Development and Test of an Intervention to Increase Exercise among Breast Cancer Survivors

By

Rachel Hirschey

Nursing
Duke University

Date:
Approved:

___________________________
Isaac Lipkus, Supervisor

___________________________
Marilyn Hockenbery

___________________________
Wei Pan

___________________________
Gretchen Kimmick

___________________________
Ryan Shaw

Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing
Duke University

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ABSTRACT

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Abstract

Most breast cancer survivors do not exercise enough to experience its numerous benefits that include improved quality of life and decreased recurrence risk. A potentially effective strategy to increase exercise among this population is to increase their outcome expectations (OEs). OEs are what one expects to obtain or avoid by engaging in a behavior. OE dimensions include 1) importance - value placed on the outcome(s); 2) certainty - perceived probability outcome(s) will occur; and 3) accessibility - frequency with which outcome(s) are considered. The purpose of this dissertation is to develop knowledge on the impact of OEs on exercise in breast cancer survivors. This is achieved through three independent studies. First, an exploratory study to identify common OEs among breast cancer survivors. Secondly, through a measurement study, in which a scale is created and pilot tested to measure OE dimensions. Finally, an intervention is created in collaboration with active breast cancer survivors and pilot tested in a randomized controlled trial among 60 breast cancer survivors. Findings from this dissertation indicate that breast cancer survivors are overwhelmingly unaware of the extent to which exercise can benefit them. Fortunately, findings from this dissertation also indicate that the tested strategy to increase OEs is both feasible and effective among breast cancer survivors. Finally, this dissertation contributes a measure to assess intervention effects on multiple OE dimensions. In summary, findings from this dissertation indicate that targeting OEs is an effective
strategy to improve the quality and duration of breast cancer survivorship and future work in this area is warranted.
Dedication

This work is dedicated to Matthew David Hirschey. As you promised to do on September 7th, 2008, you have challenged my mind, supported my dreams and shared my spirit. On September 1, 2011 and November 14, 2015, we met the two greatest gifts of our lives, Henry and Grace. Without the unfettered love and strength of our family, I would not be able to make contributions to this great world we occupy and my personal achievements would be negligible.
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1. Introduction

1.1 Effects of Exercise for Breast Cancer Survivors

Regular aerobic exercise has many benefits for breast cancer survivors (Eyigor & Kanyilmaz, 2014; P. D. Loprinzi & Lee, 2014). Specifically, higher levels of moderate and strenuous intensity exercise are associated with 20-50% lower risk of breast cancer recurrence (X. Chen et al., 2011; Holmes, Chen, Feskanich, Kroenke, & Colditz, 2005; Ibrahim & Al-Homaidh, 2011; P. D. Loprinzi, Cardinal, Winters-Stone, Smit, & Loprinzi, 2012; Sternfeld et al., 2009). For example, 3 hours of moderate-intensity walking per week is associated with a significant decrease in breast cancer recurrence risk among 2,987 survivors (Holmes et al., 2005). Exercise is also associated with 15-53% lower cancer-specific mortality (Betof, Dewhirst, & Jones, 2013; X. Chen et al., 2011; Dal Maso et al., 2008; Holick et al., 2008; Holmes et al., 2005; Ibrahim & Al-Homaidh, 2011; Irwin et al., 2011; 2008; P. D. Loprinzi et al., 2012; Peel et al., 2009; Pierce et al., 2007; Sternfeld et al., 2009) and 18–67% lower all-cause mortality (Bertram et al., 2011; Betof et al., 2013; X. Chen et al., 2011; Dal Maso et al., 2008; Holick et al., 2008; Holmes et al., 2005; Irwin et al., 2008; 2011; Pierce et al., 2007; Sternfeld et al., 2009).

Several late and long-term effects of cancer treatments are decreased by exercise. For example, aerobic exercise improves cardiorespiratory function and fitness (Fong et al., 2012; Jones et al., 2011; Jones, Pituskin, & Battaglini, 2012; McNeely et al., 2006; Speck, Courneya, Masse, Duval, & Schmitz, 2010), which are especially important for survivors who have received cardio-toxic chemotherapeutic agents (Scott et al., 2011).
Similarly, cancer treatments frequently lead to increased weight and decreased bone strength and muscle mass (Sheean, Hoskins, & Stolley, 2012). Fortunately, aerobic exercise improves body mass index (Baumann et al., 2013; Fong et al., 2012; Jones et al., 2012; Speck et al., 2010), bone strength (Winters-Stone, Schwartz, & Nail, 2010), and muscle mass/strength (Fong et al., 2012; Speck et al., 2010) among these survivors. Exercise benefits are further demonstrated through improvements in physical performance (Baumann et al., 2013), physical function (Fong et al., 2012; McNeely et al., 2006; Spence, Heesch, & Brown, 2010), decreased reports of pain (Craft, Vaniterson, Helenowski, Rademaker, & Courneya, 2012) and decreased fatigue (Baumann et al., 2013; J. C. Brown et al., 2011; Craft et al., 2012; Cramp & Byron-Daniel, 2012b; Cramp & Daniel, 2008; Duijts, Faber, Oldenburg, van Beurden, & Aaronson, 2011; Fong et al., 2012; Jones et al., 2012; McNeely et al., 2006; Mishra et al., 2012; Puetz & Herring, 2012a; Speck et al., 2010; Spence et al., 2010; Wanchai, Armer, & Stewart, 2011).

Regular aerobic exercise has many psychological benefits for breast cancer survivors. For example, positive exercise effects have been demonstrated on: sleep quality (Mishra et al., 2012); anxiety (Mishra et al., 2012); depression (Craft et al., 2012; Duijts et al., 2011; Fong et al., 2012; Jones et al., 2012; Mishra et al., 2012); mood disturbances (Speck et al., 2010; Spence et al., 2010); self-esteem/body image (Duijts et al., 2011; Mishra et al., 2012; Speck et al., 2010); social functioning (Fong et al., 2012; Mishra et al., 2012); emotional well-being (Mishra et al., 2012); sexuality (Mishra et al., 2012); cognitive function (Fong et al., 2012; Mohammadi, Sulaiman, Koon, Amani, & Hosseini,
and quality of life (Baumann et al., 2013; Craft et al., 2012; Duijts et al., 2011; Jones et al., 2012; McNeely et al., 2006; Mishra et al., 2012; Speck et al., 2010; Wanchai et al., 2011).

Despite the many benefits of exercise, only 16-37% (Blanchard, Courneya, & Stein, 2008; Smith & Chagpar, 2010) of the 2.8 million breast cancer survivors in the U.S. adhere to the national exercise guidelines for cancer survivors. The American Cancer Society (ACS) and the American College of Sports Medicine (ACSM) recommend that cancer survivors engage in 150 weekly minutes of moderate-intensity or 75 weekly minutes of strenuous-intensity aerobic exercise, or an equal combination of the two (Rock, Doyle, Demark-Wahnefried, Meyerhardt, Courneya, Schwartz, Bandera, Hamilton, Grant, McCullough, Byers, & Gansler, 2012a; Schmitz et al., 2010). Among survivors who did exercise regularly pre-diagnosis, exercise levels decrease during and after adjuvant therapy (Bock, Schmidt, Vrieling, Chang-Claude, & Steindorf, 2013; Pinto, Trunzo, Reiss, & Shiu, 2002). Efforts are needed to increase levels of exercise among breast cancer survivors.

1.2 Exercise Interventions Targeting Outcome Expectations

Potentially powerful exercise interventions may be those that focus on exercise outcome expectations (OEs). OEs refer to what people expect to obtain or avoid by engaging in a behavior (Bandura, 2004). People exercise because they believe it will produce desired outcomes and avoid undesirable ones. According to several prominent health behavior change theories, high OEs lead to behavior change (Ajzen, 1991;
Among non-cancer populations, individuals who expect more positive and less negative outcomes of exercise have stronger intentions to exercise and exercise more (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002; Schutzer & Graves, 2004). Yet, little is known about how OEs influence exercise among breast cancer survivors. Exercise interventions that have included OEs have been successful; however, these interventions have not manipulated OEs to their full potential. First, to fully understand the impact increasing OEs can have on increasing exercise, interventions should account for the multidimensionality of this construct (Wegener, Downing, & Krosnick, 1995). That is, interventions should aim to increase the: 1) value placed on the outcome(s), i.e., importance (Boninger, Krosnick, & Berent, 1995; Olson, Roese, & Zanna, 1996); 2) perceived probability outcome(s) will occur, i.e., certainty (Gross, Holtz, & Miller, 1995; Olson et al., 1996); and 3) frequency with which outcome(s) are considered, i.e., accessibility (Fazio, 1995; Olson et al., 1996).

Secondly, interventions focused solely on OEs are needed to identify: 1) effective strategies to increase exercise OEs; 2) the most useful dimensions to focus on; and 3) the unique contributions of OEs to exercise among breast cancer survivors. Initial research inclusive of OEs for breast cancer survivors shows promise, however, a complete understanding of how OEs can be leveraged to promote exercise is in its infancy. Studies that have explicitly aimed to increase OEs have successfully increased levels of exercise among breast cancer survivors (Hatchett, Hallam, & Ford, 2013; Rogers et al., 2009; Short, James, Girgis, D’Souza, & Plotnikoff, 2014; Stacey, James, Chapman, & Lubans,
However, as outlined in Table 1, many other constructs were also manipulated in these interventions and the extent to which OEs were focused on is minimal. Specifically, inclusion of OEs consisted of providing information of exercise benefits in a newsletter (Short et al., 2014); providing “realistic expectations of exercise” through emails (Hatchett et al., 2013); “addressing” OEs in counseling sessions (Rogers et al., 2009); or using SCT to “guide content and delivery approach” (Stacey et al., 2016). Thus, while all of these interventions included OEs, it appears none were designed with specific strategies to increase the importance, certainty and accessibility of OEs. Notably, one of these studies reported a decrease in exercise OEs (Rogers et al., 2011). It is difficult to conclude why or how “addressing” OEs in this intervention could have resulted in decreased OEs and increased levels of exercise. The only study (Stacey et al., 2016) that reported an increase in OEs did not provide a theoretical definition and described strategies to increase OEs that are not consistent with Bandura’s definition of OEs. Specifically, the strategies listed by the study to increase OEs include “use training diaries to record PA and exercise sessions” and “use testing and assessment for motivation and chart improvement.” It is not clear how these strategies are intended to increase OEs, especially given the lack of a theoretical definition. However, OEs were operationalized in this study and increased post intervention. The other two studies (Hatchett et al., 2013; Short et al., 2014) did not report measuring OEs. Research focused exclusively on OEs is needed to identify effective strategies to increase OEs and their effects on exercise levels.
Table 1: Summary of Inclusion and Effects of OEs in Exercise Intervention for Breast Cancer Survivors.

<table>
<thead>
<tr>
<th>Author and year</th>
<th>OE definition</th>
<th>Intervention delivery method</th>
<th>Details of OE inclusion in the intervention</th>
<th>Intervention effects on OEs</th>
<th>Intervention effects on exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short 2014</td>
<td>“Expected effects of physical activity (PA) behavior”</td>
<td>Tailored newsletters delivered via mail</td>
<td>Newsletters included information about beneficial outcomes of PA and a “testimonial illustrating success.” Information targeting five other constructs also included.</td>
<td>Not reported</td>
<td>Non statistically significant increase</td>
</tr>
<tr>
<td>Hatchett 2013</td>
<td>“Anticipatory consequences of behavior”</td>
<td>Email messages</td>
<td>Three of 12 email messages included tailored information about “realistic expectations of exercise. Information targeting four other constructs also included.</td>
<td>Not reported</td>
<td>Statistically significant increase</td>
</tr>
<tr>
<td>Rogers 2009</td>
<td>“Expected benefits or harms resulting from exercise”</td>
<td>6 group and 3 individual counseling sessions</td>
<td>“Addressed” along with nine other constructs in group sessions. Also “addressed” along with five other constructs in individual sessions.</td>
<td>OEs decreased</td>
<td>Statistically significant increase</td>
</tr>
<tr>
<td>Stacey 2016</td>
<td>Not provided</td>
<td>6 in-person education and group discussion sessions</td>
<td>“Content and delivery approach was guided” by SCT (OEs and three other constructs).</td>
<td>Statistically significant increase</td>
<td>Statistically significant increase</td>
</tr>
</tbody>
</table>

A valid and reliable exercise OE measure is needed to effectively assess intervention effects. Notably, of the four studies that have aimed to increase OEs among breast cancer survivors, two did not measure OEs (Hatchett et al., 2013; Short et al., 2014). James (2016) measured OEs certainty by asking level of agreement (1 = strongly disagree to 5 = strongly agree) that “participating in regular physical activity over the next eight weeks would” enable participants to: reduce tension or manage stress; feel
more confident about their health; sleep better; have a more positive outlook; or help control weight. Rogers (2009) assessed OE certainty using the same level of agreement Likert scale (1 = strongly disagree to 5 = strongly agree) for 14 positive outcomes (e.g., feel less depressed) and 3 negative outcomes (e.g., increased joint pain). Neither of these scales included outcomes that may be most relevant and necessary to assess among breast cancer survivors such as recurrence risk. Rogers (2009) also measured OE importance using a Likert scale (1 = not important at all to 5 = extremely important) to assess the importance of achieving the positive OEs or avoiding the negative OEs. No studies have assessed OE accessibility among breast cancer survivors. A tool to measure accessibility, certainty and importance of OEs most relevant to breast cancer survivors is needed to advance research about increasing exercise OEs for breast cancer survivors.

1.3 Theoretical Framework

The theoretical framework guiding this dissertation (Figure 1) is based on evidence that while behavioral change is complex and includes many constructs, the two fundamental reasons any behavior is performed (e.g., exercise) is because 1) desired outcomes are expected (i.e., a person has strong OEs) (Bandura, 2004; Hatchett et al., 2013; Rogers et al., 2009; 2013) and 2) a person believes he/she can perform the behavior (i.e., one has strong exercise self-efficacy) (Bandura, 2004; P. D. Loprinzi & Cardinal, 2013). According to this framework, self-efficacy and OEs increase intentions to exercise (the most proximal predictor of behavior) (Ajzen, 1991; Scholz et al., 2009) and exercise. A considerable amount of research has already focused on strategies to increase self-
efficacy and the corresponding effects on exercise (P. D. Loprinzi & Cardinal, 2013; Marcus, Selby, Niaura, & Rossi, 1992). Thus, this dissertation will focus solely on OEs, which have received little to no attention in previous studies.

Figure 1: Theoretical Framework

1.4 Purpose and Specific Aims

The purpose of this dissertation is to develop knowledge on the impact of OEs on exercise in breast cancer survivors. This will be accomplished through eight aims addressed in six chapters:

Aim 1 (Chapter 1): Introduce the significance of the need to increase exercise among breast cancer survivors through manipulating OEs.

Aim 3 (Chapter 3): Develop and test initial psychometrics of an exercise outcome expectation measure for breast cancer survivors.

Aim 4 (Chapter 4) Create an intervention to increase OE importance, certainty and accessibility among breast cancer survivors.

Aim 5 (Chapter 5): Explore the feasibility of implementing a multi-component strategy to increase exercise OEs among breast cancer survivors and assess intervention fidelity.

Aim 6 (Chapter 5): Examine trajectories of overall OEs, OE importance, certainty and accessibility between participants in an OE intervention arm compared to participants in an attention control arm, across four time points: baseline, 4-, 8- and 12-weeks post-intervention. This aim will test hypothesis one that OE importance, certainty, and accessibility will increase in the intervention arm compared to the attention control arm.

Aim 7 (Chapter 5): Examine trajectories of exercise intentions and exercise among participants in the OE intervention arm compared to participants in the attention control arm, across four time points: baseline, 4-, 8- and 12-weeks post-intervention. This aim will test hypothesis two, that exercise intentions and exercise will increase significantly more in the intervention arm compared to the attention control arm when controlling for self-efficacy (i.e., a potentially significant covariate).

