Managing Stress in Breast Cancer's Wake: A Brief Isometric Intervention

by

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A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
(Kinesiology)

At the

UNIVERSITY OF WISCONSIN – MADISON

2013

Date of final oral examination: May 3, 2013

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To my daughters who were patient and understanding beyond their years.

To my partner who helped me more fully appreciate the value that each day offers.

To my mom for her abiding love.

To my grandparents who modeled persistence and integrity.

To women who participated in this study and to those they represent.

Acknowledgements

I am sincerely grateful to my committee members for their ongoing support of my work. Dr. Ruth Benedict and Dr. Jo-Anne Lazarus served formally as advisors and encouraged me throughout this project. Dr. Julia Wilbarger generously provided her laboratory and expertise to facilitate conducting the experiment with substantially upgraded instrumentation. Dr. Ward was instrumental in directing me to invaluable resources essential to pilot studies and further served in an informal advisory capacity. Dr. Ryff's early interest and ongoing support of this study has been essential to putting this work in context. Dr. Colbert's awareness of the scope of cancer research and guidance toward excellent resources grounded this study. Dr. van Kan was an early influence on study design. And finally, Douglas Hemken at the Social Science Computer Cooperative patiently supported my data analysis. This research was funded in part by Caroline Thompson Distinguished Ph.D. Fellowships, the Virginia Horne Henry Wisconsin Distinguished Graduate Fellowship, and the Virginia Horne Henry Fund for Physical Education Issues through the University of Wisconsin-Madison.

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Chapter 1: Introduction

Problem statement

One in every eight American women (12%) will develop breast cancer in her lifetime (2007-2008 Breast Cancer Facts & Figures) (American Cancer Society, 2009). Although 25 of every 100,000 women diagnosed may die, nearly 2.7 million women are living with a history of breast cancer (National Cancer Institute, 2009). These women reflect about 2% of all American women *(US Census Bureau, 2009*). Many living with breast cancer histories are relatively young women. Approximately 10,000 women younger than 40 are diagnosed with breast cancer each year (American Cancer Society, 2009). Their diagnoses often come in the midst of productive lives. Breast cancer diagnoses add a burden of increased physical, emotional, and psychological stress to women who have preexisting normative life stress. Personal and family history of breast cancer has also been implicated as a chronic stressor among women (Cohen 2005; Gold, Valdimarsdotir, & Bovbjerg, 2003; Zakowski, Valdimarsdottir, & Bovbjerg, 2001). Overexposure to stress hormones like cortisol and epinephrine can lead to a chronic low-level inflammatory state that has been linked to cancer and other diseases through allostatic theory (Bruunsgaard, 2005; McEwen, 1998). For these reasons, it is important to explore ways to help young women diagnosed with breast cancer manage life stressors. Healthy management of stressors has been associated with biomarkers of health (Carlson, 2007; Witek-Janusek, 2008). Swift management of stressors is expected to heighten well-being and health through participation in healthy life occupations.

Overview

The purpose of this study was to determine how a novel intervention could affect stress management in women who had been diagnosed with breast cancer before menopause. These younger women often have more aggressive tumors and treatment than their older counterparts. Normative daily life challenges of younger women, who are likely to be simultaneously active at home and work, may add to the complexity of cancer-related stressors putting their well-being and health at risk. Twenty-eight women who were diagnosed with non-metastatic breast cancer before menopause who were at least three months, but not more than ten years, post cancer treatment (surgery, chemotherapy, and radiation) and 33 women without breast cancer history participated in this study. Women with and without breast cancer histories were studied engaging in a novel intervention.

Young women diagnosed with breast cancer are uniquely challenged by cancer-related and normative stressors. Although many navigate cancer treatment and recovery without known long-term side-effects, there is increasing evidence that physical activity interventions can limit treatment side-effects (McNeely et al., 2006; Schmitz, Holtzman, & Courneya, 2005), improve coping (Courneya & Friedenreich, 2001), decrease cancer recurrence (Holmes, Chen, Feskanich, Kroenke, & Colditz, 2005), and enhance quality of life (Antoni et al., 2006; Courneya, Friedenreich, Sela, Quinney, & Rhodes, 2002).

A more subtle concept, meaningful engagement, has not been well explored in intervention studies. Meaningful engagement captures the ability of a woman with breast cancer to attend to people and tasks in her environment during treatment and recovery in ways that she finds meaningful.

Stress is often studied as part of the cancer experience. Because stress responses vary between individuals, targeting interventions to specific lifestyle and physiological factors may be a way to address the needs of targeted populations. The complexity of stress research necessitates first testing the

proposed intervention in the laboratory setting to optimize the internal validity of the experiment. Coupling the physiological and self-report data may provide insights into stress response patterns that will help target the intervention toward women who have the most potential to reap benefits.

Women can be remarkably resilient throughout the breast cancer experience. I worked with many such women during my years as a clinical occupational therapist specializing in lymphedema interventions. Women referred for therapy presented similar patterns of the physical side-effects of breast cancer treatment. Strategies for coping with stress and engagement in physical activity, however, divided many women into two broad categories: resilient and impaired. Many women spontaneously reported daily life conflicts over the course of their treatment. The most resilient women tried to resolve the conflicts as they arose and then engaged in physical activity. Often, their chosen physical activity occurred in their immediate environment and the intensity of their activity seemed related to the amount of stress the woman felt. Many women reported engaging in household tasks like scrubbing floors, mowing the lawn, or gardening. Other women reported taking brisk walks. Conversely, the most impaired women reported having a conflict, ruminating about it for hours or days, and described sedentary disengaged activity patterns: They more often reported feeling overwhelmed by routine activities like housework and were resistant to structured home therapy programs or encouragement to engage in health promoting activities.

Resilient women who encountered conflict, who tried to resolve it, and who engaged in physical activity in close temporal proximity to the stressor also seemed to make more rapid progress in their rehabilitation than their more impaired peers. Response and recovery patterns associated with everyday stressors seemed to correlate with the speed of their rehabilitation. This faster, more comprehensive rehabilitation had far reaching effects on their reports of overall well-being and retention of rehabilitative outcomes upon clinical reassessments months later. Some women even reported having

higher levels of engagement in meaningful life activities than they did prior to their breast cancer diagnosis. Ryff and Singer (1998) might describe these women as flourishing. I bring the legacy of all of these women - resilient, impaired, and flourishing - to this study. In my experience, women who flourish in the immediate wake of the breast cancer experience are truly few and inspiring. Many women can be resilient through the experience, but may need interventions to help them cope with daily life and cancer-related stressors. Some women may have inadequate strategies for coping with pre-morbid life stressors and cancer-related stressors deepen their impairment. There is insufficient evidence to support those anecdotal observations. Therefore, this study attempted to provide evidence to better understand the effects of engaging in a brief physical activity after an acutely stressful encounter. The relationship between stress recovery, well-being, and health was also of interest. These clinical anecdotes regarding the occupational choices, rehabilitation outcomes, and well-being of women who have had breast cancer inform this study.

Significance

Physical activity has been shown to be a powerful tool for broadly promoting health and well-being among women (McNeely et al., 2006) and has specifically been linked to lower rates of breast cancer (Holmes et al., 2005). However, selecting an ecologically valid physical activity intervention for women with breast cancer presents challenges. Activity choice may be constrained by health status during stages of active cancer treatment despite the importance of stress management during this time. The significance of this study is that it provides evidence about a stress management tool for women who have been diagnosed with breast cancer prior to menopause. Others have studied stress management for women with breast cancer history through cognitive-behavioral therapy, social support, and cardiovascular exercise. Self-report instruments have been the primary data collection tools and few younger women have been represented in these studies. Furthermore, the selected interventions all required that participants have resources (e.g. time, family support, and physical capacity) available for study participation and ongoing application of strategies. The isometric physical activity stress intervention in this study was brief, required no equipment, and appeared to have few if any barriers to use.

Specific aims of this study were as follows: 1) to describe the demographic, health, and well-being characteristics of this sample of women with and without breast cancer history; 2) to test the efficacy of the stress intervention; 3) and to describe the women for whom the intervention enhanced recovery and develop recovery models for future hypothesis development.

Chapter 2: Literature Review

When a woman is diagnosed with breast cancer, her world is irrevocably changed (Lundgren & Bolund, 2007). One in eight American women will receive this news in her lifetime (American Cancer Society, 2007). The "news" will come amidst the flow of life…during her lunch-break…or just before picking up her children from school. A woman is never again "the same" after her diagnosis; however. She may sustain, regain, or develop a high level of well-being and optimize her health. Mathieson and Stam (1995) suggest that a major challenge of this diagnosis is integrating the self known before diagnosis into a whole self enriched by the cancer experience. .

Optimizing well-being, from the point of initial breast cancer diagnosis, through treatment and beyond requires effective coping with daily life and cancer-related stressors. Well-being is an essential part of psychological health (Ryff, 1989). Adult well-being is more than the absence of mental disease. It is a reflection of adjustment to life circumstances in ways that enhance further healthy development (Ryff, 1989). Emerging evidence suggests that well-being also influences physical health (Friedman, Hayney, Love, Singer, & Ryff, 2007; Gruenewald, Seeman, Ryff, Karlamangla, & Singer, 2006; Ryff et al., 2006). Although many authors have written about well-being over the centuries, it is Ryff's psychological well-being theory and scale that inform this study. Ryff's psychological well-being measure is theory-based and reflects the nexus of previous work of noted psychologists from the developmental and clinical psychology fields (Ryff & Singer, 2008). Well-being may be adversely affected when individuals are not able to associate meaning to life events (Ryff, 1989). Rising to the life challenge presented by cancer may be instrumental to a woman's future development and well-being. Well-being may, further, be associated with engagement in activities referred to as occupations (Reid, 2008).

"Occupations" are the things that people do with their time while performing self-care, being productive, and engaging in leisure activities. All women engage in occupations that are influenced by people, objects, and conditions in their environments. The Person-Environment-Occupation Model (PEO) lends understanding to the transactions of the individual in context (Law et al., 1996). Occupational performance may be thought of as the central overlap of three circles representing a person engaged in occupation in the environment as depicted in Figure 1. The occupational performance of a woman with breast cancer may be affected by the many changes occurring at the "person" level. Physical status, cognitive abilities, affective responses, and spiritual being are all included in the PEO model. This review will focus on physical, cognitive, and affective qualities of the cancer experience. A person withdrawing from occupations or the environment may be depicted by an outward moving "person" circle that reduces the central overlap thereby reducing overall occupational performance. A reduction in actual or perceived performance may have far-reaching effects on a woman with breast cancer.

"Health" results when there is a match between a woman's occupations, the environment, and individual physiological state (Irwin et al., 2005). "Doing" is the key to occupation and a major building block of well-being (Hasselkus, 2002). Occupational patterns may be similar among individuals of the same gender and age. For instance, young women are more likely than older women to be raising children and working outside of the home. Environmental influences such as children and work may affect individuals in similar ways as they engage in occupations like providing care and being productive at work. Cancer treatment may affect the woman, her occupations, and her environment thereby destabilizing occupational performance at the center of the occupational performance model.

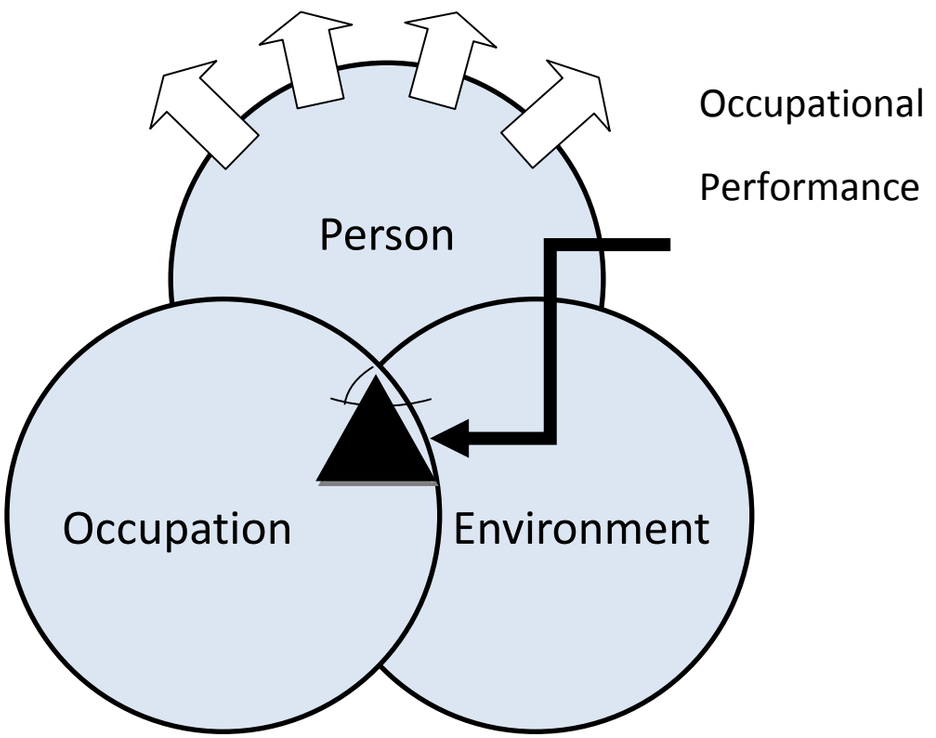


Figure 1: Occupational Performance Model

Both transient and chronic cancer treatment side-effects can further affect a woman's engagement in occupations (Curt et al., 2000). Women with cancer report behavioral, psychosocial, social, career, and daily living challenges (Curt et al., 2000). What a woman does each day may be dependent on her perceptions of her capacity to perform her desired occupations. A woman's daily occupations are affected by the breast cancer experience (Lyons, 2006; Mathieson & Stam, 1995).

Occupational presence, a recently introduced concept describing the feeling that a person has when she is engaged in any occupation (Reid, 2008) may also be affected by the cancer experience. Everyday occupations like taking a shower, going to work, playing with children, or taking a walk may all be experienced differently after a cancer diagnosis (Mathieson & Stam, 1995). Some occupations, like competitive athletics, may be postponed (Curt et al., 2000). Self-care, childcare, and work occupations may be modified, yet other occupations may be relatively unaffected by the breast cancer experience. Some occupational changes are temporary, while others may develop into new habits and routines.

Occupations are influenced by physical, institutional, cultural, and social environmental factors (Law et al., 1996). Women are challenged to remain meaningfully engaged in daily occupations and to be understood by others in their home, work, and health care environments during the year following a breast cancer diagnosis. The breast cancer treatment environment uniquely affects the occupations of each woman with breast cancer despite the similarities in treatment protocols among women with similar diagnoses (Ganz et al., 2004). Well-being depends, in part, on social engagement, (Ryff, 1989). Daily life events and interactions hold unique meanings for each individual. When a person is not able to participate in her usual occupations, she may struggle to find meaning in life (Hasselkus, 2002; Lyons, 2006). This struggle may transcend all areas of her life and negatively affect well-being and health.

