activity guidelines for cancer survivors and providing feedback on progress over-time. While we

suggested in the first instance that participants should focus on what is doable for them and progress slowly, feedback was always provided in the context of their activity level compared to the guidelines. This is fairly standard practice in computer-tailoring studies. However, it makes sense that for deconditioned participants, receiving feedback in this way would have seemed less relevant. Encouraging large changes in behaviour may also result in less sustainable behaviour change [39]. Given this, it would be more appropriate to develop feedback algorithms in computer tailoring interventions that encourage small improvements (e.g., 10% increase in step counts per month) and on-going participation, rather than focusing on a cut-point not suited to an individuals' situation or behavioural maintenance capacity. For users deconditioned due to age or a health issue, our data also suggests that additional tailored messages are likely needed, explaining how to do exercises with physical limitations, or at least information on how, where and who to seek advice from.

Action planning has also been associated with increased intervention effects [25]. It was clear in our study that while some participants found this activity helpful, others felt it provided little support. Indeed, few participants continued to complete action plans throughout the course of the intervention [20]. There is some evidence from previous research that incorporating automated feedback into the action planning system may help to improve acceptability [40]. This was also reflected in our data, with participants expressing that they would have liked to have received feedback on their plans and progress towards achieving them. This could be achieved utilising computer-tailoring techniques, and simplified somewhat by relying more heavily on graphical feedback than text messaging. A similar approach has been used previously to provide iterative feedback across eight computer-tailored modules [41]. Another way to increase perceived usefulness may be to incorporate ongoing self-monitoring. Previous studies among breast cancer survivors have shown that this is well accepted [42,43], and self-monitoring has been associated with higher

effect-sizes in physical activity interventions previously [44]. From a theoretical point of view, incorporating these components may help to foster greater relatedness and a sense of competence, which should result in greater engagement and in turn greater intervention effects [17].

A significant limitation of our study, common among online interventions [35] is that those who utilised the intervention the least were lost to follow-up. As such, information on reason for drop out, and indeed on website perceptions among these people is lacking. While it is assumed that those lost to follow-up have more negative perceptions than those remaining in the study, this is a difficult assumption to test with the data available. Usage data alone is not considered a valid marker of participant perceptions [15]. To combat this in future studies, strategies to assess participants' perception of the intervention in real-time are needed. Our research group is currently trialling prompting participants to provide a star rating for each module they complete. This allows us to identify early who has a low opinion of the intervention. If the participant drops out from the study all together it also provides greater insight as to why this might be the case. Strategies capable of providing this information are recommended in future studies.

Conclusion and practical implications

This study provides a nuanced understanding of breast cancer survivors' goals when participating in an online physical activity intervention, their long-term intervention needs and their experience of two recommended intervention features likely to be implemented in future interventions. Based on this data and related previous research we recommend that future intervention developers in this setting consider the following recommendations: 1) Ensure physical activity recommendations and feedback on progress take individual goals and health circumstances into account. While the intervention objective may be to progress

participants towards meeting public health goals, communication with the participant should focus more on their personal behavioural and/or health goals and encourage incremental progress as this is likely to be more motivating and lead to sustainable changes; 2) incorporate self-monitoring and tailored feedback components into action planning activities. This may help participants feel more supported and may result in greater engagement; 3) Include tailored intervention content demonstrating how to do aerobic and resistance-based exercises when physical limitations relating to older age or breast cancer treatment are an issue; 4) consider how the proposed design of the intervention is likely to suit participants based on their individual goals and circumstances. Traditionally, most computer-tailored interventions have offered customised advice within a “one-sized fits all” system. Designing more flexible systems that adapt to the users’ needs are recommended. This could be achieved using a recommender system approach, which essentially combines traditional computer-tailoring feedback methods with more advanced algorithms to adapt recommendations based on interactions with users past and present [45]; and 5) Explore the use of real-time process evaluation measures. Such measures can provide valuable information about website perceptions from those who will be lost to follow-up, and further can be useful for understanding who likes what intervention components and content. This is useful in the pilot phase, especially when adaptive design is employed [46], and may also facilitate data-based recommendations in the future (e.g., “people like you liked this article”).