Aim 8 (Chapter 6): Synthesize findings to provided recommendations for future research and implications for practice.
2. Exploration of Exercise Outcome Expectations among Breast Cancer Survivors

The American Cancer Society (ACS) recommends that breast cancer survivors engage in at least 150 minutes/week of moderate-intensity or 75 minutes/week of strenuous intensity aerobic exercise and strength training exercises twice weekly (Rock, Doyle, Demark-Wahnefried, Meyerhardt, Courneya, Schwartz, Bandera, Hamilton, Grant, McCullough, Byers, & Gansler, 2012a). However, only 17% – 37% (Blanchard et al., 2008; Smith & Chagpar, 2010) of breast cancer survivors in the United States (US) comply with these activity recommendations. Among those who exercised pre-diagnosis, levels decrease during adjuvant therapy and fail to return to pre-diagnosis levels after completion of treatment (Bock et al., 2013; Pinto et al., 2002). This is remarkable in light of empirical work supporting breast cancer survivors as generally motivated to make healthy lifestyle changes, including exercise (Demark-Wahnefried, Peterson, McBride, Lipkus, & Clipp, 2000). A critical step to understand why survivors do not exercise at the recommended levels may be to explore their beliefs about the results of exercise. In this paper we report on breast cancer survivors’ knowledge and beliefs about benefits of exercise.

For survivors, remission does not always equate to a return to pre-diagnosis health, functioning, and quality of life. Advancements in cancer treatments have substantially decreased mortality rates and brought about a surge in the number of long-term survivors, with approximately 2.8 million breast cancer survivors alive in the US today. These survivors may endure many physical, psychological, emotional, social, and
spiritual challenges for up to 10 or more years after finishing treatment (Harrington, Hansen, Moskowitz, Todd, & Feuerstein, 2010; Ness et al., 2012). Long-term effects, such as fatigue, are those that begin during and persist beyond the conclusion of primary treatment (Carver et al., 2007). Late effects, such as secondary cancers, are those that do not manifest until primary treatment is complete (Carver et al., 2007).

Exercise has been shown to decrease many negative long-term and late effects caused by chemotherapy, radiation, surgery, and hormone therapy (P. D. Loprinzi & Lee, 2014). Thus it may become even more beneficial to survivors to exercise after treatment than it was pre-diagnosis. For example, cardio-pulmonary gains from exercise are especially significant for survivors who have undergone chemotherapy and may be at risk for cardio-pulmonary toxicities and aerobic capacity decline (Carver et al., 2007; Hahn, Lenihan, & Ky, 2014). Similarly, women who undergo radiation are at risk for bone loss and muscular atrophy, (Sheean et al., 2012) both of which are improved by regular exercise (Hojan, Milecki, Molińska-Glura, Roszak, & Leszczyński, 2013; P. D. Loprinzi & Cardinal, 2012). Further, exercise improves quality of life for breast cancer survivors through decreasing treatment effects including fatigue, (P. D. Loprinzi & Cardinal, 2012; Pinto, Dunsiger, & Waldemore, 2013a) pain, (Nyrop et al., 2013; Winters-Stone, Schwartz, Hayes, Fabian, & Campbell, 2012) decreased self-esteem, (Duijts et al., 2011) trouble concentrating, (Rogers et al., 2009) weight gain, (Demark-Wahnefried et al., 2012; DeNysschen, Brown, Cho, & Dodd, 2011) depression, (Ergun, Eyigor, Karaca, Kisim, & Uslu, 2013) and disrupted sleep (Payne, Held, Thorpe, & Shaw, 2008). Finally,
due to the association of exercise and recurrence risk reduction, exercise may improve
QOL by providing a sense of control to the estimated 34% of breast cancer survivors
who fear recurrence to the degree that it effects quality of life (Custers et al., 2014).
Because exercise lessens long-term effects and is associated with a 20-50% lower risk of
recurrence, (X. Chen et al., 2011; Holmes et al., 2005; Ibrahim & Al-Homaidh, 2011; P. D.
Loprinzi et al., 2012; Sternfeld et al., 2009) it is especially advantageous for survivors. Yet
the extent to which survivors are aware of these benefits and recognize their increased
need for exercise is not well known.

A critical step in increasing exercise among survivors is understanding what
outcomes they expect from exercise, that is outcome expectations (OEs). OEs refer to
what people expect to obtain or avoid by engaging in a behavior. Simply stated, people
exercise because they believe it will produce desired and avoid undesired outcomes
(Bandura, 2004). Understanding survivors’ OEs is key to understanding their exercise
behavior. OEs are highly influential in predicting health behaviors and are thus central
to key theoretical frameworks of health behavior change such as social cognitive theory,
(Bandura, 2004) theory of planned behavior, (Ajzen, 1991) and transtheoretical model
(Prochaska et al., 2002). Among non-cancer populations, individuals who expect more
positive and less negative outcomes are more likely to exercise (Resnick & Nigg, 2003; D.
M. Williams, Anderson, & Winett, 2005). Understanding survivors’ exercise OEs may
provide insights to clinicians and researchers about how to promote exercise among
survivors. Identification of more and less recognized OEs will illuminate which OEs to reinforce and which to introduce.

Little is known about which OEs to intervene upon to increase breast cancer survivors’ exercise. We located only one study that identified OEs among survivors who have completed adjuvant treatment (Short, James, & Plotnikoff, 2013). Findings indicated that among eight survivors, common exercise OEs include enjoyment, increased energy, feeling good mentally, and maintaining a healthy weight (Short et al., 2013). Exercise effects on late and long-term treatment effects, such as recurrence risk were not identified by survivors in this study. Thus the purpose of this study was to explore common exercise OEs among breast cancer survivors and develop a deeper understanding of their beliefs about exercise.

2.1 Methods

2.1.1 Design

A mixed-method descriptive design was used to explore exercise-related outcome expectations in women post breast cancer treatment.

2.1.2 Recruitment

A convenience sample of twenty female survivors of stage IA – IIB breast cancer were recruited. The sample was post adjuvant treatment and had completed an exercise intervention study, (Jones et al., 2010) at an academic tertiary care center in the southeastern US within the last year. The parent study was a three-arm randomized controlled trial that included a 16–week lab based aerobic exercise intervention.
Participants were randomized to either moderate-intensity exercise, strenuous-intensity exercise, or an attention control stretching group. It is not our intention to examine effect of group assignment on OEs as all groups engaged in some intensity of exercise. Because this sample had exercised, it was identified as an ideal group of women to provide preliminary insights into the exercise outcomes that may be most motivating and thus important to target in future exercise interventions for breast cancer survivors. The study prescribed to state and national ethical standards, and was approved by the medical center Institutional Review Board.

2.1.3 Procedures

A semi-structured interview guide was used to conduct telephone interviews to assess exercise outcome expectations and if and how the experience of cancer and its treatment/s influenced expected exercise outcomes. At the beginning of the interview “regular exercise” was defined by the interviewer as 150 minutes per week of moderate intensity physical activity and examples of fast walking, baseball, tennis, and easy bicycling were provided. The interview questions (see Table 2 for interview guide) were selected based on a literature review of OEs and consultations with experts in exercise oncology as well as experts in OEs. The telephone interviews began with open-ended questions about participants’ exercise OEs, moving them first through their expectations about exercise in general, and then specific OEs related to cancer and treatment effects, such as recurrence risk. After the open ended questions were asked, participants’ answers to the exercise specific questions were elicited by using the Outcome
Expectations for Exercise (OEE) Questionnaire (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000) which was administered by the investigator during the interview. The measure uses a 5-point scale (1 = strongly agree and 5 = strongly disagree) to assess levels of agreement that exercise will result in 9 positive outcomes. This measure was selected because it has demonstrated reliability and validity in a sample of older adults with Cronbach’s alpha = .75 - .87 (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2001). Given that the 9 items on this questionnaire do not ask about exercise outcomes specific to breast cancer and its treatment, we modified the OEE questionnaire by adding 15 items to assess level of agreement about exercise specific to breast cancer survivors. These breast cancer specific items were identified through a review of empirical studies. Items with both causative and correlational support were included. Face validity of the additional 15 items was agreed on by the first author, last author and an exercise physiologist who has expertise in oncology. See Table 3 for items from the Modified Outcome Expectations for Exercise Questionnaire including those from the OEE and the breast cancer specific items that were added. All interviews were conducted by the first author and digitally recorded. On average, the interviews lasted 18 minutes. Notes were taken during the interviews and all recordings were reviewed twice, by the first author, to confirm accuracy of written notes.
**Table 2: Interview Guide**

1. In general, what are your thoughts and feelings about exercise?
2. What do you expect you will experience during, that is, while you exercise at a moderate to strenuous intensity?
3. What do you expect will be the outcome(s) of exercising regularly for at least 150 minutes per week at a moderate to strenuous intensity? These outcomes can occur immediately after exercise to years down the road.
4. Based on how much you have exercised so far, what expected outcomes have been met?
5. What expected outcomes have not been met?
6. How, if at all, do you keep track of the outcomes you experience from exercising? That is, how do you know when an expected outcome has been met?
7. What if anything have you experienced, either during exercise or as a result of exercise, which you did not expect?
8. Have your expectations of exercise changed, since you began exercising?
9. (If Yes) How have your expectations changed?
10. What has brought you the most satisfaction from exercise and why?
11. What has brought you the least satisfaction from exercise and why?
12. How, if at all, do you keep track of how much you exercise?
13. To what extent do you intend to exercise for at least 150 minutes per week at a moderate to strenuous intensity, in the next six months, on this scale from 1 to 7 where 1 means “I definitely do not intend to exercise” and 7 means “I definitely intend to exercise”?
14. How, if at all, has your cancer influenced what you expect to be the outcomes from exercise?
15. How, if at all, has your cancer influenced your intention to exercise?
16. Are there any additional things, I didn’t ask about, which you expect may result from regularly exercising 150 minutes per week at a moderate to strenuous intensity?
17. Would you like to share any thoughts you have about this interview?
Table 3: Modified Outcome Expectations for Exercise (OEE) Questionnaire

<table>
<thead>
<tr>
<th>Original 9 items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Makes me feel better physically</td>
</tr>
<tr>
<td>2. Makes my mood better in general</td>
</tr>
<tr>
<td>3. Helps me feel less tired</td>
</tr>
<tr>
<td>4. Makes my muscles stronger</td>
</tr>
<tr>
<td>5. Is an activity I enjoy</td>
</tr>
<tr>
<td>6. Gives me a sense of personal accomplishment</td>
</tr>
<tr>
<td>7. Makes me more alert mentally</td>
</tr>
<tr>
<td>8. Improves my endurance performing daily activities</td>
</tr>
<tr>
<td>9. Helps strengthen my bones</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Added 15 items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reduces the chance of breast cancer coming back</td>
</tr>
<tr>
<td>2. Reduces the long term side effects of breast cancer treatment</td>
</tr>
<tr>
<td>3. Improves overall quality of life</td>
</tr>
<tr>
<td>4. Decreases risk for osteoporotic bone fractures</td>
</tr>
<tr>
<td>5. Improves arm range of motion (range of motion = the distance and direction your arm can move)</td>
</tr>
<tr>
<td>6. Decreases risk of lymphedema (lymphedema = swelling due to a build up of fluid)</td>
</tr>
<tr>
<td>7. Improves heart health</td>
</tr>
<tr>
<td>8. Improves lung health</td>
</tr>
<tr>
<td>9. Results in weight loss</td>
</tr>
<tr>
<td>10. Improves my body image</td>
</tr>
<tr>
<td>11. Helps me sleep better</td>
</tr>
<tr>
<td>12. Decreases neuropathy (neuropathy = nerve damage that can result in pain or numbness)</td>
</tr>
<tr>
<td>13. Improves sexual desire</td>
</tr>
<tr>
<td>14. Improves sexual satisfaction</td>
</tr>
<tr>
<td>15. Increases the length of my life</td>
</tr>
</tbody>
</table>

2.1.4 Data Analyses

The qualitative data were analyzed using a summative content analysis procedure. First, the content of the interviews related to exercise OEs was identified and quantified. Next, latent analysis was conducted to make meaning of the exercise OEs (H.-F. Hsieh & Shannon, 2005). Alternative terms for common keywords and content were identified and their contexts were examined. The trustworthiness of the qualitative analysis and findings were strengthened by the following procedures. An audit trail was created to document data collection, coding and analysis decisions. Reflexive memos
where made by the first author, immediately following the interviews and these notes were reviewed in conjunction with the audio recordings to identify linkages, gaps and questions. Peer debriefing was completed between the first and last author to discuss emerging findings, throughout data analysis. Specifically, throughout data collection and analysis, the two researchers met on a weekly basis to review interview content and discuss analysis and findings. The first author also consulted with a qualitative data analysis expert on three occasions to discuss emergent findings.

The quantitative data were analyzed by calculating means and standard deviations for each item on the modified OEE questionnaire. Results from the quantitative and qualitative analyses were linked to ascertain whether they confirm, refute, or otherwise extend or modify each other, and the interview findings offered potential explanations for the quantitative findings.

Participant demographics and characteristics of the parent study were collected to assure scientists and clinicians working to increase exercise among breast cancer survivors will be able to evaluate usefulness of study findings for the patients with whom they interact.

2.2 Results

2.2.1 Demographic and medical-related characteristics

The sample (n=20) was 70% Caucasian and 30% African American. The mean age was 62 years (± 8.5). Average time since completion of cancer treatment was 4.2 years (± 1.3). Most participants (65%) had undergone chemotherapy and radiation (70%),
with 55% having had a total mastectomy and 45% a lumpectomy. All participants had completed the larger lab based 16-week exercise intervention within the last year.

2.2.2 Qualitative interview data

Participants were asked, using both broad open-ended and specific questions, to talk about their exercise-related outcome expectations. Overall, responses were consistently non-specific and provided minimal details. For example, many participants said they expect to feel better from exercise, but despite probing for greater detail, were unable to discuss in what way or how. Participants predominately discussed mental or psychological benefits of exercise with greater detail provided for psychological than physical benefits. Even when asked to focus specifically on physical outcomes, most defaulted to discussing mental health benefits or concluded with final thoughts about the importance of exercise to psychological health. Importantly, participants did not discuss exercise outcomes related to treatment effects such as decreased recurrence risk or improved cardiac health. Overall they seemed unaware of the potential benefits that exercise has to ameliorate negative health effects of cancer and its treatments. Three general themes emerged from analysis of the interviews: 1) prevalence of common expectations, 2) pervasive impact of fatigue, and 3) a brighter future.

2.2.2.1 Prevalence of common expectations

Participants identified and focused predominately on the benefits that exercise has for the general, non-cancer population. The six most commonly reported expected outcomes or OEs included increased energy, feeling good overall, cardiac health, general
health, feeling good mentally and achieving healthy weight. When prompted to talk about exercise outcomes in relation to how it may influence effects associated with their cancer treatments, they had difficulty identifying specific benefits. This sample of women was not able to identify the added benefit that exercise has for those who had survived cancer and its treatment. For example, none spontaneously discussed decreased recurrence risk as an exercise OE. When probed to talk about how their experience with cancer and treatments has changed what they expected to experience from exercise, 30% said they thought exercise might decrease their recurrence risk. One woman explained that she did not learn this from her health care providers and stressed that nurses should educate patients about the association of exercise with recurrence risk. She said:

“Breast cancer is less likely to occur in the first place and less likely to recur if you exercise - I never knew this, I only learned this through the study [referring to the parent RCT]. My doctor actually told me to stop walking the dog during treatment - I didn’t listen to her, I decided that was the worst advice I ever got. I would have lost out if I had listened, I walked through my whole treatment. In fact, nurses are important in relaying the message about exercise and cancer. I didn’t get any of this information through treatment.”

Talk about the heightened benefits of exercise for cancer survivors was limited to two participants (10%) who provided examples of an increased need for exercise due to treatment effects. One participant discussed her expectation that exercise would mitigate problems she has with her heart that resulted from cancer treatment. Another woman said, “Even now five years later I still have some side effects - major joint and bone pain. Exercise works best to help with this.”
2.2.2.2 Pervasive effect of fatigue

Almost all participants (75%) stressed the role that fatigue played in decisions to exercise. Increased energy was the most common theme participants said they enjoyed or would enjoy most from exercise. However, others (40%) expressed extreme fatigue, most often a result of hormone therapy, as a barrier to exercise. One participant stated she has “scaled back what I expect, I have problems with my energy, tamoxifen almost killed me, and my body is still trying to recover from the treatments.” Similarly, another participant expressed that she needs to exercise more but she is too tired; she said “cancer, radiation, then that medication I took for a year zapped my energy.” Several participants explained that they are simply too fatigued to exercise and saved their energy for other higher priority life activities.

