DETERMINANTS OF PHYSICAL ACTIVITY AND QUALITY OF LIFE IN BREAST CANCER SURVIVORS

BY

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DISsertation

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Kinesiology in the Graduate College of the University of Illinois at Urbana-Champaign, 2011

Urbana, Illinois

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Abstract

Physical activity (PA) is associated with reduced side effects and enhanced quality of life (QOL) in breast cancer survivors. However, PA participation in this population is abysmal. The purpose of this study was to test a social cognitive theory (SCT) model of (a) PA behavior and (b) PA and QOL in a sample of breast cancer survivors (N = 370; M age = 56.5) over a 6-month period. Participants wore an accelerometer and completed measures of PA, self-efficacy, goals, outcome expectations, fatigue, social support, health status, and global QOL. It was hypothesized that (a) self-efficacy directly and indirectly influences PA through goals, social support, fatigue, and outcome expectations, and (b) PA indirectly influences global QOL through self-efficacy and health status. Relationships were examined using panel analysis within a covariance modeling framework. Model A provided a good model-data fit ($\chi^2 = 577.98$, df = 261, $p = 0.00$; CFI = 0.95; RMSEA = 0.06; SRMR = 0.06). At baseline, self-efficacy directly and indirectly, via goals, influenced PA. The same results were found for changes in these constructs. Model B was a good fit to the data ($\chi^2 = 278.70$, df = 127, $p = 0.00$; CFI = 0.95; RMSEA = 0.07; SRMR = 0.06). PA indirectly influenced global QOL via self-efficacy and health status at baseline and the same relationships were found for changes in model constructs. These results support the use of SCT to understand PA behavior and QOL in breast cancer survivors. Recommendations are made relative to future examinations of these models.
Acknowledgments

This study was supported by a Ruth L. Kirschstein National Research Service Award from the National Institute on Aging (Award #F31AG034025) awarded to Siobhan White and by a Shahid and Ann Carlson Khan Professorship awarded to Dr. Edward McAuley.

I am deeply indebted to so many individuals for their unending support, encouragement and belief in me.

First, I would like to thank my advisor, Dr. Edward McAuley for all of your guidance and support and instilling in me the qualities of being a good scientist and mentor. I am so grateful for all of the opportunities you provided me with, your door always being open and the example you have set of the work ethic and drive needed to succeed.

I would also like to thank my committee members, Dr. Robert Motl, Dr. Wojtek Chodzko-Zajko, and Dr. Arthur Kramer for your insight and guidance.

Thank you to all of the members of the Exercise Psychology lab, past and present: Thomas Wójcicki, Emily Mailey, Amanda Szabo, Erin Olson, Neha Gothe, Jason Fanning, Susan Herrel, Dr. Ruth Franklin, Dr. Katherine Hall, Dr. Liang Hu, and Dr. Shawna Doerksen. I am so fortunate to have had the opportunity to work with all of you. You have made the long days and nights so much more bearable and have provided me with so much support, inspiration, and laughs.

Thank you to all of the undergraduate research assistants. This study would not have been possible without your help preparing the countless mailings.

A very special thank you to my parents, Murray and Susan White, your unwavering love, support and confidence in me over the years has made me who I am today. You have given up so much for me and have believed in me and the decisions I have made. Mom, I have been trying to
fight cancer since you were diagnosed, and only hope I can get science a few steps closer. That experience has shaped me and our family so much, and the older I get the more I admire all of your strength and courage. You are truly a “survivor” and such a great example to me.

Thank you to my life partner and future husband, Steven. I could not have done this without your understanding, support and love. You have believed in me on the days I did not believe in myself. Thank you for always helping me to see the positive side of things and always letting me be “me” and loving me in spite of it.

Thank you to my siblings: Rebecca, Brittany, Matthew, and Phil. I am so grateful for your support and so proud of each and every one of you. You were my first “collaborators” and have taught me so much about being a team. You inspire me, teach me so much and help keep grounded.

Thank you to my aunts, uncles and cousins for all of your love and support. I am so grateful to have such a wonderful family.

Thank you to my late grandma, Jane Blanchard. I see your strong will, unending desire to learn, and unconditional love in me, and thank you for always thinking each and every one of us was “the greatest” and keeping us in line. I can only imagine what you would have done had you grown up in a different time and am glad you were able to see me live a part of your dream.

Thank you to my closest friends and confidants- Meredith, Tanya, Vicky, Crystal, Taylor, Claire and Cristina- you have all been so wonderful and supportive over the years, and are some of the most intelligent and wonderful women I know.

Finally, thank you to all of the teachers who believed in me as well as those that didn’t. You inspired me to work that much harder and prove myself. I can’t imagine how different my life might have been had I just gotten moved up in that reading group in first grade…
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Chapter I: Introduction

Study Significance

Cancer is the second leading cause of death in the United States with 1 in 4 deaths in the U.S. attributed to cancer (Jemal et al., 2010). Excluding cancers of the skin, breast cancer is the most prevalent type of cancer in women. Women have a 1 in 8 lifetime risk of receiving a breast cancer diagnosis and an estimated 28% of all cancers diagnosed in U.S. women are breast cancer (Jemal et al., 2010). An individual diagnosed with cancer is considered a cancer survivor from the time of diagnosis prior to the development of a recurrence of cancer or for the balance of life (Hewitt, Greenfield, & Stovall, 2006). The most recent data suggests the relative survival rates for breast cancer 5 and 10 years post-diagnosis are 89% and 83%, respectively, and the breast cancer mortality rate declined 2.2% annually from 1990-2007 (Altekruse et al., 2010). Additionally, approximately 2.6 million breast cancer survivors currently reside in the U.S. (Altekruse et al., 2010). Much of the increase in the survival rate for breast cancer can be attributed to advances in medical technology, particularly early detection and improved treatment options. Thus, if advances in early detection and treatment continue, the number of surviving breast cancer patients can also be expected to increase creating a relatively large population with special public health needs resulting from disease and treatment related side effects (Parkin, Bray, Ferlay, & Pisani, 2005).

Most women diagnosed with breast cancer undergo treatments including surgery, chemotherapy, radiation therapy, and hormone replacement therapy which can alone, and combined, produce many and varied negative side effects (Shapiro & Recht, 2001). Surgery and radiation therapy are considered first line defense treatments and are categorized as local treatments. They are provided to patients to reduce the risk of recurrent cancer in the breast,
chest wall, and regional lymph nodes. Chemotherapy and hormone replacement therapy are categorized as systemic adjuvant therapies and are provided to reduce breast cancer recurrences and overall breast cancer mortality (Shapiro & Recht, 2010). These treatments are deemed second line defense treatments and are typically only given following local treatments. Because the specificity of these breast cancer treatments are low, normal healthy tissue is oftentimes damaged resulting in negative side effects, decrements in quality of life (QOL) and an increased risk for second cancers, comorbidites and premature death.

A substantial body of literature exists providing evidence for the beneficial effects of regular physical activity on overall quality of life and quality of life indicators (e.g. fatigue, physical functioning, depression) in breast cancer survivors. This literature suggests that physical activity holds significant promise as a potential therapy for reducing the negative effects of breast cancer treatment (Kirshbaum, 2007; McNeely et al., 2006). The findings from this literature have been so promising, they have resulted in physical activity holding a prominent place in the American Cancer Society’s guidelines for cancer prevention (Kushi et al., 2006) and cancer survivors (Brown et al., 2003). However, the mechanisms underlying the relationship between physical activity and quality of life in breast cancer survivors are not well understood and have received limited attention in the existing literature. Thus, further research is warranted to better understand the mechanisms underlying the beneficial effects of physical activity, how to maximize these effects, and how these findings may be incorporated into standard care practices. Additionally, despite the quality of life benefits associated with physical activity in breast cancer survivors, studies have shown that this population, in general, is relatively inactive with less than one third meeting public health recommendations for physical activity (Irwin et al., 2004; Pinto, Trunzo, Reiss, & Shiu, 2002). In fact, women often reduce their physical activity levels
following a breast cancer diagnosis with those individuals who were the most active pre-diagnosis reporting the greatest declines in physical activity post-diagnosis (Irwin et al., 2004; Pinto et al., 2002). Although a number of studies exist that have examined correlates of physical activity participation in breast cancer survivors, this work has, in general, failed to fully integrate theoretical models. As a result, further research is also warranted to examine factors that influence physical activity participation following a breast cancer diagnosis with the goal of identifying modifiable factors that can potentially be targeted to assist breast cancer survivors in maintaining their pre-diagnosis physical activity levels or increasing their physical activity levels post-diagnosis. As Courneya and Friedenreich (2007) have noted, the application of optimal theoretical models of physical activity behavior in cancer survivors is critical for the advancement of physical activity and cancer research. As Social Cognitive Theory (SCT; Bandura, 1986, 1997, 2004) has been shown to be effective in explaining physical activity behavior, quality of life, and functional limitations in the general population and aging individuals (Elavsky et al., 2005; McAuley et al., 2006), it has considerable promise as a theoretical model for understanding physical activity behavior in breast cancer survivors.

Social Cognitive Theory (Bandura, 1986, 2004) specifies a core set of psychosocial determinants (i.e., self-efficacy, outcome expectations, goals, and sociocultural factors (facilitators and impediments)) for effectively understanding a broad range of health behaviors, including physical activity. Although SCT has been one of the most frequently used theoretical models for understanding physical activity behavior, these applications have rarely incorporated more than one or two model constructs, especially in the physical activity and breast cancer literature. Indeed, self-efficacy is often relied upon as the sole social cognitive determinant of physical activity. However, the social cognitive model hypothesizes that self-efficacy has both
direct and indirect influences on behavioral outcomes. In a recent paper, Bandura (2004) clearly articulates that the theoretical pathways from self-efficacy to behavioral outcomes are both direct and indirect. The indirect pathways are proposed to operate through a number of social cognitive constructs including outcome expectations, goals, and facilitators and impediments to behavioral performance (Bandura, 2004). Individuals with higher levels of self-efficacy have more positive expectations about what the behavior will bring about, set higher goals for themselves, and are more likely adopt the view that they are capable of overcoming difficulties and barriers with effort and coping skills.

Additionally, the relationship between physical activity and self-efficacy is reciprocal, such that self-efficacy can influence physical activity behavior and physical activity behavior can influence self-efficacy. Moreover, evidence exists to suggest that self-efficacy may act as a mediator between physical activity and behavioral and health-related outcomes including self-esteem (Elavsky et al., 2005), physical functioning (McAuley et al., 2006) and quality of life (McAuley et al., 2006; White, Wojcicki, & McAuley, 2009). More specifically, research examining the relationship between physical activity and quality of life in older adults (McAuley et al., 2006; White, Wojcicki, & McAuley, 2009) and individuals with Multiple Sclerosis (Motl, McAuley, Snook, & Gliottoni, 2009) indicates that physical activity may influence quality of life indirectly via self-efficacy and health status indicators. Thus, Social Cognitive Theory may provide a theoretically grounded framework, not only for understanding physical activity behavior, but for understanding the relationship between physical activity and quality of life in breast cancer survivors.

Social Cognitive Theory has been extensively applied in the general physical activity literature and has been shown to be effective in explaining both physical activity behavior
(Dzewaltowski, Noble, & Shaw, 1990; Petosa, Suminski, & Hortz, 2003) and the relationship between physical activity and quality of life in older adults (McAuley et al., 2006; White et al., 2009) and other diseased populations (Motl et al., 2009). As such, Social Cognitive Theory may be an “optimal” model for explaining and understanding these relationships in breast cancer survivors. However, to date, only a few studies have employed Social Cognitive Theory to examine physical activity behavior in breast cancer survivors, and none have used any construct other than self-efficacy. Moreover, no studies in the breast cancer and physical activity literature have attempted to model the relationship between physical activity and quality of life in this population. Consequently, in order to fully understand physical activity participation in breast cancer survivors and its influence on quality of life, it is important to, first, determine how social cognitive constructs influence physical activity behavior in breast cancer survivors and, second, how these factors (i.e. self-efficacy) are related to quality of life. Exploring these relationships has the potential to inform future research and result in the development of more comprehensive programs to maximize effective behavior change and positively impact QOL in breast cancer survivors.

Specific Aims

To this end, the present study adopted a prospective design to test the full social cognitive model for physical activity participation and examine the associations among physical activity, social cognitive variables and quality of life in breast cancer survivors across a six month period of time. Specifically, it was hypothesized that:

1) At baseline, self-efficacy would have a direct effect on physical activity behavior and an indirect effect through outcome expectations, goals, and impediments. These latter constructs were also expected to have direct effects on physical activity. The same series of hypotheses
were proposed among changes in the constructs across the 6-month period. This model is shown in Figure 1.

2) Baseline physical activity would indirectly influence QOL through self-efficacy and health status indicators. Self-efficacy was hypothesized to be indirectly associated with QOL through multiple indicators of health-related QOL including: social well-being, physical well-being, functional well-being, emotional well-being, and breast cancer specific health-related concerns. All of these health-related quality of life indicators were, in turn, proposed to have a direct effect on QOL. The same series of hypotheses was proposed among changes in the constructs across the 6-month period. The proposed physical activity and QOL model is shown in Figure 2.
Chapter II: Literature Review

The present study adopted a social cognitive framework to investigate physical activity behavior as well as the relationship between physical activity and quality of life in breast cancer survivors. The subsequent sections will briefly review the following: the benefits of physical activity for breast cancer survivors; current physical activity recommendations for breast cancer survivors; trends in physical activity participation in breast cancer survivors; social cognitive theory as a proposed mechanism for understanding physical activity behavior in breast cancer survivors; breast cancer treatment and QOL and the proposed conceptualization of QOL.

Benefits of Physical Activity for Breast Cancer Survivors

Research has consistently demonstrated that participation in physical activity has many benefits for breast cancer survivors and new breakthroughs in understanding this relationship continue to emerge. The beneficial effects of physical activity on breast cancer survivors’ health and well-being can be classified into five general categories: physical, psychological, emotional, quality of life and survival. Overall, physical activity participation has been shown to decrease the negative physical, psychological, and emotional side effects of treatment and increase quality of life in cross-sectional (Milne, Gordon, Guilfoyle, Wallman, & Courneya, 2007), longitudinal (Alfano et al., 2007), and randomized control (Kirshbaum, 2007; McNeely et al., 2006) physical activity studies. Preliminary cross-sectional and longitudinal evidence indicates that physical activity also positively influences survival (Friedenreich, Gregory, Kopciuk, Mackey, & Courneya, 2009; Holick et al., 2008; Holmes, Chen, Feskanich, Kroenke, & Colditz, 2005). Collectively, the existing evidence suggests that individuals who participate in any type of physical activity experience some positive effects in comparison to sedentary survivors (Pinto et al., 2002).
**Physical Health Benefits**

Current evidence suggests that participation in physical activity can have robust physical benefits for breast cancer survivors. Consistent with findings from older adults (Brach, Simonsick, Kritchevsky, Yaffe, & Newman, 2004; DiPietro, 1996; McAuley et al., 2007), participation in physical activity has been demonstrated to improve physical functioning in breast cancer survivors based on results from both self-report (Campbell, Mutrie, White, McGuire, & Kearney, 2005; Ohira, Schmitz, Ahmed, & Yee, 2006) and functional performance tests (Basen-Engquist et al., 2006). Improvements in physical functioning have been found as a result of aerobic (Campbell et al., 2005), resistance training (Ohira et al., 2006) and combined aerobic and resistance training (Herrero et al., 2006) interventions. Physical functioning benefits are found for both supervised (Campbell et al., 2005) and home-based (Basen-Engquist et al., 2006; Mock et al., 2001; Segal et al., 2001) interventions as well as interventions conducted both during (Campbell et al., 2005; Mock et al., 2001) and following (Basen-Engquist et al., 2006) active treatment for breast cancer. In addition to improvements in physical functioning, physical activity has also been associated with self-reported improvements in functional well-being in aerobic (Courneya et al., 2003; Daley et al., 2007) and combined aerobic and strength training (Herrero et al., 2006) physical activity interventions in breast cancer survivors.