Conflict of interest

None declared

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Table 1– Illustrative quotes relating to participants goals

Goal	Illustrative quotes
Regular exercise routine	<p>‘Walking 3 times a week (preferably with my husband)’</p> <p>‘Having a routine that has me walking my dog at least four times a week for 30 minutes’</p> <p>‘Having a fixed routine that will see me walk 20 minutes at least 5 times a week, plus attend one Pilates class a week’</p> <p>‘Go for a 30 minute walk at least 5 days a week, do stretch and strengthening exercise routine at least 4 times a week’</p> <p>‘Having a fixed routine that will see me run 30 minutes at least 3 times a week and walk at a very fast pace for 30 minutes at least 3 times a week. Included in the routine is resistance training for least 3 times a week for 20 minutes’</p> <p>‘In one year from today I will have lost 20 kilos and be doing some sort of physical exercise 5 times per week for at least 30 minutes’</p> <p>‘1 hour brisk walking, or bike riding every day’</p> <p>‘Ride my bicycle to work and home once per week’</p>
Body weight and image	<p>‘Losing 15 cms from around my waistline.’</p> <p>‘Making it to my goal weight (about 7kg to go) and maintaining it’</p> <p>‘Keep the weight off that I lost after being diagnosed with Cancer’</p> <p>‘Definitely losing 10kg’</p> <p>‘Be 30 kgs lighter’</p> <p>‘Would like to drop two dress sizes’</p> <p>‘lose the excess fat around my waist and hips’</p>

‘Feel better about myself and not look in the mirror and go yuck, I hate my body since I have had breast cancer and that my 2 breasts were cut off and new ones were put on. I want to love my body and breasts and not feel that I don't want my hubby looking at me.’

Fitness and strength ‘My long term plan would be to be able to walk the pambula- merimbula beach walk by July 2015’

‘Be fit enough to ride 50kms without using my power assist’

‘Being able to swim 10 laps without feeling tired.’

‘Not puffing when walking up the Sandy Point hill’

‘Bring able to ride my bike to the chook farm without getting off to push’

‘By July 2015, I would like to be able to walk 10km without being puffed or having to stop.’

Health ‘Being fit enough to paddle in competitions’

‘Manage my hot flushes. Reduce the amount my bones ache’

‘Having more energy to do the things I want to do - getting back to work, getting down to a healthier weight, Control diabetes better’

‘less fatigue and more energy’

‘capacity to get out of a bath’

‘I have had a total knee replacement in the right knee and my goal is to increase my mobility without too much strain by putting myself in jeopardy for further injury so my overall task is slow and steady’

‘Being able to play tennis, with full movement and able to run for ball’

‘Being able to live a life with predictable reasonable energy levels, greater mobility and flexibility’

Table 2: Illustrative quotes relating to participants positive perceptions of the website

Theme	Illustrative quote
Relevant	‘It was relevant to my situation’ <i>42 years old, 1 year post treatment (Acceptability=27, Usability= 85)</i>
	‘The information was informative and relevant to me’ <i>51 years old, 15 years post treatment (Acceptability =32, Usability = 95)</i>
	‘It was unbiased and related to my general circumstance’ <i>55 years old, 6 months post treatment (Acceptability =27, Usability = 90)</i>
	‘I like the content and the way it addresses me’ <i>78 years old, 4 years post treatment (Acceptability =29, Usability = 87.5)</i>
	‘Was mostly quite relevant’ <i>68 years old, 12 years post treatment (Acceptability =25, Usability = 82.5)</i>
Interesting	‘I found it all interesting, particularly the practical exercises’ <i>71 years old, 21 years or more post treatment (Acceptability =26, Usability = 40)</i>
	‘I found the personal plan interesting’ <i>52 years old, 2 year post treatment (Acceptability =17, Usability = 57.5)</i>
	‘I found 1 sheet of resistance exercises interesting, and intend to do those when able.’ <i>68 years old, 21 years or more post treatment (Acceptability =13, Usability = 60)</i>
	‘It was interesting’ <i>50 years old, 2 year post treatment (Acceptability =31, Usability = 72.5)</i>
	‘Interesting. Gave me ideas, motivation’