2.2.2.3 A brighter future

Many participants (35%) focused and elaborated on the psychological benefits they have or expect to experience from exercise. When the women talked about physical benefits, they tended to just list them; however, those who experienced mental benefits discussed them in more detail. While participants valued both physical and psychological outcomes of exercise, the psychological outcomes were described as the most powerful in affecting their lives. One woman explained, “you really need to focus on mental benefits of exercise for breast cancer and control is a big issue too, you are dealing with not being in control, exercise is something you can do.” Another participant explained that exercise really helped her to survive cancer, she said “to go through diagnosis and treatment and the aftermath is a lot to go through. Personally I think exercise makes it brighter at the end. That you want to stay healthier, you want to eat healthier, you look at
life differently because of the diagnosis. A lot of people say cancer, oh god, you hear a lot of women die and you hear the good stories and I say I’m a survivor.” Participants did not discuss the personal importance of physical outcomes.

2.2.3 Quantitative data

Our intent in using the OEE measure was to quantitatively explore potential exercise outcomes participants thought exercise was most and least likely to produce. Cronbach’s alpha of the modified measure for this sample is 0.94, demonstrating excellent reliability. The mean agreement scores and standard deviations from the modified OEE measure are presented in Table 4. Mean level of agreement scores for each item were calculated and ranged from 2.8 (outcome participants least agreed would result from exercise) to 1.1 (outcomes participants most agreed would result from exercise). The average level of agreement score was 1.9 for psychological outcomes, 1.7 for physical outcomes and 1.7 overall. We used the mean level of agreement score of 1.7 to divide the outcomes into those participants most agreed would result from exercise (score <1.7) and those participants who least agreed with what would result from exercise (score ≥ 1.7). Notable items with a mean agreement score ≥ 1.7 include: reducing long-term effects of treatment, feeling less tired, sleeping better, increasing length of life, reducing recurrence risk, increasing mental alertness and decreasing risk of osteoporotic bone fractures. These items are noteworthy as, despite empirical support of their benefit, they were those least endorsed by this sample of survivors.
Table 4: Mean Scores for Items on the Modified Outcome Expectations for Exercise (OEE) Questionnaire.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improves overall quality of life</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Improves heart health</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Make my muscles stronger</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Improves lung health</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Makes me feel better physically</td>
<td>1.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Helps strengthen my bones</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Make my mood better in general</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Improves my body image</td>
<td>1.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Give me a sense of personal accomplishment</td>
<td>1.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Results in weight loss</td>
<td>1.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Improves my endurance performing daily activities</td>
<td>1.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Increases the length of my life</td>
<td>1.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Reduces the chance of breast cancer coming back</td>
<td>1.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Makes me more alert mentally</td>
<td>1.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Decreases risk for osteoporotic bone fractures</td>
<td>1.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Improves arm range of motion</td>
<td>1.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Is an activity I enjoy</td>
<td>1.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Helps me sleep better</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Reduces the long-term side effects of breast cancer treatment</td>
<td>2.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Helps me feel less tired</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Decreases risk of lymphedema</td>
<td>2.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Decreases neuropathy</td>
<td>2.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Improves sexual satisfaction</td>
<td>2.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Improves sexual desire</td>
<td>2.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Note. Items are listed in order participants most agree they may experience from exercise to those they least agree they experience from exercise with 1= strongly agree – 5 = strongly disagree.

2.2.4 Linking qualitative and quantitative data

The qualitative and quantitative data were compared to ascertain whether they confirmed or refuted each other. The qualitative data was used to make meaning of the quantitative data. We first explored how often items with less agreement on the OEE measure (i.e., scores above 1.7) were mentioned during the interview. Again, the quantitative results indicated that participants reported lower levels of agreement in
relation to exercise resulting in: improved sexual desire, improved sexual satisfaction, decreased neuropathy, decreased lymphedema, reduction in long term side effects of breast cancer treatment, feeling less tired, sleeping better, being an enjoyable activity, increasing length of life, recurrence risk reduction, improved arm range of motion, increased mental alertness and decreased risk for osteoporotic bone fracture. With the exception of feeling less tired, items with low agreement scores were not prominent in the qualitative data.

Survivors have been known to be motivated to exercise to reduce their fear of recurrence (Templeton et al., 2013). However, recurrence risk reduction did not spontaneously come up in the qualitative interviews. When asked more specifically about potential exercise outcomes in relations to having cancer and treatments, 30% mentioned recurrence risk reduction. Finally when asked as part of the OEE measure, risk reduction was rated with a lower level of agreement (m = 1.7), and several participants paused and made comments such as “huh, I have no idea”, “I really don’t know”, “I really hope so, so I’m going to have to say one.”

In summary both the qualitative and quantitative data supported that among a sample of women who are motivated to complete an exercise study, there are low levels of agreement that exercise may mitigate several significant late and long-term cancer and treatment effects.
2.3 Discussion

Overall, findings from this study highlight that despite extensive evidence that exercise effectively treats many long-term and late treatment effects, survivors who are motivated to exercise may still be unaware or question these potential benefits. While this sample generally has positive expectations of exercise, they still hold some doubt about the efficacy of exercise as a treatment for long term cancer effects. Given these findings among a sample of survivors who have exercised, knowledge related to exercise benefits among those who are not motivated to exercise is highly questionable. Breast cancer survivors’ OEs may be similar to those of non-cancer survivors. The qualitative data revealed that the most common OEs of breast cancer survivors are increased energy, feeling good overall, cardiac health, general health, feeling good mentally, and achieving healthy weight. These findings are similar to those of Short and Colleagues (2013) who report that breast cancer survivors anticipate enjoyment, increased energy, feeling good mentally and maintaining a healthy weight as effects of physical activity. Thus there is an opportunity to increase awareness about the exercise benefits that extend beyond those for the general population to those that decrease late and long term cancer and treatment effects.

Mean scores from the quantitative data indicate that outcomes breast cancer survivors least agree exercise will produce are: decreasing long-term effects of breast cancer treatment, feeling less tired, sleeping better, increasing length of life, reducing recurrence risk, increasing mental alertness and decreasing risk of osteoporotic bone
fractures. These qualitative and quantitative data are congruent. Specifically, none of the items with a low (≥ 1.7) quantitative agreement score (i.e. outcomes survivors are least likely exercise will produce) were discussed by participants in the qualitative interviews. The absence of low agreement outcomes in the qualitative data confirm the finding that survivors do not agree, are unaware, or rarely think about exercise resulting in such outcomes. Especially notable is the low scores for recurrence risk and lack of recurrence risk in the qualitative data. These findings support each other in that overall, survivors are unsure of the efficacy of exercise to decrease recurrence risk. Both survivors who do and do not exercise, should be made aware of the association between exercise and risk recurrence.

Increased awareness of the numerous diverse positive outcomes of exercise may motivate breast cancer survivors to exercise more. The greatest concerns among breast cancer survivors include fear of recurrence, fatigue, sleep disturbance, neuropathy, concerns about long-term effects of treatment, weight changes, and sexual issues, (Ness et al., 2012) all of which exercise can positively impact. Generally, cancer survivors are motivated to engage in behaviors they believe will improve their health including exercise. (Templeton et al., 2013) Thus, it is possible that increased awareness of the efficacy of exercise to improve long term and late effects may motivate sedentary survivors to exercise and help maintain or increase activity among active survivors.

In addition to increasing knowledge about exercise benefits, highlighting psychological outcomes may be especially effective to increase exercise among breast
cancer survivors. This sample, of survivors who have exercised, discussed psychological OEs in greater detail than physical outcomes. Participants explained that they enjoy the psychological outcomes of exercise and that these benefits are especially important given the emotional challenges of going through cancer and treatment. These findings indicate that psychological outcomes are crucial to focus on in exercise interventions among this population.

Fatigue plays a significant role in breast cancer survivors’ decisions to exercise. Cancer-related fatigue is defined by the National Comprehensive Cancer Network as “a distressing persistent subjective sense of physical, emotional, and/or cognitive tiredness or exhaustion related to cancer or cancer treatment that is not proportional to recent activity and that interferes with usual functioning.” (Piper & Cella, 2010) Cancer-related fatigue persists up to ten years into survivorship (Bower et al., 2006; Minton & Stone, 2008). Increased energy was one of the most common OEs in the qualitative data, yet the quantitative data indicates low levels of agreement that exercise will help survivors feel less tired and sleep better. This contradiction confirms the pervasive nature of fatigue related to exercise, as survivors identify fatigue as both a great benefit of and barrier to exercise. Indeed, survivors who exercise consistently report having more energy (Cramp & Byron-Daniel, 2012a). Further research is needed to identify how to break down fatigue as an exercise barrier so that survivors may exercise to enjoy higher levels of energy and an improved quality of life. Similarly, efforts are needed to increase levels of exercise to decrease fatigue experienced by survivors.
One weakness of this study is the convenience sample of highly motivated survivors actively engaged in an exercise intervention, limiting generalizability of findings to all breast cancer survivors. Yet, this sample provided great initial insights into what may motivate exercise among survivors. However, because all participants completed a 16-week lab based exercise oncology intervention at a large research hospital, it is reasonable to consider that these participants are more aware of exercise outcomes, compared to other breast cancer survivors. This indicates that among the larger breast cancer population, there is likely an even greater need to shine light on the benefits of exercise related to cancer and treatment effects. Another study weakness is the accuracy with which the quantitative measure assessed OEs. Items on the measure were asked after participants had thought about and discussed outcomes of exercise. Thus, these conversations may have primed participants and impacted their rating.

2.4 Implications of These Findings

Clinicians working with breast cancer survivors have an opportunity to educate survivors about the role exercise plays in managing late and long-term side effects. Connections between the heightened need for exercise due to treatment effects should be outlined for patients. Particular attention should be given to the association between exercise and recurrence risk reduction. Overall, research is needed to identify the most effective strategies to increase breast cancer survivors’ exercise OEs, as a means to increase exercise. OEs have several dimensions including 1) importance – value placed on the outcome(s);(Boninger et al., 1995; Olson et al., 1996) 2) certainty - perceived
probability outcome(s) will occur; (Gross et al., 1995; Olson et al., 1996) and 3) accessibility – the frequency with which outcome(s) are considered. (Fazio, 1995; Olson et al., 1996; Petty & Krosnick, 2014) Interventions that simultaneously enhance all these dimensions may be most effective to increase exercise. In summary, it may be necessary to both increase survivors’ awareness of diverse exercise outcomes as well as enhance the importance and certainty of these outcomes.

This information contained in this chapter is published (Hirschey, Docherty, Pan, & Lipkus, 2016a)
3. Development of a Multidimensional Exercise Outcome Expectation Measure for Breast Cancer Survivors

Among breast cancer survivors, higher levels of aerobic exercise are associated with improved survival and quality of life, thus ≥150 minutes/week of moderate- or ≥75 minutes/week of strenuous-intensity aerobic exercise is recommend for this population (P. D. Loprinzi & Lee, 2014). Yet only about one third of the 2.8 million breast cancer survivors in the U.S meet these guidelines (Blanchard et al., 2008). Increasing exercise outcome expectations may be a promising strategy to increase these levels.

Outcome Expectations (OEs) refer to what people expect to obtain or avoid by engaging in a behavior (Bandura, 2004). Interventions that have targeted OEs have been effective in increasing levels of exercise (Hatchett et al., 2013; Rogers et al., 2009; Short et al., 2014). However, intervention effects on OEs, among breast cancer survivors, have been reported only once (Rogers et al., 2009), possibly due to the lack of a valid and reliable measure.

Existing exercise OE measures do not contain items most pertinent to breast cancer survivors such as issues pertaining to treatment effects. Survivors are faced with long-term treatment and late effects that may impact motivation to exercise. For example, outcomes of exercise for breast cancer survivors may include management of long-term effects such as pain (Nyrop et al., 2013) and cancer related fatigue (Puetz & Herring, 2012b). Exercise may also minimize late breast cancer effects such as cancer recurrence, secondary cancers and cardiotoxicities (Ingram & Visovsky, 2007). Asking questions about these as OEs are thus very relevant. To accurately assess intervention
effects on exercise OEs among breast cancer survivors, measures should include items most relevant to survivors.

Interventions may increase OEs in several ways. For example, by increasing one’s perceived probability (i.e. certainty) that exercise will decrease cancer recurrence or by increasing one’s value (i.e. importance) for risk reduction. Another possibility is that an intervention will increase the frequency (i.e., accessibility) one thinks about exercise decreasing recurrence risk. For an intervention to most effectively increase OEs, it should include strategies to increase these multiple OE dimensions of certainty, importance and accessibility (Petty & Krosnick, 2014). Thus OE measures should also capture these dimensions. Most existing measures assess only the certainty of OEs, few assess OE importance, and none include OE accessibility. Thus the purpose of this study is to develop an exercise OE importance and accessibility measure, for breast cancer survivors, and conduct initial validity and reliability testing.

3.1 Methods

3.1.1 Selection of items

Measurement items were selected through literature reviews and pilot work. One review sought to identify all empirically supported exercise outcomes for breast cancer survivors. A second search was conducted to identify common OEs among breast cancer survivors. Only two studies that explored exercise OEs among this population were identified (Rogers, Courneya, Shah, Dunnington, & Hopkins-Price, 2007; Short et al., 2013). Therefore an exploratory study was conducted to further explore OEs of breast
cancer survivors (Hirschey, Docherty, Pan, & Lipkus, 2016a). All items were pooled from the aforementioned publications and reviewed by the research team and an expert in exercise oncology for relevance to breast cancer survivors and face validity. Then, to establish content validity, three advance practice nurses not directly involved with the development of this measure, who have clinical expertise working with breast cancer survivors scored the items. They were asked to rate how relevant each item is for breast cancer survivors. All items that scored 2 (somewhat relevant), 3 (quite relevant) or 4 (very relevant) were retained for a final 20 items (see Table 2).

3.1.2 Construction of questions and anchors

To create questions capturing OE importance and accessibility, the research team reviewed the outcome expectation literature, questions and anchors of existing measures and consulted with a behavioral psychologist who has expertise in outcome expectations. Two 20-item measures were created, one to assess importance and another to assess accessibility. The importance measure contains the question “How important to you is”, with a 7-point Likert response option of 1=extremely unimportant to 7=extremely important. The accessibility measure contains the question “How often do you think about exercise resulting in you….”, with a 7-point Likert response option of 1=never to 7=all the time. The 20 aforementioned items, that had been selected from literature review and pilot work and scored for face and content validity are all included in both the importance and accessibility measures.
3.1.3 Measure administration

Participants were recruited at Duke Cancer Institute through a cancer registry and by oncologist referral. Inclusion criteria consisted of: 1) stage Ia – IIb breast cancer diagnosis; 2) completion of adjuvant treatment in the prior 1-5 years; 3) no evidence of disease recurrence or medical conditions precluding participation in unsupervised exercise; and 4) English-speaking and writing. Participants completed the measure online at two time points, one month apart. The study prescribed to the state and national ethical standards, and was approved by the medical center Internal Review Board [Pro00044422].

3.2 Analyses

All statistical analyses were conducted using IBM SPSS Version 23. Frequencies were calculated to determine acceptability of each item. Specifically, a priori value of >25% missing data for any given item was set to determine the item as being unacceptable. Means, medians, ranges, frequencies and statistical tests including Kolmogorov-Smirnov and Shapiro Wilks for normality, with a significance level set at 0.05, were conducted to examine item distributions. Ceiling effects were a priori defined as >50% of the sample responding 6 (somewhat important) or 7 (extremely important) to any item. Cronbach’s alpha was used to determine internal consistency. Intra-class correlations were used to determine one-month test re-test reliability. Spearman’s correlation coefficients and factor analysis were run to explore relationships between the two measures. Items from the two measures were pooled and principle components
factor analysis, with a forced two factor solution, using promax with kaiser normalization rotation, was used to examine for cross loadings and assess if importance and accessibility items load on two distinct factors. A minimal loading of 0.6 was preferred and 0.5 was considered, only if less than a 0.3 cross loading was present. Any cross loading >0.2 was considered problematic, unless one loading was >0.6.

### 3.3 Results

Recruitment packets were sent to 274 potential participants from the registry, of which 71 enrolled. Twenty-nine patients were referred from oncologists, of which 13 enrolled, for a total sample of 84. Measures were completed by 73 participants. The sample is 91.8% white, 5.4% African American, 1.4% Asian or Pacific islander and 1.4% other. The mean age is 58 (SD 9.6), 78% of the sample has at least some college and 100% has health insurance.

#### 3.3.1 Item acceptability

Six items of the importance measure had missing data. Eleven items of the accessibility measure had missing data. Of all these items, missing data ranged from from 1% (n=1) to 5% (n=4) of participants not responding. Thus <25% data was missing for all items, achieving our a priori guidelines for item acceptability by this sample.