The increase in physical functioning and functional well-being in breast cancer survivors associated with physical activity participation is likely a result of fitness changes that occur with regular participation in these activities. Studies employing aerobic activities as the sole physical activity modality (Courneya et al., 2003; Courneya et al., 2007; Kim, Kang, Smith, & Landers, 2006; Kim et al., 2008), as well as those that have used combined aerobic and strength training protocols (Herrero et al., 2006) have demonstrated efficacy in regards to their ability to
significantly increase aerobic fitness levels as measured by maximal (Courneya et al., 2003; Courneya et al., 2007; Daley et al., 2007; Kim et al., 2008) and submaximal (Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005) exercise tests. Resistance training (Courneya et al., 2007) and combined resistance and aerobic interventions (Herrero et al., 2006) have also exhibited a significant effect on varying domains of strength in breast cancer survivors. Consequently, these improvements in fitness may translate to the improvements seen in functional outcomes. Additionally, improvements in fitness could result in a number of other potential positive physical health outcomes including reductions in comorbidities and secondary disease risk.

Although body composition and body size outcomes may be particularly important for breast cancer survivors given their possible implications for survival (Abrahamson et al., 2006; Zhang, Folsom, Sellers, Kushi, & Potter, 2006), very few physical activity studies have examined body size or composition as a primary outcome. This is somewhat surprising given the potential for physical activity participation to negatively shift energy balance by increasing muscle mass and energy expenditure resulting in weight reductions and body composition changes. In a review by Schmitz and colleagues (2005), it was concluded that the evidence regarding the use of physical activity interventions to change body size or composition in breast cancer survivors is weak or insufficient. However, recent evidence is more promising. For example, one recent study demonstrated that women who increased moderate intensity physical activity levels by 129 minutes per week decreased their percent body fat and increased their lean mass while maintaining their bone mineral density (Irwin et al., 2009). Another recent study revealed that participation in a home-based walking intervention significantly reduced survivors’ waist-to-hip ratio (Rogers et al., 2009). Thus, future research in this area is warranted to fully understand the role of physical activity in changing breast cancer survivors’ body composition or
In addition to physical functioning, body composition and fitness benefits, physical activity has also been related to a reduction in the number and severity of physical side effects of treatment including fatigue, nausea and pain (Schmitz, Holtzman, Courneya, Masse, Duval & Kane). As fatigue is one of the most enduring and debilitating negative side effects of breast cancer treatment, the reduced fatigue levels manifested as a result of physical activity participation may be particularly important (Cramp & Daniel, 2008; McNeely et al., 2006). Both supervised aerobic exercise (Courneya et al., 2003; Daley et al., 2007) and home-based aerobic exercise (Vallance, Courneya, Plotnikoff, Yasui, & Mackey, 2007; Pinto et al., 2005) as well as combined resistance and aerobic exercise (Milne, Wallman, & Gordon, 2008) following active breast cancer treatment have been associated with decreased fatigue levels. Participation in aerobic exercise during treatment has also resulted in significantly smaller increases in fatigue compared to usual care (Mock et al., 2001; Schwartz, 1998). While these findings are promising, the mechanisms by which physical activity exerts its effect on fatigue are not well understood. Several factors have been proposed to influence this relationship including changes in psychosocial variables such as self-efficacy and depression (McAuley, White, Rogers, Motl, & Courneya, 2009) and changes in biological and physiological parameters such as c-reactive protein (Scott et al., 2002), cortisol (Lundstrom & Furst, 2003), and reductions in activated T-cells (Bower, Ganz, Aziz, & Fahey, 2002) resulting from physical activity participation.

Psychological Health Benefits

In addition to the physical benefits breast cancer survivors experience as a result of physical activity participation, numerous psychological benefits have been reported. Randomized controlled physical activity trials in breast cancer survivors have revealed that participation in
physical activity is associated with significant positive improvements in a variety of psychological outcomes including: increased levels of self-esteem (Courneya et al., 2003), physical self-worth (Daley et al., 2007), and vigor (Pinto et al., 2005) and decreased levels of tension (Culos-Reed, Carlson, Daroux, & Hately-Aldous, 2006), depression (Daley et al., 2007; Segar et al., 1998), social physique anxiety (Milne et al., 2008), and mood disturbance (Mock et al., 2001). Additionally, physical activity participation has been significantly associated with overall psychological well-being (Ohira et al., 2006). The mechanisms underlying these relationships in breast cancer survivors have not been extensively studied but may be similar to those in the general population and may include a number of biopsychosocial mechanisms such as cardiopulmonary adaptation, endorphins, distraction, mastery achievements, positive feedback and social interaction in group interventions (Courneya et al., 2003).

*Emotional Health Benefits*

Participation in physical activity has also exhibited an association with improved emotional functioning in breast cancer survivors. Courneya and colleagues (2003) found that participation in a supervised aerobic exercise intervention post-treatment resulted in significant improvements in happiness compared to usual care controls. Participation in a yoga program post- breast cancer treatment also resulted in improved emotional functioning compared to standard care (Culos-Reed et al., 2006). In addition, emotional well-being was shown to improve following participation in a post-treatment supervised combined aerobic and resistance training intervention in comparison to usual care (Milne et al., 2008). Potential mechanisms underlying improvements in emotional health as a result of physical activity participation include increased social support from other survivors participating in group exercise interventions and improved physical or psychological well-being.
Quality of Life Benefits

Quality of life (QOL) has been one of the most frequently studied outcomes in the physical activity and breast cancer literature. Most of the studies examining QOL as an outcome have examined health- and disease- related QOL. In a review by McNeely and colleagues (2006), physical activity interventions were demonstrated to be superior to usual care in minimizing declines in health related QOL associated with breast cancer treatments. Physical activity has also been shown to be positively correlated with health-related QOL in both cross-sectional and longitudinal in population based studies of short and long-term breast cancer survivors (Hong et al., 2007; Kendall, Mahue-Giangreco, Carpenter, Ganz, & Bernstein, 2005). Furthermore, home-based (Basen-Engquist et al., 2006) and supervised (Campbell et al., 2005; Courneya et al., 2003; Daley et al., 2007; Sandel et al., 2005) aerobic exercise interventions, supervised combined aerobic and resistance training interventions (Herrero et al., 2006; Milne et al., 2008) and supervised yoga interventions (Culos-Reed et al., 2006), have resulted in improvements in overall health-related and disease specific quality of life in breast cancer survivors. Less intense interventions involving merely distributing print materials providing information on becoming physically active and a pedometer have also resulted in increases in physical activity sufficient to elicit improvements in overall health related QOL (Vallance et al., 2007). In addition to improvements in overall health related QOL, physical activity has demonstrated a positive effect on a variety of QOL subdomains including: general health, bodily pain, social/family well-being, breast cancer specific concerns (Basen-Engquist et al., 2006; Daley et al., 2007; Milne et al., 2008). Consequently, the overall improvement in health related QOL observed with physical activity participation may be a function of improvements in various sub domains. No studies to date have examined the relationship between physical activity and
global QOL adopting the mainstream psychological definition of QOL as a conscious cognitive judgment of satisfaction with one’s life (Diener, 1984).

Survival Benefits

In addition to reducing the deleterious side effects of treatment, emerging evidence indicates that participation in physical activity may elicit survival benefits for women diagnosed with breast cancer. Findings from a study by Friedenreich and colleagues (2009) revealed a decreased risk of breast cancer mortality and all-cause mortality a minimum of 10 years post-breast cancer diagnosis in individuals who had the highest level of lifetime recreational activity in comparison to those who had the lowest levels. Additionally, participation in moderate intensity recreational activity decreased the risk of cancer recurrence, cancer progression or development of a new primary cancer by 34% (Friedenreich et al., 2009). In another study, women who engaged in higher levels of physical activity post-diagnosis had a significantly lower risk of dying from breast cancer and all other causes (Holick et al., 2008). In a study by Holmes and colleagues (2005), the greatest overall survival, breast cancer survival and recurrence benefits occurred for women who performed the equivalent of walking 3 to 5 hours per week at an average pace, with little evidence that increasing physical activity resulted in additional benefits.

A number of mechanisms have been proposed to explain the association between physical activity participation and increased survival in breast cancer survivors. Physical activity participation has been associated with reductions in estrogen and changes in body composition in breast cancer survivors which may alone, and combined, lead to reductions in risk of recurrence due to their role as major risk factors in initial breast cancer incidence (Irwin et al., 2009; McTiernan et al., 2003). Another proposed mechanism is that the reduction in insulin and insulin
like growth factor typically occurring with physical activity increase survival rates as high levels of these hormones have been associated with increased breast cancer risk and/or death (Irwin et al., 2009). Finally, increased cardiorespiratory fitness has also been proposed as a mechanism by which physical activity may exerts its influences on survival because increased fitness has been linked to both increased levels of physical activity and reduced risk of dying from breast cancer (Peel et al., 2009).

Summary

Existing evidence suggests breast cancer survivors can benefit from physical activity participation both during active treatment (Battaglini et al., 2007; Campbell et al., 2005) and within 5 years of diagnosis (Basen-Engquist et al., 2006; Courneya et al., 2003). Additionally, various modalities of physical activity including: yoga/pilates (Culos-Reed et al., 2006), aerobic activities (Basen-Engquist et al., 2006; Courneya et al., 2003; Courneya et al., 2007), strength activities (Courneya et al., 2007; Daley et al., 2007), and a combination of aerobic and strength training activities (Ligibel et al., 2008; Milne et al., 2008), have all resulted in positive outcomes for breast cancer survivors at different points within the five year survival period. Supervised (Courneya et al., 2003; Courneya et al., 2007), home-based (Mock et al., 2001; Pinto et al., 2005) and tapered supervised to home-based (Ohira et al., 2006) physical activity interventions have all resulted in beneficial health outcomes for breast cancer survivors. Collectively, this evidence suggests physical activity, in general, may positively influence a range of health outcomes in breast cancer survivors.

Limitations in the Physical Activity and Breast Cancer Literature

Although the current evidence regarding physical activity participation for breast cancer survivors is very promising and suggests participation in physical activity results in beneficial
outcomes for breast cancer survivors with very minimal risk (Schmitz et al., 2005), this literature is not without its limitations. Several limitations exist in study design reducing the ability of any consensus to be reached regarding the necessary characteristics of a physical activity program to elicit specific benefits for breast cancer survivors. One of the major overarching issues in the literature, to date, is that very few studies have adopted similar methodologies making it difficult to compare studies to one another or to draw conclusions about the factors that influence physical activity participation and the outcomes of physical activity participation in breast cancer survivors.

Another major limitation in the extant literature is that little is known about the optimal dose (intensity and duration) and modality (aerobic, strength) of physical activity necessary to maximize physical activity benefits for breast cancer survivors. Additionally, information in regard to the point along the breast cancer survival continuum at which physical activity participation elicits the greatest benefits is lacking. Moreover, little research has been conducted to determine the trajectory of change in health and quality of life outcomes resulting from participation in physical activity interventions to determine optimal intervention length or whether there is a point at which benefits may peak or level off (Cadmus et al., 2009). The majority of the study samples have also consisted of relatively small, homogenous, convenience samples limiting the the generalizability of these findings to the breast cancer survivor population as a at large (White, McAuley, Estabrooks, & Courneya, 2009). Many of the physical activity studies conducted to date, especially supervised exercise studies, may also include women who are functioning at higher level than the average breast cancer survivor which can be attributed to study design (e.g. supervised on-site interventions), self-selection of healthier survivors into an exercise study, and strict inclusionary criteria (e.g. limit on stage of disease).
Therefore, the true magnitude of the effects of physical activity on health, disease and quality of life outcomes may not be fully realized. Another, major limitation of the current literature is that nearly all of the studies have been conducted on women who are within 5 years post-diagnosis with little consideration of breast cancer survivors beyond this time frame. As treatment related side-effects have the potential to persist long term (Ganz, Desmond, Leedham, Rowland, Meyerowitz, & Belin, 2002), and may potentially interact or compound the normal aging process (Keating, Norredam, Landrum, Huskamp, & Meara, 2005), it is critical to not neglect long-term survivors and examine physical activity behavior across the entire cancer survival continuum. Finally, although current study findings support the beneficial effects of physical activity for breast cancer survivors, very little research has been conducted to determine the mechanisms that underlie this relationship. It is imperative that these mechanisms are studied in order to advance from exploratory research to explanatory and translational research to enhance the ability to manipulate these factors to maximize the benefits of physical activity for breast cancer survivors.

**Current Physical Activity Recommendations for Breast Cancer Survivors**

In 2009, a panel of leading experts in physical activity and cancer survivorship convened to review the existing knowledge-base in regard to physical activity in cancer survivors and determine how the United States Department of Health and Human Services (USDHHS) Physical Activity Guidelines for Americans (2008) should be interpreted and altered for cancer survivors. As a result of this meeting, specific guidelines for cancer survivors were developed (Schmitz et al., 2010). In general, the guidelines state that all cancer survivors, including breast cancer survivors, should avoid inactivity and return to normal daily activities as soon as possible following surgery (Schmitz et al., 2010). Additionally, cancer survivors should strive to continue normal daily activities and exercise as much as possible during and after nonsurgical
treatments. For many breast cancer survivors, the goal may simply be to maintain or reduce the decline in physical activity levels that typically occur during certain treatment periods (Hayes, Spence, Galvão & Newton, 2009). Because breast cancer survivors may have very different treatment regimens, recommendations on the type, frequency, duration, and intensity of exercise should be individualized to the survivor’s age, previous fitness activities, type of breast cancer, stage of treatment, type of therapy, and comorbid conditions (Schmitz et al., 2010). Breast cancer survivors who are experiencing extreme fatigue, anemia or ataxia should not exercise (Schmitz et al., 2010). Additionally, individuals should avoid potentially compromising situations such as public facilities during periods of immunosuppression including during chemotherapy and radiation (Schmitz, 2010).

In regard to aerobic activity, the 2010 cancer-specific physical activity guidelines state that breast cancer survivors should follow the same recommendation as age-appropriate guidelines from the Physical Activity Guidelines for Americans (USDHHS, 2008) but should be especially aware of fracture risk (Schmitz et al., 2010). Schmitz and colleagues (2010) caution that exercise tolerance of individuals currently on treatment and immediately post-treatment may vary from exercise session to exercise session. Previous work by Courneya and colleagues (2002) and Hayes and colleagues (2009) suggested that deconditioned individuals or individuals experiencing severe side effects of treatment should combine short bouts of aerobic activity (e.g. 3 to 10 minutes) with rest intervals to achieve the public health recommendation for physical activity.

In regard to resistance training, breast cancer survivors should follow guidelines that are slightly altered compared to those for the general population. Specifically, breast cancer survivors should start with a supervised resistance training program of at least 16 sessions using
very low resistance and progress at small increments (Schmitz et al., 2010). Women should pay particularly close attention to arm and shoulder symptoms, including lymphedema, and reduce resistance or stop specific exercises according to symptom response (Schmitz et al., 2010). These guidelines caution that individuals should return to reduced levels of resistance following any breaks from resistance training of a week or more to avoid injury (Schmitz et al., 2010). There is no upper limit on the amount of weight to which breast survivors can progress.

In terms of other exercise, breast cancer survivors should follow the Physical Activity Guidelines for Americans (USDHHS, 2008) recommendations for flexibility training. Yoga and dragon boat racing are also deemed to be safe activities for breast cancer survivors as long as arm and shoulder morbidities are taken into consideration (Schmitz et al., 2010). There is currently no existing evidence regarding the safety of organized sport or Pilates for breast cancer survivors (Schmitz et al., 2010).

Physical Activity Participation in Breast Cancer Survivors

Trends in Physical Activity Participation

Studies of physical activity levels in breast cancer survivors’ pre- and post- diagnosis have exhibited that the majority of breast cancers experience a decline in physical activity following a breast cancer diagnosis. In a study examining physical activity participation from the point of breast cancer diagnosis to 3, 6, and 12 months post-surgery, it was found that physical activity levels experienced the sharpest declines 3 months post-surgery but started to rebound over the 12 month period (Devoogdt et al., 2010). However, post-surgery physical activity levels still remained significantly lower than pre-surgery levels at all time points (Devoogdt et al., 2010). Another study examining post-diagnosis physical activity found that physical activity levels decreased by 50% in the 12 months after diagnosis relative to pre-diagnosis (Littman,
Unfortunately, the change in physical activity levels exhibited in the year after diagnosis is often maintained several years post-diagnosis as the majority of breast cancer survivors do not meet the current public health recommendations for physical activity or the cancer specific recommendations. In a population based study of breast cancer survivors, only 32% met the recommendations of 150 minutes a week of any type of moderate or vigorous physical activity (Irwin et al., 2004). In another smaller sample, only 16% of the sample met the recommendation for vigorous physical activity and only 16% met the recommendation for moderate intensity physical activity (Pinto et al., 2002). In a population based study in Canada, obese breast cancer survivors were found to be less active than obese women without a history of breast cancer (Courneya, Katzmarzyk, & Bacon, 2008). Moreover, a large proportion of breast cancer survivors exhibit a significant increase in sedentary behaviors in conjunction with their decreased participation in physical activity (Irwin et al., 2004; Kendall et al., 2005), and individuals who were most active pre-diagnosis show evidence of experiencing the greatest declines in physical activity post-diagnosis (Irwin et al., 2003; Littman et al., 2010). Thus, although physical activity has been associated with improvements in QOL, survival, and psychological, emotional and physical well-being, physical activity levels tend to decline following a breast cancer diagnosis and few breast cancer survivors participate in physical activity on a regular basis.