A woman's reactions to and management of stressors in the environment may play an important role in her occupational performance, satisfaction, and presence. Her occupational patterns may contribute to a lifestyle that promotes or impairs her well-being and health. Women for whom one occupation is physical activity cope better with breast cancer than their less active peers (Courneya et al., 2003). During treatment, physical activity can increase quality of life (Bicego et al., 2009; Cheema, Gaul, Lane, & Singh, 2008; McNeely et al., 2006), physical function, and well-being (McNeely et al., 2006) and minimize cancer treatment side-effects to facilitate coping (Courneya & Friedenreich, 2001).

Barriers exist for some women to participate in physical activity requiring full-body exercise. However, alternative physical activity interventions may confer stress ameliorating benefits (Ben-Sira & Oliveira, 2007).

The occupational performance model guided a review of literature in the areas of (1) breast cancer, (2) stress, and (3) physical activity. Findings of previous work informed the design of this study. This review provides the basis for a brief physical activity stress intervention for women who have had breast cancer. The main goals of this study were to test a stress management tool for women with breast cancer history and to identify predictors of faster stress recovery.

The breast cancer experience

Breast cancer is increasingly being identified and successfully treated in young women diagnosed before menopause. More than 250,000 American women40 years-old or under are living with active or historic breast cancer (http://www.youngsurvival.org/young-women-and-bc). Many in this cohort are balancing career, family, and personal demands. Cancer treatment in younger women may be more aggressive and disruptive to occupations than it is in post-menopausal women (Ganz et al., 2004). Breast cancer diagnosis introduces a potentially life-threatening stressor with the capability to wreak transient or progressive chaos in even the most orderly life. The potential impact of breast cancer on young women and their daily occupations is chronicled in the literature reviewed below.

Diagnosis. A breast cancer diagnosis dramatically changes a woman's life (Lundgren & Bolund, 2007). Confirmation of this diagnosis marks the beginning of a difficult adaptation process in which the woman may perceive a loss of control and a sense of vulnerability that permeates all aspects of her life (Lundgren & Bolund, 2007). From diagnosis forward, she will make choices about her body that will have an impact on what she chooses to do as well as her interactions with her environment (Mathieson

& Stam, 1995). Typical breast cancer treatment interventions, including surgery, chemotherapy, and radiation, have both curative properties and common side-effects.

A woman must learn to manage both pre-existing demands and the new environmental demands associated with the treatment of and adjustment to her condition. Mastering individual factors associated with cancer and the environment can be overwhelming (Mathieson & Stam, 1995). A person who struggles to manage her environment may report a lower level of well-being (Ryff, 1989). After diagnosis, a woman must make treatment decisions at the same time she rearranges her daily life to accommodate active cancer treatment protocols and to manage treatment side-effects. From a very practical perspective, her entire set of goals and routines is disrupted. Carver (2005) considers cancer a threat to goal seeking. Pre-cancer goals related to family, self, and career may be reprioritized to accommodate new cancer treatment goals (Mathieson & Stam, 1995).

Surgery. Surgery is the first treatment administered to most women with breast cancer. Techniques now spare as much breast tissue as possible, but surgical treatment side-effects still occur. Women who undergo breast surgery have some unique challenges in addition to the infection risk, wound healing, and transient edema and pain associated with any surgery. The surgical location can limit arm mobility in acute and subacute healing stages. For many, prescribed activity encouraging progressive movement of the arm to presurgical levels is sufficient to regain arm function in daily life as well as for occupational and recreational activities. However, arm morbidity may occur and can include decreases in range of motion, strength, endurance, functional performance, and the onset of lymphedema (Allard, 2007; Ganz et al., 2004; Gordon, Battistutta, Scuffham, Tweeddale, & Newman, 2005) .

The peri-surgical time period is known for overwhelming individuals with information regarding their diagnosis, prognosis and recovery (Mathieson & Stam, 1995). Pressure to make life altering

decisions based on the most complete, yet inconclusive, information can contribute to the stress felt when considering treatment options (Mathieson & Stam, 1995). Women are offered surgical choices, when they exist, which will affect subsequent treatment. Many new concepts are introduced to women and their families who several days earlier were likely unaware of the cancer. When thrust into a patient role, some women find it difficult to maintain their sense of autonomy (Mathieson & Stam, 1995). Some women report an existential change in their relationship with their bodies: some lack trust in their bodies while others attend to their body's signals in very meaningful ways (Lundgren & Bolund, 2007).

An individual experiencing cancer may not be able to match her current experience and anticipated future with her past: she may feel like a different person (Mathieson & Stam, 1995). This change in self-perception may negatively affect well-being (Ryff, 1989). Women process a lot of new information while concurrently restructuring their personal, family, and work lives to accommodate surgical recovery and further cancer treatment (Mathieson & Stam, 1995). Symptoms reported by women in the first month following surgery include stiffness, sensitivity and pain in the affected upper-quadrant of their body, fatigue, and concentration problems. (Ganz et al., 2004) In one study aggressive treatment was associated with an increase in physical problems within the month after surgery (Ganz et al., 2004). Often, side-effects are transient, but they persist in some women (Kayl & Meyers, 2006).

Chemotherapy. Many women report that chemotherapy is the most difficult part of their treatment. Fatigue, nausea, hair-loss, changes in sexual functioning, menopausal symptoms, and reduced quality of life are reported during chemotherapy (Curt et al., 2000; Kayl & Meyers, 2006). During treatment, body changes may lead to a cascade of changes in appearance - breast changes (Kayl & Meyers, 2006), hair loss (Kayl & Meyers, 2006), and fat/lean mass composition (Irwin et al., 2005) - which can affect a woman's self image (Lundgren & Bolund, 2007). Younger women report more difficulties with self image than older women (Kayl & Meyers, 2006). Many women, 25-99% in a

review, experience fatigue during chemotherapy (Bower, 2007). Some women undergoing chemotherapy demonstrate problems with attention and concentration (43%), executive function (43%), information processing speed (83%), language (50%), motor function (71%), visuospatial skills (29%), verbal memory (43%), and visual memory (67%), (Bower, 2007). These cognitive changes may complicate daily activities, particularly those requiring multi-tasking, (Jansen, Miaskowski, Dodd, & Dowling, 2005; Jansen, Miaskowski, Dodd, & Dowling, 2007). Women's occupations at home and at work are often dependent on high-level cognitive skills to optimize performance of and satisfaction with activities. Chemotherapy side-effects are expected to decrease with time. However, fatigue, arm morbidity, and other side-effects may be exacerbated by radiation.

Radiation. Radiation treatment may be necessary for some women. Cardiac, skin, connective, muscle, and lymphatic tissue may be negatively affected by radiation therapy although adverse side-effects are on the decline due to technological and clinical refinements (Shapiro & Recht, 2001). Initially, there can be burning of the skin and as treatment progresses there can be a cumulative trophic effect resulting in fibrotic changes (stiffening of soft tissue). These changes can lead to arm range of motion decreases and/or lymphedema in the affected upper quadrant (Shapiro & Recht, 2001). Arm function can be newly or further compromised during radiation. The cumulative effect of radiation over time has also been associated with progressive fatigue (Bower et al., 2007). Fatigue may resolve in the short-term (Shapiro & Recht, 2001) or persist (Bower et al., 2007).

Fatigue. Fatigue is reported as a common side-effect associated with all cancer treatments (surgery (Ganz et al., 2004), chemotherapy (Bower, 2007; Curt et al., 2000; Kayl & Meyers, 2006), and radiation (Bower, 2007; Shapiro & Recht, 2001). Fatigue becomes chronic and distressing for some women (Bower & Segerstrom, 2004; Bower et al., 2007; Curt et al., 2000). Increasingly, it can be analyzed separately from depression and sleep disturbance. An association between fatigue and a

chronic inflammatory response was noted by Kayl & Meyers (2006). This type of fatigue does not completely resolve with normally restorative sleep (Kayl & Meyers, 2006). Many women overcome the challenges of treatment and its side-effects and maintain most of their daily occupations (Ganz et al., 2004). Levels of engagement in life activities may, however, differ between women with cancer history and their healthy peers for years following diagnosis (Hansen et al., 2008; Mathieson & Stam, 1995). For example, working women with breast cancer history (about 4 years post diagnosis) reported significantly more work limitations related to fatigue than well peers (Hansen, Feuerstein, Calvio, & Olsen, 2008). Residual side-effects such as fatigue and associated changes in occupational patterns can make life after cancer diagnosis a daily challenge.

Life readjustment. The year following a cancer diagnosis is predominated by active cancer treatment and life readjustment (Ganz et al., 2004). For some, the end of active cancer treatment marks the beginning of physical, affective and spiritual challenges (Ganz et al., 2004). Even women who felt that they coped well with cancer treatment reported anxiety and depression at the end of their treatment regimen (Ganz et al., 2004). These women may have pushed through treatment with seemingly few difficulties and then felt abandoned when there was no more active "fighting" of the cancer. They may feel further abandoned by family and friends when the casseroles and "how are you doing's?" end (Mathieson & Stam, 1995). They may question whether the cancer will stay away without any active attention from others. And they are stepping off into the world with a new moniker, "cancer survivor". Most weather this transition well, but some may struggle with persistent side-effects and develop chronic conditions. At a time when women are expected to start feeling relief, some women report feeling distressed (Ganz et al., 2004). Many women report gradual improvements in quality of life during this time; however, 20-40% of women in an Australian study reported a decline in quality of life at 12 months post diagnosis (Gordon et al., 2005).

A woman's age at diagnosis may be predictive of the course of her cancer experience. Young women who have had cancer may be particularly vulnerable to affective changes years after cancer treatment. They report more depression and anxiety and lower positive affect than same-age peers without previous cancer in this longitudinal follow-up study of women assessed at two data points nine years apart (Costanso, Ryff, & Singer, 2009). The second collection point occured a mean of four years following cancer diagnosis. Older women, in contrast, reported similar levels of depression and anxiety as their age-matched peers upon nine year follow-up in the same study. Differences between younger and older women may be linked to adult development. As we age we expect that our risk of disease increases. Older women, on average, may be better prepared for the relatively normative life event of disease onset than younger women, (Costanso et al., 2009).

Young women may also differ from older women in their management of daily life demands. In a cross-sectional comparison of older and younger women regardless of disease history, older women reported more mastery over their environments than younger women, (Ryff & Singer, 2008). Younger women with breast cancer may not have fully mastered their pre-cancer environments prior to the imposition of another layer of individual and environmental stress. Active parenting is a common challenge of breast cancer diagnosis in young women. In one study, women with children were significantly more likely to report depressive symptoms than women without children (Deshields, Tibbs, Fan, & Taylor, 2006) . Depression emerged among mothers in the 6 months after the end of radiation treatment (Deshields et al., 2006). Aggressive cancers requiring equally aggressive treatment may further explain the vulnerability of some young women. In a study by Ganz et al. (2004), women with aggressive treatments had more physical problems, reduced quality of life, and more depressive symptoms (16-27.7%) at one year follow-up than those with less aggressive treatment.

Occupation. Daily life occupations must change, at least temporarily, in the wake of breast cancer diagnosis (Lyons, 2006). Variations occur in the response patterns of women to the numerous disruptions in their routines. Little is known about what causes one woman to make an occupational choice that matches her current anatomy and physiology and another woman to make a choice that is a mismatch. My clinical experiences have demonstrated that although two women may have similar self reports of fatigue level, one woman might engage in sedentary activities and the other woman might choose to be physically active despite her fatigued state. The woman choosing physical activity will optimally choose an intensity and duration that honors her fatigue, yet challenges her personal physiological state, eventually elevating her physical capacity. The sedentary woman may be more likely to stay at her current fatigue level or become even more fatigued. Finding a match between personal physiology and occupation - in this example physical activity or inactivity - can lead to improved well-being and health (Wilcock, 1998).

The level of physical activity engagement in the environment has the potential to be a rehabilitative vehicle for meaningful engagement in life because of its centrality in everyday experiences (Hasselkus, 2002; Lyons, 2006; Wilcock, 1998). Participating in meaningful life occupations keeps people engaged in life experiences. Stress can prevent people from participating fully in life occupations. However, many women report benefits of their cancer experience. For instance, in the Constanso et al. (2009) study, people diagnosed with cancer during the 9 years between longitudinal data collection points reported improvements in positive outlook after cancer. These improvements raised their levels of positive outlook to levels similar to peers who had not had cancer (Costanso et al., 2009). Generally, benefit finding starts at the person level and transcends into occupations and the environment in their ultimate effects. Some benefits are expected like better relationships with family and friends (Wilcock, 1998). Bonanno's (2004) encouraging theory reminds us that many, but certainly

not all, people are quite resilient and remain functional when confronted with various forms of loss and trauma.

Because not all women are resilient, we must return to the occupational performance model to find ways to best intervene and optimize the performance of meaningful occupations. Occupations, well chosen by the individual or with therapeutic interventions, have strong rehabilitative potential to optimize well-being and health after breast cancer diagnosis. Stress can be a barrier to engaging in meaningful occupations and maximizing overall occupational performance. The goal of the proposed stress management intervention is to introduce an activity that will maximize women's daily level of engagement in meaningful occupations and promote well-being and health.

Stress

A relationship between stress and breast cancer has been documented in the literature. However, the precise nature and the relative strength of the relationship are not clear. Researchers have tried to clarify the relationship between breast cancer and stress using multiple approaches. Although life stress has been implicated as increasing the odds of developing a first cancer, there is little evidence to support this view (Peled, Carmil, Siboni-Samocha, & Shoham-Vardi, 2008). Studies of stress related to the time of diagnosis (Carver, 2000; Dickerson, Alqaissi, Underhill, & Lally, 2011; Witek-Janusek et al., 2008), active cancer treatment, (Carver, 2000; Glinder, 2006; Gold et al.) and the end of cancer treatment, (Carlson, 2007; Carver, Meyer, & Antoni, 2000; Valdimarsdottir et al., 2002), have provided stronger evidence for the potential effects of cancer-related stress on management of daily life activities, well-being, and psychological and physical health. Increased risks of a first, (Gold et al., 2003; Valdimarsdottir et al., 2002) or recurrent, (Carver et al. 2000; Carver, 2000) cancer have also been studied as sources of chronic stress. Many interventions to reduce stress have been investigated because of the acknowledged, yet elusive, relationship between cancer and stress, (Antoni et al., 2006a 2006b;

Carlson, 2007; Carver, 2005; Witek-Janusek et al., 2008). Interventions have been limited by a lack of understanding of the precise nature of the physiological mechanisms underlying stress, cancer-related health, and well-being consequences.

Individuals respond to stressors in different ways. Contemporary stress research has repeatedly demonstrated variances in individual stress responses to the same laboratory-based stressor (Allen, Stoney, Owens, & Matthews, 1993; Benschop et al., 1998; Cacioppo et al., 1995; Herrmann, Schonecke, Wagner, Rosenthal, & Schmidt, 1980; Kudielka, Hellhammer, & Wuest, 2009; Liu, Iwanga, Shimomura, & Katsuura, 2007). The existing evidence challenges Selye's (1936) historic general adaptation syndrome which states that various stimuli trigger a generalized stress response in the majority of individual subjects. Although extreme stimuli may more predictably trigger a generalized response in the majority of individuals, contemporary paradigms have focused on mild-to-moderate stressors and find that individual response differences can be grouped into patterns of cardiac or vascular responders and nonresponders. A contemporary perspective of mild to moderate stressors will guide this study of women coping with breast cancer during the year after diagnosis.