64 years old, 3 year post treatment (Acceptability =23, Usability = 60)

Pragmatic,
sensible,

‘Sensible and practical’

65 years old, 16 years post treatment (Acceptability =19, Usability = 67.5)

‘All the advice and info was "do-able" for me. I didn't feel that I was taking on an impossible challenge’

53 years old, 1 year post treatment (Acceptability =31, Usability = 72.5)

‘Interesting, useful and practical’

57 years old, 2 years post treatment (Acceptability =30, Usability = 90)

‘The information was manageable and basic...stepped out what needed to be done’

41 years old, 1 year post treatment (Acceptability =27, Usability = 77.5)

‘Provided common sense advise’

41 years old, 2 years post treatment (Acceptability =25, Usability = 85)

Clear, easy to
understand and
read

‘Simple, clear language’

53 years old, 12 years post treatment (Acceptability =24, Usability = 77.5)

‘I thought it was easy to understand and credible’

42 years old, 2 years post treatment (Acceptability =22, Usability = 72.5)

‘Clear instructions in clear font with little background interference’

54 years old, 6 years post treatment (Acceptability =26, Usability = 82.5)

‘Clear, relevant and easy to understand’

55 years old, 3 years post treatment (Acceptability =17, Usability = 80)

‘Used plain, easy to understand language’

39 years old, 3 years post treatment (Acceptability =23, Usability = 85)

Informative	‘It was easy to understand and made sense’
	<i>57 years old, 5 years post treatment (Acceptability =26, Usability = 70)</i>
	‘Easy to interpret’
	<i>52 years old, 2 years post treatment (Acceptability =26, Usability = 80)</i>
	‘It was constructive and easy to understand’
	<i>63 years old, 18 years post treatment (Acceptability =21, Usability = 97.5)</i>
	‘The website had informative articles to read; I thought the library idea was good and the demonstration of resistance training.’
	<i>42 years old, 2 years post treatment (Acceptability =22, Usability = 72.5)</i>
	‘I liked finding out about the strength resistance exercises’
	<i>61 years old, 11 years post treatment (Acceptability =26, Usability = 80)</i>
	‘The information gave me a good basis to start from and some knowledge of the sorts of things I should advise gym attendants prior to creating a program’
	<i>49 years old, 1 year post treatment (Acceptability =26, Usability = 52.5)</i>
	‘I learned a lot of new information’
	<i>57 years old, 2 years post treatment (Acceptability =30, Usability = 90)</i>
	‘The various articles on the benefits of exercising were informative.’
	<i>55 years old, 2 years post treatment (Acceptability =33, Usability = 82.5)</i>
	‘Info on benefits of exercise, especially in relation to cancer and the recovery from it.’
	<i>38 years old, 3 years post treatment (Acceptability =22, Usability = 65)</i>
	‘I liked the examples of building everyday activities (i.e. washing, etc) into your exercise program