Factors Related to Physical Activity Participation

Several factors may influence physical activity participation in breast cancer survivors. As a higher body mass index (BMI) and higher percentage of body fat have been related to an increased risk for breast cancer, one potential explanation for low levels of physical activity participation in breast cancer survivors is that these women may, simply, have been less active to
begin with. Thus, they would be unlikely to change their sedentary lifestyle after diagnosis. However, it is unlikely this is the sole explanation for the low levels of physical activity in breast cancer survivors. Therefore, numerous studies have been conducted to examine factors that may influence physical activity in breast cancer survivors. These studies have found that post-diagnosis physical activity levels are, in fact, associated with pre-diagnosis physical activity levels and BMI (Devoogdt et al., 2010; Hong et al., 2007; Irwin et al., 2004; Irwin et al., 2003; Pinto et al., 2002). However, findings from these studies have also uncovered that demographic factors (i.e. marital status, body mass index, race/ethnicity, education, age, employment status, Devoogdt et al., 2010; Hong et al., 2007; Irwin et al., 2004; Irwin et al., 2003; Littman et al., 2010; Pinto et al., 2002) disease specific factors (i.e. time since diagnosis, stage of disease; Hong et al., 2007; Irwin et al., 2004; Irwin et al., 2003; Pinto et al., 2002), psychosocial factors (i.e. social support, depressive symptoms, emotional well being, self-efficacy; Emery, Yang, Frierson, Peterson, & Suh, 2009; Rogers, McAuley, Courneya, & Verhulst, 2008) and physical health (Emery et al., 2009) are related to post-diagnosis physical activity participation suggesting that inactivity in breast cancer survivors is a multifaceted, complex problem that may not have a simple solution.

**Physical Activity Intervention Findings**

Interventions specifically designed with an increased physical activity as the primary outcome have met with mixed results in regard to their effectiveness at increasing participants’ physical activity to desired levels. Most of these interventions have adopted either a supervised to home-based tapered design (gradual weaning from supervised to home-based) or a combined supervised and home-based intervention design (both supervised and home-based sessions concurrently). Although most of these interventions are successful at increasing physical activity
levels above baseline, few are truly successful at getting participants to achieve the desired or recommended physical activity levels. For instance, in a 12 week supervised and home-based tapered walking intervention in sedentary breast cancer survivors, there was only a 25% increase in the number of individuals meeting the current public health recommendations of 150 minutes per week of physical activity (Rogers, Hopkins-Price, Vicari, Markwell et al., 2009). In another 6 month combined supervised and home-based program with physically inactive breast cancer survivors, 73% of the women achieved an increase in weekly physical activity of at least 80%, or 120 minutes, of the 150 minutes goal (Latka, Alvarez-Reeves, Cadmus, & Irwin, 2009). In an intervention utilizing standard public health recommendations and standard public health recommendations supplemented by print materials, pedometers, or a combination of both methods, physical activity increased by 70 to 89 minutes per week over the course of 12 weeks in the supplemented groups compared to a 30 minute increase with only a standard recommendation (Vallance et al., 2007). However, the sample was already relatively active with each group reporting an average of about 120 minutes of self-reported physical activity at baseline suggesting that the findings from this particular study may not be generalizable to the typical sedentary breast cancer survivor population. Hence, although these interventions appear to be successful at increasing physical activity levels, they very rarely are successful at assisting breast cancer survivors in achieving the public health physical activity recommendations.

Although interventions designed specifically to increase physical activity participation to public health recommendation levels are not always entirely effective, retention rates in most exercise outcome interventions for breast cancer survivors are relatively high with attrition rates averaging only about 14% (White et al., 2009). Breast cancer survivors have reported that having access to study staff, knowing study staff were expecting them to attend, being told
exactly what exercise to do, keeping exercise logs, seeing other participants complete the exercise, and attending group sessions were important to their compliance (Irwin et al., 2008). These women cited being given tangible incentives such as mugs or t-shirts and exercise equipment as not influencing their participation in the program (Irwin et al., 2008). In one study where participants were assigned to either an aerobic or resistance training arm, better adherence was associated with higher aerobic fitness, as measured by VO₂ peak, more advanced disease stage, and lower levels of depression (Courneya et al., 2008). None of the behavioral variables measured in that particular study (e.g. attitude, social support, perceived behavioral control, motivation) were predictive of adherence to the intervention. In another, home-based walking trial, self-efficacy was found to be the only significant predictor of meeting weekly exercise goals (Pinto, Rabin, & Dunsiger, 2009). Thus, several factors may influence the retention and adherence rates in physical activity trials in breast cancer survivors, although, these factors are not necessarily consistent across studies.

Whether low attrition and high intervention adherence rates translate into maintained physical activity participation post-intervention is unclear as data regarding adherence to physical activity post-intervention is limited. However, a few studies have examined factors related to physical activity levels post intervention. In a 6 month follow-up study on breast cancer survivors originally assigned to one of four groups (standard recommendation or standard recommendation supplemented by print materials, pedometers, or a combination of both) meeting public health physical activity recommendations was associated with demographic variables (e.g. younger age, married, higher education), meeting public health physical activity recommendations at baseline and post-intervention, and behavioral constructs (attitude, self-efficacy, controllability, intention, and planning; Vallance, Courneya, Plotnikoff, Dinu, &
Mackey, 2008; Vallance, Plotnikoff, Karvinen, Mackey & Courneya, 2010). However, meeting physical activity recommendations was not associated with treatment modalities, disease characteristics, health status or fatigue (Vallance et al., 2010). In another study, physical activity levels post-intervention were significantly correlated with psychosocial factors and treatment related side effects such as fatigue, QOL, anxiety and self-esteem (Courneya et al., 2009). Thus, even if researchers are able to successfully change physical activity behavior and retain people in physical activity interventions, it may not translate into the long-term maintenance of participation in physical activity as other factors may influence long-term physical activity adherence. As breast cancer is not a disease with definitive risk factors and not all breast cancer survivors receive the same exact treatment plan or respond to treatment in the same way, the relationship between breast cancer and physical activity is complex with many potential factors influencing participation and maintenance of physical activity during and after treatment.

Application of Social Cognitive Theory for Understanding Physical Activity Behavior in Breast Cancer Survivors

Social Cognitive Theory Overview

One theoretical framework that may be useful for understanding and explaining physical activity behavior in breast cancer survivors is Social Cognitive Theory (SCT; Bandura, 1986, 2004). SCT is well recognized as a useful framework for the design of physical activity interventions (McAuley & Blissmer, 2000). SCT explains human behavior in terms of a triadic, dynamic, and reciprocal model in which behavior, personal factors, and environmental influences all interact (Bandura, 1986). SCT conceptualizes the person as an active agent in control of his or her own life and views behavior as dynamic. The constructs included as
behavioral predictors in SCT include: self-efficacy, outcome expectations, sociocultural factors and goals.

Most models of health behavior focus on predicting health habits. Although components from these models may overlap with SCT constructs, many of the seemingly additional constructs in these models are really just different types of outcome expectations. For example, in the health belief model, perceived severity and susceptibility to disease are really expected negative physical outcomes. Attitudes in the theory of planned behavior are defined as perceived outcomes and the value placed on those outcomes. As such, these are essentially outcome expectations. Additionally, in the theory of planned behavior, norms are defined as perceived social pressures and one’s motivation to comply with them. Thus, norms are synonymous with social outcome expectations. Other overlapping constructs include goals and intentions whereby intentions are essentially proximal goals. Perceived control in the theory of planned behavior also overlaps with perceived self-efficacy. Regression analyses (Dzewaltowski et al., 1990) have revealed substantial redundancy between predictors bearing the different names. For example, after controlling for the contributions of self-efficacy and self-evaluative reactions, neither intentions nor perceived behavioral control, added any additional predictiveness.

SCT is unique compared to other theories of health behavior in that it specifies a core set of determinants, the mechanisms through which they work and the optimal ways of translating this knowledge into effective practice rather than simply focusing on predicting health habits (Bandura, 2004). SCT offers predictors and principles on how to inform, enable, guide and motivate people to adapt habits that promote engagement in a particular behavior and reduce those that impede it and do not just focus on factors that predict health behaviors (Bandura, 2004). Thus, SCT provides a comprehensive framework by which to understand not only what
factors influence physical activity behavior, but provides insight to how these factors can be manipulated in order to change physical activity behavior which is an area in which other health behavior theories may fall short.

*Self-efficacy*

Self-efficacy is the primary construct in SCT and has implications for both the initiation and maintenance of a behavior. Self-efficacy expectations encompass an individual’s beliefs in one’s capabilities to successfully execute a task and have been consistently identified as a correlate of physical activity adoption and maintenance (McAuley & Blissmer, 2000; Trost, Owen, Bauman, Sallis, & Brown, 2002). Unless individuals believe they are capable of producing the desired effects of their actions, there is little incentive to act or persevere in the face of adversity (Bandura, 2000). There are four sources of efficacy information: mastery experiences, social modeling, social persuasion, and the interpretation of physiological and emotional responses (Bandura, 1997). The relationship between self-efficacy and behavior is reciprocal such that higher levels of self-efficacy have been associated with greater participation in physical activity and greater participation in physical activity has been associated with higher levels of self-efficacy (McAuley & Blissmer, 2000). Despite the high level of influence self-efficacy exerts on behavior, it is not the only determinant specified by SCT, although it is the most frequently studied. In fact, SCT postulates that self-efficacy has both direct and indirect effects on behavior. For example, individuals with higher levels of self-efficacy have more positive expectations about what the behavior will bring about, set higher goals for themselves, and are more likely to believe they are capable of overcoming difficulties and barriers with effort and coping skills which, in turn, will influence participation in a particular behavior (Bandura, 2004). Thus, it is also important to examine the indirect relationships between self-efficacy,
physical activity and the other SCT constructs over time (outcome expectations, goals, and sociocultural factors; see Figure 1), especially in breast cancer survivors because of the complex psychological, emotional, and physical side effects associated with diagnosis and treatment.

*Outcome Expectations*

Outcome expectations reflect beliefs that a given behavior will produce a specific outcome and higher outcome expectations have been associated with greater physical activity participation (Stewart & King, 1991; Williams, Anderson, & Winett, 2005). Outcome expectations lie along three related, but conceptually independent, subdomains representing physical, social, and self-evaluative outcome expectations (Bandura, 1997). Physical outcome expectations for physical activity reflect beliefs about pleasant and aversive physical experiences resulting from engagement in physical activity. Social outcome expectations reflect beliefs about physical activity resulting in increased opportunities for socialization and attaining social approval. Finally, self-evaluative outcome expectations capture beliefs relative to the feelings of satisfaction and self-worth associated with involvement in physical activity. The three types of outcome expectations may mediate the relationship between self-efficacy and physical activity and may also be directly related to physical activity participation such that higher outcome expectations result in increased physical activity participation (Bandura, 2000). It is also important to note that the three types of outcome expectations may be differentially related to physical activity participation in different populations (Wojcicki, White, & McAuley, 2009).

*Goals*

Goals are powerful motivators and are important for focusing and directing activity and increasing and directing effort. Process goals, or those focused on aspects of the physical activity program that are directly under an individual’s control (i.e. frequency of participation, intensity,
etc) have been shown to be more effective for behavior change than outcome goals (i.e. weight loss). Additionally, goals set within a specific time frame (i.e., short- or long-term) have been shown to be more effective than those without a specific endpoint as the specified timeframe can serve as a checkpoint to evaluate progress and set new goals. Long-term goals (e.g., next six months or year) help individuals keep the big picture in mind, whereas short-term goals focus on the near future (e.g., current day, week, or month) and are critical for maintaining high levels of motivation and bolstering self-efficacy. Increased frequency of goal setting has exhibited a relationship with increased use of behavioral strategies for engaging in physical activity (Nothwehr & Yang, 2007) and setting higher goals has been associated with greater increases in physical activity participation (Dishman, Vandenberg, Motl, Wilson, & DeJoy, 2009). Additionally, self-regulation, or the ability to monitor behavior in order to achieve goals, has also been shown to be associated with regular exercise participation (Umstattd & Hallam, 2007; Son et al., 2009).

**Sociocultural Factors**

Sociocultural factors are barriers or facilitators to participation in physical activity. Potential individual barriers or facilitators to physical activity participation in breast cancer survivors include: demographics, disease characteristics, fatigue, lack of interest, social support, treatment status, depression, functional status, feeling sick, or lack of time (Courneya & Friedenreich, 1998; Courneya et al., 2008; Perna, Craft, Carver, & Antoni, 2008; Rogers, Courneya, Shah, Dunnington, & Hopkins-Price, 2006). These factors may vary considerably in breast cancer survivors, and in their contribution to physical activity levels depending on the point along the cancer continuum a survivor resides (during treatment, recovery/rehabilitation or palliation). Other potential barriers to physical activity for breast cancer survivors include the
fact that physical activity is not part of the current breast cancer treatment regimen; most medical insurance programs do not cover any type of physical activity counseling for breast cancer survivors; and breast cancer survivors may be confused about the benefits of participation (Irwin, 2009). Low levels of barriers coupled with high levels of social support could act as potential facilitators to participation in physical activity by breast cancer survivors (Rogers et al., 2008).

Tests of Social Cognitive Theory and Physical Activity

Only a few studies have attempted to incorporate more than one SCT construct into models predicting physical activity behavior. For example, Rovniak and colleagues (2002) found a longitudinal SCT model incorporating outcome expectations, self-efficacy and self-regulation with social support acting as a moderator accounted for 55% of the variance in physical activity. In another study by Anderson and colleagues (2010), 36% of the effect of an on-line intervention on physical activity behavior was explained by a SCT model that tested the relationship of all model constructs (self-regulation, outcome expectations, and social support) to one another and to physical activity. Plotnikoff and his colleagues (2008) tested the effect of baseline SCT variables on 6 month physical activity behavior using the paths specified by Bandura (2004) in individuals with type I and type II diabetes. These models accounted for 14% and 9% of the variance in physical activity in type I and type II diabetes, respectively, and exhibited support for all of the specified relationships except for the direct effect of baseline outcome expectations on 6 month physical activity. Suh and colleagues (in press) specifically tested the social cognitive pathways proposed by Bandura in a cross-sectional sample of adults with relapsing-remitting multiple sclerosis using disability limitations as a measure of impediments. The findings from this study showed that self-efficacy indirectly influenced physical activity via impediments, goals, and self-evaluative outcome expectations, but that it did not directly influence physical
activity participation (Suh, Weikert, Dlugonski, Sandroff, & Motl, in press). Overall, this model accounted for 40% of the variance in self-reported physical activity among individuals with relapsing-remitting MS (Suh et al., in press).

Breast Cancer Survivors

Few studies exist which have specifically examined physical activity in breast cancer survivors from a social cognitive perspective. Rogers and colleagues (2005) examined the relationship between self-efficacy and physical activity behavior in rural breast cancer survivors and found that higher daily energy expenditure was significantly associated with higher barrier self-efficacy, higher task self-efficacy, having an exercise partner, having an exercise role model, and higher physical activity enjoyment. Thus, it appears that various types of self-efficacy may be correlated with physical activity behavior in breast cancer survivors. However, the majority of the measures used in this study were not standardized measures, and it is important to replicate and expand on these findings using measures with established psychometric characteristics. In another study, Rogers and her colleagues (2008) examined the correlates of self-efficacy for physical activity in breast cancer survivors reporting significant correlations between barrier self-efficacy and perceived physical activity barriers, fatigue, social support, enjoyment, and pre-diagnosis physical activity. In this same study, pre-diagnosis physical activity, social support, and barrier self-efficacy were directly associated with current physical activity levels further providing rationale for examining the use of SCT to understand physical activity behavior in breast cancer survivors (Rogers et al., 2008). Findings from these studies provide at least some preliminary evidence to suggest the utility of SCT, particularly self-efficacy, for explaining physical activity behavior in breast cancer survivors. However, as previously noted, Bandura has argued that self-efficacy has a number of indirect associations with behavior (Bandura, 2004).
That is, more efficacious individuals have more positive outcome expectations about the behavior in question (e.g., physical activity will make me stronger and feel less tired), perceive environmental barriers to be surmountable (e.g., I can structure my day differently to incorporate my physical activity routine), and set realistic, challenging, and modifiable goals for the behavior in question. To date, these indirect relationships have received very little attention and examination in the physical activity literature, in general, and particularly, in breast cancer survivors. It is important to determine how these constructs operate in the context of changing physical activity behavior in breast cancer survivors as they are all potentially modifiable constructs and could be manipulated to enhance initiation and maintenance of physical activity in this population.