Transactional theory of stress. A transactional theory of stress, rather than conventional stress theory, more accurately describes the range of stressors naturally experienced by most people (Folkman& Lazarus, 1988). In the transactional stress model, cognitive processes such as appraisal trigger coping which mediates the effect of stressors within an acute stress encounter (Folkman & Lazarus, 1988). Behaviors that regulate emotions can also help individuals cope with stressful encounters (Folkman, 2004). Coping can change emotions during an encounter through its effect on the relationship between the person and environment or the meaning of the stressor, (Folkman & Lazarus, 1988). According to the transactional theory, stress is the result of an individual's primary and secondary cognitive appraisals of the environmental demands exceeding their capacity to respond,

(Folkman & Lazarus, 1988). Transactional theory may also be reframed in the vernacular of the occupational performance model. At the individual level, coping occurs through cognitive reassessment, regulation of affective responses, or physical behaviors. A change in the environment may also facilitate coping. Coping may also occur through the occupational choices that are made or imposed. Stress would be expected to diminish with disengagement from a stress producing occupation and engagement in a stress ameliorating occupation. Although each circle in the model is described separately, a more accurate depiction of coping in the occupational performance model would include dynamic movement of the circles toward and away from the central overlap. A larger occupational performance area seen in Figure 3 would result from more effective (healthier) coping than a smaller area seen in Figure 2 resulting from less effective coping.

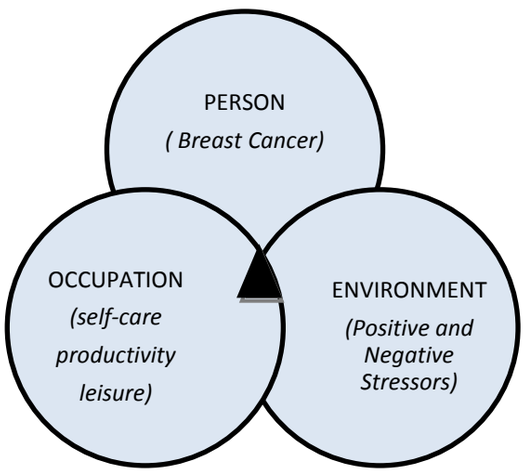


Figure 2: Less Effective Coping

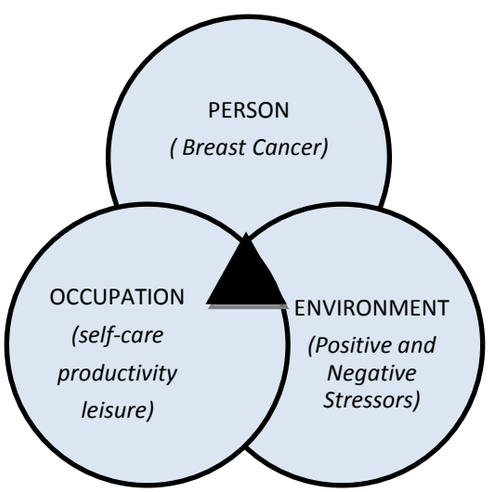


Figure 3: More Effective Coping

Stress moderators. Stress responses, as measured during laboratory stress challenges, may be influenced by moderator variables such as gender (Allen et al., 1993; Kudielka et al., 2009), age (Benschop et al., 1998; Kudielka et al., 2009; Uchino, Uno, Holt-Lunstad, & Flinders, 1999), and fitness level (Hamer & Steptoe, 2007; Traustadottir, Bosch, & Matt, 2005). Women tend to respond to laboratory stressors by increasing heart rate which is indicative of cardiac reactivity as compared to men who tend to have more vascular responses (Allen et al., 1993). Either cardiac or vascular responses may increase blood pressure (Allen et al., 1993). Salivary cortisol reactivity, an indicator of the hypothalamic-pituitary-adrenal (HPA) axis, to laboratory stressors in women is typically half that of men (Kudielka et al., 2009). Older women demonstrated greater HPA stress reactivity to laboratory stressors than younger women in a meta-analysis (N=128) (Benschop et al., 1998). A similar age effect was found in a study of 133 men and women (Uchino et al., 1999). Fitness level (measured by VO_2Max) may affect the neuroendocrine changes associated with aging (Traustadottir et al., 2005). Traustadottir and colleagues found that fit older female subjects had significantly healthier cortisol responses to a laboratory stressor when compared to unfit older female subjects. Older women who were fit had body mass indexes (23.9 +- 6 (21-26)) that were similar to younger women (23 +-7 (20-27)) when compared to older unfit women in the study who had higher BMIs (Traustadottir et al. 2005). Central adipose tissues have heightened metabolic activity in response to cortisol increases (Veilleux et al. 2009).

Men and women (N=207) who were an average of 52±3 years old with higher fitness levels (as measured by exercise heart rate) than same-age peers demonstrated lower stress reactivity as measured through heart rate variability in response to laboratory stressors (Hamer & Steptoe, 2007). BMI differences were associated with these fitness levels. Variation in stress responses may be dependent on individual study design and methods. Therefore, to date the role of fitness in stress challenge paradigms remains inconclusive. Because of the physiological role adipose, BMI may be a variable of interest in

the absence of fitness level testing apparatus. Gender, age, and fitness level may moderate the effect that laboratory stressors have on individual stress physiology and, thus, were included in the design of this study.

Physiological stress response. The body responds to a stressor by triggering a series of events resulting in the release of stress hormones in healthy people during an acute stressor. After a robust response, stress hormone levels return to baseline (McEwen, 1998). Overexposure to stress hormones can lead to a chronic low-level inflammatory state that has been linked to cancer and other diseases (Bruunsgaard, 2005; McEwen, 1998). The impact of stress on health has been studied from acute and chronic perspectives. Chronic stress may create allostatic load with an associated link to negative health outcomes (McEwen, 1998). Managing stress in the short term may have benefits for long-term well-being and health.

Stress is mediated by two pathways: the autonomic nervous system primarily via the sympathetic adrenal medullary (SAM) axis and the hypothalamic pituitary adrenal (HPA) axis (Antoni, Lutgendorf, Cole, Dhabhar, & Septon, 2006). Fight or flight responses, first described by Cannon (1932) are associated with the sympathetic release of catecholamines (e.g. adrenalin and noradrenaline). Whereas, defeat/withdrawal responses result from the HPA axis release of glucocorticoids (e.g. cortisol). Fight or flight responses are evident within seconds of stress, (Sapolsky, Romero, & Munck, 2000). These responses have conventionally included increased blood pressure, increased heart rate, and dilation of peripheral blood vessels to the extremities (Sapolsky, Romero, & Munck, 2000). Laboratory stressors which require participants to physically do something tend to increase blood pressure through increased heart rate and stroke volume (Ironson, Schnieiderman, & Siegel, 2005). Stressors requiring passive responses associated with defeat/withdrawl responses, however, may decrease heart rate and increase

blood pressure from increased resistance in vessels, (Sapolsky, Romero, & Munck, 2000; Ironson, Schnieiderman, & Siegel, 2005).

Glucocorticoids both facilitate acute stress responses and stop stress responses before they become harmful to the body (Sapolsky, Romero, & Munck, 2000). Baseline glucocorticoid levels are more predictive of stress reactivity and glucocorticoid levels triggered by stressors are most linked with the suppression of the stress response (Sapolsky, Romero, & Munck, 2000). Glucocorticoids suppress both immunity and inflammation (Sapolsky, Romero, & Munck, 2000). The effects of the release of catecholamines and glucocorticoids in response to an acute environmental stressor start less than a minute after exposure and generally resolve within an hour in individuals with healthy stress physiology (Sapolsky, Romero, & Munck, 2000).

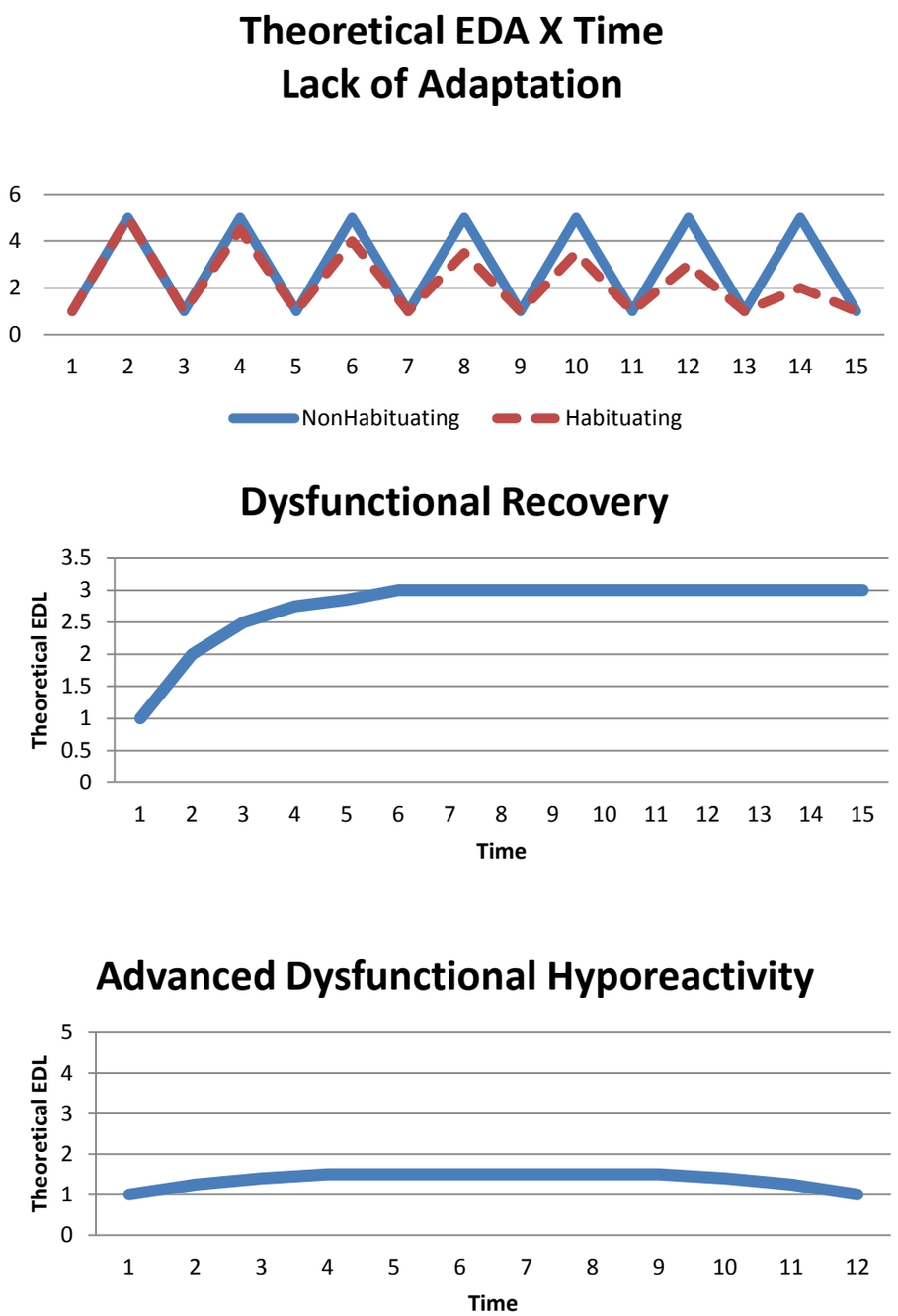
Allostatic theory. Individual stress physiology may be related to overall health (McEwen & Seeman, 1999). Allostasis describes changes in physiological set points within body systems, (McEwen, 2000) . This term was coined by Sterling and Eyers (1988) to describe cardiac responses to situations and in relationship to pathological blood pressure changes (1988). The autonomic nervous system and HPA axis are examples of allostatic systems with wide variability tolerances (McEwen, 2000). These systems influence the homeostatic systems that must be maintained for survival (McEwen, 2000). Allostatic systems, like the cardiac and endocrine systems, facilitate short-term physiological coping by changing with environmental demands as part of healthy physiological functioning. Unhealthy physiological coping can lead to allostatic load.

Allostatic load may result from: 1) too many stressors such as results from chronic stress; 2) an inability to habituate when exposed to the same types of stressors; 3) sustained stress responses; or 4) an insufficient stress response (McEwen & Seeman, 1999). A model adapted from McEwen's illustrates three types of allostatic load in Figure 4 (2000). A lack of adaptation to stressors is shown in the top

graph where physiological reactivity remains high. Dysfunctional recovery is shown in the middle graph. In this graph, physiological reactivity persists into the recovery time period. In functional recovery, downward trending physiological values are expected. The proposed mechanism of these types of allostatic load is overexposure to stress hormones (McEwen & Seeman, 1999). The bottom graph illustrates dysfunctional advanced physiological hyporeactivity. Systems responsible for physiological arousal are dampened by chronic stress. There is an underexposure of stress hormones in the last type of allostatic load (McEwen & Seeman, 1999). This graph exemplifies the highest level of allostatic load in this figure. Figure 4 illustrates only one physiological variable to explain the concept of allostatic load. However, a statistical model defined by multi-systemic biomarkers, may be more strongly predictive of health risk than any single biomarkers (Seeman; McEwen; & Rowe; et al., Rowe, Seeman, & Singer, 2001). For example, women in their seventies, who had high blood pressure were represented in all female high risk pathways (containing biomarkers from multiple systems) that prospectively predicted mortality within 12 years (Gruenewald et al., 2006).

Allostasis is a potential stress mediating mechanism for women at increased familial risk of breast cancer who experience the effects of chronic stress. Women at increased risk of breast cancer reacted more to stress challenges than women who had normal risk of breast cancer. (Gold, Valdimarsdottir, Bovbjerg, 2003; Valdimarsdottir et al., 2002) Stress reactivity was measured by distress, heart rate, number and activity level of natural killer cells, (Zakowski, Valdimarsdottir, & Bovbjerg, 2001) cortisol and epinephrine (Gold, Valdimarsdottir, Bovbjerg, 2003). Exaggerated laboratory stress responses may predict similar reactions to daily stressors (Gold, Valdimarsdottir, Bovbjerg, 2003). This may provide physiological evidence of chronic stress associated with increased breast cancer risk.

Figure 4: Types of Allostatic Load (Adapted from McEwen, 2000)



Stress and women with breast cancer. Interventions targeting women who have had breast cancer attempt to improve women's capacity to cope with their cancer experiences. Many stress intervention trials for women who have had breast cancer include weekly support group meetings requiring 12 to 32 hour commitments over a three to 12 week time period (Antoni, Wimberly, Lechner, & et. al, 2006; Cameron, Booth, Schlatter, Ziginskas, & Harman, 2007; Telles Nunes et al., 2007; Witek-Janusek et al., 2008). Such interventions target the cognitive and affective aspects of the "person" level in the occupational performance model. Following stress management interventions, women report improvements in quality of life (Antoni et al., 2006; Witek-Janusek et al., 2008), emotional well-being, coping effectiveness (Cameron et al., 2007; Witek-Janusek et al., 2008), anxiety (Antoni et al., 2006; Cameron et al., 2007; Telles Nunes et al., 2007), stress (Telles Nunes et al., 2007), and intrusive thoughts about cancer (Antoni et al., 2006).