	<p><i>69 years old, 3 years post treatment (Acceptability =26, Usability = 70)</i></p> <p>‘It gave me an idea of how much exercise I should be doing and what kind of exercise I should be participating in. This was good as I had no idea what would be a suitable amount’</p>
	<p><i>48 years old, 6 months post treatment (Acceptability =27, Usability = 85)</i></p> <p>‘The website gave me a lot of valuable information. It helped me to realise the different types of exercise. I was not aware of this information previously’</p>
	<p><i>61 years old, 10 years post treatment (Acceptability =25, Usability = 70)</i></p>
Positive, friendly	<p>‘There is a very positive feeling throughout the website, without being too 'sweet and sugary'. There is no feeling of judgement and an understanding that everyone will and can participate to the level that suits them’</p>
	<p><i>46 years old, 6 months post treatment (Acceptability =34, Usability = 95)</i></p> <p>‘The funnies can be uplifting’</p>
	<p><i>38 years old, 3 years post treatment (Acceptability =22, Usability = 65)</i></p> <p>‘Reminders were friendly.’</p>
	<p><i>78 years old, 4 years post treatment (Acceptability =29, Usability = 87.5)</i></p>
Encouraging	<p>‘The information encouraged me to keep going’</p>
	<p><i>53 years old, 7 years post treatment (A=28, Usability = 80)</i></p> <p>‘It offered encouragement’</p>
	<p><i>69 years old, 3 years post treatment (Acceptability =26, Usability = 70)</i></p> <p>‘I have no support from anyone else with my exercise so it was nice to have the Move More for Life as a kind of support’</p>
	<p><i>48 years old, 6 months post treatment (Acceptability =27, Usability = 85)</i></p>

‘I liked that it provided the encouragement to do something, no matter how small’

55 years old, 2 years post treatment (Acceptability =26, Usability = 75)

“The information was just what I needed to reinforce and support my ideas about the importance of exercise, and was a great incentive to continue and increase my physical activity. Many of those close to me (children, grandchildren, husband) seemed to find my desire for increased physical activity to be inappropriate for someone my age (69). This study and the website has given me the confidence to go ahead and I am now back playing tennis (even competition) - which I am enjoying so much!’

68 years old, 8 years post treatment (Acceptability =27, Usability = 85)

Awareness raising ‘It made you think more about how much exercise I do and that's a good thing’

53 years old, 6 months post treatment (Acceptability =15, Usability = 85)

‘Some of it I knew already on some level but my awareness was increased’

57 years old, 2 years post treatment (Acceptability =30, Usability = 90)

‘Made me focus and think about my physical activity’

39 years old, 3 years post treatment (Acceptability =23, Usability = 85)

‘It increased my awareness that I needed to increase my level of activity’

51 years old, 6 months post treatment (Acceptability =25, U= 97.5)

Motivating ‘It was helpful in motivating me to do more’

68 years old, 5 years post treatment (Acceptability =26, Usability = 70)

‘It is a good tool to use when I want inspiration’

71 years old, 10 years post treatment (Acceptability =25, Usability = 67.5)

‘Clear and helpful and got me motivated to start exercising again and continue’

	<p><i>56 years old, 7 years post treatment (Acceptability =29, Usability = 77.5)</i></p> <p>‘Having the program in the background has kept a quiet motivation in me’</p> <p><i>49 years old, 1 year post treatment (Acceptability =26, Usability = 52.5)</i></p> <p>‘I liked that it prompted me for a detailed plan each week, and I liked the 3 monthly review towards the longer term goals’</p> <p><i>55 years old, 6 months post treatment (Acceptability =27, Usability = 90)</i></p>
Helpful	<p>‘I have exercised most days for 30 years but this had fallen off during my cancer journey. This website prompted me to get back into it’</p> <p><i>57 years old, 6 months post treatment (Acceptability =25, Usability = 50)</i></p> <p>‘Loved the pictures of the resistance exercises, they were very helpful’</p> <p><i>54 years old, 6 years post treatment (Acceptability =26, Usability = 82.5)</i></p> <p>‘I’ve never written exercise goals! I liked that it made me focus on my 'intended' exercise plans, and kind of 'forced' me to look at what I was doing, and going to do’</p> <p><i>67 years old, 3 years post treatment (Acceptability =28, Usability = 72.5)</i></p> <p>‘Actually writing my goals made them more solid and do-able’</p> <p><i>53 years old, 1 year post treatment (Acceptability =31, Usability = 72.5)</i></p> <p>‘I found it very helpful to be able to complete the surveys on the physical activity I had done and the feedback you provided’</p> <p><i>55 years old, 2 years post treatment (Acceptability =33, Usability = 82.5)</i></p> <p>‘I like the easy access to the poster with the resistance training exercises - which I have used to refer to when exercising. It gave me some helpful hints’</p>