**Breast Cancer Treatment and Quality of Life**

**Overview**

The majority of women diagnosed with breast cancer undergo treatments including surgery, chemotherapy, radiation therapy, and hormone therapy which can alone, and in combination, produce negative side effects including fatigue, sexual dysfunction, lymphedema, nausea, weight gain, menopausal symptoms, disturbed body image and self-concept, anxiety, depression, and cognitive dysfunction (Hewitt, Herdman, & Holland, 2004; Shapiro & Recht, 2001). In addition, breast cancer survivors, in general, tend to report poorer health related outcomes than non survivors. For instance, breast cancer survivors often report significantly lower levels of health related quality of life than non-cancers survivors (Baker, Haffer, & Denniston, 2003). Breast cancer survivors also tend to have poorer physical health and slightly more functional problems than women who have never been diagnosed with cancer (Dorval, Maunsell, Deschênes, Brisson, & Mâsse, 1998). Furthermore, breast cancer survivors are more
likely to report having a medical condition that limits their daily activities as well as higher rates of pain and physical symptoms than healthy women (Ganz, Rowland, Desmond, Meyerowitz, & Wyatt, 1998). Over one-third of survivors are estimated to experience some form of distress at some point post-diagnosis (Hewitt et al., 2004; Zabora, BrintzenhofeSzoc, Curbow, Hooker, & Piantadosi, 2001). Although it has been suggested that treatment related side effects may be solely responsible for poor psychosocial functioning (Cadmus et al., 2009), these side effects may also be influenced, or potentially compounded, by the high levels of distress experienced by breast cancer survivors following their diagnosis.

*Prevalence of Treatment Related Side Effects in Breast Cancer Survivors*

The experience of negative treatment related sides effects is highly prevalent in breast cancer survivors. An estimated 70% to 99% of breast cancer patients experience fatigue during treatment (de Jong, Courtens, Abu-Saad, & Schouten, 2002). Prevalence rates of sexual dysfunction range from 15% to 64% in breast cancer survivors (Thors, Broeckel, & Jacobsen, 2001) and between 12.5% (Kwan et al., 2002) and 30% (Deo et al., 2009; Ozaslan & Kuru, 2004) of women experience lymphedema. Estimates of the prevalence of nausea in breast cancer survivors range as high as 57% (Andrykowski et al., 1988). Significant weight gain occurs in 10% (Ingle, Mailliard, & Schaid, 1991) to 96% (Demark-Wahnefried, Winer, & Rimer, 1993) of women with early-stage breast cancer depending on the type of treatment received. Menopausal symptoms are experienced by between 60% and 77% (Canney & Hatton, 1994; Carpenter & Andrykowski, 1999; Harris, Remington, Trentham-Dietz, Allen, & Newcomb, 2002) of breast cancer patients. Disturbed body images is experience by up to 50% of breast cancer survivors (Fobair et al., 2005), and up to 58% (Massie, 2004) of women diagnosed with breast cancer are estimated to experience depressive symptoms. Finally, an estimated 17% to 35% of women
Impact of Treatment Related Side Effects

Breast cancer treatment related side effects can result in a host of deleterious outcomes including poorer disease related outcomes and reduced quality of life. For instance, breast cancer survivors who experience depression secondary to their disease diagnosis have been found to have an increased risk of morbidity and mortality (Gallo et al., 2007; Spiegel & Giese-Davis, 2003). Additionally, women who gain more weight as a result of treatment have also exhibited a greater risk of recurrence (Chlebowski, Aiello, & McTiernan, 2002; Kroenke, Chen, Rosner, & Holmes, 2005) and early mortality (Chlebowski et al., 2002; Enger, Greif, Polikoff, & Press, 2004; Kroenke et al., 2005) which could negatively impact quality of life (Arndt, Merx, Stegmaier, Ziegler, & Brenner, 2005). Treatment related side-effects are also often linked to important elements of health-related quality of life including poor physical functioning and emotional well-being (Ganz et al., 2004). Studies have suggested that deficits in QOL in breast cancer patients and survivors may differ according to a variety of factors including age, education, income and race/ethnicity. For example, Ganz and her colleagues (2004) found that African American women, women who were married or partnered, and women with better emotional and physical functioning reported better QOL whereas women who reported greater vulnerability had poorer QOL. Additionally, women with a lower level of education also report
lower levels of quality of life (McBride, Clipp, Peterson, Lipkus, & Demark-Wahnefried, 2000). Research also suggests that younger women may experience the largest deficits in functioning and health-related QOL as a result of their breast cancer diagnosis (Ganz et al., 2004; Kroenke et al., 2004).

**Persistence of Treatment Related Side Effects**

Research on longer-term breast cancer survivors has, unfortunately, revealed that many treatment related side effects do not necessarily diminish post-treatment. Although some are short lived, many have been shown to persist, or even increase, several years’ post-diagnosis (Ganz et al., 2002). Some side effects of breast cancer treatment may even be permanent or may not manifest until months or years after treatment (Aziz & Rowland, 2003). For example, it has been reported that greater than 50% of breast cancer survivors continue to suffer fatigue post-treatment (Kim et al., 2008; Okuyama et al., 2000) and lymphedema may persist even up to 20 years post-diagnosis (Petrek, Senie, Peters, & Rosen, 2001). It has been theorized that the most universal and lasting effect of having cancer is most likely the fear of cancer recurrence (Dunkel-Schetter, Feinstein, Taylor, & Falke, 1992). Hence, researchers have proposed that follow-up care for cancer survivors should include more than just the typical monitoring for cancer recurrence and should, instead, address some of these potentially longer-term treatment-related side effect (Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005; Pollack et al., 2005). With the an increasing number of women surviving breast cancer for longer periods of time, issues concerning QOL during and after cancer treatment have become increasingly important. Additional research needs to be conducted to explore behaviors, services and treatment modalities that help prevent recurrence and maximize breast cancer survivors’ QOL.
**Conceptualization of Quality of Life**

In mainstream psychology, QOL is defined as a conscious cognitive judgment of satisfaction with one’s life (Diener, 1984). However, over the years, QOL has been conceptualized in several different ways. Early methods of QOL assessment used morbidity and mortality indices as QOL indicators. As such, life expectancy and the absence of disease were considered markers of QOL. Another common approach to the examination of QOL, especially in the medical literature, is to use QOL as an umbrella term under which different health outcomes and health status fall. QOL has also been inferred through assessments of other indices such as self-esteem, physical functioning, depression and anxiety or through the absence of negative affect (Diener, Napa Scollon, & Lucas, 2009). Although the relationship between physical activity and quality of life has been studied quite extensively, the lack of a common precise operational definition of QOL has been identified as a major barrier to advancing knowledge in this area (Rejeski & Mihalko, 2001). In defining QOL, it is important to realize that a true conceptualization must take into consideration both the subjective nature of the evaluation of QOL and the comparative process of one’s current life with some personally identified criteria (Trine, 1999). Unfortunately, the majority of the conceptualizations and definitions of QOL in the general physical activity literature fail to do so, and this approach is also almost non-existent in the breast cancer and physical activity literature.

**Physical Activity and Health-Related Quality of Life**

Early conceptualizations of the relationship between QOL and physical activity presented QOL as two broad categories, functioning and well-being, with each category encapsulated a number of more specific QOL outcomes (Stewart & King, 1991). Physical abilities, dexterity, cognition and the ability to perform activities of daily living were listed as subcategories of
functioning while symptoms, bodily states, emotional well-being, self-concept, and global perceptions related to health and overall life satisfaction were listed as subcategories of well-being. This model was rooted in the Health Related Quality of Life (HRQOL) framework provided by the Medical Outcomes Study (Tarlov et al., 1989). In this framework, QOL is considered a multidimensional, or umbrella, construct that describes health outcomes or health status indicators such as physical, social, psychological, and spiritual well-being. Defining QOL as HRQOL is one of the most frequently adopted approaches in the biomedical and behavioral medicine literature with the 36-item Short Form Health Survey (SF-36; Ware & Sherbourne, 1992) and its derivatives representing the most common multidimensional measure of HRQOL.

Conceptualizing QOL as HRQOL has also been the most frequently adopted approach in the physical activity and breast cancer literature with HRQOL and disease-specific QOL measures being the most commonly used. These include the SF-36 (Ware & Sherbourne, 1992), Functional Assessment of Cancer Therapy-General (FACT-G; Cella et al., 1993) or the Functional Assessment of Cancer Therapy-Breast (FACT-B; Brady et al., 1997). It is important to note, however, that general measures such as the SF-36, were developed as measures of health status rather than QOL which may be especially problematic when trying to make inferences and consensus statements regarding physical activity and quality of life in the both the general population and breast cancer survivors. Although physical and mental health status are each significantly associated with global measures of QOL, these constructs are conceptually and theoretically independent (McAuley et al., 2008; McAuley, Konopack, Motl et al., 2006).

*Physical Activity and Global Quality of Life*

Another approach to conceptualizing QOL in the physical activity literature (McAuley, Konopack, Motl et al., 2006) is through the adoption of Diener’s (1984), position that QOL
reflects a cognitive judgment of an individual’s life and, thereby, represents a more global construct. In this approach, HRQL is viewed as a more proximal outcome of physical activity participation and is proposed to act as a mediator of the relationship between physical activity and global QOL (McAuley et al., 2006). McAuley and his colleagues (2006) conducted a 24-month longitudinal test of this position in a sample of older women. Their findings indicated that changes in physical activity over time were associated with residual changes in self-efficacy, a very proximal outcome of physical activity. Changes in self-efficacy were then significantly associated with residual changes in physical and mental health status and changes in mental health status were significantly related to residual changes in global QOL. This model supports the perspective that the relationship between physical activity and QOL may be mediated by factors more proximal to physical activity participation. Furthermore, this model has been supported in another sample of older adults (White, Wojcicki & McAuley, 2009) and in individuals suffering from multiple sclerosis (Motl, McAuley, Snook, & Gliottoni, 2009) suggesting it has the potential to be a useful model for understanding the relationship between QOL and physical activity in breast cancer survivors. Application of such a model to examine the relationship between physical activity and QOL in breast cancer survivors would represent a unique theoretical contribution to this literature, as few studies in the breast cancer literature report data to explain the mechanisms underlying physical activity’s influence on QOL. Additionally, expanding the QOL model to include other health status indicators such as social well-being, functional well-being and breast cancer specific symptoms and side effects could enhance the understanding of the relationship between QOL in breast cancer survivors and other populations. This model is presented in Figure 2.
The Present Study

A 6-month prospective study design examined the effectiveness of social cognitive constructs for explaining physical activity behavior and its effects on quality of life in a representative sample of breast cancer survivors. Data were collected at baseline and at six months and the hypothesized relationships among SCT constructs and physical activity and physical activity and QOL were simultaneously analyzed using a panel model within a covariance framework. Additionally, this study served to identify factors which may be associated with changes in both psychosocial and disease specific outcomes and physical activity participation across time and the spectrum of survivorship.
Chapter III: Methods

Participants

Participants were female breast cancer survivors over the age of 18. Participants were recruited via the Army of Women®, university email lists, and on-line postings. After participants’ expressed an initial interest in participation, they were contacted via e-mail or telephone, depending on their personal preference, to verify contact information and desire to participate in the study. Individuals recruited through the Army of Women® received a subscribed e-blast with information regarding the study and contacted the Army of Women® directly to express their initial interest in study participation. The Army of Women® then forwarded contact information for all eligible participants who consented to having their contact information released to study investigators. The study investigators then contacted these women to screen for eligibility criteria and further willingness to participate.

The response to recruitment materials was greater than expected as 2,546 women contacted study investigators expressing an initial interest in participating in the present study. Of those individuals who expressed an initial interest in participating in the study, 1,631 (64%) qualified to participate. Because of the large number of women still interested in participating, 500 of these individuals were randomly to participate in the current study. All other individuals were extended an offer to participate in another, similar study. Accelerometers and survey links were sent to 500 women at baseline. However, for the purposes of these analyses, only those women who had a minimum of 3 valid days of accelerometer data at both time points were included resulting in a total sample of 370 breast cancer survivors.

Inclusionary Criteria

Given that breast cancer is the focal aspect of this study and the majority of breast cancer
survivors are female, only women over the age of 18 who had been diagnosed with breast cancer were eligible to participate in this study. As all study materials were in English, participants were also required to be English speaking. Additionally, because all questionnaires were electronic, women had to have access to a computer. Women from diverse racial, ethnic and socio-economic backgrounds were encouraged and aggressively recruited to participate.

**Exclusionary criteria**

Women who were not over the age of 18, did not speak English, did not have access to a computer or had not been diagnosed with breast cancer were excluded from participation in this study. There was no limit on the time since breast cancer diagnosis, stage of disease, recurrence, or second cancer. However, these constructs were assessed and used as possible covariates in the panel model analyses.

**Measures**

*Demographic and participant information*

Basic demographic information was collected including marital status, number of children, age, date of birth, occupation, income, and education.

*Health History*

Participants’ were asked to indicate (yes or no) whether or not they have been diagnosed with a list of 18 different comorbidites (i.e. diabetes, obesity, high cholesterol). Additionally, participants’ current height and weight was assessed in order to calculate their body mass index (BMI). Current and past smoking habits were assessed as well as current alcohol consumption.

*Breast Cancer History*

Participants were asked to report information regarding their breast cancer history including: diagnosis information (i.e. date, age at diagnosis, cancer stage, estrogen receptor...
status), treatment status/regimen, family history of breast or other cancer, menopausal status, and recurrence history. Cancer history, including any other cancer diagnoses was also collected.

Physical Activity

Physical activity was measured as a latent variable using both a self-report and objective measure of physical activity participation.

Self-reported physical activity. The Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985) was used to assess current levels of self-reported physical activity. The GLTEQ is a simple, self-administered instrument assessing usual physical activity during the past seven days and has been widely used in epidemiological, clinical, and behavioral change studies and. The first set of questions are open-ended and asked participants to indicate the frequency of their participation in strenuous (e.g., jogging), moderate (e.g., fast walking), and mild (e.g., easy walking) exercise for periods of more than 15 minutes. The second set of questions asked participants to indicate the average duration each time they exercised. The weekly frequencies of strenuous, moderate, and mild activities were multiplied by 9, 5, and 3 metabolic equivalents, respectively, and summed to form a measure of total leisure time activity. The GLTEQ has been shown to be both a valid and reliable measure of physical activity participation (Godin & Shephard, 1985).

Accelerometer. In addition to self-reported physical activity, physical activity was assessed by accelerometry. The Actigraph accelerometer (model GT1M version, Health One Technology, Fort Walton Beach, FL) is a small (1.5 x 1.44 x .70 in) and lightweight (27 grams) device. It is powered by a rechargeable lithium polymer battery capable of over 14 days use without recharging. Participants were instructed to wear the monitor for seven consecutive days on the non-dominant hip, under clothing, and fastened to a belt worn around the waist during all
waking hours, except for when bathing or swimming. Participants were provided with detailed instructions for wearing the accelerometer and a log for recording when they started and stopped wearing the accelerometer each day. Activity data was collected in one-minute intervals (epochs). For the purposes of this study, a valid day of data consisted of an individual wearing the monitor for at least 10 valid hours with a valid hour being defined as no more than 30 minutes of consecutive zeros. The total number of counts for each valid day was summed and divided by the number of days of monitoring to arrive at an average number of activity counts. Only data for individuals with a minimum of 3 valid days of wear time were included in analyses as this has been identified as the minimum threshold for estimating habitual physical activity in adults (Trost, McIver & Pate, 2005).