In two intervention studies, investigators tested the related concepts, emotional regulation (Cameron et al., 2007) and "being able to relax at will" (Antoni et al., 2006). Women exposed to both interventions reported many benefits immediately after intervention and upon 12-month follow-up (Antoni et al., 2006; Cameron et al., 2007). Interventions included relaxation training, guided imagery, meditation, emotional expression, activities that encouraged a sense of control and finding benefits of the cancer experience (Cameron et al., 2007), cognitive behavioral techniques, muscle relaxation, and stress management education aimed at daily stressors (Antoni et al., 2006).

Stress management interventions confer cognitive and affective benefits to women who are able to make the time commitment to attend group therapy sessions. "Person" level benefits likely enhance women's capacities to engage in occupations in the dynamic post cancer environment. However, the amount of time required toattend and meeting time and location may be barriers to participation for some women. The delivery of multiple interventions to small groups of women limits the

generalizability of previous intervention studies. Both the multiplicity of interventions and group dynamics are among potential confounders of the findings.

Women may require different stress management tools to accommodate their various states of health, personal preferences, and lifestyles. Physical stressors associated with cancer have been the targets of physical activity intervention studies for women who have had breast cancer. They focus on physical rather than cognitive and affective changes, yet often report improvements in quality of life and well-being.

Physical Activity

Physically active women cope better with breast cancer treatment (Courneya et al., 2003) and enjoy a higher quality of life (Courneya et al., 2004) than their less active peers. Physical activity may even reduce cancer recurrence (Holmes et al., 2005). The majority of evidence supporting the benefits of physical activity for women with breast cancer involves cardiovascular exercise. Because cardiovascular exercise or full-body resistance may not be accessible to all women in active cancer treatment, isometric hand-grip evidence in well populations will also be explored. This review will focus on the time when women are being actively treated for nonmetastatic breast cancer. However, participants in this study have completed their primary cancer treatment due to recruitment limitations.

Breadth of physical activity evidence. Aerobic and mixed aerobic/resistance exercise have been the most studied physical activity interventions among women who are undergoing breast cancer treatment. Quality of life and fitness are commonly studied outcomes of these physical activity interventions: less studied outcomes include physical function, body composition, chemotherapy completion rate, fatigue, psychosocial functioning, strength, and treatment side-effects like pain, disability, and severity of medical complications (Courneya et al., 2007; Fillion et al., 2008; McNeely et al., 2006; Schmitz, Ahmed, Hannan, & Yee, 2005). Menopausal status at diagnosis, pre-diagnosis

activity level, and intervention timing are important considerations when evaluating the effectiveness of these interventions. Women enrolled in previous studies were usually at mid-life (approximately 50 years-old) and were engaged in active chemotherapy (Andrykowski, Beacham, & Jacobsen, 2007; Courneya et al., 2007; Segal et al., 2001) or radiation therapy, (Andrykowski et al., 2007). Many women in these physical activity studies reported engaging in regular exercise at baseline.

Two of the larger studies (Andrykowski et al., 2007; Courneya et al., 2007) represent the range of physical activity reported by women at baseline. More than 26% of 242 participants in a multicenter randomized control study reported being "exercisers" upon study enrollment, (Courneya et al., 2007). Seventy-five percent of participants in a prospective, longitudinal study of 231 participants with early-stage breast cancer reported some level (just meeting guidelines through strenuous) of leisure-time exercise at baseline (Andrykowski et al., 2007). In comparison, approximately 60% of women polled in a telephone survey, regardless of disease status, reported meeting federal physical activity guidelines (CDC, 2008). Women who reported relatively higher levels of physical activity before being diagnosed with breast cancer may have been predisposed to enrolling in physical activity research; however, the baseline level of physical activity reported was in line with that reported by women in the general population.

Contribution of Physical Activity to quality of life. Quality of life is often selected as the primary outcome measure of physical activity studies enrolling women who have had breast cancer and consequently was the topic of recent meta analyses. Women who participated in aerobic and/or resistance exercise during or after breast cancer treatment generally reported a higher quality of life than those who didn't exercise (Bicego et al., 2009; Cheema et al., 2008; McNeely, et al., 2006). Women who complete full-body resistance (Ohira et al., 2006) or mixed resistance/aerobic (Courneya et al., 2007; Milne, Wallman, Gordon, & Courneya, 2008) interventions within the early months following

treatment also report quality of life improvements. The timing of these and other exercise intervention studies indicates a historic hesitancy to enroll women in physical activity studies during active breast cancer treatment (Brockow, Markes, & Resch, 2006). Emerging evidence supports using resistance exercise to improve quality of life and other outcomes during chemotherapy and up to one-year follow-up (De Backer et al., 2008). Women who participate in full-body aerobic, resistance, and mixed aerobic/resistance interventions 2-3 times per week during and soon after cancer treatment report improvements in quality of life (McNeely et al., 2006)

Physical functioning and well-being may be considered components of quality of life (McNeely et al., 2006). A meta-analysis pooling 408 women with breast cancer history, showed improved physical function and well-being among those who exercised (McNeely et al., 2006). The importance of early physical activity intervention following diagnosis is supported by a study where more than half (52.5%) of all study participants were physically active prior to breast cancer diagnosis and were enrolled in an exercise program within two weeks of starting chemotherapy (Segal et al., 2001). A 26-week home-based moderate intensity walking program was superior to both exercise supervised at a cancer center and a typical non-exercising standard of care among a group of middle-aged women with breast cancer (Segal et al., 2001). In contrast, women who did not exercise during the 26 weeks reported a decline in physical function. This evidence suggests that women who are not directed to exercise during cancer treatment may lose physical functional abilities in as few as six months. Therefore, it is important to provide physical activity interventions designed to improve physical functioning in women during breast cancer treatment.

Effects of treatment for breast cancer on physical activity. Treatment side-effects such as pain, disability, body composition changes, physiologic outcomes, and fatigue have also responded positively to physical activity interventions (Courneya et al., 2007; McNeely et al., 2006; Schmitz et al.,

2005). Evidence from two meta-analyses and several RCTs indicate that 30 minutes of moderate to vigorous aerobic exercise performed three to five times weekly helps women in active cancer treatment cope with some side-effects of their treatment (Courneya et al., 2007; Courneya et al., 2008; Friedenreich, Gregory, Kopciuk, Mackey, & Courneya, 2009; McNeely et al., 2006; Schmitz, et al., 2005). Resistance exercise 3 times weekly increased chemotherapy completion rates in a multicenter randomized control trial (Courneya et al., 2007).

Fatigue, is a multifaceted side effect that is variably affected by exercise. In one meta-analysis investigators concluded that exercise during breast cancer treatment, although helpful, did not have a statistically significant effect on reducing fatigue in four of six studies (McNeely et al., 2006). Exercise did, however, significantly reduce fatigue in studies conducted after cancer treatment (McNeely et al., 2006). A Cochrane review reflecting 16 of 28 studies enrolling women with breast cancer concluded that exercise can reduce fatigue in women during and after cancer treatment (Cramp & Daniel, 2008). A high intensity resistance intervention was found to decrease fatigue during chemotherapy and for up to one year thereafter (De Backer et al., 2008). A limitation of previous work is the specificity of selected fatigue measurements. For instance, subjects with fatigue who had already been treated for a variety of cancers reported improvements in non-cognitive fatigue after a three-week combined aerobic and resistance program (Dimeo, Schwartz, Wesel, Voigt, & Thiel, 2008). However, this group did not report significant decreases in cognitive fatigue. Available evidence suggests that exercise can reduce cancer-related fatigue. However, the optimal exercise qualities like mode, intensity, and intervention timing for reducing fatigue have been more difficult to ascertain than they have been for other common outcome variables like quality of life. Fatigue is a significant potential barrier to full-body exercise.

Barriers to physical activity. Despite evidence supporting the use of aerobic and full-body resistance exercise to improve quality of life, physical functioning, and reduce cancer treatment side-

effects, significant barriers may prevent engagement in sufficient physical activity. A review of 65 exercise studies that enrolled people with cancer concluded that only half of qualified subjects completed an exercise trial (Maddocks, Mockett, & Wilcock, 2009). Lack of time was the leading reason provided by individuals who were not interested in enrolling (Maddocks et al., 2009).

One study of women who were genetically predisposed to breast or ovarian cancer lends further insight. These women reported that a lack of time and childcare were the largest barriers to engaging in regular exercise despite acknowledging the many benefits of increasing physical activity (Maddocks et al., 2009). Women reporting barriers to enrolling in an exercise trial may have already been struggling to manage the demands of their environments. Environmental mastery is a component of well-being (Ryff, 1989). Therefore, these women may have lower well-being than enrolled peers. Ironically, they may have had the most to gain from a physical activity intervention.

Even women who were active prior to their breast cancer diagnosis report a decline in physical activity (Irwin et al., 2003; Irwin et al., 2005) and sports participation (Curt et al., 2000; Curt et al., 2002) during treatment. These women, sensing "person" level changes reduce physically active occupations. The occupational performance area in the model shrinks as a result of dual withdrawals in the person and occupation circles. These changes may contribute to an increase in stress.

Side-effects of breast cancer treatment can be significant barriers to aerobic and full-body resistance exercise. The health and well-being benefits of physical activity may however be accessible through alternative means.

Forearm exercise. There are fewer barriers to forearm exercise than full-body aerobic or resistance exercise (Ben-Sira & Oliveira, 2007). The short duration of engagement, ease, and portability of forearm exercise has made it more accessible to older adults who require the cardiovascular protective effects of exercise, but have barriers to conventional exercise (Ben-Sira & Oliveira, 2007). A

small body of evidence promotes the health benefits of isometric hand grip training. Findings are consistent between studies and suggest that isometric hand grip training can improve health status; however, the studies are limited by small sample sizes.

Isometric hand grip training has been shown to significantly reduce resting blood pressure among normotensive individuals in their 20's and 30's and hypertensive individuals in their 60's, (Ray & Carrasco, 2000; Taylor et al., 2003; Wiley et al., 1992). Older subjects demonstrate the additional benefit of increased vagal modulation as indicated by changes in heart rate variability after training (Taylor et al., 2003). Findings from studies of younger normotensive subjects are limited to cardiovascular outcomes. Hypotensive outcomes of isometric exercise training were observed in individuals trained in laboratory (Ray & Carrasco, 2000; Taylor et al., 2003; Wiley et al., 1992) and work settings, (Wiley et al., 1992). Trained individuals have also demonstrated residual hypotensive post-training and washout period effects during psychosocial laboratory stress challenges (Millar et al., 2009).

There is only initial speculation into potential mechanisms explaining the hypotensive effect of isometric hand grip training (Ben-Sira & Oliveira, 2007). Cardiac, peripheral vascular, and neurological mechanisms are potential mediators of acute stress reactivity and the chronic training effect of isometric handgrip, (Ben-Sira & Oliveira, 2007; Millar et al., 2009; Ray & Carrasco, 2000; Wiley et al., 1992). Transient inflammation is associated with acute exercise, but chronic exercise produces an anti-inflammatory response (Kasapis & Thompson, 2005). Breast cancer is among a group of chronic noncommunicable diseases thought to be mediated by low-grade chronic inflammation (Mathur & Pedersen, 2008). The cytokine Interleukin-6 has been referred to as a myokine because it is released during skeletal muscle contractions. In this way, the authors suggest that skeletal muscle has an endocrine function and can shield the body from the effects of low-grade chronic inflammation (Mathur

& Pedersen, 2008). The purpose of this study is not to discover the particular mechanism of the proposed intervention, but rather to determine the efficacy of a brief isometric intervention to mediate the effects of stress in women with breast cancer history.

Jendrassik maneuver. Behavioral changes associated with increased arousal or activation of the sympathetic nervous system have responded clinically to proprioceptive neurological input (Ayers, J., 1972). Interventions that improve control of the limbic system can reduce stress behaviors and promote resilience (Southwick, S.M., Vythilingam, M. & Charney, D.S., 2005). The goal of these interventions is to modulate the autonomic nervous system leaving the individual calm, yet alert and ready to interact with the environment. Proporioceptive signals generated by isometric muscle contraction are translated to muscle tendon tension providing feedback to the central nervous system. The intervention utilizes isometric muscle contractions. Therefore, it has the potential to moderate physiological and behavioral effects of acute stress. However, a mechanism has not yet been tested for stress management using the Jendrassik-based intervention. The Jendrassik manuever has classically been used to elicit stronger reflex responses to clinical tendon testing. Although a central nervous system mechanism has not been identified, peripheral nervous system mechanisms have not explained the complete phenomena. The properties of the Jendrassik manuever, isometric muscle contractions translated to muscle tendon tension providing feedback to the central nervous system, are theoretically linked to modulating stress reactivity.

The Jendrassik manueuver was first used to potentiate tendon reflexes in 1883 by Ernst Jendrassik (Zehr & Stein, 1999). He found that active contraction of the arm and jaw muscles of human patients was able to facilitate stronger stretch reflexes in the legs. This manuever has been used since as part of clinical neurological assessments. Research has provided some evidence of peripheral mechanisms and theorized about central mechanisms, but has not provided a conclusive mechanistic explanation for this phenomenon.

From a mechanical perspective, the Jendrassik manuever can be thought of as an isometric muscle contraction. Active muscle contraction against resistance creates neurological inputs from mechanical forces. These proprioceptive signals travel through the dorsal column medial lemniscal pathway to the CNS. Therapeutic interventions capitalize on the autonomic modulating effects of deep pressure and proprioceptive inputs when treating individuals with sensory integrative dysfunction. Ayres' sensory integration theory is the basis for these ideas (1972). In this context, isometric muscle contraction could be proprioceptive input to promote autonomic modulation. Physiological evidence to support this relationship is emerging. In a small sensory integration occupational therapy intervention, cortisol levels moved toward midrange in four toddler boys after an intervention targeting deep proprioception was used (Kimball, Lynch, Stewart, Williams, Thomas, & Atwood, 2007). This research begins to provide evidence of autonomic regulation through neuroendocrine markers, but doesn't yield insight into a direct mechanism. Clinical usefulness translating to higher levels of function and well-being has encouraged such interventions without definitive insight into mechanisms.

Like sensory integration interventions, the Jendrassik manuever became integrated into clinical assessment despite sparce mechanistic evidence. Over recent decades several mechanisms have been commonly explored. One research group completed an experiment to test the fusiform, alpha motor neuron, and presynaptic inhibition hypotheses (Gregory, Wood, & Proske, 2001). They found that fusimotor potentiation of the Jendrassik manuever is one, but not the only mechanism involved. Sufficient evidence supporting the alpha motor neuron and presynaptic inhibition hypotheses was not found. In the absence of significant evidence to support these peripheral mechanisms, an alternative theory is that there may be central nervous system (CNS) involvement (Delwaide, & Toulouse ,1981; Chen,T., Chen, C., Kao, Wu, & Liao, 1999; Chuang, & Chiou-Tan, 2000; Dick, 2003; Frigon, Collins, & Zehr, 2004; Sugawara & Kasai 2002). A mixed peripheral/central nervous system model is promising

given many previous attempts to find a peripheral mechanism that consistently explains the majority of the Jendrassik manuever effect. Because the Jendrassik manuever mechanism appears to have some central contribution, it is reasonable to examine it's ability to modulate other CNS activity.