#### 3.3.2 Item distributions

Importance measure item means ranged from 4.95 (SD =1.5) to 6.63 (SD =1.1); medians ranged from 5.5 to 7. Accessibility item means ranged from 3.50 (SD =1.7) to 5.62 (SD =1.3); medians ranged from 3 to 6 (see Table 5). More than 50% of participants
responded 6 or 7 to 95% of items on the importance measure and 30% of items on the accessibility measure, thus meeting a priori ceiling effect criteria. Kolmogorov-Smirnov and Shapiro Wilks tests showed statistically significant (p<0.05) negatively skewed distribution for both the importance accessibility measures.

Table 5: OE Importance and Accessibility Measure Items and Descriptive Statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Importance</th>
<th></th>
<th>Accessibility</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Mean</td>
<td>SD</td>
<td>Median</td>
</tr>
<tr>
<td>1. Having more self-esteem</td>
<td>6</td>
<td>5.64</td>
<td>1.61</td>
<td>4</td>
</tr>
<tr>
<td>2. Achieving/maintaining a healthy weight</td>
<td>7</td>
<td>6.06</td>
<td>1.56</td>
<td>6</td>
</tr>
<tr>
<td>3. Having less tension and stress</td>
<td>7</td>
<td>6.16</td>
<td>1.44</td>
<td>5</td>
</tr>
<tr>
<td>4. Having less risk of disease</td>
<td>7</td>
<td>6.49</td>
<td>1.32</td>
<td>6</td>
</tr>
<tr>
<td>5. Feeling more attractive</td>
<td>6</td>
<td>5.71</td>
<td>1.53</td>
<td>5</td>
</tr>
<tr>
<td>6. Having a more healthy heart</td>
<td>7</td>
<td>6.41</td>
<td>1.32</td>
<td>5</td>
</tr>
<tr>
<td>7. Being less tired</td>
<td>7</td>
<td>6.0</td>
<td>1.56</td>
<td>5</td>
</tr>
<tr>
<td>8. Having increased/maintained bone strength</td>
<td>7</td>
<td>6.36</td>
<td>1.24</td>
<td>5</td>
</tr>
<tr>
<td>9. Having improved general health</td>
<td>7</td>
<td>6.33</td>
<td>1.48</td>
<td>6</td>
</tr>
<tr>
<td>10. Having less pain</td>
<td>6</td>
<td>5.93</td>
<td>1.44</td>
<td>4</td>
</tr>
<tr>
<td>11. Lowering your risk of breast cancer coming back</td>
<td>7</td>
<td>6.63</td>
<td>1.12</td>
<td>6</td>
</tr>
<tr>
<td>12. Sleeping better</td>
<td>7</td>
<td>6.07</td>
<td>1.48</td>
<td>5</td>
</tr>
<tr>
<td>13. Living longer</td>
<td>7</td>
<td>6.27</td>
<td>1.23</td>
<td>5</td>
</tr>
<tr>
<td>14. Lowering risk of getting other types of cancer</td>
<td>7</td>
<td>6.48</td>
<td>1.18</td>
<td>4.5</td>
</tr>
<tr>
<td>15. Having social interactions</td>
<td>5</td>
<td>4.95</td>
<td>1.45</td>
<td>3</td>
</tr>
<tr>
<td>16. A sense of accomplishment</td>
<td>5.5</td>
<td>5.51</td>
<td>1.45</td>
<td>4.5</td>
</tr>
<tr>
<td>17. Enjoying exercise</td>
<td>5.5</td>
<td>5.63</td>
<td>1.28</td>
<td>4.5</td>
</tr>
<tr>
<td>18. Having control over your health</td>
<td>7</td>
<td>6.25</td>
<td>1.25</td>
<td>5</td>
</tr>
<tr>
<td>19. Feeling better physically</td>
<td>7</td>
<td>6.44</td>
<td>1.21</td>
<td>6</td>
</tr>
<tr>
<td>20. Feeling better mentally</td>
<td>7</td>
<td>6.47</td>
<td>1.20</td>
<td>6</td>
</tr>
</tbody>
</table>
3.3.3 Reliability and validity

Both the importance and accessibility measures demonstrated excellent reliability with a $\alpha .96$ and $\alpha .97$, respectively. Sixty-five (89%) of participants completed the measure, one month later. Baseline and one-month importance ($r_s = 0.638$) and accessibility ($r_s = 0.742$), are both highly correlated indicating stability of both measures over one month.

3.3.4 Relationships between measures

There is a moderate ($r_s = .48$) relationship between the importance submeasure and accessibility submeasure. Factor analysis revealed minimal cross loadings (see Table 6).
<table>
<thead>
<tr>
<th>Item</th>
<th>Accessibility</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling better physically</td>
<td>.847</td>
<td>.513</td>
</tr>
<tr>
<td>General health</td>
<td>.795</td>
<td>.356</td>
</tr>
<tr>
<td>Control of health</td>
<td>.789</td>
<td>.338</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>.752</td>
<td>.328</td>
</tr>
<tr>
<td>Feeling better mentally</td>
<td>.744</td>
<td>.350</td>
</tr>
<tr>
<td>Less tired</td>
<td>.735</td>
<td>.239</td>
</tr>
<tr>
<td>Live longer</td>
<td>.714</td>
<td>.554</td>
</tr>
<tr>
<td>Feeling attractive</td>
<td>.710</td>
<td>.478</td>
</tr>
<tr>
<td>Accomplishment</td>
<td>.708</td>
<td>.331</td>
</tr>
<tr>
<td>Recurrence risk</td>
<td>.691</td>
<td>.234</td>
</tr>
<tr>
<td>Sleep</td>
<td>.677</td>
<td>.536</td>
</tr>
<tr>
<td>Risk of Disease</td>
<td>.657</td>
<td>.508</td>
</tr>
<tr>
<td>Other cancer risk</td>
<td>.642</td>
<td>.263</td>
</tr>
<tr>
<td>Healthy heart</td>
<td>.638</td>
<td>.199</td>
</tr>
<tr>
<td>Tension/stress</td>
<td>.632</td>
<td>.419</td>
</tr>
<tr>
<td>Feeling attractive</td>
<td>.618</td>
<td>.554</td>
</tr>
<tr>
<td>Social interactions</td>
<td>.589</td>
<td>.065</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>.582</td>
<td>.359</td>
</tr>
<tr>
<td>Bone strength</td>
<td>.578</td>
<td>-.021</td>
</tr>
<tr>
<td>Less pain</td>
<td>.570*</td>
<td>.455*</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>.548*</td>
<td>.454*</td>
</tr>
<tr>
<td>Social interactions</td>
<td>.446*</td>
<td>.206*</td>
</tr>
<tr>
<td>Less tired</td>
<td>.403*</td>
<td>.334*</td>
</tr>
<tr>
<td>General health</td>
<td>.399</td>
<td>.865</td>
</tr>
<tr>
<td>Sleep</td>
<td>.368</td>
<td>.857</td>
</tr>
<tr>
<td>Healthy heart</td>
<td>.341</td>
<td>.826</td>
</tr>
<tr>
<td>Less pain</td>
<td>.378</td>
<td>.817</td>
</tr>
<tr>
<td>Feeling better physically</td>
<td>.428</td>
<td>.803</td>
</tr>
<tr>
<td>Bone strength</td>
<td>.507</td>
<td>.797</td>
</tr>
<tr>
<td>Tension/stress</td>
<td>.532</td>
<td>.746</td>
</tr>
<tr>
<td>Feeling better mentally</td>
<td>.569</td>
<td>.733</td>
</tr>
<tr>
<td>Control of health</td>
<td>.409</td>
<td>.728</td>
</tr>
<tr>
<td>Other cancer risk</td>
<td>.170</td>
<td>.726</td>
</tr>
<tr>
<td>Risk of Disease</td>
<td>.313</td>
<td>.724</td>
</tr>
<tr>
<td>Recurrence risk</td>
<td>.132</td>
<td>.717</td>
</tr>
<tr>
<td>Live longer</td>
<td>.289</td>
<td>.705</td>
</tr>
<tr>
<td>Healthy weight</td>
<td>.133</td>
<td>.693</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>.467</td>
<td>.683</td>
</tr>
<tr>
<td>Accomplishment</td>
<td>.519*</td>
<td>.561*</td>
</tr>
<tr>
<td>Healthy weight</td>
<td>.375*</td>
<td>.405*</td>
</tr>
</tbody>
</table>

Note. (I) indicates item from importance measure, (A) indicates item from accessibility measure.
3.4 Implications for Nursing

Nurses are influential in increasing exercise among cancer survivors (Karvinen, McGourty, Parent, & Walker, 2012). A successful strategy to increase exercise is to strengthen exercise OEs (Rogers et al., 2013; Short et al., 2014). This measure may help nurses identify patients who have low exercise OEs. Nurses may then council patients and make referrals to institutional resources, community exercise programs, or exercise interventions. Additionally, this reliable and valid OE measure will facilitate evaluation of nursing exercise interventions.

3.5 Conclusions

High participant response rates suggest breast cancer survivors understand and are agreeable to answering all items. Significant ceiling effects are noted for both measures. Researchers should consider that exercise beliefs are generally positive among breast cancer survivors, when designing and appraising interventions targeting OEs. Implementing bootstrap analysis (Efron & Tibshirani, 1994) may help account for non-normally distributed data. The moderate correlation and minimal cross-loading between measures indicates that OE importance and accessibility are related yet distinct. Both measures revealed high internal consistency and reliability and future measure refinement is warranted. Further measure development should be conducted with larger and more diverse samples. Items that show little variability and low reliability may be omitted.

These initial analyses are promising and call for continued measure
implementation and development. Because OEs are included in so many exercise interventions, there is a great utility for these measures. Currently, these measures may aid researchers in identifying intervention effects on exercise OEs and developing improved interventions.
4. An Exercise Intervention Developed with and for Breast Cancer Survivors

The purpose of this paper is to describe the multistep process of creating the study known as “Moving On”. Moving on is an intervention that aims to increase exercise Outcome Expectations (OEs) among breast cancer survivors. OEs are what people expect to obtain or avoid by engaging in a behavior (Bandura, 2004). Moving on also aims to increase exercise, among breast cancer survivors.

4.1 Background

Breast cancer is the most prevalent cancer among women in 145 countries (World Health Organization, 2011). Exercise is an effective self-management strategy for late and long-term treatment side effects experienced by many of the five million breast cancer survivors in the world (World Health Organization, 2011). These side effects include depression, fatigue (P. D. Loprinzi & Cardinal, 2012) and increased cardiac disease risk (Schneider, Hsieh, Sprod, Carter, & Hayward, 2007). Additionally, exercise is associated with decreased mortality and recurrence risk (X. Chen et al., 2011).

However, only 17% (Smith & Chagpar, 2010) – 37% (Blanchard et al., 2008) of breast cancer survivors in the U.S. engage in 150 weekly minutes of moderate-intensity exercise, as recommended by the American Cancer Society (ACS) (Rock, Doyle, Demark-Wahnefried, Meyerhardt, Courneya, SCHWARTZ, Bandera, Hamilton, Grant, McCullough, Byers, & Gansler, 2012b). Thus, interventions are needed to increase exercise in this population.
Interventions guided by behavioral theory are more effective and easier to translate into practice (Glanz & Bishop, 2010). These theories include Social Cognitive Theory (Bandura, 2004), Theory of Planned Behavior (Ajzen, 1991) and the Transtheoretical Model of Behavior Change (Prochaska & Velicer, 1997). A key concept in these theories are OEs. OEs have been studied more extensively among non-cancer populations. In general individuals with high OEs exercise more (Schutzer & Graves, 2004). While some studies in the United States (Hatchett et al., 2013; Rogers et al., 2009) and in Australia (Short et al., 2014) have incorporated OEs in interventions for breast cancer survivors, the extent to which OEs are understood and targeted among breast cancer survivors remains in its infancy. An improved understanding of how to increase exercise OEs may improve the efficacy of a multitude of exercise interventions guided by behavioral theories.

4.2 The Study

4.2.1 Design

This is a methods paper detailing the creation of an exercise intervention for breast cancer survivors. Multiple components including pilot work, development of a theoretical framework, and collaboration with breast cancer survivors and oncologists are described below.
4.2.2 Methods

4.2.2.1 Pilot work

A study was conducted to explore OEs among breast cancer survivors (Hirschey, Docherty, Pan, & Lipkus, 2016a). Three major study findings were used to develop Moving On. First, the diagnosis of cancer and its treatments does not seem to increase the perceived benefits of exercise. For example, only 30% of participants identified the association between exercise and recurrence risk as a reason to exercise. Second, participants report fatigue as the greatest barrier to exercise; yet they also identified decreased fatigue as the best benefit of exercise. Finally, psychological, (e.g. mood) compared to physical, (e.g. heart health) benefits of exercise are more highly valued, among participants. Thus, Moving On is designed to: 1) increase salience of the added value exercise has for someone who may be experiencing or is at risk for side effects such as cardiotoxicity, neuropathy and recurrence; 2) focus on decreased fatigue as a benefit of exercise, even for those individuals experiencing fatigue; and 3) target psychological exercise outcomes as motivators to exercise.

4.2.2.2 Theoretical framework construction

Pilot results informed what exercise outcomes to focus on; yet it is well established that simply giving people health information is insufficient to motivate behavior change (Hardcastle et al., 2015). Consequently, we created a theoretical framework (see Figure 2) to inform not only what OEs to include in the intervention but how to include them. The framework is adapted from Bandura’s self-efficacy theory
the theory supports that exercise increases when people both expect desired outcomes will occur (Bandura, 2004; Hatchett et al., 2013; Rogers et al., 2009; 2013) and believe they can perform exercise (i.e., have high exercise self-efficacy) (Bandura, 2004; P. D. Loprinzi & Cardinal, 2013). In contrast to the many studies targeted to increase self-efficacy, tested strategies to increase OEs are few. Therefore, this intervention focuses on increasing OEs. To be maximally effective, several dimensions of OEs are included. These dimensions include: 1) importance - value placed on the outcome(s) (Boninger et al., 1995; Olson et al., 1996); 2) certainty - perceived probability outcome(s) will occur (Gross et al., 1995; Olson et al., 1996); and 3) accessibility - frequency with which outcome(s) are considered (Fazio, 1995; Olson et al., 1996). This framework is novel because multiple OE dimensions are considered. Prior interventions have simply informed participants of exercise benefits (Short et al., 2014). Following this framework, Moving On is designed to increase OE importance, certainty and acceptability, that in unison are hypothesized to increase exercise intentions (the most proximal predictor of behavior) (Ajzen, 1991; Scholz, Keller, & Perren, 2009) and exercise. This approach may be more successful than previous attempts to increase exercise OEs.
4.2.2.3 Collaboration with active breast cancer survivors and oncologists

Breast cancer survivors are influenced to act on messages received from other breast cancer survivors (Hopfer, 2012) and oncologists (Jones, Courneya, Fairey, & Mackey, 2004). Thus, breast cancer survivors were recruited to help create this intervention in collaboration with the research team, which includes an oncologist, as well as three nurses, and a behavioral psychologist. The survivors were purposively selected because they effectively manage late and long-term treatment effects with regular exercise. The knowledge these women contribute to the intervention derives from their personal experience with cancer, its treatments, and exercise. This knowledge is called practical knowing (i.e. the knowledge that comes from doing what is proposed) (Heron & Reason, 1997). Practical knowing comes from participatory action research (Heron & Reason, 2008) and is a critical component in designing effective interventions.
The survivors and oncologist supplied narrative messages for the intervention. Narratives are stories told in first person that connect the reader with the narrator and the narrator’s experience (Bell & Bell, 2013). This connection results in the reader considering the information as more personally relevant, processing it more deeply, and better retaining it (Hinyard & Kreuter, 2007). Narrator photographs were included and survivors of different ages and races were selected to maximize the possibility of readers identifying with at least one narrator. The survivors’ narratives detail their experience of how exercise has helped manage their cancer and treatment effects; they focused on topics related to pilot study findings (see Table 1). The oncologist’s narrative supports the ACS activity guidelines and highlights exercise benefits she has personally observed among her patients. Her message also details the associations between exercise and recurrence risk as well as reductions in mortality.

4.2.3 Intervention description

The resultant intervention is a print booklet which, among cancer survivors, is an effective (Hirschey, Lipkus, Jones, Mantyh, Sloane, et al., 2016b; Short et al., 2014) and preferred (Stull, Snyder, & Demark-Wahnefried, 2007) delivery mode. It contains reading, reflecting and writing activities that are based on empirical support for increasing multiple OE dimensions, as discussed below.