In comparisons with other activity monitors, the Actigraph demonstrates acceptable reliability and validity among young and middle-aged adults (Bassett et al., 2000; Hendelman, Miller, Baggett, Debold, & Freedson, 2000; Matthews, Ainsworth, Thompson, & Bassett 2002; Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002). The casing of the accelerometer is relatively bland and does not provide any feedback to participants on their activity levels. Therefore, unlike a pedometer which would provide visual feedback, the accelerometer was unlikely to have a reactivity effect prompting participants to be more physically active.

Self-efficacy

Two measure of self-efficacy were collected to obtain a latent self-efficacy construct. The six-item Exercise Self-Efficacy Scale (EXSE; McAuley, 1993) was used to assess participants’ beliefs in their ability to exercise five times per week, at a moderate intensity, for 30 or more minutes per session at two week increments over the next 12 weeks. For each item, participants indicated their confidence to execute the behavior on a 100-point percentage scale comprised of
10-point increments, ranging from 0% (not at all confident) to 100% (highly confident). The Barriers Self-Efficacy Scale (BARSE; McAuley, 1993) was used to assess participants’ perceived capabilities to exercise three times per week for 40 minutes over the next two months in the face of commonly identified barriers to participation. For each item, participants indicated their confidence to execute the behavior on a 100-point percentage scale comprised of 10-point increments, ranging from 0% (not at all confident) to 100% (highly confident). Total strength for each measure of self-efficacy was then calculated by summing the confidence ratings and dividing by the total number of items in the scale, resulting in a maximum possible efficacy score of 100. Both measures have been used widely in the physical activity and social cognitive literature (Duncan & McAuley, 1993; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003). The reliability of these measures was excellent in this sample both at baseline (α= 0.99 for EXSE; α= 0.95 for BARSE) and follow-up (α= 0.95 for EXSE; α= 0.99 for BARSE).

**Outcome Expectations**

The fifteen-item Multidimensional Outcome Expectation for Exercise Scale (MOEES; Wojcicki et al., 2009) was used to assess participants’ social (4 items), self-evaluative (5 items), and physical (6 items) outcome expectations for exercise. This scale asked participants to indicate how strongly they agreed with each statement on a 5 point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The MOEES has been shown to be valid and demonstrate high internal consistency (Wojcicki et al., 2009). Example social outcome expectation items include: “Exercise will make me more at ease with people” and “Exercise will provide companionship”. Example self-evaluative outcome expectation items include: “Exercise will give me a sense of personal accomplishment” and “Exercise will improve my psychological state”. Example physical outcome expectation items include: “Exercise will improve my overall
body functioning” and “Exercise will aid in weight control”. Scores range from 4 to 20, 5 to 25, and 6 to 30 on the social, self-evaluative and physical outcome expectations subscale, respectively. The reliabilities of these subscales was high in this sample with values of 0.84, 0.88, and 0.93 at baseline and 0.86, 0.92, and 0.93 at follow-up for the social, self-evaluative, and physical outcome expectations subscales, respectively.

Goals

The Exercise Goal Setting Scale (EGS; Rovniak, Anderson, Winett, & Stephens, 2002) was used to assess participants’ goal setting for physical activity participation. It is a 10-item scale that includes items related to goal setting, self-monitoring, and problem solving. Participants were instructed to indicate the extent to which each of the statements describes them on a scale from 1 (does not describe) to 6 (describes completely). Example items include: “I often set exercise goals” and “I usually keep track of my progress in meeting my goals”. All items are summed and divided by 10 to achieve a possible score ranging from 1 to 6. Scores on the EGS range from. The reliability of the EGS in the current sample was excellent at baseline ($\alpha=0.94$) and follow-up ($\alpha=0.95$).

Facilitators/ impediments

Fatigue. Fatigue was assessed using the Fatigue Symptom Inventory (FSI; Hann et al., 1998). Fatigue has been found to be a common and persisting side effect of breast cancer treatments which may influence participation in physical activity with higher levels negatively influencing physical activity participation (Bower et al., 2000). The FSI is a 14 item measure used to assess the severity, frequency, and diurnal variation of fatigue, as well as its perceived interference with quality of life. Fatigue severity was measured using four individual items that assessed current fatigue and most, least, and average fatigue over the past week on a scale from 0
(not at all fatigued) to 10 (as fatigued as I could be). Items from this subscale are averaged to obtain a total fatigue score ranging from 0 to 10. Fatigue frequency was measured using two separate items that assessed the number of days in the past week from 0 to 7 that respondents felt fatigued as well as the portion of each day, on average, they felt fatigued on a scale from 0 (none of the day) to 10 (the entire day). These two items were then averaged to obtain a fatigue frequency score ranging from 0 to 8.50. Diurnal variation in fatigue was measured using a single 5-point item that provided descriptive information about daily patterns (e.g., worse in the morning; worse in the evening). Perceived fatigue interference was measured using seven items that assessed the degree to which fatigue in the past week was judged to interfere with general level of activity, ability to bathe and dress, normal work activity, ability to concentrate, relations with others, enjoyment of life, and mood on a scale from 0 (no interference) to 10 (extreme interference). The interference ratings were then averaged to yield a total interference score ranging from 0 to 10. A latent fatigue variable was formed using each of the three subscales as indicators. The reliability of each of the subscales was excellent at both baseline (α= 0.89 for severity; α= 0.94 for interference and α= 0.77 for duration) and 6 months (α= 0.91 for severity; α= 0.95 for interference and α= 0.81 for duration).

Social Support. The Social Support for Exercise Scale (SSE; Sallis, Grossman, Pinski, Patterson, & Nader, 1987) is a 10-item scale that assesses the degree to which friends and family have demonstrated verbal and behavioral support for exercise behaviors in the previous 3 months. The frequency for each of the 10 items was rated twice, once for family members and once for friends. A 5-point Likert scale, ranging from 1 (never) to 5 (very often), was used. Example items include “exercised with me,” and “gave me helpful reminders to exercise.” The 10 items from each of the subscales were added to obtain total scores ranging from 10 to 50. The
reliability of each of the subscales was excellent in the present study. ($\alpha = 0.92$ for friend; $\alpha = 0.92$ for family) at baseline and 6 months ($\alpha = 0.92$ for friend; $\alpha = 0.93$ for family).

**Quality of Life**

*Health-related quality of life.* Health-related quality of life was assessed using the Functional Assessment of Cancer Therapy- Breast (FACT-B; Brady et al., 1997). The FACT-B is a 37-item scale that has five subscales: psychological well-being (PWB), social/family well-being (SWB), emotional well-being (EWB), functional well-being (FWB), and other concerns that are breast cancer specific (BCS). The scale asked individuals to indicate how true each of the statements had been for them over the last 7 days on a five-point Likert-scale ranging from 0 (*not at all true*) to 4 (*very much true*). Each of the subscales was treated as a distinct manifest indicator of health-related quality of life in the hypothesized QOL model. Subscale scores were calculated by multiplying the sum of the items from each subscale by the number of items in the subscale and then dividing by the number of items answered with higher scores indicating better QOL. Scores for the PWB, SWB and FWB subscales ranged from 0 to 28. Scores on the EWB subscale range from 0 to 24, and scores on the BCS subscale range from 0 to 36. A total score can be obtained by adding all of the items together. The internal consistency of the majority of the FACT-B subscales in this sample were relatively high at baseline ($\alpha = 0.83$ for PWB, $\alpha = 0.83$ for FWB, $\alpha = 0.84$ for SWB, $\alpha = 0.80$ for EWB) and 6 months ($\alpha = 0.84$ for PWB, $\alpha = 0.84$ for FWB, $\alpha = 0.894$ for SWB, $\alpha = 0.76$ for EWB). However, the internal consistency for the BCS was only moderate at both baseline ($\alpha = 0.54$) and follow-up ($\alpha = 0.59$).

*Global quality of life.* In addition to the FACT-B, the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985) was utilized to assess global life satisfaction. The Satisfaction with Life Scale is a 5-item scale that asked participants to rate how much they
agreed with each statement on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Items from the SWLS are summed to obtain a total score ranging from 5 to 35 with higher scores representing greater life satisfaction. This measure has been shown to be a valid and reliable measure of global life satisfaction (Pavot, Diener, Colvin, & Sandvik, 1991). The items from the SWLS were used as indicators for a latent global quality of life construct. The SWLS had high internal consistency (α = 0.91) at baseline and follow-up (α = 0.92) in the present study.

*Procedure*

*Study Recruitment and Randomization*

Participants were recruited utilizing the Army of Women, University e-mail, fliers, print media, and community groups and postings. All recruitment materials were approved by the university institutional review board for content. Because the response from Army of Women members was much higher than anticipated, the study investigators decided to randomly select 500 women from all interested women to participate in the current study. All other women were offered an opportunity to participate in another study with the same basic eligibility criteria. Any woman interested in the study was sent a link to a website that provided a full description of the study and details on study randomization. If interested, participants were asked to answer questions to determine their eligibility. If eligible, participants were extended an offer to participants and an electronic version of the University of Illinois Institutional Review Board approved informed consent which was required to be completed before proceeding further. Qualified participants were randomized into the two studies and informed of which study they would be participating in via e-mail.

*Data Collection*

After participants expressed an initial interest in participating in the study, qualified for
participation, consented to participation and were randomized, a study packet was prepared for them that contained an accelerometer, accelerometer record of use form, accelerometer instructions, mailing checklist and a self-addressed stamped envelope. When the study packet was placed in the mail, participants were sent an e-mail containing notification that their accelerometer was en route as well as a link to an electronic version of the study questionnaires. Participants were instructed to wear the accelerometer according to the instructions provided for seven consecutive days and to complete the daily record of use form indicating when they started and stopped wearing the accelerometer each day. Participants were also instructed to complete the on-line questionnaire and mail the accelerometer and record of use form back to the study investigators in the self-addressed stamped envelope provided within two weeks of their receipt. Accelerometer reminder e-mails were sent to participants on the last day they were supposed to be wearing the monitor, and additional e-mails or calls were made if their packets were not returned within two weeks. Reminder calls and e-mails continued until the accelerometer was returned to the study investigators. Participants were sent a study update after all baseline data were collected to maintain contact and remind them of six month testing. No other contact was solicited with participants over the course of the 6 month study period. At 6 months, participants were contacted to inform them that they should expect to receive their 6 month packet, and they were instructed to follow the same procedures as at baseline testing. Once again, reminder contacts via e-mail and telephone were made after two weeks and continued until accelerometers were received.

Compensation for participation in the study included $10.00 for wearing the monitor at each time point and entry into a cash drawing upon completion of questionnaires at both baseline and 6 months.
Data Analysis

Quality Control and Data Checking. Data were downloaded from the on-line survey software and checked by trained graduate students and quality of data were checked for missing data and erroneous data by examining descriptive statistics and score ranges of all variables. Subsequently, all data were examined for violation of basic statistical assumptions (i.e., normality, multicollinearity, and homoscedascity) and transformed if necessary.

Data Analysis. Initially, descriptive and bivariate correlation analyses were performed in SPSS, version 18.0. To test both of the primary aims, baseline and follow-up measurement models for each of the proposed panel analyses were analyzed first. Next, a separate panel analyses within a covariance framework was conducted for each of the proposed models. Panel models are ideally suited to the analysis of hypothesized, theoretically-based relationships among constructs across defined periods of time. With repeated observations of relationships across time periods, the panel model allows one to examine the dynamics of relationship changes within a time series. Both the measurement model and panel analysis was conducted using covariance modeling with full-information maximum likelihood (FIML) estimation in Mplus V5.0 (Muthén & Muthén, 1998-2007). The FIML estimator is an excellent approach to the analysis of missing data in structural equation modeling and has yielded accurate parameter estimates and fit indices with simulated missing data (Arbuckle, 1996; Enders, 2001; Enders & Bandalos, 2001). Each model included both manifest variables and latent variables. Latent variables were derived from a minimum of two measured variables as indicators of the latent constructs proposed.

The preliminary analyses indicated that any missing data were missing at random (MAR) thereby justifying the use of FIML estimation. At baseline, the extent of missing data for the variables included in the SCT model of physical activity behavior were: BARSE (6.0%),
EXSE (0.5%), FSI subscales (0.3%), GLTEQ (6.5%), SSE subscales (0.3%), goals (1.6%) and MOEES physical outcome expectations (3.8%). There were no missing data for accelerometry or either of the MOEES self-evaluative and social outcome expectations subscales. Missing data for this model at follow-up were: BARSE (7.9%), EXSE (3.8%), FSI subscales (4.3%), GLTEQ (7.0%), SSE family subscale (4.1%), SSE friends (4.3%), goals (4.3%), and MOEES subscales (3.8%). The degree of missing data for the additional factors included in the physical activity and QOL model at baseline were: physical well-being (0.5%), functional well-being (0.5%), emotional well-being (0.8%), social well-being (1.4%), breast cancer specific concerns (0.5%), and SWLS (4.1%). While the extent of missing data for these variables at follow-up were: physical well-being (3.5%), functional well-being (3.7%), breast cancer specific concerns (3.5%), emotional well-being (4.1%), social well-being (3.8%), and SWLS (4.3%).

The first model (Figure 1) tested a social cognitive model of physical activity which proposed the following hypothesized relationships: (a) a direct path from self-efficacy to outcome expectations, goals, impediments and facilitators (social support, fatigue), and physical activity; (b) direct paths from outcome expectations, goals, and impediments and facilitators to physical activity; and (c) a direct path from self-efficacy to physical activity and indirect paths through outcome expectations, goals, and impediments and facilitators. Because latent variables were included in this model, a measurement model was tested to determine that each of the proposed indicators held together as latent variables. BARSE and EXSE were used as indicators of the latent self-efficacy construct. Impediments and facilitators were both modeled as latent factors with each of the subscales from the FSI serving as indicators of a latent fatigue construct, and each of the subscales from the SSE serving as indicators of a latent social support variable.
Physical activity was also modeled as a latent construct using the total score from the GLTEQ and average accelerometer counts for 3 or more days as indicators.

Our second model (Figure 2) tested the following relationships relative to the physical activity and QOL model: (a) a direct path from physical activity to self-efficacy; (b) an indirect path from self-efficacy to quality of life through health status represented by each of the FACT-B subscales (i.e., physical well-being, functional well-being, social well-being, breast cancer specific concerns, emotional well-being); (c) direct paths from each of these indicators to global quality of life; and (d) bi-directional associations or correlations among physical well-being, functional well-being, social/family well-being, emotional well-being and breast cancer concerns. Once again, a measurement model tested the veracity of physical activity as a latent construct with the GLTEQ and accelerometer data serving as indicators and self-efficacy as a latent construct with BARSE and EXSE serving as indicators. Each of the FACT-B subscales represented a manifest health status indicator, and global QOL was represented as a manifest construct using the total score from the SWLS.

In addition to the hypothesized paths, stability coefficients were calculated (Kessler & Greenberg, 1981) to reflect correlations between the same variables measured in each model separately across time while controlling for the influence of other variables in the model. The significance of the indirect paths was also tested in Mplus. Finally, each model was tested controlling for covariates including age, education, income, body mass index, number of comorbidities, time since diagnosis and stage of disease.

Several indices of model fit were used. The chi-square statistic assessed absolute fit of the model to the data (Jöreskog & Sörbom, 1996). Values for the root mean square error of approximation (RMSEA) approximating 0.06 and zero demonstrate close and exact fit of the
model, respectively (Browne & Cudeck, 1993; Hu & Bentler, 1999). The Comparative Fit Index (CFI; Bentler, 1990) suggests that a minimally acceptable fit value is 0.90 (Bentler, 1990) and that values approximating 0.95 or greater indicate good fit (Hu & Bentler, 1999). Modification indices were also inspected in order to identify possible changes in the parameterization of the model that would improve model-data fit and were still complimentary to the theoretical framework adopted in this study.
Chapter IV: Results

Participant Characteristics

Characteristics of the sample are presented in Table 1. Participants were a nationwide sample of middle-aged \((M\text{ age}= 56.5, SD = 9.3)\) breast cancer survivors. Women from 39 different states were represented in this study. The majority of the sample was white (96.7%) and non-Hispanic/Latino (98.1%). About two-thirds of the sample (66.1%) had at least a college degree, and 87.4% of the sample had an annual household income greater than or equal to $40,000. Data regarding self-reported comorbidities can be found in Table 1.