46 years old, 6 months post treatment (Acceptability =34, Usability = 95)

‘The action plans helped me to focus on what I needed to do - I knew I needed to exercise more and had tried to be more active before entering the study but had difficulty doing so consistently’

57 years old, 2 years post treatment (Acceptability =30, Usability = 90)

The information given has increased my chances of setting goals to exercise, made me think more about exercising and making it part of my day to day lifestyle’

36 years old, 6 months post treatment (Acceptability =33, Usability =100)

‘Having to exercise on my own, this website assisted me in making the necessary plans to get myself moving’

55 years old, 2 years post treatment (Acceptability =26, Usability = 75)

* Description of Acceptability measure (possible range = 0-36) and Usability measure (possible range = 0-100) available here [13]. Higher scores represent more positive perceptions for both measures.

Table 3: Illustrative quotes relating to participants negative perceptions of the website

Theme	Illustrative quotes
Nothing new/didn't learn anything from it.	‘It was thorough, but really didn't tell me anything that my doctors hadn't already told me’ <i>44 years old, 6 months post treatment (Acceptability =19, Usability = 75.5)</i>
	‘I felt I knew a lot of it already but it still wasn't enough to motivate me. Eventually I realised I would never be motivated by this kind of program so joined Curves’ <i>52 years old, 3 years post treatment (Acceptability =22, Usability = 60)</i>
	‘Personally I did not learn anything from this program at all’ <i>63 years old, 2 years post treatment (Acceptability =5, Usability =45)</i>
	‘I didn't learn anything from being involved in Move for Life....except how annoying these things can be’ - <i>62 years old, 3 years post treatment (Acceptability =11, Usability =35)</i>
Too much information at once	‘I found the information provided in Session 1 too wordy - it seemed to be continuous pages of words that completely bored me and I switched off. 22 pages of information was overwhelming’ <i>53 years old, 1 year post treatment (Acceptability =31, Usability = 72.5)</i>
	‘Lots of information to sort through’ <i>67 years old, 2 years post treatment (Acceptability =16, Usability = 57.5)</i>
	‘Sometimes too much info can be overwhelming’ <i>38 years old, 3 years post treatment (Acceptability =22, Usability = 65)</i>
	‘Maybe a bit much in each session’ <i>46 years old, 2 years post treatment (Acceptability =22, Usability = 50)</i>
	‘There was more than I had time to read’

Difficult to read or view	<i>61 years old, 4 years post treatment (Acceptability =20, Usability = 75)</i>
	‘Sometimes a bit too hard to read’
	<i>42 years old, 1 year post treatment (Acceptability =14, Usability = 62.5)</i>
	‘Writing too small’
	<i>46 years old, 3 years post treatment (Acceptability =35, Usability = 80)</i>
	‘Had to print out as I don't like reading on a computer screen’
Advice not tailored adequately to fit circumstances	<i>53 years old, 13 years post treatment (Acceptability =19, Usability = 70)</i>
	‘The size of the photographs and print on the resistance exercises was too small’
	<i>69 years old, 3 years post treatment (Acceptability =26, Usability = 70)</i>
	‘Too much reading with illustrations too small to follow easily’
	<i>55 years old, 6 months post treatment (Acceptability =12, Usability = 50)</i>
	‘Thought the information received was good but not really suitable for all age groups’
	<i>80 years old, 6 months post treatment (Acceptability =22, Usability = 45)</i>
	‘Fairly generic not helpful if having health issues’
	<i>53 years old, 6 months post treatment (Acceptability =15, Usability = 85)</i>
	‘I didn't find any specific advice for me personally. It was all general and no age group specific ones either.’
	<i>68 years old, 21 years or more post treatment (Acceptability =13, Usability = 60)</i>
	‘Generalist.....but that is OK.... as it actually does cater for most people who do not have specific physical disability’
	<i>66 years old, 2 years post treatment (Acceptability =19, Usability = 62.5)</i>
	‘It wasn't individual or specific to what I was going through and my capabilities’