The qualities of the intervention (deep proprioception) planned for this research are clinically grounded in sensory integrative theory for autonomic modulation. The intervention is theorized to provide deep proprioceptive feedback to the CNS where neurochemicals may signal the hypothalamus to stop the cascade of stress hormones. The Jendrassik manuever literature proposes a mixed peripheral and central mechanism to explain the phenomenon whose clinical application is to enhance reflexes. Although reflex enhancement and stress modulation are not intuitively linked, muscle action and mechanical forces are the same. Therefore, an intervention initially intended to enhance reflexes may have qualities, through a currently elusive proprioceptive mechanism, to modulate acute stress responses.

Conclusion

Physical activity can benefit women undergoing breast cancer treatment. Many women may benefit from conventional exercise programs. However, for some other women, significant barriers to conventional exercise exist. A brief isometric physical activity intervention was tested for use as a barrier-free activity to mediate the effects of stress in women with breast cancer history. The underlying rationale was that women who manage stressors as they arise through brief engagement in physical activity can stay more fully engaged in occupations in their daily lives thus promoting their well-being and health and minimizing their allostatic load. Young women who have had breast cancer may have different stress physiology after cancer treatment due to cancer-related stress and/or changes in cancer treatment-related hormonal changes. These factors may make their stress reactions and recovery

different from those of similarly aged peers without breast cancer history thereby accumulating allostatic load at a faster rate. The main hypothesis of this study is to test the efficacy of an isometric intervention to decrease reactivity to and hasten recovery from mild to moderate stressors in hopes that young women with breast cancer history would be able to manage stressors in age-normative ways and return to meaningful occupations at similar rates as women who had not had breast cancer. Reengaging in health promoting occupational patterns may help women with breast cancer history optimize their occupational performance as depicted by the inner triangle in Figure 5. Optimal occupational performance may be associated with higher levels of well-being and health through minimizing allostatic load.

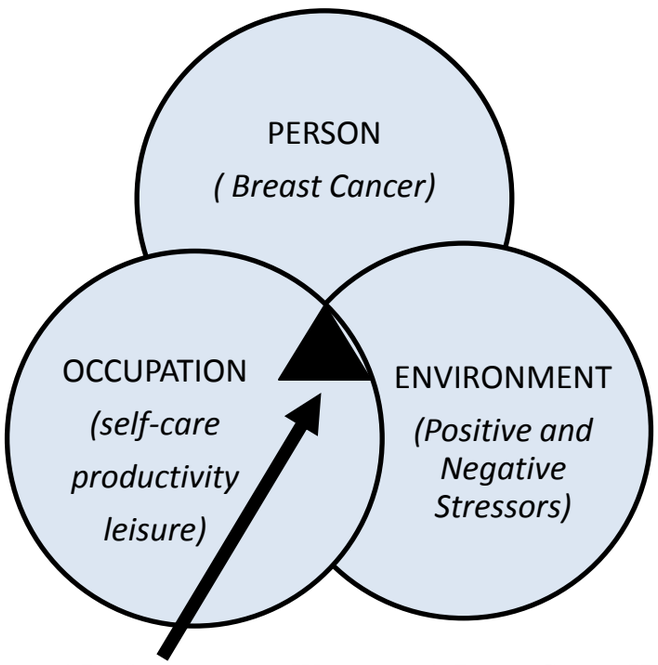


Figure 5: Occupational Performance in a Woman with Breast Cancer History

Chapter 3: Methods

Design

A repeated-measures crossover design was used to increase experimental control over individual differences and the potential effects of stress task sequencing (Portney & Watkins, 2000). Each subject was her own control in this within-subjects design. Stress research is known for individual variability (Kudielka et al., 2009). This study design is best suited to reveal effects of the intervention rather than inter-subject variability (Portney & Watkins, 2000). Practice and carryover effects are potential limitations of repeated measures designs, but can be moderated by the counterbalancing of stress tasks in the crossover modification.

Human subjects approval

This study was approved by the Education and Social & Behavioral Sciences Institutional Review Board at the University of Wisconsin-Madison.

Overview

Women with and without breast cancer history were recruited for this exploratory intervention study. Flyers were distributed to Madison-area breast cancer support groups, at events, and through community and campus outreach. Enrolled women visited campus twice to participate in a laboratory challenge testing a simple isometric intervention. The primary aim of this study was to test an intervention that was designed to reduce stress reactivity and hasten recovery after stress exposure among women with and without breast cancer history. Specific aims were as follows.

- Aim 1 was to describe demographic, health, well-being, and baseline physiological stress indices among women with and without cancer history.

- Aim 2 was to test the efficacy of the intervention in reducing stress reactivity and hastening stress recovery.

- Aim 3 was to describe the women for whom the intervention was of greatest benefit in hastening stress recovery and to develop preliminary stress recovery models.

Participants

A convenience sample of twenty-eight women who were diagnosed with non-metastatic breast cancer before menopause who were at least 3 months, but not more than 10 years, post cancer treatment (surgery, chemotherapy, and radiation) and 33 pre-menopausal women without breast cancer history were recruited for this study. The upper criterion for sampling for the breast cancer history group was expanded during recruitment from 5 to 10 years post cancer treatment. This adjustment was made primarily to increase sample size. However, 5-Year SEER conditional relative survival data reports that women who had already survived 0, 1, or 3 years after being diagnosed with local or regional breast cancer were very likely, > 95% and 80-85% respectively, to survive the next 5 years (2009). Therefore, expanding the sampling criterion was unlikely to have an effect on study outcomes. Age variability, however, was increased through the sampling strategy used to enroll sufficient numbers of women into the breast cancer history group. Women older than 53 years of age were eliminated from the sample in an attempt to minimize the effect of menopause or other age-related factors on differences between the

group of women with cancer history and the group of women without cancer history. Because women in the comparison group were premenopausal, it was not reasonable to expect that there would be age matching. Average menopausal age is 51 years old, but the range may extend to 55 years old, (http://womenshealth.gov/menopause/menopause-basics/).

Recruitment

Flyers were distributed to Madison-area breast cancer support groups, at events, and through community and campus outreach. Women with breast cancer history were sought through general community recruitment and breast cancer resource groups. General community recruitment was included as it was recognized that women already seeking support or information from breast cancer groups may have different characteristics than women with breast cancer history who have not approached groups. Attempts were made to find women with breast cancer history by seeking volunteers through various work or neighborhood communities. Women without breast cancer history were sometimes recruited through women with breast cancer history who expressed interest in this study.

The rational for this strategy was to enhance the likelihood that the groups of women with and without breast cancer would have similar demographic profiles (e.g. age, income and educational levels). Snowball sampling was employed when participants expressed interest in reaching out to others that might have interest in study participation. Exclusion criterion was reviewed during telephone screening of those interested in study participation using the "Telephone Participant Screening Tool and Visit Log" in Appendix A. Women with the following conditions were excluded from participation in this study: active cancer; pregnancy; conditions requiring the use of orally ingested steroids or beta-blockers; clinical depression; untreated high blood pressure; and known cardiac disease. All participants

completed detailed medical and activity histories and were asked to report all prescription and nonprescription medications and supplements.

After expressing interest in the study and completing the telephone screening, participants were scheduled for their first visit, and then were electronically-mailed an informed consent letter, medical history form, Ryff Well-Being Scales, and Center for Epidemiologic Studies Depression Scale. They were asked to complete the scales and bring them along when coming to their first laboratory appointment. Participants were electronically mailed reminder letters which included directions to the parking structure. Participants were instructed to avoid exercise on the days of their appointments and avoid smoking, caffeine, or brushing teeth during the hour before their appointments. These steps were necessary for obtaining an accurate cortisol measure from saliva (Salimetrics, LLC, 2009). Participants were met at the parking garage with a free parking pass and escorted to the laboratory. Women with and without cancer history were randomly assigned to intervention or no intervention trials for their first laboratory stress challenge. They were assigned to the opposite trial condition for the second laboratory stress challenge approximately four weeks following their first challenge. Weekend appointments were available to accommodate participants' schedules. Efforts were also made to schedule the second laboratory appointment during the same phase of the menstrual cycle as the first laboratory visit because of the potential effect of reproductive hormone levels on stress physiology.

Measures

Physiological measures

Stress is mediated by two physiologic pathways: the sympathetic adrenal medullary (SAM) axis and the hypothalamic pituitary adrenal (HPA) axis. Cortisol is a well established indicator of changes in the HPA while electrodermal response is commonly used to measure SAM axis activity. Heart rate and blood pressure are accepted measures of autonomic nervous system activity. Cortisol may

be measured in the blood, urine, and saliva. Saliva collection is safe and comfortable for participants and has been found to be sensitive and reliable in research (Salimetrics, LLC, 2009). Cortisol is at a low point in its diurnal rhythm in the later afternoon. Laboratory appointments were in the afternoon to avoid the natural morning rise in cortisol (Salimetrics, LLC, 2009). Electrodermal level (EDL) and heart rate were monitored with MP150 Data Acquisition System hardware and AcqKnowledge software from BIOPAC Systems, Inc. Monitoring activity of the eccrine sweat glands with EDL provided a means of observing sympathetic nervous system activity separate from parasympathetic activity. Visual and audio representations of behavioral responses to the stress protocol were collected by video camera and microphone. Blood pressure was collected with an automatic blood pressure cuff at the beginning and end of the stress protocol. Blood pressure is a mixed measure of autonomic activity. Height was collected and weight was measured to allow body mass index (BMI) calculation. A standard digital scale was initially calibrated and tested intermittently during data collection to insure accuracy for BMI calculations.

Self- report measures

Self-report measures were used to gather participants' perceptions of stress and to provide descriptive data for understanding the characteristics of individuals and groups. The Lab Visit Activity Log (Appendix B) is an investigator-developed tool for monitoring adherence to caffeine, tobacco, and activity limitations necessary for analysis of cortisol in the saliva in accordance with Salimetrics (LLC, 2009) recommendations. A medical history form (Appendix C) was also developed to gather information on history related to breast cancer, other medical conditions, physical activity, and medications that may affect stress physiology. Items selected for inclusion on the medical history form reflected the researchers' clinical experience with women with breast cancer, pilot research, and saliva processing laboratory guidance about potential confounds to primary study variables.

The Ryff Psychological Well-Being Scale (Appendix D) is a theoretically-based widely used self-report measure of personal well-being with 6 subscales: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance (Ryff, 19890. The Ryff Psychological Well-Being Scale demonstrated good internal consistency in a study of aging women (Cronbach alpha coefficient = .85 - .91). These women were categorized as younger (n=133, mean age=19.5 years) and older (n=108, mean age=49.85 years).

The Center for Epidemiologic Studies Depression Scale (CES-D) (Appendix E) is a 20 item, self-report scale which was used to screen for depressive symptoms (Radloff, 1977). The CES-D demonstrated good internal consistency with a Cronbach alpha coefficient = .89 in a study of depression in women with breast cancer (Hann, Winter, & Jacobsen, 1999) and a Cronbach alpha coefficient = .85 in a general population (Radloff, 1977). Construct validity was established using a healthy placebo group and examining correlations with other measures of anxiety, fatigue, and mental functioning (Radloff, 1977). Symptoms of depression may confound biomarkers of stress suggesting the need to collect depression data.

The Sympathetic Nervous System Arousal Scale (SNSAS) (Appendix F) was developed and piloted by the investigator to measure self-report of sympathetic arousal. The pilot study revealed a moderate correlation between systolic blood pressure and the SNSAS in pre and post stress measurements. SNSAS data are not presented as part of the current study.

The Canadian Occupational Performance Measure (COPM) (Appendix G) is a semi-structured interview designed to measure change in occupational performance and personal satisfaction with performance over time based on two or more administrations. The measurement of occupational performance relies on participant perception. Participants report on ability and satisfaction with performance in self care, productivity, and leisure activities. For the purposes of the present study, participants were

asked to report their performance of stress management and other occupations during the interviews. The COPM, first published in 1990, is standardized and multiple studies demonstrate its validity, and reliability. A study of 105 consecutive occupational therapy outpatients conclude that the COPM collected data that was not captured by other assessments, namely the Sickness Impact Profile , the Disability and Impact Profile and an open-ended questioning (Dedding, Cardol, Eyssen, & Beelen, 2004). The COPM is a valid and reliable instrument (Carswell , McColl, Baptiste, Law, Polatajko, Pollock, 2000). These researchers found high levels of correlation between the COPM and theoretical constructs. The COPM data is not presented in this study.

The Brief Stress Questionnaire (Appendix H) was developed for this study to assess capacity for meaningful engagement in the minutes after encountering a stressor. This data is not presented in this study.

Laboratory sessions overview

Laboratory sessions 1 and 2 were very similar. Total time for session 1 was 90 minutes and for session 2 was 80 minutes. The stress protocols varied from each other in that participants were exposed to the intervention in one visit and were not exposed to the intervention on the other visit. Intervention exposure order was randomized and participants were blinded to randomization in the first laboratory session. Blinding to trial condition was not possible for the second laboratory visit because the participants had been told that they could expect to be in the opposite condition (of the first trial) in their second visit to the laboratory. Sessions differed because of the collection of self-report data after the stress protocol and because informed consent and medical history needed to be reviewed in the first visit. After the stress protocol, the COPM was administered in session 1 and the Brief Stress Questionnaire was administered in session 2. Height and weight were collected at the end of session 2. Body mass index was calculated prior to manual entry using the following formula: ((weight in lbs X 703)/(height in inches squared)). Overviews of the laboratory visits are depicted below in Figures 6 and 7.