Disease specific sample characteristics are presented in Table 2. Participants had a mean age of 49.7 \((SD= 9.0)\) at time of diagnosis, and time since diagnosis ranged from one month post-diagnosis to 478 months post-diagnosis with an average time since diagnosis of 85.8 months \((S.D. = 65.5)\). The majority of the sample was diagnosed with early stage disease with 17.9% diagnosed with stage 0 or ductal carcinoma in-situ (DCIS), 30.4% diagnosed with stage 1 and 33.6% diagnosed with stage 2 (32.9%) breast cancer. At baseline, only 2.2% of the sample was currently receiving chemotherapy, and none of the participants were currently receiving radiation therapy. However, over half of the sample (60.5%) had received chemotherapy at some point following their breast cancer diagnosis, and just over two-thirds (68.8%) had received radiation therapy. Additionally, almost the entire sample (99.7%) had undergone some type of surgery to treat their breast cancer. Just under half (43.2%) of the sample were currently taking at least one breast cancer treatment-related drug.

Descriptive Statistics and Correlations

Table 3 contains the means, standard deviations, and t-values for each of the factors in the social cognitive model of physical activity. Briefly, over the six month study period, women
experienced a significant \( (p < 0.05) \) decline in self-efficacy for exercise, fatigue severity, fatigue duration, physical, social and self-evaluative outcome expectations for exercise, family social support for exercise and objectively measured physical activity, although there was considerable variation. No other variables in either of the models changed significantly across the 6-month study period. All of the variables included in the social cognitive model of physical activity were significantly \( (p < 0.05) \) correlated at baseline except for objectively measured physical activity and the physical outcome expectations subscale, social outcome expectations subscale, and social support for exercise from friends subscale (see Table 4). At 6-month follow-up, all of the variables were significantly correlated \( (p < 0.05) \) with the exception of the fatigue and outcome expectations subscales which were not significantly related (see Table 5). Table 6 displays the correlations among constructs at each time point. The majority of the variables included in the social cognitive model of physical activity behavior were significantly correlated across time. However, the fatigue severity and interference subscales at baseline were not related to any of the three outcome expectations subscales at follow-up. Additionally, social support for exercise from friends at baseline was not related to fatigue duration at follow-up, and objectively measured physical activity at baseline was not significantly related to any of the fatigue subscales or social support for exercise from friends at follow-up. Correlations among changes in self-efficacy variables and changes in physical activity variables across the six month period were also conducted. Changes in exercise self-efficacy were significantly \( (p < .01) \) related to changes in self-reported physical activity \( (r = 0.17) \), but were not significantly related to changes in accelerometer counts \( (r = 0.05) \). Changes in barriers self-efficacy were also significantly \( (p < .01) \) related to changes in self-reported physical activity \( (r= 0.31) \), but not changes in accelerometer counts \( (r = 0.01) \).
The descriptive statistics for all of the variables included in the physical activity and quality of life model are displayed in Table 7. The only variables that significantly \((p < 0.05)\) changed over the study period were self-efficacy for exercise and objectively measured physical activity with both variables exhibiting significant declines. All of the variables included in the model were significantly \((p < 0.05)\) correlated at baseline except objectively measured physical activity which was not significantly related to functional well-being or global QOL (see Table 8). At follow-up, all variables were significantly related \((p < 0.05)\) except for the measures of physical activity which were not significantly related to social well-being or emotional well-being (see Table 9). Table 10 displays the correlations among constructs at each time point. The majority of the variables included in the physical activity and quality of life model were significantly correlated across time. However, social well-being and emotional well-being were not significantly correlated with self-reported physical activity at follow-up, and emotional and functional well-being at baseline were not significantly correlated with objectively measured physical activity at follow-up. Additionally, baseline objectively measured physical activity was not associated with social or emotional well-being at follow-up, and barriers self-efficacy at baseline was not associated with social well-being at follow-up.

In addition to correlating the variables across time, correlations among changes in the main predictor variable (physical activity) and the main outcome variable (global quality of life) were conducted. Changes in self-reported physical activity were not significantly related with changes in satisfaction with life \((r = 0.06)\). However, changes in objectively measured physical activity were significantly \((p < 0.05)\) related with changes in global quality of life \((r = 0.12)\).

All of the non-significant correlations were between constructs that were not hypothesized to be directly related to one another in the proposed models at either time point.
Covariance Modeling Results

Social Cognitive Model for Explaining Physical Activity in BCS

The proposed measurement model which included latent self-efficacy, physical activity, social support and fatigue constructs was a good fit to the data at baseline ($\chi^2 = 95.38$, df = 42, $p = 0.00$; CFI= 0.97; RMSEA [90% CI] = 0.06 [0.04-0.07]) and at 6 month follow-up ($\chi^2 = 75.63$, df = 42, $p = 0.00$; CFI= 0.98; RMSEA [90% CI] = 0.05 [0.03-0.06]). In turn, the hypothesized structural model and proposed directional relationships were tested. This model provided an acceptable overall fit to the data ($\chi^2 = 845.34$, df = 263, $p = 0.00$; CFI= 0.90; RMSEA [90% CI] = 0.08 [0.07- 0.08]). However, a specification search suggested that correlating the social support for exercise family subscale at baseline and 6 month follow-up and barriers self-efficacy at baseline and 6 months would substantially improve the fit of the model. Adding these relationships resulted in a good fitting model ($\chi^2 = 567.98$, df = 261, $p = 0.00$; CFI= 0.95; RMSEA [90% CI] = 0.06 [0.05-0.06]). This model is shown in Figure 3. Overall, the stability coefficients were acceptable for self-efficacy ($\beta = 0.80$), fatigue ($\beta = 0.72$), social support ($\beta = 0.90$), physical outcome expectations ($\beta = 0.37$), self-evaluative outcome expectations ($\beta = 0.45$), social outcome expectations ($\beta = 0.58$), goals ($\beta = 0.52$), and physical activity ($\beta = 0.54$). These pathways and the added bi-directional correlations have been omitted from the figure for clarity.

At baseline, the direct paths from self-efficacy to physical, self-evaluative and social outcome expectations, social support, fatigue, goals and physical activity were all significant ($p < 0.05$). More efficacious breast cancer survivors had higher physical ($\beta = 0.49$), self-evaluative ($\beta = 0.51$) and social ($\beta = 0.34$) outcome expectations, greater social support for exercise ($\beta = 0.45$), set higher goals ($\beta = 0.52$), had less fatigue ($\beta = -0.46$) and participated in greater levels of physical activity ($\beta = 0.62$). Higher self-evaluative outcome expectations ($\beta = 0.17$) and greater
social support for exercise ($\beta = 0.16$) were associated with engaging in more goal setting behaviors. Women with higher physical outcome expectations engaged in less exercise-related goal setting behaviors ($\beta = -0.13$) while engaging in more goal-setting behavior was associated with greater physical activity participation ($\beta = 0.10$). The only statistically significant indirect path in the baseline model was between self-efficacy and physical activity via goals ($\beta = 0.07$).

At 6-month follow-up, changes in self-efficacy were significantly directly associated with residual changes in physical ($\beta = 0.27$), self-evaluative ($\beta = 0.25$), and social ($\beta = 0.14$) outcome expectations, social support for exercise ($\beta = 0.22$), goals ($\beta = 0.26$), and physical activity ($\beta = 0.39$) and inversely associated with changes in fatigue ($\beta = -0.16$). Thus, breast cancer survivors whose self-efficacy increased also demonstrated increases in all three types of outcome expectations, social support for exercise, goal-setting behavior, and physical activity participation while experiencing a decline in fatigue. The opposite effects occurred for declines in self-efficacy. Changes in goal setting behavior were related to residual changes in physical activity participation ($\beta = 0.16$). At follow-up, only changes in social outcome expectations ($\beta = 0.08$) were positively associated with residual changes in goals such that individuals whose social outcome expectations for exercise increased set higher goals while those whose social outcome expectations declined engaged in less goal setting. Once again, the only statistically significant indirect path was between changes in self-efficacy and residual changes in physical activity via goals ($\beta = 0.05$). Overall, the model account for 41% and 81% of the variance in physical activity participation at baseline and follow-up, respectively.

The next model tested controlled for the contribution of age, education, income, time since diagnosis, disease stage, number of comorbidities and body mass index in the original model. This allowed us to determine: (a) whether demographic characteristics changed the nature
of the model relationships and (b) how demographic factors were related to individual components of the model. This model was an adequate fit to the data ($\chi^2 = 701.08, df = 331, p = 0.00$, RMSEA [90% CI] = 0.06 [.05 -.06], CFI = 0.94). The path coefficients of the hypothesized model were not dramatically changed. However, the direct relationship between goals and physical activity at baseline was no longer significant. All path coefficients for this model are shown in parentheses in Figure 3. In terms of the relationships among model constructs and the covariates, a few interesting relationships emerged. At baseline, women who were further from diagnosis were more active ($\beta = 0.15$) while women who were closer to diagnosis were more fatigued ($\beta = -0.18$). Women with more comorbidities were more fatigued ($\beta = 0.23$) and less efficacious ($\beta = -0.27$). Additionally, breast cancer survivors with a higher body mass index ($\beta = -0.23$) were also less efficacious. At 6-month follow-up, women with a higher body mass index reported lower levels of physical activity ($\beta = -0.10$), and women with a greater number of comorbidities reported higher self-evaluative outcome expectations for exercise ($\beta = 0.10$).

The results from this model suggest that self-efficacy both directly and indirectly, via goals, influences physical activity participation across time. The addition of covariates to the model did not significantly change any of the pathways other than the direct path between goals and physical activity at baseline which was no longer significant.

**Physical Activity and QOL model in BCS**

The hypothesized physical activity and QOL measurement model which included latent self-efficacy and physical activity variables represented a good fit to the data at baseline ($\chi^2 = 6.96, df = 11, p = 0.80$; CFI = 1.00; RMSEA [90% CI] = 0.00 [0.00-0.04]) and at 6 month follow-up ($\chi^2 = 10.72, df = 11, p = 0.47$; CFI = 1.00; RMSEA [90% CI] = 0.00 [0.00-0.05]). The initial structural model which included each of the FACT-B subscales as manifest variables
representing different components of health-related QOL provided an adequate overall fit to the data ($X^2 = 369.43$, df = 132, $p = 0.00$; CFI = 0.94; RMSEA [90% CI] = 0.07 [0.06-0.08]). However, a specification search indicated that the model-data fit could be improved by adding a bidirectional correlation between barriers self-efficacy at each time point. This second model provided a better fit to the data ($X^2 = 322.43$, df = 131, $p = 0.00$; CFI = 0.95; RMSEA [90% CI] = 0.06 [0.05-0.07]). As the pathway from breast cancer specific concerns to QOL was not significant at baseline or follow-up, and this particular subscale had poor internal consistency, this indicator of health-related quality of life was removed from the model. This revised model represented a good overall fit to the data ($X^2 = 278.70$, df = 107, $p = 0.00$; CFI = 0.95; RMSEA [90% CI] = 0.07 [0.06-0.8]) and is shown in Figure 4. The stability coefficients among the model constructs were acceptable for physical activity ($\beta = 0.89$), self-efficacy ($\beta = 0.57$), functional well-being ($\beta = 0.58$), emotional well-being ($\beta = 0.65$), social well-being ($\beta = 0.60$), physical well-being ($\beta = 0.62$), and SWLS ($\beta = 0.59$). Once again, these pathways as well as the bidirectional correlation between barriers self-efficacy at baseline and follow-up have been omitted from the figure for the sake of clarity.

At baseline, more active breast cancer survivors reported significantly ($p < 0.05$) higher self-efficacy ($\beta = 0.68$). In turn, more efficacious women reported significantly higher physical ($\beta = 0.46$), emotional ($\beta = 0.29$), functional ($\beta = 0.43$), and social ($\beta = 0.24$) well-being. Finally, women reporting higher levels of ($\beta = 0.28$), functional ($\beta = 0.30$), and social ($\beta = 0.30$) well-being also reported higher global QOL. The direct path from physical well-being to global QOL was not significant. Furthermore, physical activity had statistically significant indirect effects on global quality of life via self-efficacy and social well-being ($\beta = 0.05$), self-efficacy and functional well-being ($\beta = 0.09$), and self-efficacy and emotional well-being ($\beta = 0.06$) at
At 6-month follow-up, changes in physical activity were significantly associated with residual changes in self-efficacy ($\beta = 0.35$). Changes in self-efficacy were, in turn, significantly related to residual changes in physical ($\beta = 0.17$) and functional ($\beta = 0.15$) well-being. Changes in physical ($\beta = 0.07$), emotional ($\beta = 0.07$), functional ($\beta = 0.19$), and social ($\beta = 0.09$) well-being were significantly associated with residual changes in global quality of life. The only statistically significant indirect relationship between physical activity and global quality of life at follow-up was via self-efficacy and functional well-being ($\beta = 0.01$). Overall, the model account for 49% of the variance in global quality of life at baseline and 64% of the variance in global quality of life at follow-up.

The next analyses tested the model when controlling for age, education, income, time since diagnosis, stage of disease, body mass index, and total number of comorbidities. This model provided a good model-data fit, ($\chi^2 = 326.58$, df = 135, $p= 0.00$, RMSEA [90% CI] = 0.06 [.05 -.07], CFI = 0.95) and did not significantly change the path coefficients of the hypothesized model. The path coefficients when controlling for covariates are shown in parentheses in Figure 4. Several of the model constructs were significantly related to the covariates included in this model. Time since diagnosis was inversely related to self-efficacy ($\beta = - 0.12$) and global QOL ($\beta = - 0.19$). Individuals who were closer to their diagnosis exhibited higher levels of self-efficacy and global QOL. Women who were further from their diagnosis date participated in more physical activity ($\beta = 0.16$). Breast cancer survivors with more comorbidities were less active ($\beta = -0.15$) and efficacious ($\beta = -0.17$) and had lower functional ($\beta = -0.16$), emotional ($\beta = -0.13$), social ($\beta = -0.13$) and physical ($\beta = -0.21$) well-being. Higher body mass index was associated with lower physical activity at baseline ($\beta = - 0.15$), and women
with a higher disease stage at diagnosis had lower functional ($\beta = -0.13$) and emotional ($\beta = -0.18$) well-being. At follow-up, breast cancer survivors with more comorbidities had significantly lower emotional ($\beta = -0.13$) and physical ($\beta = -0.12$) well-being. In addition, individuals who were longer-term survivors ($\beta = 0.09$) and those who were diagnosed with a lower stage of breast cancer ($\beta = -0.08$) reported higher physical well-being.

Thus, in this sample, physical activity indirectly influenced global quality of life via more proximal outcomes of physical activity participation including self-efficacy and health status indicators. These relationships were not significantly changed when covariates were added to the model.
Chapter V: Discussion

General Summary of Findings

Findings from a 6-month prospective study examining (a) a social cognitive model for explaining physical activity behavior in breast cancer survivors and (b) a social cognitive model for explaining the relationship between physical activity and quality of life in this population are reported. The proposed social cognitive model of physical activity behavior in breast cancer survivors tested the relationships hypothesized by Bandura (2004) and resulted in a good model-data fit. The proposed physical activity and quality of life model sought to replicate and expand on the model proposed by McAuley and colleagues (2006) in a sample of breast cancer survivors and also resulted in a good fitting model. Overall, findings from this study support the position that self-efficacy is both an important predictor and outcome of physical activity participation (McAuley & Blissmer, 2000). Self-efficacy appears to play an important role, not only as a predictor of physical activity participation in breast cancer survivors, but as a mediator of health outcomes of physical activity in this population. Specific details relative to the implications of the findings from each of the models are discussed below.

Social Cognitive Theory and Physical Activity Model Findings

The outcomes of this study provide at least some support for a social cognitive model of physical activity behavior in breast cancer survivors utilizing the pathways specified by Bandura (2004). Self-efficacy was the strongest predictor of physical activity behavior in this model. Breast cancer survivors who believe they are capable of being active and overcoming barriers to physical activity participate in higher levels of physical activity across time. These findings are consistent with other findings regarding the relationship between physical activity and self-efficacy in breast cancer survivors (Rogers et al., 2008) and the general adult population (Trost et
al. 2002). Furthermore, this study provides support for the often ignored indirect relationship between self-efficacy and physical activity as self-efficacy also exhibited a significant indirect relationship with physical activity via goals. It appears that more efficacious breast cancer survivors participate in higher levels of physical activity and are also better able to self-regulate their behavior resulting in greater physical activity participation. These findings regarding the relationship between self-efficacy and self-regulation of physical activity behavior are also consistent with the general physical activity literature.