22 years old, 6 months post treatment Acceptability =6, Usability = 45)

‘As much as I liked the variety of exercises I would have liked to have some info regarding the usefulness of one exercise over the other, and relevance to aspects of health. For example I have had sciatica pain for most of the time and following surgery am unable to do any exercise other than walking or lying on my back. So am afraid to do any resistance training’

74 years old, 6 months post treatment (Acceptability =20, Usability = 40)

‘I felt some of it was not relative to me’

61 years old, 2 years post treatment (Acceptability =18, Usability = 97.5)

‘Depressing - information set expectations of unachievable goals particularly in the initial stages when fatigue was such a big factor. I found some information on another site about fatigue management and exercising when fatigue is a limiting factor, which I was able to incorporate into my own personal goals, however still got depressed when I could not achieve the expectation set on the site. This was de-motivating for me’

47 years old, 1 year post treatment (Acceptability =22, Usability = 77.5)

“No-one on the other side” /
not enough feedback

‘I realised that there was no feedback so it didn't really matter if I completed what I said I would or not’

65 years old, 16 years post treatment (Acceptability =19, Usability = 67.5)

‘I have found the act of having to record what I think I am going to do annoying. Also it achieves nothing. There is no follow up if it is has been done. I have stopped using the website’

54 years old, 5 years post treatment (Acceptability =15, Usability = 30)

‘It's hard to be motivated when you are just reading something on your own.

44 years old, 6 months post treatment (Acceptability =19, Usability = 75.5)

‘I felt like I was just going through the motions - but no-one was on the other side’

48 years old, 2 years post treatment (Acceptability =18, Usability = 72.5)

‘I would have like some feedback on my plans and if I had or had, not met the outcomes I had hoped for.

53 years old, 2 years post treatment (Acceptability =24, Usability = 60)

‘I would have liked more individual feedback and more checking to see if I was doing what I said in the plans’

61 years old, 2 years post treatment (Acceptability =18, Usability = 97.5)

‘Not enough information and details on personal progress’

48 years old, 6 months post treatment (Acceptability =27, Usability = 85)

‘No face-to-face contact’

55 years old, 4 years post treatment (Acceptability =17, Usability = 77.5)

‘It all felt totally pointless. I don't recall getting much real feedback about my exercise or encouragement to do more. I found I could easily plan my exercise for a week but I found it extremely difficult to remember what exercise I had done.....at the end of a whole month. I also don't understand why housework is not included, surely that is exercise also. I think I saw some bar graphs of my exercise but they were not helpful, sorry but I can't remember exactly why now. I think it was something to do with the categories of exercise.’

62 years old, 3 years post treatment (Acceptability =11, Usability =35)

Did not increase motivation
or was demotivating

‘I did not find it provided any motivation to exercise’

68 years old, 1 year post treatment (Acceptability =17, Usability = 42.5)

‘Using the website was ok. I keep looking for something that would put me in the next gear and really start the process of regular exercise. Because I realised that I wasn't quite ready to commit, I felt the website as a pressure’