4.2.3.1 Booklet cover and introduction

The booklet cover (Figure 3A) contains the study name, Moving On. This name captures the stage of cancer survivorship and encourage participants to take action by
moving, (i.e. exercising). The cover image was selected because the research team thought it was uplifting and motivational. The woman in the picture is intended to be relatable to many breast cancer survivors because she is of average to slightly above average weight, and her age and race is ambiguous. The first page of the booklet (Figure 3B) introduces the ACS recommendations on diet and exercise for cancer survivors. The second page (Figure 3C) lists empirically supported benefits of exercise for cancer survivors (e.g. decreased fatigue, improved survival). This section aims to increase awareness of the many benefits of exercise for breast cancer survivors. It explicitly states that because one has had breast cancer and treatment, these outcomes may be especially important.
Note. Intervention Booklet A = cover, B and C = introduction, D = oncologist narrative / certainty section, E and F = survivor narratives / certainty section, G = accessibility section, H = importance section.

Figure 3: Intervention Booklet

4.2.3.2 Content to increase OE dimensions

The booklet content is based on evidence on increasing OEs (Boninger et al., 1995; Fazio, 1995; Gross et al., 1995; Hinyard & Kreuter, 2007; Hopfer, 2012; Kreuter et al., 2008; Olson et al., 1996; Shaffer & Zikmund-Fisher, 2013; Wegener et al., 1995). OE importance is targeted through elaboration of why outcomes are important to the participant (Boninger et al., 1995; Wegener et al., 1995). In this section (Figure 3H) the person is instructed to consider three things she would most like to experience from exercise and then elaborate on all the things that will happen if those outcomes occur.
OE certainty is primarily targeted in the intervention through narrative stories (Figure 3E and 3F). As explained above, participants should identify with the survivors and oncologist; thus, as the narrator elaborates on outcomes personally experienced or witnessed, the participant should become more certain that she too will experience similar outcomes (Gross et al., 1995; Hinyard & Kreuter, 2007; Hopfer, 2012; Kreuter et al., 2008; Kreuter & Wray, 2003; Shaffer & Zikmund-Fisher, 2013; Wegener et al., 1995). Finally, accessibility is targeted by having the participant think about the association between exercise and its outcomes (Fazio, 1995; Wegener et al., 1995). This section (Figure 3G) asks the participant to develop strategies to think more often about how her life may change if she decides to exercise. Suggestions (e.g. reading booklet daily, making a computer screen saver) are provided.

4.3 Ethics

Study participants, who provided narrative messages, completed written informed consent and a media authorization for their pictures to be published in the booklet, manuscripts and scientific presentations. They were paid $40 as a compensation for their time. These procedures were approved by an institutional review board (Pro00059469).

4.4 Discussion

If Moving On increases exercise, the booklet will provide an economical strategy for busy cancer centers to support and increase breast cancer survivors’ levels of exercise. This booklet could easily be distributed during a regular follow up visit.
Further, it can be adapted for any clinic by including a photograph of a provider well known in the respective geographical area. Finally, findings about how to increase exercise OEs, may be applied to make all theory guided interventions that include OEs more effective.

Globally, nurses provide a great deal of cancer survivorship care and are ideally positioned to educate patients on the importance of exercise. Distribution of motivational, informative print materials is an effective means to promote exercise among breast cancer survivors that can be incorporated into a busy clinical schedule.
5. Feasibility Randomized Controlled Trial to Increase Exercise Outcome Expectations among Breast Cancer Survivors

5.1 Introduction

Regular aerobic exercise is associated with many positive outcomes for breast cancer survivors including decreased recurrence risk of 20-50% (X. Chen et al., 2011; Holmes et al., 2005; Ibrahim & Al-Homaidh, 2011; P. D. Loprinzi et al., 2012; Sternfeld et al., 2009), cancer-specific mortality of 50-53%, all-cause mortality of 24-67% (Eyigor & Kanyilmaz, 2014) and improved quality of life (P. D. Loprinzi & Lee, 2014). Exercise is also an effective self-management strategy for late and long-term treatment side effects including decreased cardiorespiratory function (Fong et al., 2012; Jones et al., 2011; 2012; McNeely et al., 2006; Speck et al., 2010), decreased bone strength (Winters-Stone et al., 2010), decreased physical function (Fong et al., 2012; McNeely et al., 2006; Spence et al., 2010), increased weight (Baumann et al., 2013; Fong et al., 2012; Jones et al., 2012; Speck et al., 2010), pain (Craft et al., 2012), and fatigue (Cramp & Byron-Daniel, 2012b).

Additionally, exercise positively impacts sleep quality (Mishra et al., 2012); anxiety (Mishra et al., 2012); depression (Craft et al., 2012; Duijts et al., 2011; Fong et al., 2012; Jones et al., 2012; Mishra et al., 2012); mood disturbances (Speck et al., 2010; Spence et al., 2010); self-esteem/body image (Duijts et al., 2011; Mishra et al., 2012; Speck et al., 2010); social functioning (Fong et al., 2012; Mishra et al., 2012); emotional well-being (Mishra et al., 2012); sexuality (Mishra et al., 2012); and cognitive function (Fong et al., 2012; Mohammadi et al., 2013; Speck et al., 2010) for breast cancer survivors.
The American Cancer Society (ACS) and the American College of Sports Medicine (ACSM) recommend that cancer survivors engage in 150 weekly minutes of moderate-intensity or 75 weekly minutes of strenuous-intensity aerobic exercise, or an equal combination of the two (Rock, Doyle, Demark-Wahnefried, Meyerhardt, Courneya, SCHWARTZ, Bandera, Hamilton, Grant, McCullough, Byers, & Gansler, 2012a; Schmitz et al., 2010). Despite the many benefits of exercise, only 16-37% (Blanchard et al., 2008; Smith & Chagpar, 2010) of the 2.8 million breast cancer survivors in the U.S. adhere to the national exercise guidelines for cancer survivors. Among survivors who did exercise regularly pre-diagnosis, exercise levels decrease during and after adjuvant therapy (Bock et al., 2013; Pinto et al., 2002). Interventions are needed to increase levels of exercise among this population.

Potentially powerful interventions may be those that focus on exercise outcome expectations (OEs). OEs refer to what people expect to obtain or avoid by engaging in a behavior (Bandura, 2004). People exercise because they believe it will produce desired and avoid undesired outcomes. According to several prominent health behavior change theories, high OEs lead to behavior change (Ajzen, 1991; Bandura, 2004; Prochaska et al., 2002). Among non-cancer populations, individuals who expect more positive and less negative outcomes of exercise have stronger intentions to exercise and exercise more (Brassington et al., 2002; Schutzer & Graves, 2004). Yet, little is known about how OEs influence exercise among breast cancer survivors. Two studies that increased exercise among breast cancer survivors manipulated OEs by emailing participants “realistic
expectations of exercise” (Hatchett et al., 2013) and “addressing” OEs during counseling sessions. This suggests that targeting OEs is effective for this group. However, these interventions targeted several constructs; thus the unique effects of OEs on exercise remain unknown. Further, no interventions have targeted all the dimensions of OEs. Dimensions of OEs include 1) importance – value placed on the outcome(s); 2) certainty – perceived probability outcome(s) will occur; and 3) accessibility – the frequency with which outcome(s) are considered (Gross et al., 1995; Olson et al., 1996; Petty & Krosnick, 2014).

Breast cancer survivors have low OEs of exercise impacting recurrence and mortality risk (Karvinen & Vallance, 2015). In one study, only 30% of survivors said they thought exercise may decrease recurrence risk (Hirschey, Docherty, Pan, & Lipkus, 2016a). However, survivors are motivated to change behaviors they believe will improve their long-term outcomes and quality of life (O’Neill et al., 2013). Thus, increasing OEs may be effective to motivate exercise among breast cancer survivors.

The primary aim of this randomized controlled trial is to explore feasibility and fidelity of an intervention to increase exercise OEs among breast cancer survivors. A secondary aim is to test intervention effects on the primary outcome of interest, OEs, as well as effects on exercise, a secondary outcome of interest. The secondary aim tests two hypotheses: first, that OE importance, certainty, and accessibility will increase more in the intervention compared to the attention control arm; secondly, that exercise will increase more in the OE arm than the attention control arm.
5.2 Theoretical Framework

The theoretical framework guiding this study (Figure 4) is based on evidence that exercise increases when breast cancer survivors 1) expect desired outcomes will ensue (Bandura, 2004; Hatchett et al., 2013; Rogers et al., 2009; 2013), and 2) believe they can perform exercise (i.e., have high exercise self-efficacy) (Bandura, 2004; P. D. Loprinzi & Cardinal, 2013). This framework proposes that self-efficacy and OEs increase exercise intentions (the most proximal predictor of behavior) (Aizen, 1991; Scholz et al., 2009) and exercise. This study tests intervention effects on OEs, exercise intentions and exercise, while controlling for self-efficacy. This study is a preliminary test of intervention effects (indicated with black arrows). This is the first step for a future larger study adequately powered to test the full model, including direct and meditational relationships between OEs, exercise intentions and exercise (indicated with grey arrows).

Figure 4 Intervention Theoretical Framework
5.3 Methods

5.3.1 Study design

This feasibility study is a randomized two-arm trial. Participants had one week to complete a self-directed, home-based intervention. Follow-up measures were collected at 4-, 8-, and 12-weeks post intervention. A thank you card including a study update was sent to participants one week prior to each measure-completion time point. The Consolidating Standards of Reporting Clinical Trials guidelines were used to conduct and report this study (Moher et al., 2010). This study is registered with Clinical.Trials.gov and was approved by Duke University Medical Center’s Cancer Protocol Committee and Internal Review Board (Protocol #00059469).

5.2.2 Participants and setting

This study was conducted from April through November 2016. Inclusion criteria consisted of: 1) stage 1A – 2B breast cancer diagnosis; 2) being 2 months – 10 years status post-surgery, radiation and chemotherapy; 3) ability to read and write English; 4) no evidence of recurrence; 5) being inactive (self-reported ≤ 150 min/wk moderate – strenuous-intensity exercise); 6) no contradictions to exercise based on the Physical Activity Readiness Questionnaire (PAR-Q) (Thomas, Reading, & Shephard, 1992); 7) approval for participation by an oncologic provider; 8) access and ability to use a computer for completion of online measures; and 9) possession of a smartphone. Participants were recruited in person and via mail at a tertiary cancer center in the southeastern United States. Potential subjects were identified by medical chart review.
and then either introduced to a researcher by an oncologic provider, at the time of a
regularly scheduled visit, or mailed a study invitation packet.

5.3.3 Random assignment

A randomization table was created in excel and uploaded into REDCap (Harris
et al., 2009). After the researcher entered screening data, each participant was randomly
assigned with equal probability to the attention control or intervention arm. The
research assistant who oriented patients to the study and facilitated data collection was
blinded. To reduce performance bias among participants, the study was introduced as
being about important lifestyle information. Participants were told they would receive
diet and exercise information and be randomly assigned to a group focused more on
exercise or more on diet.

5.3.4 Intervention

The intervention is described in detail in chapter four of this dissertation. Briefly,
the intervention consists of a researcher-created exercise OE booklet containing narrative
messages, writing and thinking activities intended to increase OE dimensions of
importance, certainty, and accessibility. The booklet provides a global overview of the
many and diverse positive outcomes breast cancer survivors may experience from
exercise. To increase OE importance, a participant is instructed to select the three
outcomes that she would most like to experience and then reflect on and write about
why it is personally important for her to experience each outcome. To increase OE
certainty, the booklet also contains three narrative messages (two from breast cancer
survivors who exercise regularly and one from an oncologist). Each survivor narrative is a few paragraphs long, written in first-person and includes a photograph of the author. The survivor narratives summarize the woman’s personal story of: 1) cancer treatments and side effects she experiences/ed; and 2) outcomes obtained as a result of exercise and how achieving these outcomes helped her manage symptoms (e.g., stress, pain). The oncologist’s narrative contains: 1) her personal recommendation for breast cancer survivors to exercise; and 2) outcomes she believes survivors may obtain, based upon current research. Finally, to increase OE accessibility, the booklet instructs participants to identify at least three strategies to help them think about outcomes they may experience if they exercise regularly.

5.3.5 Attention control arm

The attention control arm received a similar booklet focused on diet instead of exercise. The diet booklet included one oncologist and one survivor narrative, created by the research team. Both arms were also given the American Cancer Society’s diet and exercise recommendations for cancer survivors.

5.3.6 Measures

Demographic data was collected by medical chart review and participant interview. Outcome data was collected through online surveys and a waistband accelerometer, Fitbit®.
5.3.6.1 Primary aim - feasibility

Recruitment and retainment of participants, use of Fitbit® as an objective exercise measure, and intervention booklet fidelity were explored to assess feasibility. The number of potential participants approached, reasons for ineligibility, or declining participation and completion of measures at each time point was documented to assess recruitment and retention. Notes detailing communication with participants and data from Fitbit® accounts was collected to assess feasibility of using Fitbit® as an objective exercise measure. To evaluate intervention fidelity, the research team constructed 9 quantitative (Table 7) and 5 qualitative (Table B) questions that were included in 4-week post-intervention measures for the intervention arm.
Table 7: Quantitative Feasibility Questions, Mean Scores and Correlations with OE Measures at Week Four Post-intervention.

<table>
<thead>
<tr>
<th>Question / targeted dimension</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How much did the pamphlet make you think about how the benefits of exercise may apply to you as a cancer survivor?</td>
<td>21</td>
<td>3.57</td>
<td>1.08</td>
<td></td>
</tr>
<tr>
<td>2. How much did the pamphlet make you think about why the benefits of exercise are personally important for you? / Importance</td>
<td>22</td>
<td>3.68</td>
<td>1.17</td>
<td>0.49</td>
</tr>
<tr>
<td>3. How much did at least one of the survivor’s stories resemble your own experience with breast cancer treatment and side effects?</td>
<td>22</td>
<td>2.50</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td>4. How much did both of the survivors’ stories resemble your own experience with breast cancer treatment and side effects?</td>
<td>22</td>
<td>2.27</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td>5. How much did at least one women’s’ stories make you feel that if you exercise you will experience benefits? / Certainty</td>
<td>21</td>
<td>3.43</td>
<td>1.33</td>
<td>0.27</td>
</tr>
<tr>
<td>6. How much did the survivor’s stories make you believe that you can exercise for at least 150 minutes per week at a moderate to strenuous intensity?</td>
<td>22</td>
<td>3.45</td>
<td>1.18</td>
<td></td>
</tr>
<tr>
<td>7. How much did the oncologist’s story make you feel that if you exercise you will experience benefits? / Certainty</td>
<td>22</td>
<td>3.86</td>
<td>1.13</td>
<td>0.06</td>
</tr>
<tr>
<td>8. How much did the oncologist’s story make you believe that you can exercise for at least 150 minutes per week at a moderate to strenuous intensity?</td>
<td>22</td>
<td>3.59</td>
<td>1.22</td>
<td></td>
</tr>
<tr>
<td>9. How much did the pamphlet increase how often you think about the reasons you want to exercise? / Accessibility</td>
<td>22</td>
<td>2.95</td>
<td>1.13</td>
<td>-0.06</td>
</tr>
<tr>
<td>Average of above nine items</td>
<td>3.31</td>
<td>0.87</td>
<td>0.52</td>
<td></td>
</tr>
</tbody>
</table>

Note. Likert Scale Rating 1 = Not much, 2 = A little, 3 = Somewhat, 4 = Much, 5 = A great deal. r = the correlation between the feasibility question and the mean score of the OE dimension the respective intervention booklet section targets.
Table 8: Qualitative Feasibility Questions and Major Themes from Participants’ Answers