The current study did not provide support for a direct relationship between any of the three types of outcome expectations and physical activity or for the role of outcome expectations as a mediator between self-efficacy and physical activity alone or via goals. Given the strong relationship between self-efficacy and physical activity exhibited in the current study, the lack of a relationship between outcome expectations and physical activity is not entirely unexpected. These findings may suggest that outcome expectations are reduced to a redundant predictor in breast cancer survivors as a result of the strength of the relationship between self-efficacy and physical activity as hypothesized by Bandura (1997). Thus, regardless of whether or not breast cancer survivors have high outcome expectations, more efficacious women may be more likely to be active. Interestingly, both physical and self-evaluative outcome expectations were directly related to goals at baseline, but only changes in social outcome expectations were related to changes in goals at follow-up. This suggests that individuals who expected some type of social benefits from physical activity were more likely to be able to regulate their behavior across time. Breast cancer survivors with higher social outcome expectations may potentially have more social support for exercise or be more likely to engage in group fitness activities both of which could require more self-regulation as a result of regularly scheduled pre-arranged meeting times.
associated with group fitness classes or meeting friends or relatives to exercise.

Although fatigue is a commonly identified barrier to physical activity in breast cancer survivors (Bower et al., 2000; Rogers et al., 2006; Courneya et al., 2009), this study did not provide support for the direct relationship between fatigue and goals or for its role as a mediator between self-efficacy and physical activity participation. This suggests that the influence of self-efficacy on physical activity may negate any influence that fatigue has on physical activity participation in breast cancer survivors. As such, high levels of fatigue may not interfere with physical activity participation if an individual is highly efficacious and engages in more self-regulatory behaviors. Alternatively, the lack of a relationship between fatigue, goal-setting and physical activity behavior could be explained by the low levels of fatigue reported, relatively high average length of time since diagnosis (85.8 months) and the fact that most women were not actively receiving treatment for breast cancer. Fatigue may be most problematic for individuals who are close to diagnosis and actively receiving treatment. As a result, fatigue may not be a particularly salient barrier to physical activity in this particular sample, and thus, does not interfere with their ability to be active or regulate their behavior.

Finally, the model provided some evidence to suggest social support, a facilitator of physical activity behavior, may influence goal-setting at baseline. However, this relationship did not hold across time, and the model did not provide support for the role of social support as a mediator between self-efficacy and physical activity participation via goals. Although, social support may help to motivate individuals to self-regulate their physical activity behavior initially, given the findings relative to social outcome expectations, it may be that social outcome expectations are more important in motivating individuals to self-regulate their behavior across time, especially if social support is already in place. Additionally, because social support was not
found to act as a mediator between self-efficacy and physical activity it could be that social support is also reduced to a redundant predictor as a result of the strength of the relationship between self-efficacy and physical activity. If an individual is efficacious enough, the level of social support they have may not influence their ability to successfully regulate their behavior.

The results from this study regarding the influence of social cognitive constructs on physical activity behavior have important implications for advancing the understanding of physical activity behavior in breast cancer survivors as well as for designing effective physical activity behavior change interventions for this population. All of the constructs included in the present model (self-efficacy, outcome expectations, fatigue, social support, and goals) are modifiable suggesting that they could, and should, be targeted in interventions. Self-efficacy was demonstrated to be the strongest predictor of physical activity behavior in this sample implying that designing interventions that target sources of efficacy may be extremely important in order to increase physical activity participation in breast cancer survivors. These sources of efficacy information could be targeted at a relatively low cost in most interventions and programs, but have substantial pay-offs in terms of breast cancer survivors physical activity participation and the associated health outcomes. Potential ways in which these sources of efficacy could be targeted include: (a) designing progressive interventions that allow women to experience success before advancing (mastery experiences); (b) using active breast cancer survivors as exercise leaders (vicarious experiences); (c) conducting programs in a group setting or pairing participants with an exercise “buddy” (social persuasion); and (d) properly educating breast cancer survivors on how their body should respond to exercise (interpretation of physiological and psychological states).

Although there is a strong relationship between self-efficacy and physical activity across
time, these data suggest that it is not the only construct which should be targeted in physical activity interventions and programs. Goal-setting also appears to be an important direct predictor of physical activity participation as well as a mediator of the relationship between self-efficacy and physical activity across time. As such, it represents an appropriate candidate for inclusion in physical activity programs for breast cancer survivors. Educating individuals on ways to self-regulate their behavior (e.g., scheduling physical activity, writing down goals, and recording physical activity behavior), as well as incorporating these self-regulatory strategies into interventions (e.g., regularly scheduled meeting times, physical activity logs, individualized program feedback) may be particularly effective and provide breast cancer survivors with the necessary tools to effectively maintain physical activity behavior in the long-term. Additionally, although the indirect relationships between self-efficacy and social support and self-efficacy and outcome expectations via goals were not significant in this sample, social support and outcome expectations did appear to have some direct influence on goal setting. Thus, increasing breast cancer survivors’ outcome expectations for physical activity as well as their social support for physical activity may still have beneficial outcomes via their direct influence on goal-setting.

Model-specific Study Strengths and Limitations

The findings regarding the utility of social cognitive constructs to explain physical activity participation in breast cancer survivors are promising. However, this study is not without limitations. First, there was no relationship between fatigue and any model variables except for self-efficacy. Thus, testing whether other, potentially more salient, barriers (e.g., functional status, depression) are related to physical activity participation in this population may be warranted. Additionally, manifest variables were used to represent goals or each of the three types of outcome expectations. Future tests of this model should incorporate latent variables for
goals and outcome expectations using multiple measures of these constructs to better understand their relationship to physical activity participation in breast cancer survivors.

To the best of our knowledge, this study was the first longitudinal study to examine the influence of the social cognitive pathways proposed by Bandura (2004) on physical activity participation in breast cancer survivors. These data provides further support for the role of self-efficacy in physical activity behavior in breast cancer survivors. Additionally, the findings from this study highlight the importance of recognizing that self-efficacy does not exert its influence on physical activity behavior in isolation. Developing a better understanding of the other social cognitive constructs, particularly the role of goal-setting and self-regulation, in physical activity participation in breast cancer survivors is important. Incorporating social cognitive constructs into the design of physical activity interventions for breast cancer survivors may not only increase physical activity adoption, but could increase long-term maintenance of physical activity if targeted properly. Moreover, if programs and interventions are able to effectively target social cognitive constructs to change and maintain physical activity behavior, considerable public health benefits could occur in terms of health and survival outcomes for breast cancer survivors.

*Physical Activity and Quality of Life Model Findings*

The purpose of this aspect of the study was to extend the work of McAuley and colleagues (2006) in a longitudinal sample of breast cancer survivors by (a) replicating their social cognitive model of physical activity and QOL and (b) expanding their model by including additional health status indicators. Findings relative to this model indicate that changes in breast cancer survivors’ physical activity were associated with changes in self-efficacy. Changes in self-efficacy were associated with changes in physical and functional well-being which were, in
turn, associated with changes in global QOL. Changes in self-efficacy only indirectly influenced
global quality of life across time via functional well-being. This study provides support for the
perspective that: (a) the relationship between physical activity and QOL across time in breast
cancer survivors can be understood as incorporating more proximal, modifiable, and temporally
sensitive factors (e.g., self-efficacy), as well as more stable and global constructs (e.g.,
satisfaction with life) and (b) multiple indicators of health status can adequately be used as
outcomes of physical activity and predictors of QOL across time.

Furthermore, the results of this study provide support for the role of self-efficacy as both
an outcome of physical activity participation in breast cancer survivors and a predictor of more
proximal health outcomes in this population. Physical activity was found to indirectly influence
global QOL via emotional, social, and functional well-being at baseline, and changes in physical
activity were indirectly related to changes in global QOL via self-efficacy and functional well-
being providing insight into some of the potential mechanisms underlying the relationship
between physical activity and QOL in breast cancer survivors. The findings regarding the
influence of physical activity and self-efficacy on functional well-being are consistent with those
from older adults (Brach et al., 2004; McAuley et al., 2007). The lack of an indirect relationship
between changes in physical activity and changes in global QOL via changes in self-efficacy and
social well-being is not all together surprising. Social well-being may not be a salient outcome of
physical activity for all individuals and could depend on several factors including whether they
choose to exercise alone or in a group and whether or not they receive social support for
exercise. In fact, if there is a lack of support, finding time to exercise could potentially put a
strain on some social relationships.

It is somewhat surprising, however, that the indirect effects of changes in physical
activity via changes in self-efficacy and emotional well-being did not hold across time. Emotional well-being can be viewed as an indicator of mental health status which has exhibited relationships with physical activity and global QOL across time in studies of older adults (McAuley et al., 2006; White et al., 2009). Additionally, that physical well-being was not directly related to global QOL at baseline and did not act as a mediator between physical activity and global QOL at baseline or follow-up was unexpected. In previous studies, physical health status has mediated the relationship between physical activity and global QOL (McAuley et al., 2006; White et al., 2009). One potential explanation for the findings regarding both physical and emotional well-being is the items on the FACT-B representing these constructs largely reflect how one’s “illness” is influencing their life. Example items from the emotional well-being subscale include: I am satisfied with how I am coping with my illness and I worry that my condition will get worse. Example items from the physical well-being subscale include: I am bothered by side effects of treatment and I am forced to spend time in bed. Because the average time since diagnosis (85.8 months) was relatively high in this sample, and the vast majority of the sample was post-treatment, it is conceivable that this measure contain items that are neither relevant nor salient to them as longer-term survivors. Consequently, these findings are to be interpreted with caution and other health status indicators should be included in future examinations of the physical activity and QOL relationship in breast cancer survivors.

Model-specific Study Strengths and Limitations

Once again, this study does have a number of limitations. First, manifest variables were used to represent all health status indicators and global quality of life. Several other variables (e.g., self-esteem, depression, functional limitations) have the potential to be included as indicators of the health status variables included in this model. Thus, further identification of
other factors that may represent social, functional, emotional and physical health status outcomes is warranted in order to advance the understanding of the complex relationship between physical activity and QOL in breast cancer survivors. Additionally, it may be important to examine the potential role of other health status indicators such as cognitive health in the current model. Second, the measure of health-related quality of life used in this study may not be appropriate for the current sample as it assumes that the more acute phase of breast cancer survivorship is still very salient. Thus, more general measures of health status (e.g., the SF-12) may be more appropriate when examining these relationships in longer-term breast cancer survivors. In addition, only measures of exercise-related self-efficacy were included in the present study. Although exercise-related self-efficacy was related to all health status variables at baseline, changes in exercise related self-efficacy were only associated with changes in physical and functional well-being at follow-up. Future studies may want to include other types of self-efficacy (e.g., disease management or coping efficacy) to determine their differential role in model relationships. However, it could also be argued that including coping or disease management self-efficacy may not be entirely relevant to longer-term breast cancer survivors as they may not view themselves as “sick”. Finally, although there were some significant changes in self-efficacy and physical activity over the 6 month study period, no changes were exhibited in the measures of health-related or global quality of life suggesting that examining the mean values may not fully reflect variation in change over the 6-month study period. Alternatively, 6-months may not be a long enough study period to see mean-level changes in these constructs. Therefore, future studies should assess these constructs across longer study periods to determine how they are influenced across time.

As one of the first studies to examine factors underlying the relationship between
physical activity and quality of life in breast cancer survivors, these findings provide an important initial step in understanding this relationship. Specifically, the results from this study suggest the possibility that health status and global QOL could be modified in breast cancer survivors if both physical activity and self-efficacy are targeted appropriately. Thus, targeting self-efficacy as part of physical activity programs for breast cancer survivors may increase physical activity participation as well as result in greater improvements in health status outcomes, and, in turn, global QOL. Improvements in QOL as an outcome of physical activity participation in breast cancer survivors could have implications in terms of utilization of healthcare services and could also serve as a motivating factor for the adoption, maintenance and adherence to physical activity programs in breast cancer survivors. These findings may also have implications for conceptualizing and examining QOL in breast cancer survivors and possibly other populations. The relationship between physical activity and QOL does appear to be indirect. Thus, other potential mechanisms underlying this relationship should be explored to identify other avenues for intervention.

General Study Strengths and Limitations

This study provides support for both the social cognitive model of physical activity and the physical activity and quality of life model in breast cancer survivors. However, as with any study, there are several limitations that transcend both models. First, this study adopted a longitudinal observational design. Randomized controlled exercise trials will be needed to determine how the proposed relationships among changes in model constructs hold up as a result of an intervention. Second, the study sample was largely homogenous. Although no restrictions were placed on disease characteristics or time since diagnosis as is typical of most other studies of breast cancer survivors, the sample consisted mainly of middle-aged, white, highly educated,
high income, normal weight, longer term breast cancer survivors who may not be entirely representative of this population at large. Thus, it is important to examine whether these models hold in other, more diverse samples of breast cancer survivors or within subgroups of this population. (e.g., survivors within 5 years of diagnosis versus longer term survivors, older and younger survivors, obese and non-obese survivors).

Although the sample was relatively homogenous, this was still one of the largest, nationally representative longitudinal studies of physical activity in breast cancer survivors to date. It is one of the few studies that have been conducted in this population incorporating an objective measure of physical activity. Additionally, to the best of our knowledge, this is the only study that has examined the influence of several social cognitive constructs on physical activity participation in breast cancer survivors as well as the potential psychosocial pathways underlying the relationship between physical activity and quality of life in breast cancer survivors. These data provide an important step forward in the application of social cognitive theory to understanding physical activity participation and its outcomes in breast cancer survivors. The findings from this study can serve to inform future research and programming in regard to physical activity participation and outcomes in breast cancer survivors.

**Future Directions**

These data support the application of social cognitive theory for understanding physical activity behavior and outcomes of physical activity behavior in breast cancer survivors across a 6 month period of time. Specifically, the study provides support for the reciprocal relationship between physical activity and self-efficacy. In general, future studies should attempt to replicate each model in other samples of breast cancer survivors and other cancer survivor populations in order to understand whether the relationships among model constructs hold across time and as a
result of intervention. Relative to the social cognitive model of physical activity in breast cancer survivors, future replication studies should also attempt to better understand the relationship of outcome expectations, facilitators and impediments and goals to physical activity participation across time and as a result of intervention. Findings from such research could be applied to program design and implementation at multiple levels (e.g., individual, community, organizational) which could ultimately increase physical activity participation in breast cancer survivors and other survivor populations, as well as reduce the risk of cancer recurrence and burden of disease through its effects on health outcomes and quality of life. Regarding the physical activity and quality of life model, future replication studies should also seek to develop a better understanding of other factors that may mediate the relationship between physical activity and quality of life and incorporate other indicators of health status such as cognitive and biological health status to develop a better understanding of the mechanisms underlying this relationship.

The optimal time along the cancer continuum at which to intervene to prevent a decline in physical activity and maximize the benefits of a physical activity program following a breast cancer diagnosis has yet to be determined. However, the results from this study indicate that physical activity participation at baseline was inversely associated with time since diagnosis suggesting that targeting survivors early on may be beneficial. As the time immediately following a breast cancer diagnosis may be particularly overwhelming, however, more research needs to be conducted to determine what types of interventions (e.g. supervised, educational, home-based) are most effective and feasible for not only increasing physical activity behavior, but maximizing health outcomes at various points along the cancer survival continuum. Additionally, cumulative measures of physical activity were used in this study. Future research
should examine whether different characteristics of physical activity (i.e. type, intensity, duration) are influenced by social cognitive constructs as well as whether these characteristics may differentially influence QOL. Furthermore, as the breast cancer survivor population continues to age, it will be important to determine the factors that influence physical activity participation in aging breast cancer survivors. It will also be imperative to determine how physical activity influences health outcomes in the aging survivor population as these women have been shown to have physical, social, and psychological health needs that may extend beyond those of the normal aging population (Baker, Haffer & Denniston, 2003; Yancik, 2005).