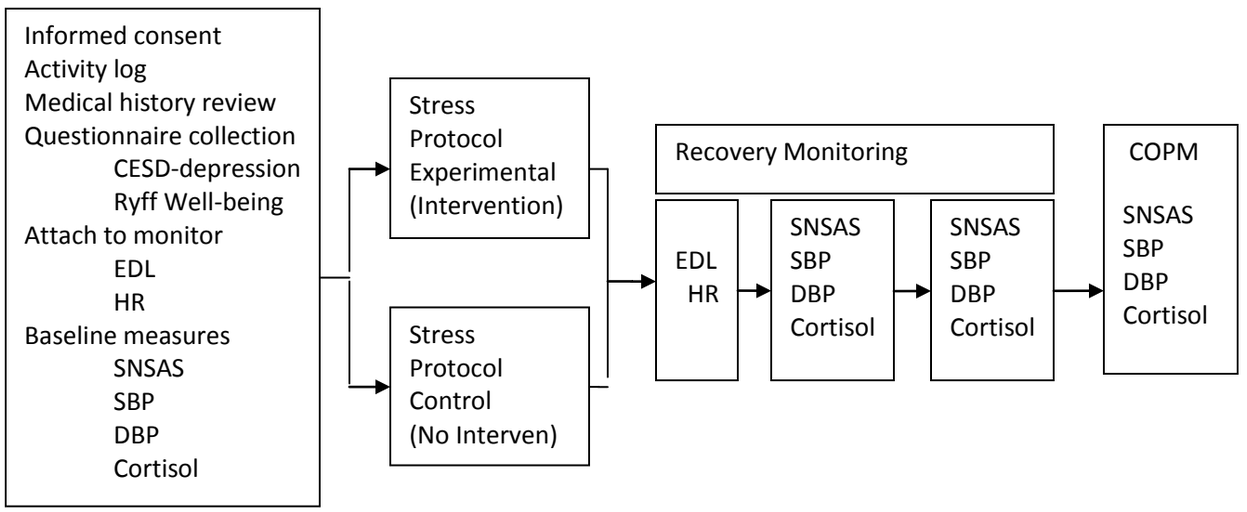


Figure 6: Laboratory Visit 1-Methodology

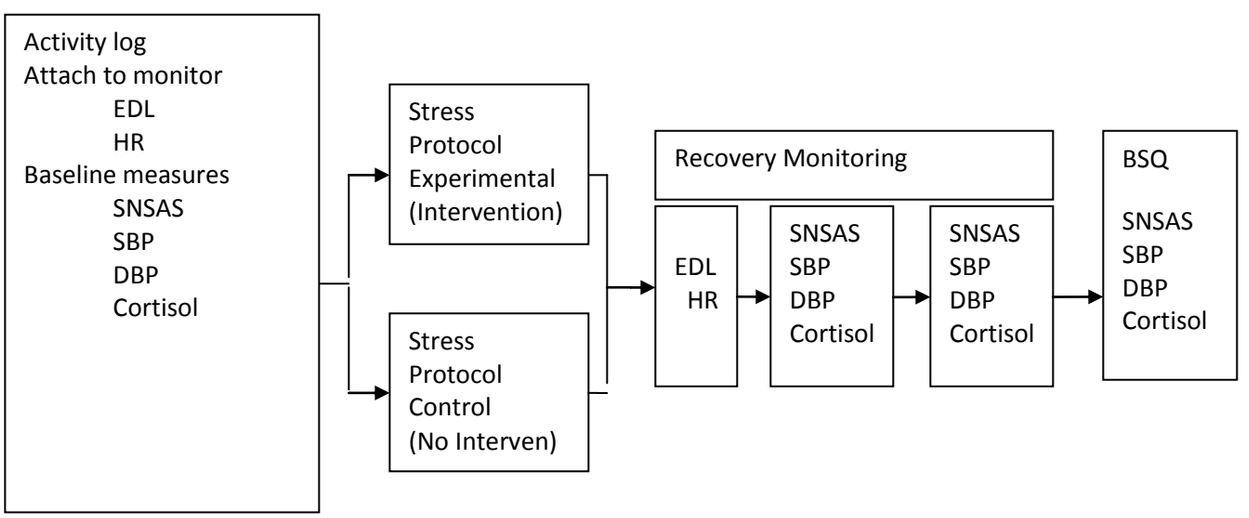


Figure 7: Laboratory Visit 2-Methodology

Stress protocol

After collecting and checking the preliminary self-assessments, baseline measurements of blood pressure and salivary cortisol and were collected. The cortisol collection protocol required that participants place an oral swab under their tongues for approximately two minutes. Saliva was collected using a sorbette (cotton). Swabs were inserted in test tubes and transferred to a cooler in the lab space. Samples were transferred to a -30° C freezer at the end of the protocol per Salimetrics recommended procedures (Salimetrics, LLC, 2009).

Participants were then fit with electrodes on the fourth and fifth digits of their nondominant hand according to the BIOPAC protocol. Faux researcher-designed electrodes were fit to the second and third digits to equalize finger-tip surface area contact and joint angle and comfort during the intervention. After being connected to BIOPAC instrumentation to monitor skin conductance and heart rate, the participant started the stress protocol guided by computer software routines programmed by the researcher.

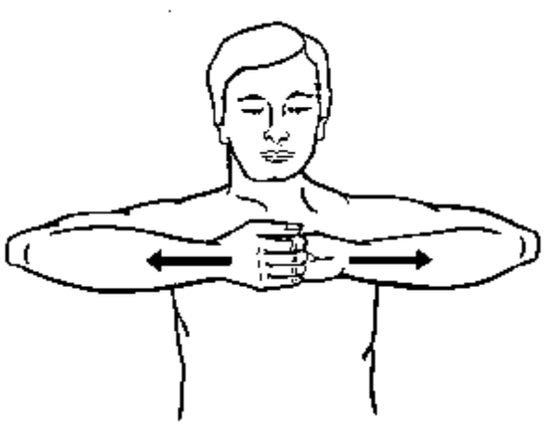
Baseline data collection

All participant instructions and stressors were displayed on a computer screen driven by protocols generated with E-Prime Psychological Software Tools, Inc. The protocol began with the collection of Sympathetic Nervous System Arousal Self-report via keyboard input. Next, the participant viewed internationally normed neutral images for 6 minutes to facilitate collection of baseline electrodermal and cardiac data (Lang, Bradley, & Cuthbert, 2008). General instructions were presented for both groups and then the experimental group was presented with intervention instructions while the no intervention group was instructed to sit with their hands in their laps. This was the first of three times that participants performed the intervention.

Intervention

The Intervention was a novel physical activity intervention with the advantage of being a quick isometric exercise protocol with few implementation barriers. The intervention used a variation of the body positioning for the Jendrassik maneuver (Zehr et al., 1999). The elbows were flexed, one forearm was pronated and the other was supinated with both hands at chest height; one hand was palm up and the other hand was palm down; fingers were flexed into a hook to grasp each other as depicted in Figure 8. Only the arm portion of the conventional Jendrassik manueuver was used in this study. During the protocol, timed slides instructed participants to pull their hands against each other with maximal effort for 5 seconds; relax 5 seconds; and repeat for a total of 3 holds and 3 breaks. Next, they lowered their hands to their lap to rest for 1 minute. They then repeated the isometric contract/relax protocol. The intervention duration was 2 minutes. Participants were instructed to perform the intervention before and after every stressor. In the intervention trial, the intervention was performed a total of three times.

Figure 8: Intervention



Stressors

Two stressors were used during the stress challenge. The first stressor was a variant of the Stroop (Stroop, J.R., 1935). The second stressor was developed for this study to simulate multitasking. Verbal responses to stress challenges and other behaviors were captured with mounted video cameras and a microphone. The cameras focused on 1) participants' faces and 2) the computer screen. Audio recordings were collected at this time. These recordings captured any audible expression (vocalization, sighs, coughs, sneezes, etc). The visual and audio representations were used to inform data analysis.

Stressor 1, flexibility Stroop, challenged participants with the presentation of color words which were displayed in congruent or incongruent colors with or without underlines: an underlined word indicated that the participant should state the color word; a word without an underline indicated that the

participant should state the displayed color and ignore the content of the word. Participants verbalized their responses aloud.

Stressor 2, the dual task stressor, was presented during the next 9 minutes. It had a primary task of reading a paragraph of text written at the 8th grade reading level. A secondary task (e.g. a visual image of a shopping list, schedule, or telephone number) appeared on the screen for a variable part of the exposure time of the primary text reading task. This secondary task was linked to an auditory distracter. Auditory distracters included many noises encountered in daily life both inside and outside the home. Some examples include sound bytes of appliances (blender, microwave, timer), children, animals, restaurants, and traffic. The participant could choose to eliminate the auditory distracter by entering a keystroke. However, if the participant struck a key to eliminate the secondary task, the secondary task could disappear from the screen. Each stimulus screen was followed by a question screen with one comprehension recall question related to the primary task and recall question related to the secondary task.

Recovery

After the 2 minute intervention or no intervention period, participants entered a 6-minute physiologically monitored recovery time where they viewed internationally normed neutral images. The AcqKnowledge software stopped collecting physiological data at the end of these 6 minutes. Details of the stress protocol are presented below in Table 1.

INTERVENTION TRIAL	**NO INTERVENTION TRIAL**
COLLECT BP/SNSAS/CORTISOL – 6 MINUTES	COLLECT BP/SNSAS/CORTISOL – 6 MINUTES
START BIOPAC MONITORING	START BIOPAC MONITORING
INSTRUCTION SCREENS	INSTRUCTION SCREENS
INTERVENTION INSTRUCTIONS – 1 MINUTE	NO INTERVENTION INSTRUCTION SCREEN – 1 MINUTE
INTERVENTION – 2 MINUTES	NO INTERVENTION – 2 MINUTES
STRESSOR 1 – 6 MINUTES	STRESSOR 1 – 6 MINUTES
INTERVENTION – 2 MINUTES	NO INTERVENTION – 2 MINUTES
STRESSOR 2 – 9 MINUTES	STRESSOR 2 – 9 MINUTES
INTERVENTION – 2 MINUTES	NO INTERVENTION – 2 MINUTES
RECOVERY MONITORING – 6 MINUTES/IMAGES	RECOVERY MONITORING- 6 MINUTES/IMAGES
STOP BIOPAC RECOVERY MONITORING	STOP BIOPAC RECOVERY MONITORING

Table 1: Laboratory Stress Protocols

Post stressor measurements of blood pressure, salivary cortisol, and sympathetic nervous system arousal were collected immediately after the AcquKnowledge software stopped collecting other physiological data. As participants continued to recover, they were presented with magazines to browse while waiting for the final saliva, blood pressure, and SNSAS collection 15 minutes later.

Interviews

The Canadian Occupational Performance Measure (COPM - See Appendix G), was conducted during session 1 to obtain a baseline measurement of participants' level of satisfaction with and performance of daily stress management activities. During session 2, participants completed the Brief Stress Questionnaire (BSQ – See Appendix H) to identify capacity for engagement following a conflict. Height and weight were collected at the end of session 2.

Summary

To enhance presentation clarity, the data analysis methods and description of findings are linked to each of the specific aims and the associated hypotheses. The following three chapters include a statement of the specific aims to be addressed, a description of the sample included in the analysis, an overview of the analysis plans, and the relevant findings. Chapter 4 describes the sample. The intervention is tested in Chapter 5, and Chapter 6 describes characteristics of those most likely to benefit from the intervention.

Chapter 4: Describing the Sample of Women With and Without Cancer History

Evidence suggests that women with breast cancer history may differ from their peers without breast cancer history (American Cancer Society, 2012). Although some of the differences have direct links to cancer treatment (Howard-Anderson, Ganz, Bower & Stanton, 2012), others may be independent of disease history. Depression can emerge in women following cancer treatment (Ganz et al., 2004). Rates of anxiety and depression were higher in women with cancer history than among same-age peers without previous cancer in a longitudinal follow-up study of women assessed at two data points 9 years apart (Costanso, Ryff, & Singer, 2009). Stress has also been associated with cancer diagnosis (Carver, 2000; Dickerson, Alqaissi, Underhill, & Lally, 2011; Witek-Janusek et al., 2008), active cancer treatment, (Carver, 2000; Glinder, 2006; Gold et al.) and the end of cancer treatment (Carlson; Carver, Meyer, & Antoni, 2000; Valdimarsdottir et al., 2002)).

Daily life activities, well-being, and psychological and physical health may all be affected by stress associated with cancer. Targeted outcome measures of interventions for women with breast cancer history include the following: quality of life (Antoni et al., 2006; Howard-Anderson, Ganz, Bower & Stanton, 2012; Witek-Janusek et al., 2008), emotional well-being, coping effectiveness (Cameron et al., 2007; Witek-Janusek et al., 2008), anxiety (Antoni et al., 2006; Cameron et al., 2007; Telles Nunes et al., 2007), stress (Telles Nunes et al., 2007), and intrusive thoughts about cancer (Antoni et al., 2006). Health and physical activity are positively linked among women with breast cancer history (McNeely et al., 2006).

Measured outcomes of these exercise studies conducted with women with breast cancer include body composition, well-being and cancer treatment side-effects (Courneya et al., 2007; McNeely et al., 2006; Schmitz et al., 2005). Evidence suggests that body composition, depression, well-being, stress,

and physical activity may be negatively affected by the breast cancer experience. Involvement in physical activity generally declines during cancer treatment. Even women who were active prior to their breast cancer diagnosis report a decline in physical activity (Irwin et al., 2003; Irwin et al., 2005) and sports participation (Curt et al., 2000; Curt et al., 2002) during treatment. Tamoxifen is an often prescribed medication for women with estrogen receptive tumors. The documented side-effect of Tamoxifen is weight loss (National Cancer Institute, 2012). However, weight gain has been associated with time period after primary cancer treatment during which tamoxifen is prescribed. Women taking tamoxifen reported weight gain (6%) and depression (6%) in a study by Wu and colleagues (2012). Women in another study who were tracked from baseline (prior to any chemotherapy) through the first year following diagnosis had variable changes in body composition. Women with normal baseline BMIs were more likely to increase torso fat mass (Nissen, Shapiro & Swenson, 2011). This change in body composition was associated with a decrease in physical activity from baseline (Nissen, Shapiro & Swenson, 2011). The weight gain sometimes associated with ongoing cancer treatment is multifactorial (Demark-Wahnefried, Platz, Ligibel, Blair, Courneya, Meyerhardt, et al. 2008; Howard-Anderson, Ganz, Bower & Stanton, 2012). Women with breast cancer history may differ from those without breast cancer history on measures of quality of life, depression, well-being, body composition, and stress and disease indices. Specific Aim 1 compares this study's sample to the evidence supporting differences in women with and without breast cancer history.

Aim 1

The first aim was to compare the demographic, health, and well-being characteristics of this sample of women with and without breast cancer history. Research questions directed at this aim included the following.

1a) Is breast cancer history associated with demographic characteristics (education or employment status)?

1b) Do women with breast cancer history have higher BMIs than women without breast cancer history?

1c) Do women with breast cancer history report using more daily medications than women without breast cancer history?

1d) Do women with breast cancer history report lower levels of well-being than women without breast cancer history?

1e) Do women with breast cancer history report more depressive symptoms than women without breast cancer history?

1f) Do women with breast cancer history demonstrate higher levels of stress than women without breast cancer history after controlling for depressive symptoms?

Methods

Participants completed a health and activity questionnaire, Ryff well-being scales, and CES-D scale which provided data to test the first set of research questions. Physiological data were collected during the stress challenge to examine associations related to these questions.

Complete methods are fully described in Chapter 3. Women with breast cancer history were hypothesized to have lower well-being and higher depression than women without breast cancer history. They were further hypothesized to have indications of poorer health beyond history of breast cancer as reflected in higher BMIs, and the number of prescription medications required daily. Depression was expected to be associated with poorer baseline stress indices among women with breast cancer history when compared to women without breast cancer history.

Data analysis

Demographic, health, and physiological data were compared by group using ANOVAs for continuous data, Chi-square tests for nominal data, and Mann Whitney U tests for categorical data when cell sizes were less than 5. Groups were determined by the presence or absence of breast cancer history. Sample size used for the following analyses varied due to missing data and ranged from 20 to 22 in the breast cancer history sample and 27-30 in the non breast cancer history group. Group comparisons of the well-being, depression, and physiological variables were statistically tested with ANOVAs with the significance level set to .05.

Pearson correlation coefficients were calculated to describe relationships between well-being and depression as well as between well-being, depression, and physiological stress measures. Depression, total well-being, and 6 well-being sub-scales were each assessed for an association with baseline EDL and cortisol variables. Portney and Watkin's criterion for correlation strength was used throughout these analyses. For simplicity, poor correlations less than .25 were only reported in select circumstances when values were very near the criterion. Correlations between .25 and .5 were as being classified fair, correlations between .5 and .75 were classified as being moderate-good, and correlations above .75 were classified as being excellent (Portney & Watkins, 2000).