	<p><i>68 years old, 20 years post treatment (Acceptability =23, Usability = 50)</i></p> <p>‘You gave me no reason to exercise’</p> <p><i>59 years old, 3 years post treatment (Acceptability =14, Usability = 60)</i></p> <p>‘Information didn't help my mind set or to motivate me to want to exercise’</p> <p><i>43 years old, 3 years post treatment (Acceptability =18, Usability = 75)</i></p> <p>‘Whilst I understand the reason for tracking low, medium, high intensity exercise and resistance exercise I found the goal setting for all of these at once resulted in the development of what I thought were realistic goals but what turned out to be totally unrealistic goals resulting in a sense of failure within the first week which led to a significant decline in my exercise as a result of this feeling’</p> <p><i>46 years old, 2 years post treatment (Acceptability =22, Usability = 50)</i></p> <p>‘Just doing a fixed survey did not match where I was at or offer encouragement or inspire me.’</p> <p><i>53 years old, 1 year post treatment (Acceptability =21, Usability = 75)</i></p> <p>‘They didn’t help make me more active!’</p> <p><i>52 years old, 5 years post treatment (Acceptability =22, Usability = 75)</i></p>
Reminders were erratic and confusing	<p>‘At one stage I was getting surveys sent one on top of the next & being expected to complete all of them within 7 days which didn't make sense’</p> <p><i>65 years old, 16 years post treatment (Acceptability =19, Usability = 67.5)</i></p> <p>‘I got lost as to the order of the surveys that were sent’</p> <p><i>56 years old, 6 years post treatment (Acceptability =17, Usability = 42.5)</i></p> <p>‘The email reminders seemed to arrive erratically, and when they did they were too frequent. I think once a month would be OK’</p>

Action plan activity had usability issues	<i>52 years old, 3 years post treatment (Acceptability =22, Usability = 60)</i>
	‘Took up a lot of time and very repetitive’
	<i>42 years old, 1 year post treatment (Acceptability =14, Usability = 62.5)</i>
	‘Not enough choice of exercises’
	<i>53 years old, 2 years post treatment (Acceptability =24, Usability = 60)</i>
	‘At times it asked if I did exercise and I thought well yes, but then it said did you do aerobic exercise/ light exercise/ high intensity. I found this confusing.’
	<i>22 years old, 6 months post treatment (Acceptability =6, Usability = 45)</i>
	‘Didn't appear to be any scope to record improvements in fitness/strength’
	<i>51 years old, 6 months post treatment (Acceptability =25, Usability = 97.5)</i>
	‘I often found there were not the options there for my particular time planned or number of resistance positions which fitted what I planned or was doing. eg. I had thirty resistance exercises, four repetitions each. There was not an option for this’
Trouble printing/downloading information	<i>70 years old, 1 year post treatment (Acceptability =29, Usability = 37.5)</i>
	‘It was a chore when I was busy’
	<i>63 years old, 4 years post treatment (Acceptability =15, Usability = 45)</i>
	‘Little ability to adjust printing mode for weekly agreement - I wanted a sgl A4 page/sheet that I could use as a reminder on the mirror, not several pages’
	<i>53 years old, 12 years post treatment (Acceptability =24, Usability = 77.5)</i>
	‘I was unable to download the exercises so that I could get the illustrations and diagrams in a size I could use to exercise and follow’

	<p><i>74 years old, 6 months post treatment (Acceptability =20, Usability = 40,)</i></p> <p>‘I am travelling around Australia in a Caravan and do not have a printer, therefore I'm unable to read and follow the instructions for the Resistance exercises as the print is too small’</p> <p><i>69 years old, 3 years post treatment (Acceptability =26, Usability = 70)</i></p> <p>‘I could not print out the information and had to ask for help as the print would not fit on the page’</p> <p><i>52 years old, 7 years post treatment (Acceptability =23, Usability = 47.5)</i></p>
Difficult to use on iPad	<p>‘Using an iPad, I had to keep scrolling up and down to see what the tick box headings were’</p> <p><i>52 years old, 4 years post treatment (Acceptability =22, Usability =95)</i></p> <p>‘Sometimes not easy to use on iPad’</p> <p><i>56 years old, 7 years post treatment (Acceptability =29, Usability =77.5)</i></p> <p>‘Did not always work on iPad’</p> <p><i>62 years old, 6 months post treatment (Acceptability =23, Usability =50)</i></p> <p>‘The tables and graphs did not appear on the IPad, only on the laptop.’</p> <p><i>68 years old, 8 years post treatment (Acceptability =27, Usability =85)</i></p>

* Description of Acceptability measure (possible range = 0-36) and Usability measure (possible range = 0-100) available here [13]. Higher scores represent more positive perceptions for both measures.