The data from this study suggest that social cognitive factors, particularly self-efficacy and goals, may be important predictors of physical activity participation in breast cancer survivors. Additionally, these findings suggest that participation in physical activity can improve quality of life in breast cancer survivors. Thus, future research should focus on enhancing the evidence to support the implementation of programs and policies that focus on increasing physical activity participation in breast cancer survivors. Implementing policy and procedural changes to encourage breast cancer survivors to engage in physical activity have the potential to improve these individuals’ quality of life. Additionally, it could potentially reduce the healthcare costs associated with treating reduced health-related and global quality of life as well as the long-term side effects of treatment including comorbidities, recurrence, and early mortality. Providing breast cancer survivors with insurance coverage for a physical activity rehabilitation program similar to cardiac rehabilitation designed using social cognitive behavior change could be extremely beneficial for reducing long-term side effects of treatment. At the very least, incorporating some type of educational component describing benefits of physical activity and strategies for becoming active into the standard of care may warranted. Future studies should
focus on developing evidence-based physical activity programs that can be adopted as part of the standard of care and maintained in the current healthcare system.

Conclusions

In conclusion, these data provide evidence for (a) the role of social cognitive variables, including self-efficacy and goal-setting in physical activity participation across time and (b) the role of self-efficacy and health status indicators in understanding the relationship between physical activity and global QOL in breast cancer survivors. As advances in early detection and treatment continue to progress and the population continues to age, the number of breast cancer survivors will continue to grow. Thus, it is becoming increasingly important to understand, not only how life expectancy can be maximized for breast cancer survivors, but how quality of life can be effectively enhanced in this population. Physical activity has been shown to have numerous health benefits for breast cancer survivors. However, this population still remains largely inactive. Therefore, developing a better understanding of physical activity behavior and the role it plays in reducing negative health outcomes for breast cancer survivors is crucial. Findings from this study can be used to inform future research and programs to effectively increase physical activity and quality of life in breast cancer survivors with the potential to profoundly impact public health.
Chapter VI: References


Marcoulides & R. E. Schumacker (Eds.), *Advanced structural equation modeling: Issues

in quality of life from the first to the third year after diagnosis in women with breast

Aziz, N. M., & Rowland, J. H. (2003). Trends and advances in cancer survivorship research:


Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of

Promotion, 12*(1), 8-10.

Company.

Bandura, A. (2000). Health promotion from the perspective of social cognitive theory. In P.
Norman, C. Abraham, & M. Conner (Eds.), *Understanding and changing health behavior*
(pp. 299-339). Reading, UK: Harwood.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior,
31*(2), 143-164.


Chapter VII: Tables
### Table 1

**Sample Baseline Demographics**

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<th>Total Sample (n=370)</th>
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<td>Retired, not working at all</td>
<td>28.8%</td>
</tr>
<tr>
<td>Part-time</td>
<td>14.9%</td>
</tr>
<tr>
<td>Employment Status</td>
<td>Percentage</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Retired, working part-time</td>
<td>7.3%</td>
</tr>
<tr>
<td>Full-time homemaker</td>
<td>4.6%</td>
</tr>
<tr>
<td>Laid off/unemployed</td>
<td>3.8%</td>
</tr>
<tr>
<td>Disabled</td>
<td>1.6%</td>
</tr>
<tr>
<td>Self-employed</td>
<td>1.1%</td>
</tr>
<tr>
<td>Student</td>
<td>0.8%</td>
</tr>
<tr>
<td>Other</td>
<td>0.3%</td>
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</table>

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; $40,000</td>
<td>12.6%</td>
</tr>
<tr>
<td>≥ $40,000</td>
<td>87.4%</td>
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</table>

**Health Conditions**

- Arthritis: 33.5%
- Osteoporosis: 16.6%
- Asthma: 9.7%
- COPD, ARDS or Emphysema: 2.5%
- Angina: 0.8%
- Congestive Heart Failure/Heart Disease: 3.0%
- Heart Attack: 0.6%
- Stroke/TIA: 1.4%
- Neurological Disease: 0.0%
- PVD: 1.4%
- Diabetes: 5.2%
- Depression: 22.8%
- Anxiety or Panic Disorder: 14.4%
- Degenerative Disc Disease: 13.9%
- Obesity: 14.6%
- Upper GI Disease: 13.8%
Table 2

*Sample Breast Cancer Specific Health History/Characteristics*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Sample (n=486)</th>
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<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Age at diagnosis</td>
<td>49.74</td>
</tr>
<tr>
<td>Time Since Diagnosis (months)</td>
<td>85.82</td>
</tr>
<tr>
<td>Breast Cancer Stage</td>
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</tr>
<tr>
<td>Stage 0/DCIS</td>
<td>17.9%</td>
</tr>
<tr>
<td>Stage 1</td>
<td>30.4%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>33.6%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>11.1%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>2.2%</td>
</tr>
<tr>
<td>Don’t Know</td>
<td>4.9%</td>
</tr>
<tr>
<td>Estrogen Receptor Positive Tumor</td>
<td>70.8%</td>
</tr>
<tr>
<td>Current Treatment Status</td>
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</tr>
<tr>
<td>Receiving Chemotherapy</td>
<td>2.2%</td>
</tr>
<tr>
<td>Receiving Radiation</td>
<td>0.0%</td>
</tr>
<tr>
<td>Taking Breast Cancer Treatment Drug</td>
<td>43.2%</td>
</tr>
<tr>
<td>Post-menopausal at diagnosis</td>
<td>44.3%</td>
</tr>
<tr>
<td>Post-menopausal</td>
<td>86.8%</td>
</tr>
<tr>
<td>Treatment History</td>
<td></td>
</tr>
<tr>
<td>Had Surgery for Breast Cancer</td>
<td>99.7%</td>
</tr>
<tr>
<td>Received Chemotherapy</td>
<td>60.5%</td>
</tr>
<tr>
<td>Received Radiation Therapy</td>
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</tr>
<tr>
<td>Diagnosed with Breast Cancer Recurrence</td>
<td>11.1%</td>
</tr>
<tr>
<td>Diagnosed with Any Other Cancer</td>
<td>14.9%</td>
</tr>
<tr>
<td>Family History of Breast Cancer</td>
<td>53.7%</td>
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Table 3

*Descriptives of SCT Model Constructs at Baseline and 6 months*

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<tr>
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<th>SD</th>
<th>6 months M</th>
<th>SD</th>
<th>t-value</th>
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<tr>
<td>BARSE</td>
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<td>22.90</td>
<td>49.20</td>
<td>24.19</td>
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<td>31.34</td>
<td>71.23</td>
<td>33.07</td>
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<tr>
<td>FSI-Severity</td>
<td>3.19</td>
<td>2.02</td>
<td>2.90</td>
<td>2.07</td>
<td>-3.30*</td>
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<tr>
<td>FSI-Interference</td>
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<td>1.95</td>
<td>1.68</td>
<td>2.02</td>
<td>-0.97</td>
</tr>
<tr>
<td>FSI-Duration</td>
<td>2.69</td>
<td>2.17</td>
<td>2.91</td>
<td>2.17</td>
<td>2.32*</td>
</tr>
<tr>
<td>MOEES-PO</td>
<td>28.25</td>
<td>2.77</td>
<td>27.78</td>
<td>3.30</td>
<td>-2.80*</td>
</tr>
<tr>
<td>MOEES-SEO</td>
<td>22.50</td>
<td>2.77</td>
<td>22.02</td>
<td>3.31</td>
<td>-3.27*</td>
</tr>
<tr>
<td>MOEES- SO</td>
<td>12.39</td>
<td>3.28</td>
<td>11.90</td>
<td>3.46</td>
<td>-3.20*</td>
</tr>
<tr>
<td>SSE-Family</td>
<td>25.56</td>
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<td>24.15</td>
<td>10.38</td>
<td>-3.60*</td>
</tr>
<tr>
<td>EGS</td>
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<td>1.32</td>
<td>2.57</td>
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<td>0.74</td>
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<td>GLTEQ</td>
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<td>22.42</td>
<td>30.04</td>
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</tr>
<tr>
<td>Accel</td>
<td>25,2219.97</td>
<td>16,9805.00</td>
<td>21,2765.22</td>
<td>9,7755.46</td>
<td>-4.96*</td>
</tr>
</tbody>
</table>

*Note.* BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; FSI= Fatigue Symptom Inventory; MOEES= Multidimensional Outcome Expectations for Exercise Scale; PO= Physical Outcome Expectations; SEO= Self-evaluative outcome expectations; SO= Social Outcome Expectations; SSE= Social Support for Exercise; EGS= Exercise Goals Survey; GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts

*significant at p = <.05*
Table 4

Correlations Among Social Cognitive Theory and Physical Activity Model Constructs at Baseline

<table>
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<tr>
<th>Variable</th>
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<th>2</th>
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<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
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<tbody>
<tr>
<td>1</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>EXSE</td>
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<td>1.00</td>
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<td></td>
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</tr>
<tr>
<td>3</td>
<td>EGS</td>
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</tr>
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<td>PO</td>
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<td>0.39**</td>
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<tr>
<td>5</td>
<td>SEO</td>
<td>0.35**</td>
<td>0.38**</td>
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<td>0.80**</td>
<td>1.00</td>
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<td></td>
</tr>
<tr>
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<td>0.20**</td>
<td>0.35**</td>
<td>0.37**</td>
<td>0.50**</td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>FSI-int</td>
<td>-0.35**</td>
<td>-0.34**</td>
<td>-0.22**</td>
<td>-0.22**</td>
<td>-0.14**</td>
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</tr>
<tr>
<td>8</td>
<td>FSI-sev</td>
<td>-0.30**</td>
<td>-0.29**</td>
<td>-0.24**</td>
<td>-0.13**</td>
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<td>FSI-dur</td>
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<td>-0.31**</td>
<td>-0.23**</td>
<td>-0.17**</td>
<td>-0.14**</td>
<td>-0.11**</td>
<td>0.82**</td>
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<td>0.20**</td>
<td>0.26**</td>
<td>0.28**</td>
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<td>-0.09</td>
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<td>-0.27**</td>
<td>0.30**</td>
<td>0.32**</td>
<td>0.31**</td>
</tr>
</tbody>
</table>

Note. BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; FSI= Fatigue Symptom Inventory; MOEES= Multidimensional Outcome Expectations for Exercise Scale; PO= Physical Outcome Expectations; SEO= Self-evaluative outcome expectations; SO= Social Outcome Expectations; SSE= Social Support for Exercise; EGS= Exercise Goals Survey; GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts

*significant at p < .05; **significant at p < .001
Table 5

*Correlations Among Social Cognitive Theory and Physical Activity Model Constructs at 6-month Follow-up*

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
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<th>5</th>
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<th>11</th>
<th>12</th>
<th>13</th>
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<tr>
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<td>9 FSI-dur</td>
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</tbody>
</table>

*Note.* BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; FSI= Fatigue Symptom Inventory; MOEES= Multidimensional Outcome Expectations for Exercise Scale; PO= Physical Outcome Expectations; SEO= Self-evaluative outcome expectations; SO= Social Outcome Expectations; SSE= Social Support for Exercise; EGS= Exercise Goals Survey; GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts

**significant at \( p = <.001 \)**
Table 6

Correlations Among Social Cognitive Theory and Physical Activity Model Constructs at Baseline and 6-month Follow-up

<table>
<thead>
<tr>
<th></th>
<th>BARSE m0</th>
<th>EXSE m0</th>
<th>EGS m6</th>
<th>PO m6</th>
<th>SEO m6</th>
<th>SO m6</th>
<th>FSI-int m6</th>
<th>FSI-sev m6</th>
<th>FSI-dur m6</th>
<th>SSE-fam m6</th>
<th>SSE-fr m6</th>
<th>Accel m6</th>
<th>GLTEQ m6</th>
</tr>
</thead>
<tbody>
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<td>BARSE m0</td>
<td>0.69**</td>
<td>0.51**</td>
<td>0.40**</td>
<td>0.18**</td>
<td>0.25**</td>
<td>0.22**</td>
<td>-0.32**</td>
<td>-0.34**</td>
<td>-0.34**</td>
<td>0.19**</td>
<td>0.33**</td>
<td>0.35**</td>
<td>0.39**</td>
</tr>
<tr>
<td>EXSE m0</td>
<td>0.52**</td>
<td>0.59**</td>
<td>0.39**</td>
<td>0.29**</td>
<td>0.32**</td>
<td>0.19**</td>
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<td>-0.28**</td>
<td>-0.28**</td>
<td>0.28**</td>
<td>0.32**</td>
<td>0.30**</td>
<td>0.41**</td>
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<td>0.70**</td>
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<td>0.34**</td>
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<td>-0.21**</td>
<td>-0.24**</td>
<td>0.19**</td>
<td>0.39**</td>
<td>0.32**</td>
<td>0.39**</td>
</tr>
<tr>
<td>PO m0</td>
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<td>0.31**</td>
<td>0.48**</td>
<td>0.44**</td>
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<td>-0.21**</td>
<td>-0.23**</td>
<td>0.19**</td>
<td>0.25**</td>
<td>0.24**</td>
<td>0.21**</td>
</tr>
<tr>
<td>SEO m0</td>
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Note. m0= baseline; m6= 6-month follow-up; BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; FSI= Fatigue Symptom Inventory; MOES= Multidimensional Outcome Expectations for Exercise Scale; PO= Physical Outcome Expectations; SEO= Self-evaluative outcome expectations; SO= Social Outcome Expectations; SSE= Social Support for Exercise; EGS= Exercise Goals Survey; GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts

*significant at p=.05; **significant at p=<.001
Table 7

*Descriptives of QOL Model Constructs at Baseline and 6 months*

<table>
<thead>
<tr>
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<th>6 months</th>
<th>t-value</th>
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<td>M</td>
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<td>21,2765.22</td>
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</table>

*Note.* BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; FACT-B= Functional Assessment of Cancer Therapy-Breast; PWB= Physical Well-being; FWB= Functional Well-being; SWB= Social Well-being; EWB= Emotional Well-being; BCS= Breast Cancer Specific Concerns; SWLS= Satisfaction with Life Scale; GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts

*significant at p= <.05*
### Table 8

**Correlations Among Quality of Life and Physical Activity Model Constructs at Baseline**

<table>
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<th>Variable</th>
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*Note.* GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts; BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; PWB= Psychological Well-being; FWB= Functional Well-being; SWB= Social/Family Well-being; EWB= Emotional Well-being; BCS= Breast Cancer Specific Concerns; SWLS= Satisfaction with Life Scale

*significant at $p<.05$; **significant at $p<.001$
Table 9

Correlations Among Quality of Life and Physical Activity Model Constructs at 6-month Follow-up

<table>
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Note. GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts; BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; PWB= Psychological Well-being; FWB= Functional Well-being; SWB= Social/Family Well-being; EWB= Emotional Well-being; BCS= Breast Cancer Specific Concerns; SWLS= Satisfaction with Life Scale
*significant at p=<.05; **significant at p= <.001
### Table 10

**Correlations Among Quality of Life and Physical Activity Model Constructs at Baseline and 6-month Follow-up**

<table>
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<th>EXSE m0</th>
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</table>

*Note.* m0= baseline; m6= 6-month follow-up; GLTEQ= Godin Leisure Time Exercise Questionnaire; Accel= Average Accelerometer Activity Counts; BARSE= Barriers Self-efficacy Scale; EXSE= Exercise Self-efficacy Scale; PWB= Psychological Well-being; FWB= Functional Well-being; SWB= Social/Family Well-being; EWB= Emotional Well-being; BCS= Breast Cancer Specific Concerns; SWLS= Satisfaction with Life Scale

*significant at p=<.05; **significant at p=<.001
Chapter VIII: Figures
Figure 1. Proposed Social Cognitive Theory model of Physical Activity Behavior in Breast Cancer Survivors
Figure 2. Proposed Physical Activity and Quality of Life in Breast Cancer Survivors Model
Figure 3. Significant paths are represented by solid lines. Non-significant paths and stability coefficients were not included in the figure for clarity purposes. Values in parentheses indicate path coefficients when covariates are added into the model; SE= Self-efficacy; FAT= Fatigue; SSE= Social Support for Exercise; PO= Physical Outcome Expectations; SEO= Self-evaluative Outcome Expectations; SO= Social Outcome Expectations; PA= Physical Activity; * indicates path was no longer significant when covariates were included in the model.
Figure 4. Model of Physical Activity and Quality of Life in Breast Cancer Survivors

Figure 4. Significant paths are represented by solid lines. Non-significant paths and stability coefficients were not included in the figure for clarity purposes. Values in parentheses indicate path coefficients when covariates are added into the model. PA= Physical Activity; SE= Self-efficacy; PWB= Physical Well-being; EWB= Emotional Well-being; FWB= Functional Well-being; SPWB= Social Well-being