Results

As shown in Table 2, there were no significant demographic differences between women with and without cancer history. However, there were health-related differences between these groups. Women with breast cancer history had higher BMI's ($U=.028$, $p<.05$) and reported using more daily prescription medications ($U=.001$, $p<.05$) than women without breast cancer history. Specifically, women with breast cancer history had mean BMI's midway in the overweight category ($M = 27.44$, $SD = 6.01$) and ingested nearly 3 ($M = 2.89$, $SD = 2.45$) prescription medications each day. However,

women without breast cancer history had mean BMI's midway in the normal category (M = 22.94, SD = 4.64) and ingested 1 (M = .91, SD = 1.41) prescription medications daily.

Table 2: Demographic and Health Characteristics of All Participants

Demographic Measures	**Breast Cancer History N=22** *Mean/Frequency*	**No Breast Cancer History N=30** *Mean/Frequency*	**P**
Age	43.59	39.57	.066a
Race			.553b
Caucasian	19	24	
Noncaucasian	3	6	
Education			.671b
High school graduate/some college	4	4	
College Graduate	8	11	
Graduate Degree	10	15	
Relationship Status			.079b
Single	5	14	
Married/Partnered	17	16	
Number of Dependents			.290b
0	11	19	
1	4	4	
2	4	6	
3+	3	1	
Work Status			.173b
Homemaker	3	1	
Works outside-of-home	19	29	
Body Mass Index (mean)	27.4	22.9	.011*a
Normal or Underweight	8	20	.020*c
Overweight or Obese	14	9	
Number of Prescription Medications (mean)	2.9	.9	.003*a
0 daily	2	17	.001*b
1-3 daily	13	8	
4 or more daily	7	4	

a=ANOVA (Age), b= Mann Whitney U test (Race, Education, Relationship Status, Number of Dependents, Work Status, Number of Prescription Medications), c=Pearson χ^2 (BMI), *=p<.05

Well-being and depression

There were no significant differences between women with and without breast cancer history on overall measures of well-being and depressive symptoms. Table 3 presents findings from the well-being and depression scales. Women with breast cancer history, however, reported significantly higher levels of self-acceptance than women without breast cancer history. Self-acceptance was further delineated into high, average, and low scores and compared across groups as shown in Figure 9 which illustrates an inverse self-acceptance gradient for women based on breast cancer status.

As expected, depression and well-being were negatively associated in women regardless of breast cancer history status ($r(22)=-.621$, $p<.001$) among women with breast cancer history and ($r(29)=-.675$, $p<.001$) among women without breast cancer history. Women who reported higher levels of depressive symptoms also reported lower levels of well-being. Pearson correlations between depressive symptoms and each of the well-being subscales, which ranged from fair to excellent, are displayed in Table 4.

Table 3: Well-being and Depression in Women With and Without Breast Cancer History

	Breast Cancer History N=22	**No Breast Cancer History N=29**	**F**	**p**
Well-being Scales	*Mean (SD)*	*Mean (SD)*		
Self-acceptance	67.18 (10.82)	61.03 (10.42)	4.21	.046*
Positive relations with others	65.14 (11.92)	64.45 (9.95)	.05	.828
Autonomy	75.14 (8.73)	73.28 (6.70)	.74	.393
Environmental mastery	71.59 (8.39)	68.93 12.42)	.74	.392
Purpose in life	69.55 (11.43)	70.59 (9.45)	.12	.724
Personal growth	67.14 (12.13)	67.66 (11.74)	.02	.878
Total Depression	415.73 (54.28)	405.93 (47.80)	.46	.497
CES-D	10.68 (9.44)	9.55 (7.95)	.21	.645

*** = p<0.05**

Figure 9: Self-acceptance by tertile and breast cancer status

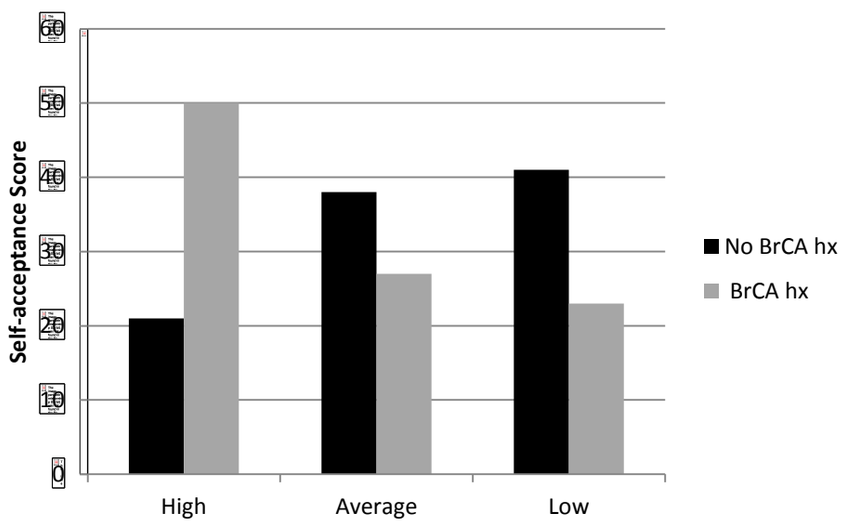


Table 4: Correlations Between Depression and Well-being by Breast Cancer History Status

Well-being	Depression	
	Breast Cancer History	No Breast Cancer History
Scales		
Self-acceptance	-.801	-.655
Positive relations with others	-.467	-.449
Autonomy	-.376	-.479
Environmental mastery	-.657	-.625
Purpose in life	-.430	-.638
Personal growth	-.621	-.675
Total	-.385	-.323

Note: Pearson r between .25 and .5 = fair, r between .5 and .75 = moderate-good, and r above .75 = excellent (Portney & Watkins, 2000).

Physiological measures of stress at baseline

Cortisol was significantly lower at baseline in women with breast cancer history than it was among women without breast cancer history. ANOVAs were run with natural logs of the cortisol and EDL values. Mean cortisol values were .1177 µg/dl for women with breast cancer history and .1602 µg/dl for women without breast cancer history. No significant differences in baseline electrodermal activity were observed between women with and without breast cancer. EDL baseline mean values were 2.532 microsiemens for women with breast cancer history and 2.8292 microsiemens for women without breast cancer history. Table 5 displays these findings.

Table 5: Baseline Physiology in Women With and Without Breast Cancer history

	Breast Cancer History N=20	**No Breast Cancer History N=27**	**F**	**P**
	Mean (SD)	*Mean (SD)*		
Ln Cortisol Baseline	-2.14(.54)	.-1.83(.43)	4.79	.03*
Ln EDL Baseline	.92 (.57)	1.04 (.50)	.54	.46

Note: Ln=natural log , *=< .05

Associations between psychological and baseline stress measures

Breast cancer history status differentiated the number, quality, and, direction of associations between psychological and baseline physiological stress measures. Associations were fair at best and prolific among women with breast cancer history status. The direction of associations were opposite in the two groups. All associations are reported in Tables 6 and 7.

Among women with breast cancer history, a higher number of depressive symptoms was associated with lower baseline EDL and marginally lower baseline cortisol in women with breast cancer history. High well-being scores were generally associated with higher levels of baseline EDL and cortisol. Four of the six well-being scales had fair or marginal associations with EDL and cortisol. The positive relations with others scale was positively associated with baseline EDL and cortisol. Baseline EDL was positively associated with scores in total well-being in addition to self-acceptance and personal growth scales. Autonomy scale scores were positively associated with baseline cortisol.

Among women without breast cancer history, a higher number of depressive symptoms was associated with higher baseline cortisol and marginally higher baseline EDL. Associations between well-being and baseline EDL and cortisol were negative. Four of the six well-being scales had marginal negative associations with EDL, but only two of the six well-being scales had fair or marginal negative associations with baseline cortisol. The personal growth scale was the only well-being scale with a fair negative correlation with a baseline stress measure, cortisol.

Overall, the strength of associations between psychological and physiological measures was stronger among women with breast cancer history than it was among women without breast cancer history. However, the direction of the associations among women with breast cancer history was the opposite of that of the associations among women without breast cancer history. Among women with breast cancer history physiological stress measures were negatively associated with depressive

symptoms and positively associated with well-being. Conversely, among women without breast cancer history physiological stress measures were positively associated with depressive symptoms and negatively associated with well-being.

Table 6: Baseline Correlations Between Psychological Measures and Cortisol

	Baseline Cortisol		
	All	Breast Cancer History	No Breast Cancer History
Well-being			
Scales			
Self-acceptance	-.132	-.041	-.086
Positive Relations with Others	.063	.313	-.228
Autonomy	.168	.322	.034
Environmental Mastery	-.071	.103	-.189
Purpose in Life	.144	.219	-.005
Personal Growth	.005	.224	-.278
Total	.027	.226	-.180
Depressive symptoms	-.052	-.229	.212

Note: Pearson r between .25 and .5 = fair, r between .5 and .75 = moderate-good, and r above .75 = excellent (Portney & Watkins, 2000).

Table 7: Baseline Correlations Between Psychological Measures and EDL

	Baseline EDL		
	All	Breast Cancer History	No Breast Cancer History
Well-being			
Scales			
Self-acceptance	.122	.329	.007
Positive Relations with Others	.082	.366	-.217
Autonomy	.008	.069	-.108
Environmental Mastery	-.066	.067	-.178
Purpose in Life	.028	.229	-.244
Personal Growth	.033	.268	-.210
Total	.046	.276	-.201
Depressive symptoms	.025	-.258	.330

Note: Pearson r between .25 and .5 = fair, r between .5 and .75 = moderate-good, and r above .75 = excellent (Portney & Watkins, 2000).

Summary

Women did not vary on basic demographic variables reflecting socioeconomic status based on breast cancer history. Findings of the analyses do, however, support the general hypothesis that there were differences between women with and without breast cancer history in physical and psychological health. The nature and direction of those differences resulted in acceptance of only four of the six specific hypotheses as noted in Table 8. Correlation analyses uncovered details of directional differences between the two groups. Women with breast cancer history had higher BMIs and required more daily medications than women without breast cancer history. The groups did not vary significantly in demographic characteristics or most psychological characteristics.

Unexpectedly, women with breast cancer history reported significantly higher levels of self-acceptance than women without breast cancer history; however there were not significant differences between the groups in depressive symptoms or other well-being scale scores. Women with breast cancer history did have significantly lower baseline cortisol than women without breast cancer history. This lower value may be associated with less healthy HPA function because it is at the lower end of the salivary cortisol healthy reference range (Salimetrics, 2009). Lower cortisol was also associated with higher numbers of depressive symptoms and lower well-being among women with breast cancer history. Conversely, lower cortisol was associated with lower numbers of depressive symptoms and higher well-being among women without breast cancer history.

Table 8: Aim 1 Hypothesis Test Results

Aim 1 Hypotheses	Test Results
1a) Women will not vary on basic demographic variables (education level, and employment status) based on breast cancer history status.	Hypothesis accepted.
1b) Women with breast cancer history will have higher BMIs than women without breast cancer history.	Hypothesis accepted.
1c) Women with breast cancer history will report more daily medication use than women without breast cancer history.	Hypothesis accepted.
1d) Women with breast cancer history will report more depressive symptoms than women without breast cancer history.	Hypothesis rejected.
1e) Women with breast cancer history will report lower levels of well-being than women without breast cancer history.	Hypothesis rejected.
1f) Associations between depressive symptoms and baseline stress indicators will be stronger among women with breast cancer history than those without breast cancer history.	Hypothesis accepted.

Discussion

In this study, a comparison of the demographic and health characteristics of women with and without breast cancer history suggests that women who had a breast cancer history were in poorer health, but had a stronger propensity for self accceptance than women who had not had breast cancer. BMI, an important indicator of overall health and potential for chronic disease, was higher in women who had breast cancer history. Indeed, this same group of women required significantly more daily medications than women who had not had breast cancer. One might expect that women with breast cancer history may have more indications of poorer health than women without breast cancer history because low-level chronic inflammatory states are associated both with disease and metabolically active adipose tissue. This finding was similar to that of Costanzo and colleagues who reported that women with cancer history had significantly more chronic conditions requiring daily medication use than women without cancer history (Costanzo, Stawski, Ryff, Coe, Almeida, 2012).

Self-acceptance, which was higher among women with breast cancer history than those without, may suggest a degree of resilience or an acceptance of health status. Long-term cancer survivors have reported improved quality of life as years of survivorship extend: with increases in age and distance from cancer. Quality of life was similar to peers without cancer history in one study (Zebrack, Yi, Petersen, & Ganz, 2007). Physical health was, however, significantly worse in women with cancer history than in peers without cancer history (Zebrack, Yi, Petersen, & Ganz, 2007). Resilience in self acceptance was demonstrated in women who were diagnosed with cancer between data collection points in a longitudinal study (Costanzo, Ryff & Singer, 2009). Self acceptance was the only well-being scale score that did not significantly decline in the post cancer diagnosis data collection wave of that study.

The pattern of higher well-being and poorer physical health among women with breast cancer history was similar to that found by Zebrak and colleagues who found a negative association between

quality of life and physical health among long-term survivors (Zebrack, Yi, Petersen, & Ganz, 2007). Like women in the study by Zebrack and colleagues, women with breast cancer history in the current study had indicators of poorer health than those of women without cancer history (2007). They had significantly higher BMIs and took significantly more daily prescription medications than women without breast cancer history. In the current study, levels of well-being and depressive symptoms were similar among women with and without breast cancer history.

Mean CES-D scores of women with and without breast cancer history were similar and fit subthreshold clinical depression criterion. The literature suggests that, when coupled with other health concerns, CES-D scores between 8 and 15 may inhibit successful aging (Sherbourne et al., 1994; Vahia et al., 2010). For example, older women (average age 72 years) with subthreshold depression were found to be lower functioning, less resilient and optimistic, and more hostile and anxious than women who did not meet subthreshold clinical depression criterion (Vahia et al., 2010). Although the women studied by Vahia and colleagues were older than the current sample, effectively managing subclinical depression may be one component of successful aging for women with breast cancer history due to their disease history.

Correlational analyses uncovered differences between the groups of women with and without breast cancer history when depressive symptoms were introduced into relationships between cancer history status and baseline stress indices. Increased susceptibility for baseline indices of stress were related to the combination of breast cancer history and higher depressive symptomatology. Women with breast cancer history had significantly lower baseline cortisol than women without breast cancer history. Because both groups of women had cortisol levels at the low end of the Salimetrics expected range, women with breast cancer history may be showing early signs of adrenal exhaustion as evidenced by lower baseline cortisol (2009). The “dysfunctional hyporeactivity” allostatic profile in Figure 4 may

illustrate this maladaptive response to stress over time. Women without breast cancer history fare somewhat better in that the higher cortisol associated with higher numbers of depressive symptoms in this group is more similar to the "dysfunctional recovery" profile in Figure 4 which precedes an "dysfunctional hyporeactivity" as may be indicated among women with breast cancer history.

Taken together, findings of this study and previous evidence suggest that women with breast cancer history may be susceptible to poorer health, but may retain well-being levels similar to peers without breast cancer history. Results of hypotheses testing the effects of the intervention on stress reactivity and recovery in women with and without breast cancer history are presented in the following chapter.