<table>
<thead>
<tr>
<th>Question</th>
<th>Common Themes</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Please write the parts of the stories that you most related to or that you found most memorable.</td>
<td>Narrator’s exercise mode, frequency and/or duration (n=6)</td>
<td>“Carla became a walking machine and is fanatical about walking 15,000 steps a day.”</td>
</tr>
<tr>
<td></td>
<td>Relating to cancer/treatment experience (n=3)</td>
<td>“I was glad to read that one of the survivors had the same effect from tamoxifen.”</td>
</tr>
<tr>
<td></td>
<td>Shared emotions (n=4)</td>
<td>“How scared having breast cancer makes you feel.”</td>
</tr>
<tr>
<td></td>
<td>Inspiration (n=5)</td>
<td>“You don’t realize that you have the power to make it until you hear someone else’s testimony.”</td>
</tr>
<tr>
<td>2. What did you do, if anything, that helped you think more often and remember your reasons to exercise?</td>
<td>Examples of strategies used (i.e., meditation, email, calendar, phone reminder) (n=4)</td>
<td>“Chose a sentence on exercise decreasing recurrence to email me and post on my google calendar.”</td>
</tr>
<tr>
<td></td>
<td>Described current exercise (n = 10)</td>
<td>“Meditate about wanting to exercise.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I started back walking my dog, exercising at the Senior Center.”</td>
</tr>
<tr>
<td>3. What did you find most useful about the booklet?</td>
<td>Narrative stories (n=13)</td>
<td>“That there were people like me with breast cancer and it made it feel like there was hope for me.”</td>
</tr>
<tr>
<td></td>
<td>Information (n=6)</td>
<td>“There was a lot of good information that made me think about what I should be doing.”</td>
</tr>
<tr>
<td>4. What did you find least useful about the booklet?</td>
<td>Easier experience than narrator (n=2)</td>
<td>“It seemed like the survivors had a cancer more serious than mine. It was harder for me to relate to their stories.”</td>
</tr>
<tr>
<td></td>
<td>Nothing (n=5)</td>
<td>“Nothing—it was really good information.”</td>
</tr>
<tr>
<td>5. Please write any additional thoughts or comments you have about this booklet.</td>
<td>Should include nutrition more (n=2).</td>
<td>“A bit more emphasis on what to eat. In my head that is more important than exercise.”</td>
</tr>
<tr>
<td></td>
<td>Positive feedback (n=4)</td>
<td>“I thought the pamphlet was very well written and covered a great deal that a cancer survivor needs to know, and realize that other people share the same emotions!”</td>
</tr>
</tbody>
</table>

5.3.6.2 Outcome Expectations (OEs)

OEs were measured using the multidimensional exercise OE measure for breast cancer survivors that is detailed in chapter three of this dissertation. This measure assesses the dimensions of accessibility, certainty and importance of 20 items that are possible outcomes of exercise specific to breast cancer survivors, such as decreased recurrence risk. As detailed in chapter three, in a sample of 73 breast cancer survivors
the importance and accessibility measures demonstrated excellent reliability ($\alpha .96 - \alpha .97$) and stability over a four-week time period ($r_s = 0.638 - 0.742$). The certainty measure was not pilot tested because its anchors and Likert scale values are similar to other reliable OE measures (Resnick et al., 2000; Wójcicki, White, & McAuley, 2009) and the research team sought to decrease participant burden by minimizing the number of questions asked to participants.

5.3.6.3 Exercise

Exercise was measured objectively and subjectively. Exercise intentions were also measured because, theoretically, they are proximal to exercise.

5.3.6.3.1 Intentions

Exercise intentions were measured with Likert scale responses to three questions:
1) How motivated are you to exercise regularly over the next month? 1=extremely unmotivated – 7=extremely motivated; 2) I intend to do everything I can to exercise regularly over the next month 1=strongly disagree – 7 strongly agree; and 3) How committed are you to exercise regularly over the next month? 1= extremely uncommitted – 7= strongly committed. These questions have previously shown excellent validity ($\alpha 0.87$) in a sample of colorectal cancer survivors (Hirschey, Lipkus, Jones, Demark-Wahnefried, & Sloane, 2013).

5.3.6.3.2 Subjective exercise

Self-reported exercise was measured using two modified versions of the Godin Leisure-Time Exercise Questionnaire (GLTEQ) (Godin, 2011). The measure demonstrates
59% specificity and 75% sensitivity among breast cancer survivors (Amireault, Godin, Lacombe, & Sabiston, 2015). The GLTEQ assesses the average weekly frequency and minutes of vigorous, moderate and mild intensity exercise over the previous 4 weeks. Average weekly number of sessions of vigorous, moderate, and mild intensity exercise are multiplied by 9, 5 and 3 respectively to create a Leisure Score Index (LSI). The LSI does not account for exercise duration, thus a modified (mGodin) score was created to weight exercise intensity and account for exercise duration ((vigorous sessions * vigorous minutes * 9) + (moderate sessions * moderate minutes * 5)). Exercise recommendations for breast cancer survivors do not include mild intensity, thus were not included in the calculation. As a second, unweighted subjective measure, average total weekly minutes of moderate and strenuous intensity were also calculated.

### 5.3.6.3.3 Objective exercise

Participants were mailed a Fitbit® that had been registered with an account on fitbit.com and was ready for use. They were also sent printed instructions to sync the Fitbit® to their smartphones. Syncing was necessary for the research team to obtain data through the Fitbit® account. A blinded research assistant set up Fitbit® accounts and, if needed, called each participant to assist with Fitbit® setup and use. Participants who had existing Fitbit® accounts and Fitbits were allowed to use them and provided the study team with their Fitbit® password for data acquisition. Participants wore the Fitbit® for two weeks to establish baseline exercise level. The baseline Fitbit® measurement was calculated as an average of two weeks. The researcher logged into
each Fitbit® account to gather step data. Fitbit® data was considered missing and not included for any week with <50% data (i.e., 4 or more days missing). For weeks with > 50% data that had a zero-step count for 1-3 days, the daily average step count was computed and then multiplied by 7 to obtain a weekly total to be used in analyses.

Fitbit® has demonstrated good reliability and validity for monitoring over-ground energy expenditure (Adam Noah, Spierer, Gu, & Bronner, 2013). For step count outputs compared to research observer counts, concordance = 0.97–1.00 and inter-device reliability of the step count at all walking speeds = ICC ≥ 0.95 (Takacs et al., 2013).

Participants were allowed to keep the Fitbit® as a compensation for their time.

5.4 Analyses

5.4.1 Data cleaning and preparation

Data were reviewed for outliers and missing values. Outliers were defined as any value more than three standard deviations higher or lower than the respective mean. The sample size is adequate for analyses, but not large enough to be robust to outliers. Thus, outliers (0.02%) were recoded to equal the next highest or lowest value within 3 standard deviations of the mean. In the data, within-wave and between-wave missing data exist. Between-wave missing data was accounted for through analyses with Proc Mixed in SAS. Missing data imputation was done for within-wave missing data. First, Little’s (1988) missing completely at random (MCAR) test was conducted using SPSS version 24 to assess if missing data were MCAR for each time point. All tests indicated that missing data were MCAR (baseline $\chi^2 = 744.590, p = 1.00$; week 4 $\chi^2 =$
244.159, \( p = 1.000 \); week 8 \( \chi^2 = 412.123, p = 1.00 \); week 12 \( \chi^2 = 443.169, p = 1.00 \), thus an expectation–maximization (EM) algorithm was used in SPSS to impute the missing data. The EM algorithm imputes missing values by alternating between computing probabilities for possible values (expectation step), based on existing data, and then re-estimating the probabilities given each imputed data point (maximization step). This process continues until data converges and a value is selected (Do & Batzoglou, 2008).

Baseline demographic variables were compared between the intervention and control arms using \( t \)-tests for continuous variables and chi-square tests for categorical variables (see Table 9). Statistically significant differences were noted between arms for race, time since surgery, and time since chemotherapy. Surgery and chemotherapy occur at a similar time and are redundant, thus both do not need to be controlled for. All participants had a cancer-related surgery, however, not all participants had chemotherapy. Thus, time since surgery and race were controlled for in all analyses.

**Table 9: Participant Demographics by Intervention vs. Control Group and by Study Completers vs. Drop Outs**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention (n= 29)</th>
<th>Control (n= 29)</th>
<th>Drop out (n= 20)</th>
<th>Completer (n= 38)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Age (years)</td>
<td>59</td>
<td>10</td>
<td>57</td>
<td>12</td>
</tr>
<tr>
<td>Months since cancer related surgery*</td>
<td>30*</td>
<td>24</td>
<td>44*</td>
<td>29</td>
</tr>
<tr>
<td>Months since chemotherapy* n=28</td>
<td>22*</td>
<td>12</td>
<td>51*</td>
<td>26</td>
</tr>
<tr>
<td>Months since radiation n=46</td>
<td>26</td>
<td>25</td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>Number of days Fitbit was not worn in the study (participants whose Fitbit data was)</td>
<td>26</td>
<td>12</td>
<td>33</td>
<td>16</td>
</tr>
<tr>
<td>Characteristic</td>
<td>N (%)</td>
<td>N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>-------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. African American or Black</td>
<td>11 (19%)</td>
<td>4 (7%)</td>
<td>8 (40%)</td>
<td>7 (18.42%)</td>
</tr>
<tr>
<td>2. White or Caucasian</td>
<td>18 (31%)</td>
<td>25 (43%)</td>
<td>12 (60%)</td>
<td>31 (81.58%)</td>
</tr>
</tbody>
</table>

| Employment                                         |       |       |
| Unemployed                                         | 2 (6.8%) | 0 (0%) | 1 (5%) | 1 (2.63%) |
| Work part time                                     | 4 (13.7%) | 1 (3.4%) | 2 (10%) | 3 (7.89%) |
| Work full time                                     | 10 (34.4%) | 14 (48.2%) | 9 (45%) | 15 (39.47%) |
| Retired                                            | 11 (37.9%) | 12 (41.3%) | 8 (40%) | 15 (39.47%) |
| Homemaker                                          | 1 (3.4%) | 1 (3.4%) | 0 (0%) | 2 (5.26%) |
| Other                                              | 1 (3.4%) | 1 (3.4%) | 0 (0%) | 2 (5.26%) |
| Has health insurance                               | 28 (97%) | 29 (100%) | 20 (100%) | 37 (97.37%) |

| Marital Status                                     |       |       |
| Single, never married                              | 3 (10.3%) | 3 (10.3%) | 3 (15%) | 3 (7.89%) |
| Married or domestic partnership                     | 17 (58.6%) | 23 (79.3%) | 10 (50%) | 30 (78.95%) |
| Widowed                                            | 3 (10.3%) | 1 (3.4%) | 2 (10%) | 2 (5.26%) |
| Divorced                                           | 4 (13.7%) | 2 (6.8%) | 3 (15%) | 3 (7.89%) |
| Separated                                          | 2 (6.8%) | 0 (0%) | 2 (10%) | 0 (0%) |

| Cancer stage                                       |       |       |
| Ia                                                 | 14 (48.2%) | 11 (37.9%) | 8 (40%) | 17 (44.74%) |
| Ib                                                 | 1 (3.4%) | 2 (6.8%) | 1 (5%) | 2 (5.26%) |
| Ila                                                | 10 (34.4%) | 11 (37.9%) | 8 (40%) | 13 (34.21%) |
| Iib                                                | 4 (13.7%) | 5 (17.2%) | 3 (15%) | 6 (15.79%) |

| Surgery type                                       |       |       |
| Mastectomy                                         | 10 (34.4%) | 9 (31%) | 6 (30%) | 12 (32.58%) |
| Partial mastectomy                                 | 0 (0%) | 4 (13.7%) | 1 (5%) | 3 (7.89%) |
| Lumpectomy                                         | 21 (72.4%) | 16 (55.1%) | 13 (65%) | 23 (65.52%) |

| Wearable device prior to study                      |       |       |
| Fitbit                                             | 6 (20.6%) | 12 (41.3%) | 4 (20%) | 9 (23.68%) |
Assumptions of mixed models were tested. There is a lineal relationship between all variables. Non-normality exists for OE certainty, OE importance, exercise intentions, weekly exercise minutes, the modified Godin, and weekly steps. Thus, a residual analysis was conducted to test the mixed models assumption that residuals are normally distributed. The raw residuals histograms show symmetric bell curve distributions (see Figure 5) and indicate sufficient data normality to satisfy the assumption. Further, the restricted maximum likelihood estimation method that was used in the mixed models analyses is robust to non-normality (Fung & Xu, 2010).

* indicates p<0.05

![Figure 5: Residuals of Non-normally Distributed Outcomes](image-url)
5.4.2 Feasibility

Descriptive statistics were conducted to assess participant recruitment and retention at each time point. Notes detailing Fitbit®-related interactions between the research team and participants were reviewed to identify common themes about Fitbit® set up and use. Means and standard deviations were calculated for the quantitative fidelity questions. Qualitative fidelity data were examined to identify reasons for low scores (defined a priori as ≤ 2.0 in a 5-point Likert scale) and common themes that inform the extent to which participants understood, completed and found the intervention booklet useful.

5.4.3 Intervention effects

Two-level multilevel modeling was done using Proc Mixed in SAS version 9.4. In the level-1 model, outcomes were modeled as a linear function of time (baseline, 4-, 8-, and 12-weeks post intervention) to create growth trends. In the level-2 model, the growth trends were modeled as a linear function of arm (intervention vs. control). Week, arm, and the interaction of arm and week were included in all models. Three covariates were added to the model one at a time to assess for significance. The covariates include race and time since surgery, which significantly differed between arms at baseline, and self-efficacy, which is a potentially significant covariate, based on our theoretical framework. Next, three way interactions of week, arm, and each covariate were included in the model one at a time. For each outcome, a model was built that contained week, arm, the interaction of week and arm and any significant covariates, two-way or three-
way interactions. Non-significant items except arm, week, and the interaction of arm and week were removed one at a time until a final parsimonious model was achieved. Models were constructed for primary and secondary outcomes of interest including OEs, exercise intentions, subjective exercise, and objective exercise. For OEs, the average of all dimensions was modeled. The OE measure used in this study demonstrates good discriminant validity, as detailed in chapter three of this dissertation, indicating that the dimensions are related yet distinct. Therefore, each dimension was modeled individually to determine if intervention effects differed between OE dimensions. The level of significance was set at 0.05, two-tailed. Effect sizes were calculated by dividing each beta coefficient by the square route or residual error variance for each outcome. This value is interpreted similar to Cohen’s d in which a small effect is 0.2, a medium effect is 0.5 and a large effect is 0.8 (Cohen, 1988).

### 5.4.4 Sample size

The focus of this feasibility study is to examine the strength and direction of intervention effects, thus 60 participants were recruited.

### 5.5 Results

#### 5.5.1 Sample characteristics

The sample was an average of 58 years old, 74% white and 26% black. About 1/3 were retired and about 1/3 worked full time. Most participants were married. Most had previously had a lumpectomy, about 1/3 had a total mastectomy and about half had chemotherapy and/or radiation. On average, participants were 2.5 years post cancer
treatment at the time of the study. Roughly 1/3 of participants were taking an aromatase inhibitor or selective estrogen receptor modulator. Participant demographics are detailed in Table 9.

5.5.2 Feasibility, primary aim results

5.5.2.1 Recruitment and retainment - flow of participants

One hundred and eighty-one participants were assessed for eligibility. Target enrollment of 60 participants took 17 weeks. Roughly half were approached in the clinic and half were mailed study invitation packets. During the recruitment period, a researcher was in the clinic for an average of 3 days a week for 6 hours a day, for a total of 42 days or 252 hours. Most n=49 participants were recruited in the clinic, 10 through mail and one participant contacted the research team and asked to be included. Sixty participants consented and were randomized. One participant from each arm withdrew prior to baseline data completion. One withdrew because she did not like wearing the waistband Fitbit® and the second for a reason unknown to the study team. Data completion rates at baseline, 4, 8, and 12 weeks post intervention were 78%, 74%, 74% and 66%, respectively. Several participants notified the research about difficulty beginning the online surveys. The research team realized that some participants were confused by the survey starter screen because it required participants to click in two places (see Figure 6). The team subsequently printed this image and reviewed it with participants at the time of enrollment. The screen shot was also sent to all participants who did not complete online measures. Overall attrition was 34%. Study flow is detailed
in Figure 7. Demographic and baseline measure differences between completers and drop outs are presented in Table 9. The only significant differences were height and researcher ability to obtain Fitbit® data. Specifically, the research team was only able to obtain Fitbit® data for 35% (n=7) of drop outs, compared to 74% (n=28) of study completers ($x^2 = 8.1943$, df 1, $p=0.0042$).

![Online Survey Start Screen](image)

**Figure 6: Online Survey Start Screen**
Figure 7: Study Flow Diagram

5.5.2.2 Use of Fitbit® an objective exercise measure.

5.5.2.2.1 Syncing to smartphone

Twelve participants had existing Fitbit® accounts and used their own Fitbit®, if they preferred. Ninety two percent (n=11) of these participants provided their password so the study team could obtain step data. One participant planned to reset her password and send it to the researcher, but never did.
Fifteen (26%) participants synced the Fitbit® to their smartphone with no reported problems or assistance. Per participant request, a researcher synced the Fitbit® for one person in the clinic, after consent. Two participants stated they would have their husband help and one said she would ask a co-worker. The research assistant helped four participants with syncing over the phone. She instructed them to turn their Bluetooth off and back on and take the Fitbit® battery out and put it back in; this worked for three participants. The research assistant helped the fourth participant, who had difficulty, to reset her password.