Table 4: Summary of participant's recommendations for improving the website with illustrative quotes

Theme	Illustrative Quotes
Tailored exercise guidance and advice, based on capabilities and health issues	<p>'More detailed information and tips for women on what types of exercises are best for post breast cancer ladies.'</p> <p>'Maybe it could be aimed at a greater variety of physical fitness levels, ages & impediments.'</p> <p>'As I am 81 years of age and a chronic asthmatic would like information and advice on what I can do to keep fit without within the limits of my health problems'</p> <p>'Perhaps some more information about the issues of lymphodeoma i.e. how best to avoid it when increasing your exercise. I think one of the biggest concerns is that there is a fine line between exercising enough to gain benefit and overdoing it.'</p> <p>'Maybe some pictures of exercises that are suitable for different muscle groups and strengthening of arms after a mastectomy, more tailored exercise plans week by week to keep me interested'</p> <p>'Maybe a section with stories from other women on what they have achieved with their health, physical activity and lifestyles and how they accomplished it and set backs they may have had. Advice of any kind of health issues would be great'</p>
More information about different physical activities that can be performed, including images	<p>'For someone wanting to begin exercising perhaps more detail about what one could do. Some more detailed activity descriptions'</p> <p>'Some extra exercises to try when you get board with the same ones all the time'</p> <p>'More ideas of how to exercise unconventionally'</p> <p>'Add some more examples of different types of exercises'</p> <p>'I think I would have used more detail eg prompts to run, what resistance exercises to do'</p>

Inclusion of physical activity/exercise plans	<p>‘More pictures - step by step’</p> <p>‘More detailed exercise plans. I thought I was signing up for a specific plan not just keeping a diary of what I had done.’</p> <p>‘Perhaps there could be set exercise programs offered with these updated weekly so there is progression’</p>
More frequently updated content	<p>‘It needs new content from time to time to keep interest’</p> <p>‘Regular updates of material such as suggestions for different exercises, tips to stay motivated, new products for monitoring exercise, etc’</p> <p>‘A new exercise to do each week, a different challenge to incorporate into your routine and why this would be of benefit, and to which muscle etc...similar to the myfitnesspal system’</p>
Reminders	<p>‘A personalised reminder of monthly/weekly goals emailed to me would be very helpful, plus similar reminder of goals reached/not reached. Like a personal trainer ...’</p> <p>‘Needed more reminders and information sent directly to me to prompt me to exercise more.’</p> <p>‘Weekly reminders via email or smart phone would have inspired me more’</p>
Flexible updatable goal-setting with feedback and encouragement	<p>‘If the information could be plotted to show progression, instead it seems like you are recording the same stuff again and again.’</p> <p>‘Set the optimum levels as a long-term goal for health, then provide encouragements, plan, advice and positive reinforcement for minor achievements in the meantime. For example, initially I was unable to do more than 5 mins without severe pain and fatigue, therefore for me, even being able to exercise 10 minutes was a success. Being able to record / graph even small improvements / increments can then, over time, show up as improvement and therefore be encouraging.’</p>

‘I would have found it helpful to have completed less volume of goals initially and more strategies to have some alternatives thought through in case the original exercise plan was not able to be carried out. I find it is not so much setting the goals or plans as having a flexible plan in place. In my case this is mainly for family reasons for example sick kids and no support.’

More interaction with real people

‘Perhaps a Blog or secure chat space might be of use to people for connecting and keeping motivated’

‘Interaction with an actual person’

Inclusion of dietary advice

‘Maybe some dietary advice for breast cancer survivors. Anything else that can help me to improve and enhance my life and reduce the risk of cancer recurrence’

‘Role of dietary considerations in collaboration with exercising’