Fitbit® data was not obtained for 23 participants. The researcher was not able to login to eleven of these accounts, indicating that either the login information documented by the research assistant was incorrect or the participant changed her password. The researcher was able to successfully contact only two of these participants. The researcher asked them to reset their password, however, the participants never provided an updated password to the study team. The researcher was able to log into 12 accounts, however, no device was paired indicating the participants never successfully synced the Fitbit® to their smartphone. Of note, three of these women planned to have their children help. The researcher attempted to contact all participants to assist with syncing. Only two participants were successfully contacted. One indicated that although she thought she had a smartphone, her daughter informed her she did not and thus could not sync the Fitbit®. The other told the researcher she was not able to sync the Fitbit® and did not accept the researcher’s offer to help.
Ultimately, as detailed in Table 10, Fitbit® data was obtained for 60% of participants (n=35). There were no significant differences in race, age, time since treatment, employment status, marital status, weight, baseline self-reported exercise, intentions or self-efficacy between participants whose Fitbit® data was obtained and those not obtained.

**Table 10: Information Regarding Researcher’s Access to Fitbit® Data**

<table>
<thead>
<tr>
<th>Potential reasons contributing to researcher’s ability to access Fitbit® data.</th>
<th>Fitbit data obtained N=35</th>
<th>Fitbit data not obtained N=23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Had existing account and gave research team password</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Family or friends helped with syncing</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Set up independently</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Researcher assisted with syncing</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Had existing account and did not give research team password</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Planned to have children help with syncing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Researcher not able to access account</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>No device set up in Fb acct</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

**5.4.2.2 Fitbit® use**

Participants were expected to wear the Fitbit® for 105 days, including the two-week baseline period, intervention week and twelve weeks post intervention. On average participants wore it 71% of the days expected (mean=75 days, SD 30). During the course of the study the researcher team was contacted by study participants regarding the Fitbit® 22 times. Questions about Fitbit® settings (n=4) and syncing problems (n=2) were resolved via telephone by the research team. Syncing problems were fixed by instructing the participant to remove and re-insert the battery and turn Bluetooth on and off on their phone. Participants who reported never receiving a Fitbit®
(n=3) and those that were damaged or stopped working (n=2) were sent a replacement. Lost Fitbits (n=3) were not replaced, however, two women chose to replace them on their own. Although the Fitbit® battery should last 4-6 months, according to manufacturer information, four participants notified research team that the Fitbit® displayed “low battery,” A replacement battery was sent to these participants. Two participants notified the researcher that they did not like the waistband Fitbit®. One indicated that she wears dresses often and using the Fitbit® was not convenient and was too much to think about. For this reason, she withdrew from the study. The other said she spends a lot of time at the lake and pool and it was hard to keep it dry. Three participants contacted the researcher to tell her how much they loved their Fitbit®. One said she synced it to her fitness pal, where she has been tracking her diet for months and another said she was so excited to start wearing it to softball. The third simply said she loved it.

5.5.2.3 Intervention workbook fidelity

Twenty-two intervention participants completed week four follow-up measures and reported completing ¾ of the intervention booklet. Thirty eight percent (n=11) of the intervention arm participants returned the intervention booklet to the research team, all were 100% complete. As detailed in Table 7, across the nine quantitative fidelity questions, the mean score is 3.31 (SD = 0.87), which equals “a little” on the Likert Scale ratings.
Qualitative data revealed positive general feedback and that most participants thought that everything in the pamphlet was useful. Most participants felt the narrative stories were the most useful part of the pamphlet. The most memorable parts of the stories were: 1) exercise details, feeling inspired, emotions experienced from cancer and relating to the cancer or treatment experience. Participants were asked the strategies they used to think more often about reasons they want to exercise, however most did not answer this question. Rather, most participants replied to this question with descriptions of the exercise routine they are trying to adhere to. Examples of participant answers are in Table 8.

There were no a priori low quantitative scores for any of the fidelity questions. However, due to the exploratory nature of this study, the lowest qualitative data across all questions was examined to understand parts of the intervention that could be improved. There were only three fidelity questions with scores less than three, including 1. “How much did at least one of the survivor’s stories resemble your own experience with breast cancer treatment and side effects?”; 2. “How much did both of the survivors’ stories resemble your own experience with breast cancer treatment and side effects?”; and 3. “How much did the pamphlet increase how often you think about the reasons you want to exercise?”

There were two aspects that some participants did not relate to in the narrators’ stories. First, as described above, some participants (n=2) felt their cancer experience was not as bad as the narrators. Additionally, some participants (n=2) felt that comparatively,
the narrators did far more exercise than they could do. For example, one said “Kick boxing. I was too weak to lift my head and she was kick boxing.”

The mean score for how much the pamphlet made participants think more often about the reasons they want to exercise is 2.95, where 2= “a little” and 3 = “somewhat”. The qualitative data supports this score as the majority of participants did not give examples of strategies they used to think about their reasons for exercise. Rather, most described what they are trying to do for exercise.

5.5.3 Intervention effects on OEs and exercise, secondary aim results

Cronbach’s alpha (α) was calculated using this sample for all measures and all had good to excellent reliability, as detailed in Table 11, along with mean scores and standard deviations for all theoretical model constructs. Over time, little variation is observed in OE scores as they ranged from 3.32 to 4.32 at baseline and 3.37 to 4.42 at 12 weeks, in the intervention group. More obvious changes are noted for exercise. Weekly minutes of exercise and weekly steps increased over time in the intervention group from 87 and 36450, at baseline to 151 and 43868, respectively.

### Table 11: Outcome Means and Measure Reliability at Each Time Point

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>4 Week Post Intervention</th>
<th>8 Week Post Intervention</th>
<th>12 Week Post Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Overall OEs</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>OE Accessibility</td>
<td>3.86 (0.38)</td>
<td>3.89 (0.51)</td>
<td>3.78 (0.49)</td>
<td>3.70 (0.40)</td>
</tr>
<tr>
<td></td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>OE Importance</td>
<td>3.32 (0.57)</td>
<td>3.20 (0.91)</td>
<td>3.07 (0.67)</td>
<td>2.28 (0.64)</td>
</tr>
<tr>
<td></td>
<td>0.95</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>OE Certainty</td>
<td>4.32 (0.44)</td>
<td>4.40 (0.47)</td>
<td>4.21 (0.52)</td>
<td>4.16 (0.53)</td>
</tr>
<tr>
<td></td>
<td>0.95</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>Exercise Intentions</td>
<td>3.94 (0.58)</td>
<td>4.08 (0.40)</td>
<td>4.07 (0.51)</td>
<td>4.13 (0.46)</td>
</tr>
<tr>
<td></td>
<td>0.95</td>
<td>0.96</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td>Min/Wk</td>
<td>6.04 (0.72)</td>
<td>6.10 (0.89)</td>
<td>5.34 (1.12)</td>
<td>5.28 (0.89)</td>
</tr>
<tr>
<td></td>
<td>0.86</td>
<td>0.82</td>
<td>0.82</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>108</td>
<td>70</td>
<td>69</td>
</tr>
</tbody>
</table>
The percent of variation due to individuals and time was examined using unconditional means and growth models and is summarized in Table 13. Intraclass correlations ranged from 28% - 64%. Zero to 16% of within participant variation in outcomes is explained by linear time and further detailed through mixed models results.

Table 12: Percent Variation Attributable to Individuals and Time

<table>
<thead>
<tr>
<th></th>
<th>% Total variation attributable to differences among participants (Intraclass correlation)</th>
<th>% Total variation attributable to linear time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall OEs</td>
<td>64%</td>
<td>0.2%</td>
</tr>
<tr>
<td>OE Accessibility</td>
<td>60%</td>
<td>0%</td>
</tr>
<tr>
<td>OE Certainty</td>
<td>45%</td>
<td>16%</td>
</tr>
<tr>
<td>OE Importance</td>
<td>48%</td>
<td>3%</td>
</tr>
<tr>
<td>Exercise Intentions</td>
<td>28%</td>
<td>0%</td>
</tr>
<tr>
<td>Minutes per week</td>
<td>38%</td>
<td>11%</td>
</tr>
<tr>
<td>mGodin</td>
<td>43%</td>
<td>13%</td>
</tr>
<tr>
<td>Steps</td>
<td>33%</td>
<td>1%</td>
</tr>
</tbody>
</table>

5.4.3.1 Intervention effects on OEs (primary outcome, hypothesis one)

The final models for OEs contain arm, week, the interaction of arm by week and any other significant covariates and interactions (see Table 13). Overall OEs, OE accessibility, certainty and importance all increased 0.01 points every four weeks in the intervention arm compared to the control arm \(p = 0.3555\), \(p = 0.6578\), \(p = 0.5026\), \(p = 0.0002\). All effect sizes are small, ranging from 0.01 – 0.09. Hypothesis one, OEs will increase more in the intervention group compared to the control group, is supported,
although only statistically significant for OE importance. Consistent with the preliminary test of the OE measures, in chapter three of this dissertation, all OEs were moderately correlated (see Table 14). This again demonstrates that the dimensions are related, yet distinct.
Table 13: Final Models of Intervention Effects

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Arm</th>
<th>Week</th>
<th>Race 1=black 2=white</th>
<th>Self-efficacy</th>
<th>Time since treatment</th>
<th>Arm*week interaction</th>
<th>Week*self-efficacy interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall OEs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>0.1803</td>
<td>-0.00435</td>
<td>-0.3857*</td>
<td>0.2047*</td>
<td>-0.00504*</td>
<td>0.007419</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.09469</td>
<td>0.005686</td>
<td>0.1047</td>
<td>0.03652</td>
<td>0.001700</td>
<td>0.007996</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>0.66</td>
<td>-0.02</td>
<td>-1.42</td>
<td>0.75</td>
<td>-0.02</td>
<td>0.03</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>OE Accessibility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>0.4651*</td>
<td>-0.00724</td>
<td>-0.6720*</td>
<td>0.4776*</td>
<td>-0.00975*</td>
<td>0.005819</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.1345</td>
<td>0.009314</td>
<td>0.1511</td>
<td>0.05755</td>
<td>0.002457</td>
<td>0.01310</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>1.05</td>
<td>-0.02</td>
<td>-1.52</td>
<td>1.08</td>
<td>-0.02</td>
<td>0.01</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>OE Certainty</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>-0.01161</td>
<td>0.007500</td>
<td>-0.3474*</td>
<td>n/a</td>
<td>n/a</td>
<td>0.007274</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.1114</td>
<td>0.007648</td>
<td>0.09765</td>
<td>n/a</td>
<td>n/a</td>
<td>0.01082</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>-0.04</td>
<td>0.02</td>
<td>-1.15</td>
<td>n/a</td>
<td>n/a</td>
<td>0.02</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>OE Importance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>0.06690</td>
<td>-0.09723*</td>
<td>-0.3558*</td>
<td>-0.08997</td>
<td>n/a</td>
<td>0.009224</td>
<td>0.02918*</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.1165</td>
<td>0.02201</td>
<td>0.1033</td>
<td>0.06441</td>
<td>n/a</td>
<td>0.009685</td>
<td>0.007467</td>
</tr>
<tr>
<td>Effect Size</td>
<td>0.20</td>
<td>-0.29</td>
<td>-1.08</td>
<td>-0.27</td>
<td>n/a</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Exercise Intentions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>0.01024</td>
<td>-0.01962</td>
<td>n/a</td>
<td>0.9721*</td>
<td>n/a</td>
<td>0.009184</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.1816</td>
<td>0.01333</td>
<td>n/a</td>
<td>0.07715</td>
<td>n/a</td>
<td>0.01876</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>0.02</td>
<td>-0.03</td>
<td>n/a</td>
<td>1.52</td>
<td>n/a</td>
<td>0.01</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Weekly minutes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>-15.9501</td>
<td>-10.4679*</td>
<td>n/a</td>
<td>15.6968</td>
<td>n/a</td>
<td>2.0404</td>
<td>4.5383*</td>
</tr>
<tr>
<td>Standard Error</td>
<td>18.1657</td>
<td>4.2042</td>
<td>n/a</td>
<td>11.6075</td>
<td>n/a</td>
<td>1.8317</td>
<td>1.4233</td>
</tr>
<tr>
<td>Effect Size</td>
<td>-0.25</td>
<td>-0.17</td>
<td>n/a</td>
<td>0.25</td>
<td>n/a</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>mGodin</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High self-efficacy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>46.7370</td>
<td>27.2261*</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>9.0643</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>164.54</td>
<td>13.4111</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>18.6432</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>0.10</td>
<td>0.06</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>0.02</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Low self-efficacy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>-88.4160</td>
<td>15.7825</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>6.3318</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>133.54</td>
<td>11.8442</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>16.7515</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>-0.32</td>
<td>0.06</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>0.02</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Steps</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>-6308.11</td>
<td>-204.69</td>
<td>n/a</td>
<td>8721.46*</td>
<td>n/a</td>
<td>969.71*</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>4153.19</td>
<td>310.20</td>
<td>n/a</td>
<td>1827.16</td>
<td>n/a</td>
<td>436.60</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>-0.42</td>
<td>-0.01</td>
<td>n/a</td>
<td>0.59</td>
<td>n/a</td>
<td>0.07</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Exercise self-efficacy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate</td>
<td>-0.03376</td>
<td>0.01656</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>-0.00139</td>
<td>n/a</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.1639</td>
<td>0.01084</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>0.01524</td>
<td>n/a</td>
</tr>
<tr>
<td>Effect Size</td>
<td>-0.07</td>
<td>0.03</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>-0.00</td>
<td>n/a</td>
</tr>
</tbody>
</table>
5.5.3.2 Intervention effects on exercise (secondary outcome, hypothesis two)

The final models for exercise measures contain arm, week, the interaction of arm by week and any other significant covariates and interactions (see Table 13). Exercise intentions increased 0.01 points, every four weeks, in the intervention arm compared to the control arm (p = 0.6254). Weekly minutes of exercise increased two minutes every four weeks in the intervention arm compared to the control arm (p = 0.2676). For mGodin score, there was a significant three-way interaction between arm, week and self-efficacy in which weighted weekly minutes of exercise increased 28 minutes every four weeks per unit of higher self-efficacy. When splitting self-efficacy by its median, weighted weekly exercise increased more for intervention arm participants than control arm participants by nine weighted weekly minutes (p=0.6298) for those with higher self-efficacy and six weighted weekly minutes (p=0.7079) for those with lower self-efficacy. Finally, intervention arm participants increased their activity by 970 steps per week every four weeks compared to participants in the control arm (p = 0.0283). All effect sizes were small ranging from 0.01 to 0.07. Steps were moderately correlated with subjective exercise measures (r=0.3). Hypothesis two, exercise intentions and exercise will increase

---

**Table 14: Correlations of OE Dimensions**

<table>
<thead>
<tr>
<th></th>
<th>Importance mean 4.26</th>
<th>Certainty mean 4.10</th>
<th>Accessibility mean 3.13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance</td>
<td></td>
<td>0.56548</td>
<td>0.54618</td>
</tr>
<tr>
<td>Certainty</td>
<td></td>
<td></td>
<td>0.52057</td>
</tr>
<tr>
<td>Accessibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean 4.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean 3.13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
more in the intervention group compared to the control group, is supported, although only statistically significant for weekly steps.

5.5.4 Ancillary analyses

5.5.4.1 Trajectory of self-efficacy

Self-efficacy had significant effects on all exercise outcomes and overall OEs. Further, it is a significant construct in the theoretical model. Thus, a mixed model was constructed for self-efficacy to examine the effects of time and arm. However, the final model included only time and arm and indicated no significant self-efficacy differences between arms and no significant effects of time or arm (see table 13).

5.5.4.2 Intervention workbook fidelity and OE changes

Correlations between workbook fidelity scores and OE scores at four weeks post intervention are detailed in Table 7. The overall fidelity and OE average score is moderately – highly correlated. To further identify which parts of the workbook were most and least effective, correlations were run between each dimension and the respective question/s assessing the components of the intervention booklet intended to increase that dimension. There is a moderate correlation for OE importance, a weak correlation for OE certainty and a negative weak score for OE accessibility.

5.6 Discussion

The primary aim of this study was to determine feasibility and fidelity of a home-based, self-directed exercise intervention.
Target enrollment was achieved in seventeen weeks. This compares favorably to similar research in which it took 12 months to recruit 40 participants at clinic follow-up visits (Fields, Richardson, Hopkinson, & Fenlon, 2016) and 23 months to recruit 210 participants through the mail (Befort et al., 2014). High recruitment rates may be due to a referring nurse practitioner being part of the study team and screening patients. Additionally the primary investigator has an established working relationship with referring providers, understanding of clinic environment, and patient flow and provider preferences, all of which facilitated recruitment. In-person and mail recruitment were both successful. However, the time, necessary resources and results varied for each. For both strategies, the nurse practitioner pre-screened eligible patients as part of her routine clinic prep, adding only minutes to her work. The researcher spent an estimated 252 hours in the clinic to recruit 49 participants. In comparison it took much less time to assemble and mail 85 study invitation packets, perhaps 2 hours total. Ten participants were recruited through the mail, which equates to 6 minutes of researcher time to recruit one participant in comparison to 5 hours per participant through in-clinic recruitment. Thus, researchers must adequately budget time and salary support to achieve target study enrollment when recruiting in busy clinic settings. In the setting of limited research funding, it is imperative that researchers and clinicians collaborate in identifying efficient recruitment methods that will not disturb the priorities of medical care.
The present study had a high attrition rate (34%) compared to other home-based exercise intervention for breast cancer survivors in which attrition ranged from 13 - 20% (Lahart, Metsios, Nevill, Kitas, & Carmichael, 2016) (Pinto, Papandonatos, & Goldstein, 2013b) (Rabin, Pinto, Dunsiger, Nash, & Trask, 2009) (Pinto, Rabin, Abdow, & Papandonatos, 2008). At all time points at least 22% of participants did not complete follow-up measures. These high rates may be due in part to participant confusion about having to click two places on the survey start screen. Future studies could make instructions more clear by including screen shot instructions, showing participants how to complete online measures or providing paper measure options.

Fitbit® data was obtained for 60% of participants for an average 71% of study days. This is similar to the amount of subjective exercise data obtained through online surveys, as across all time points online measures were completed by 73% of participants. Moderate correlations between Fitbit® steps and subjective exercise, noted in this study, are consistent with other studies that have compared accelerometer data and self-report exercise among breast cancer survivors (Grossman, Deuring, Garland, Campbell, & Carlson, 2008) (Amireault, Godin, Lacombe, & Sabiston, 2015) and indicates adequate validity of using Fitbit® to measure exercise. Fitbit® could be used more effectively in future studies if researchers sync them to participants’ smartphones. If that is not possible, due to a lack of time and space, as in this study, other measures can be taken to improve Fitbit® use. Research assistants could double document login information and participants could be given instructions to contact the research team if
they change their password. To improve Fitbit® data collection, participants could be provided instructions to turn their smartphone Bluetooth off and back on and remove and reinsert their battery, if it stops syncing.

The average score for all fidelity questions (3.31) suggests the intervention materials somewhat engaged participants, as they were intended to. The qualitative data reveals that participants thought the narratives were the most useful part of the booklet. Specifically, participants connected to the experiences and emotions of the narrators and were inspired by their stories. When a person identifies with a narrator, she believes that because they are similar, she may have a similar experience (Hinyard & Kreuter, 2007; Kreuter et al., 2008). Thus, while it was anticipated that all intervention components may impact more than one OE dimension, narratives were expected to have the greatest effects on OE certainty. However, low correlations between 4-week post intervention score and the OE survivor narrative-focused feasibility question (r=.27) and oncologist narrative fidelity question (r=.06) indicate little effect. Rather, the narratives may have impacted other outcomes such as exercise self-efficacy and intentions, as they have in other studies for breast cancer survivors (Falzon, Radel, Cantor, & d'Arripe-Longueville, 2014). Further, the oncologist narrative may have impacted other outcomes more in line with other research that shows significant effects of oncologists’ recommendations on health-related decisions (Eggly et al., 2008) and exercise (Jones et al., 2004). Some participants indicated that they did not relate to parts of the narrative stories as their cancer experience seemed harder or easier. Therefore, future research may more
effectively use narratives by tailoring messages to individuals based on cancer treatment and side effects experienced.

The least useful part of the intervention booklet was the section primarily targeting OE accessibility. In this section participants were instructed to list 3 things they will do to think more often about the reasons they exercise. Among the booklets that were returned to the researcher, most participants did not follow instructions in this section. Rather than listing strategies to think about OEs, they listed the exercise plans. It is possible that this section was not effective because participants did not understand the instructions. Further, the fidelity question addressing this section is negatively, weakly correlated with the 4-week post intervention OE accessibility score indicating this section did not function as intended. Future research should identify ways to provide more clear instructions and alternative strategies to increase OE accessibility.

This is the first study to focus solely on targeting outcome expectations to increase exercise among breast cancer survivors. Exercise is a very difficult behavior to change and usually successful interventions only produce small effects. Thus, the modest effect sizes in this study are not surprising. All intervention effects on OEs and exercise measures were in the intended direction. The focus of this study is feasibility and it is not powered for statistical testing. However, there is a statistically significant increase of 970 steps per every 4 weeks in the intervention arm compared to the control arm. More importantly, this may also be a clinically significant finding as it may equal an increase of roughly 10 minutes or ½ mile of walking every four weeks (Kazoil, 2016)
to total an increase of 40 minutes of exercise in the intervention arm over the course of the study. Regardless of the total amount of exercise, higher activity levels are related to improved health outcomes (Arem et al., 2015).

The intervention effect on steps may not have been mirrored in self-reported exercise for several reasons. First, only exercise sessions lasting at least 20 minutes were subjectively recorded. Thus the 970 step increase may be due to decreased sedentary time, rather than increased exercise. However, reductions in sedentary time produce health benefits for breast cancer survivors, independent of exercise levels (George et al., 2013; Nomura, Dash, Rosenberg, Palmer, & Adams-Campbell, 2016). It is also possible that participants did not accurately complete subjective exercise measures as they may have experienced measurement fatigue from completing multiple lengthy online surveys. Finally, it is possible that a selection bias occurred in which participants who had an affinity for exercise and thus were more experienced with or motivated to learn proper Fitbit® use provided objective data. It may be that these motivated participants were more sensitive to the intervention.

Race stands out as a significant independent predictor of all OE measures. Scores range from 0.3 to 0.7 points higher, at all time points, for black compared to white participants. This is consistent with other research that indicates black breast cancer survivors report more expected exercise benefits compared to whites (Spector, Battaglini, & Groff, 2013). Thus, increasing OEs may not be the most effective means to increase exercise among black breast cancer survivors. Other constructs, such as barriers,
may be more important for this population as they report more barriers including lack of discipline, time, energy interest, good health (Oyekanmi & Paxton, 2014) and environment (Spector et al., 2013), compared to whites. Especially because black breast cancer patients tend to have worse long-term outcomes than whites (Rauscher et al., 2017), it is critical to further explore and understand racial and cultural differences in exercise when designing future interventions.

Self-efficacy stands out as a significant independent predictor of several outcomes including overall OEs, OE accessibility, exercise intentions, and weekly steps. Additionally, the intervention only had an effect on mGodin for participants with higher self-efficacy. This supports our theoretical framework in that self-efficacy is a significant independent predictor of exercise intentions and intentions. However, self-efficacy did not change throughout the intervention period indicating that the intervention solely targeted OEs as intended.

In summary, target enrollment was achieved in a favorable time frame, compared to other studies. Insights were gained to decrease attrition in future studies. Objective exercise was successfully measured for most (60%) participants in this study using Fitbit® and insights were gained to improve measurement in future studies. Participants were able to complete the home-based self-directed intervention booklet and all fidelity scores met a priori acceptability criteria of > 2.5. Qualitative data provided insights about the most and least useful intervention components. Intervention effects were in the intended direction for all outcomes, yet significant only for objective
exercise. Overall, findings warrant a larger future study powered for statistical testing.

5.6.1 Limitations

Several limitations need to be considered for this study. First, attrition of 37% and not having Fitbit® data for 40% of participants may have caused measurement error and impacted results. Additionally, high mean OE scores (3.2 - 4.4, on a 1-5 Likert scale) at baseline, and positive skewness for OE certainty and importance indicate possible ceiling effects. Thus, the OE measure may not have been sensitive enough to note significant increases in OEs. Selection bias may have impacted study results because people who have positive attitudes toward exercise may be more likely to enroll in a healthy lifestyle intervention study. These people may have greater motivation to exercise and be more sensitive to the intervention.

Finally, high interclass correlations exist for all outcomes. This indicates a lot of within-participant variability. Thus, variability in study outcomes may have a lot to do with differences between individuals. Future analyses using latent class to identify trends and classes people based on those trends and then use characteristics to predict group may provide useful information about OEs and exercise among breast cancer survivors.

5.6.2 Research Implications

Overall, findings from this study support the utility of targeting OEs to increase exercise among breast cancer survivors. This study demonstrates that heightened OEs increase exercise. However, what happens as a person continues to exercise and either
experiences or does not experience the anticipated OEs remains unknown. Future research is needed to understand how exercise OEs change over time in relation to levels of exercise. Future research should also explore the moderating effects of OE proximity. An OE experienced more proximal to exercise, such as improved mood may impact continued exercise differently compared to an OE that takes longer to experience such as weight loss. An understanding of how OEs change over time and the influence of OE proximity on exercise, will build upon the findings of this study.

5.6.3 Clinical Implications

Intervention effects were in the intended direction and overall, participants provided positive feedback about the Pamphlet. A pragmatic trail is warranted to test the effectiveness of Moving On in a real clinic setting. If Moving On increases exercise, the quality and duration of cancer survivorship may be improved.
6. Conclusions and Implications

This dissertation provides extensive knowledge about the impact of OEs on exercise in breast cancer survivors. Baseline knowledge of OEs was established through a mixed methods exploratory study, detailed in chapter two. A valid and reliable OE measure specific for breast cancer survivors was developed in preparation for testing intervention effects, detailed in chapter three. Three physically active breast cancer survivors were recruited to provide personal stories of their experiences with cancer treatments and how they use exercise to manage late and long-term effects. These stories were included in an intervention booklet that was created to increase OEs among breast cancer survivors, detailed in chapter four. The booklet also included empirically tested and theoretically based reading, reflecting and writing strategies to increase OE accessibility, importance and certainty. The intervention was designed to be implemented in current clinical settings without need for additional resources. Finally, 60 inactive breast cancer survivors were recruited for a randomized controlled trial to test the feasibility of survivors completing the self-directed intervention and explore effects on OE dimensions, exercise intentions and exercise. This dissertation contributes a foundational understanding of breast cancer survivors’ exercise expectations, a multi-dimensional tool to assess exercise OEs, and an effective and easy-to-implement strategy to increase OEs and exercise among breast cancer survivors.

Findings from the exploratory study indicate that breast cancer survivors generally believe exercise has positive effects. However, they do not consider exercise as
part of their long-term treatment plan to manage or prevent side effects and decrease risk of recurrence and other cancers. These finding are congruent with other research that shows breast cancer survivors hold lower OEs that exercise will reduce recurrence compared to other exercise outcomes (Karvinen & Vallance, 2015). Additionally, risk reduction has been rated among the lowest of all potential exercise benefits among American oncologists (Karvinen, DuBose, Carney, & Allison, 2010). In general, providers report wanting more knowledge and resources about exercise for cancer patients (Nadler et al., 2017). Efforts are needed to increase identification and use of exercise as a treatment for side effects such as joint pain, neuropathy, cardiotoxicity and risk of additional cancers.

Findings from the exploratory study also highlight the relationship between fatigue and exercise for breast cancer survivors. Fatigue is the greatest exercise barrier, yet decreased fatigue is the greatest exercise benefit for breast cancer survivors. Future research should focus on identifying the best time to implement exercise interventions to decrease cancer-related fatigue. Many oncology providers do not discuss exercise with patients during treatment (Karvinen et al., 2010) (Karvinen et al., 2012). A common barrier to providers prescribing exercise is that patients are experiencing side effects such as fatigue (Smith-Turchyn, Richardson, Tozer, McNeely, & Thabane, 2016). However, exercise decreases fatigue for cancer patients (Cramp & Daniel, 2008) and is more effective and costs less compared to pharmaceuticals (Mustian et al., 2017). Further, most survivors feel it is beneficial and a provider’s duty to discuss the benefits

The multidimensional OE measure presented in chapter three can improve evaluation of many interventions because OEs are often included in exercise interventions for breast cancer survivors (Bourke et al., 2013). The measure demonstrates high internal consistency and reliability. Moderate correlation and minimal cross-loading between dimensions indicates OE importance and accessibility are related yet distinct. This is the first OE measure to include the dimension of accessibility and the only OE measure that includes outcomes specific to breast cancer survivors such as decreased recurrence risk. Continued measure development with larger and more diverse samples is warranted. This future work may include removing items that show little variability and low reliability and adjusting scale ranges to decrease ceiling effects.

Chapter 4 of this dissertation details the development of a theory-guided intervention that can easily be implemented for breast cancer survivors during regular follow-up visits. Theory-guided interventions are more effective and better facilitate identification of how an intervention works, compared to non-theory-guided interventions (Alexander, 2004). The intervention is a self-directed booklet of reading, reflecting and writing activities that patients can complete at home. All booklet content is derived from evidence-based strategies to increase OE dimensions (Bell & Bell, 2013; Gross et al., 1995; Olson et al., 1996; Petty & Krosnick, 2014). A significant part of the
booklet is narrative messages from breast cancer survivors. These messages are in first person and detail the experience of cancer treatment, side effects and how exercise is used to manage late and long-term side effects. According to narrative theory, messages are processed more deeply and are more believable when a reader relates to a narrator (Falzon et al., 2014).

As detailed in chapter five of this dissertation, the feasibility and fidelity of the intervention was tested among 60 breast cancer survivors. Participants were easily recruited to the intervention. Roughly three quarters of participants were retained through study completion and 75% of data was obtained through online surveys and Fitbit®. Strategies to increase measure completion rate and data acquisition were identified. In general, participants found the intervention booklet useful, especially the narratives. Intervention effects on OEs and exercise were all positive and statistically significant for weekly steps measured by Fitbit®. Of note, the study was focused on feasibility and not powered to detect statistical significance. The least effective part of the intervention was that focused on increasing OE accessibility, in which participants were instructed to list strategies they will use to increase how often they think about the reasons they want to exercise. Results indicate participants may not have understood the directions and/or this may not have been an effective means of increasing OE accessibility. Future research is needed to identify strategies for increasing OE accessibility.
According to the theoretical framework guiding this dissertation, self-efficacy is the other significant predictor of behavior, in addition to OEs. The intervention developed for this dissertation aimed solely to increase OEs and analyses were conducted to control for effects of self-efficacy. Self-efficacy remained stable throughout the intervention and follow-up period. This dissertation is the first to identify individual contributions of OEs on exercise among breast cancer survivors.

In summary, this dissertation provides a comprehensive understanding of exercise OEs among breast cancer survivors. This includes an exploration of current OEs, a strategy to measure OEs, and an effective intervention to increase OEs among this population. Most breast cancer survivors are inactive after treatment (Lucas, Levine, & Avis, 2017). Continued efforts are needed to increase exercise and, ultimately, the quality and duration of breast cancer survivorship.

Findings from this dissertation indicate that future research aimed at increasing exercise among breast cancer survivors should include focusing on OEs. Specifically, research is needed to test all 3 OE dimensions of the OE measure in larger sample sizes. Continued research efforts are also needed to identify strategies to increase OE accessibility. For example, an intervention delivered overtime that includes occasional contacts such as text messages or telephone calls, may increase the frequency participants consider OEs. Future research should also explore the best time in the cancer continuum to target exercise OEs. Treatment side effects such as fatigue contribute to exercise decline among survivors. Thus, it may be more effective to
increase OEs related to side effects before people experience such effects. Finally Moving On should be testing in a pragmatic trial to better identify implications for the larger breast cancer survivor population.
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Biography

Rachel Hirschey was born May 23, 1981 in Pittsfield, Massachusetts. She received her Bachelors of Science in nursing in 2004. Rachel is the first author of two manuscripts, “Message Framing and Physical Activity Promotion in Colorectal Cancer Survivors” and “Exploration of Exercise Outcome Expectations Among Breast Cancer Survivors”. She was a Jonas Foundation Leadership fellow from 2014 through 2016. Rachel was inducted into Sigma Theta Tau International (STTI) in 2013.