Chapter 5: Testing the Efficacy of a Simple Isometric Stress Management Intervention

Breast cancer and its treatment introduce a series of psychological and physiological stressors to women already coping with normative life stressors. The body responds to acute stressors by triggering a series of events resulting in the release of stress hormones. In healthy people, stress hormone levels return to baseline soon after a robust response to an acute stressor (McEwen, 1998). Overexposure to stress hormones can lead to a chronic low-level inflammatory state that has been linked to cancer and other diseases (Bruunsgaard, 2005; McEwen, 1998). For example, a study by Bower and colleagues found that depressive symptoms were associated with an elevated inflammatory state in women with breast cancer history who reported depressive symptoms with and without comorbid sleep disorders and fatigue (Ganz, Irwin, Swan, Bree & Cole, 2011). Contemporary stress research has repeatedly demonstrated variances in individual stress responses to the same laboratory-based stressor (Allen, Stoney, Owens, & Matthews, 1993; Benschop et al., 1998; Cacioppo et al., 1995; Herrmann, Schonecke, Wagner, Rosenthal, & Schmidt, 1980; Kudielka, Hellhammer, & Wuest, 2009; Liu, Iwanga, Shimomura, & Katsuura, 2007). Depression, even sub-clinical levels, may further increase the variability of physiological stress data. Gold and colleagues found that premenopausal women scoring in the high normal range of the Beck Depression Inventory experienced slower recovery from a stress task than women with lower depression scores, (Gold, Zakowski, Valdimarsdottir, Bovbjerg, 2004). Likewise, women may be expected to have varying responses to cancer-related stressors and those responses, over time, may underlie responses to laboratory stressors that are different from the responses of women without breast cancer history.

Techniques that stimulate proprioceptors have been used in clinical neurology (Zehr et al., 1999) and occupational therapy (Ayers, 1972; Kimball et al., 2007) to modulate reactions to physical

and sensory stressors. Isometric exercise protocols are beginning to show promise for altering physiological states through mechanisms such as decreasing resting blood pressure (Millar et al., 2009; Ray & Carrasco, 2000; Taylor et al., 2003; Wiley et al., 1992). Proprioceptive inputs are carried from receptors on muscle tendons to the brain. These receptors are activated by isometric muscle activity. In this study, a brief isometric stress management intervention was tested to see if it would reduce reactivity to and hasten recovery from laboratory stressors. It was hypothesized that breast cancer history status would contribute to the variability in stress responses because of a link to a low-level chronic inflammatory state potentially present in women with breast cancer history.

Aim 2

The second aim of the larger study was to test the efficacy of a stress intervention. Physiological responses to an isometric exercise intervention were tested among women with and without breast cancer history. The following questions were directed toward this aim.

2a) Does the intervention reduce stress reactivity?

2b) Will higher levels of depressive symptoms be associated with lower stress reactivity?

2c) Will higher levels of depressive symptoms be associated with slower stress recovery?

2d) Will recovery from the stressors in the intervention trials will be faster than recovery in the no intervention trials?

2e) Will women with breast cancer history who use the intervention have similar stress recovery compared to women without breast cancer history who did not use the intervention?

Methods

Chapter 3 describes the complete methods. Participants attended two laboratory stress challenge sessions. Two stressors were introduced in each session. In the Stroop stressor, color words were rapidly

displayed in 3 presentation options. Color responses were based on instructions presented at the beginning of the stress challenge. The dual-task stressor involved a primary reading task with visual and auditory distracters. Participants responded to two questions based on the two visual stimuli sets. One session included the intervention and the other session did not include the intervention. The sequence of intervention/no intervention trial exposure was randomized across participants. EDL and cortisol were collected as measures of baseline state, reactivity, and recovery following the stress activities.

Outliers

Two outliers were identified in the physiological data set by selecting EDL change data that were more than 3 standard deviations away from the mean. Comparative analyses were run with outliers in and out of the sample. No significant differences were noted between tests run with or without the outliers. Therefore, outliers were retained in the sample to keep the number in the sample as high as possible. No outliers were identified in the cortisol data using the same strategy.

Data analysis

The effect of an isometric intervention on stress reactivity and recovery was compared by conducting multiple pair-wise repeated measures ANOVAs for stress reactivity and recovery. T-tests compared raw mean EDL recovery values. Stress recovery variables were calculated from data collected after exposure to both stressors. Cortisol was assigned two variables, one for the intervention condition and one for the no intervention condition in the recovery time period. EDL was assigned two sets of variables - one for each of the intervention or no intervention trials. Variable sets for recovery EDL were analyzed in 6 10-second intervals that were collected during the first minute of recovery.

Reactivity was further analyzed using correlational analysis to explore nuances in the data. Pearson coefficients were calculated between depressive symptoms and electrodermal activity and cortisol variables as indicators of the reaction to stress. Groups of women with and without breast cancer

history were analyzed separately for reactivity and recovery time periods. Stress reactivity variables were calculated from data collected during exposure to the Stroop and dual-task stressors. EDL reactivity was specific to each stressor. A total of 4 variables, 2 for the intervention condition and 2 for the no intervention condition, were analyzed for electrodermal reactivity. Cortisol reactivity reflects exposure to both stressors, Stroop and dual-task. Two variables, one for the intervention condition and one for the no intervention condition, were analyzed for cortisol. Portney and Watkin's criterion for correlation strength was used throughout these analyses. For simplicity, poor correlations less than .25 were not reported. Correlations between .25 and .5 were classified fair, correlations between .5 and .75 were classified moderate-good, and correlations above .75 were classified excellent (Portney & Watkins, 2000).

Reactivity results

EDL Reactivity During the Stroop Stressor

There was a significant interaction effect $F(1) = 5.72$, $p<.05$ between intervention status and trial sequence. However, the main effect of intervention status was not significant as seen in Table 9. EDL reactivity was higher in the intervention trials than in trials without the intervention when the intervention was introduced in the first trials. However, EDL reactivity was lower in the intervention trials than in the no intervention trials when the intervention was introduced in the second trial. Trials have been grouped into "A" (intervention during first trial) and "B" (intervention during second trial) to show experimental exposure sequence in Table 10. EDL was lower in the second trials than in the first trials regardless of intervention status. Neither the intervention by cancer status nor the intervention by cancer status by trial sequence interactions were significant. Because EDL is higher in the first trial regardless of intervention status, exposure groups "A" and "B" were compared to insure that random

group assignment resulted in similar groups. Findings of this analysis follow the dual task and cortisol reactivity sections.

Table 9: Mean EDL Reactivity Change from Baseline During the Stroop Stressor

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	*Trial*	*Type III Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
EDL Stroop Reactivity	*NoIntervention vs. Intervention*	*.089*	*1*	*.089*	*.051*	*.824*
*EDL Stroop Reactivity * Sequence*	*NoIntervention vs. Intervention*	*10.113*	*1*	*10.113*	*5.720*	*.023*
*EDL Stroop Reactivity * BrCA history status*	*NoIntervention vs. Intervention*	*1.410*	*1*	*1.410*	*.798*	*.379*
*EDL Stroop Reactivity * Sequence * BrCA history status*	*NoIntervention vs. Intervention*	*.196*	*1*	*.196*	*.111*	*.742*
Error(stroopreactivity)	*NoIntervention vs. Intervention*	*54.803*	*31*	*1.768*		

Table 10: Mean EDL Reactivity by Group and Intervention Exposure During the Stroop Stressor

	Intervention	No Intervention	F	P
Group A N=27				
	1.41	**1.28**		
			5.72	**.023**
	No Intervention	**Intervention**		
Group B N=23				
	1.96	**1.85**		

Note: Group A was exposed to the intervention in the first trial and was not exposed to the intervention in the second trial. Group B was not exposed to the intervention in the first trial and was exposed to the intervention in the second trial.

To explore the relationship between depressive symptoms and stress reactivity, correlations were analyzed for women with and without breast cancer history. Women with breast cancer history and who reported higher levels of depressive symptoms had lower stress reactivity (r = -.261) during the trial without the intervention than during the intervention trial. In the context of depressive symptoms, this may reflect a less healthy reactivity pattern than that found in the intervention trial when there was no reportable correlation. Reactivity and depressive symptoms were not correlated among women without breast cancer history who had more depressive symptoms. Depressive symptoms were associated with lower stress reactivity in women with breast cancer history, but had no association with the stress reactivity of women without breast cancer history with higher numbers of depressive symptoms.

EDL reactivity during dual-task stressor

Neither main nor interaction effects of an intervention X breast cancer history X sequence ANOVA reached significance. However, the interaction of intervention and trial sequence neared significance F (1) = 3.716, p=.063. These findings are reported in Table 11. As with the Stroop stressor, EDL reactivity was lower in trials where the intervention was presented in the second trial than it was in trials without the intervention, but was higher in trials where the intervention was presented in the first trial. EDL reactivity was consistently lower in the second trials regardless of intervention status. Therefore, exposure sequence is further analyzed later in this chapter.

Among women with breast cancer history, higher levels of depressive symptoms correlated (r= .430) with higher levels of reactivity during the dual-task stressor. There were no correlations between depressive symptoms and reactivity during the dual-task stressor among women without breast cancer history.

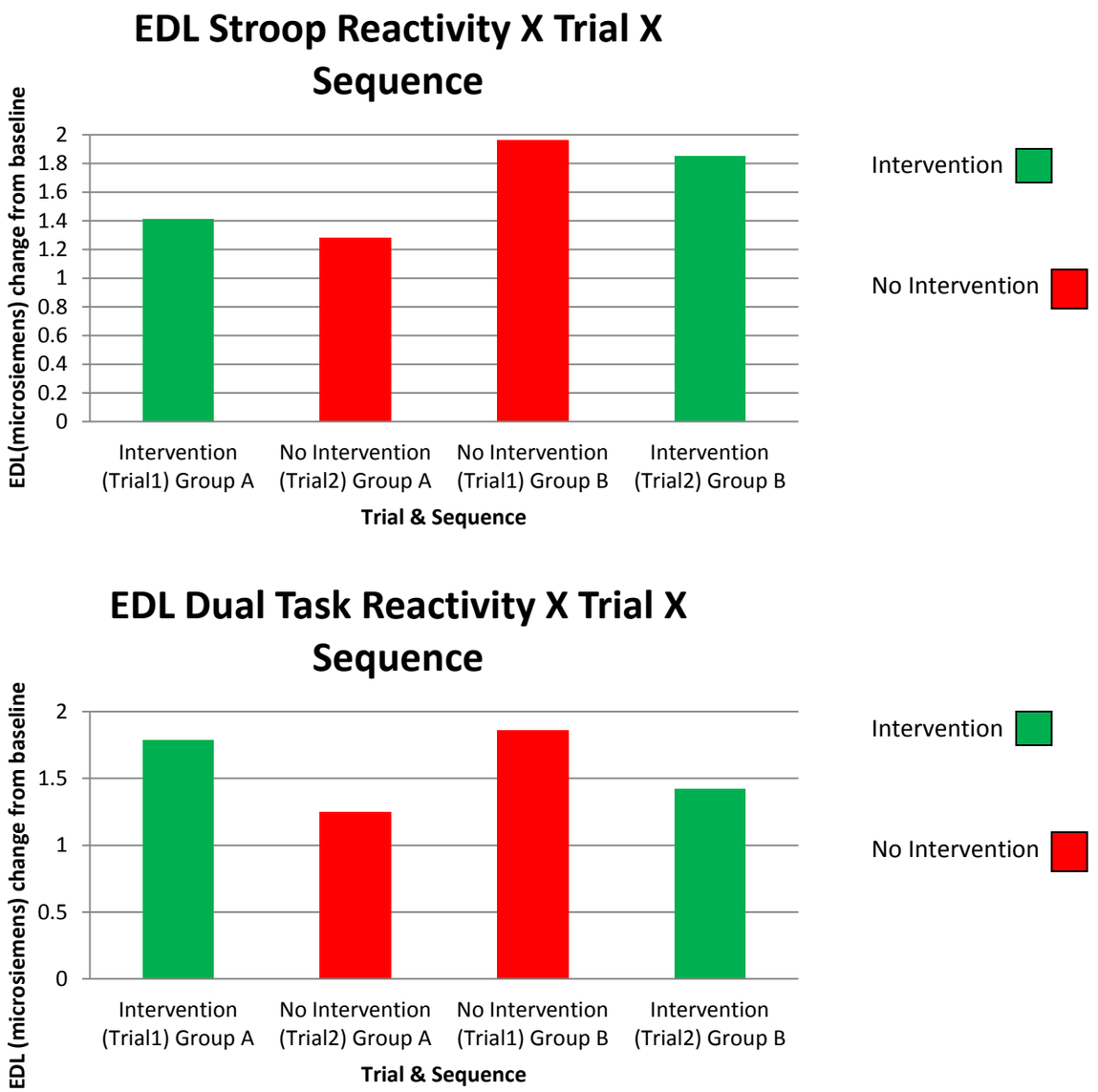
Table 11: Mean EDL Reactivity Change from Baseline During Dual Task Stressor

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Trial	Type III Sum of Squares	df	Mean Square	F	Sig.
EDL Dual task Reactivity	No Intervention vs. Intervention	.000	1	.000	.000	.993
EDL Dual task Reactivity * Sequence	No Intervention vs. Intervention	7.878	1	7.878	3.716	.063
EDL Dual task Reactivity * BrCA history status	No Intervention vs. Intervention	1.683	1	1.683	.794	.380
EDL Dual task Reactivity * Sequence * BrCA history status	No Intervention vs. Intervention	.276	1	.276	.130	.721
Error(factor1)	No Intervention vs. Intervention	65.725	31	2.120		

Figure 10: EDL Reactivity by Stressor, Trial, and Sequence



Cortisol reactivity to the summation of Stroop and dual task stressors

Cumulative reactivity to both stressors, a change measure of cortisol, was collected following the stress protocol at the beginning of the recovery time period. This is a measure of cumulative stress reactivity because of the physiological rate of cortisol release. There were no significant main or interaction effects related to the intervention.

Pearson correlations between depressive symptoms and cumulative stress reactivity were assessed among women with and without breast cancer history to determine if there was a differential effect of cancer history on the relationship between these two characteristics. Among women with breast cancer history, higher numbers of depressive symptoms were associated with less cortisol reactivity ($r = -.326$) in the no intervention trials. There were no associations between depressive symptoms and stress reactivity as measured by cortisol among women without breast cancer history.

The sequence of exposure to the intervention was a significant factor in this analysis. Participants had been randomized for exposure to the intervention in either the first or second trial. Therefore, the group of participants which was exposed to the intervention in the first trial (Group A) was compared to those who were exposed to the intervention in the second trial (Group B) to determine if randomization created two similar groups. Results of these group comparisons are found in Table 12. Demographic, health, and psychological characteristics were very similar in the two groups. Only education level was higher in the group of participants which was exposed to the intervention in the first trial. However, this difference was between women who had earned undergraduate degrees and those who had earned graduate degrees. This difference would not have affected participants' capacity to perform either stress task in the protocol. It was concluded that randomization to intervention first or second groups was successful in creating two essentially equal groups.

Table 12: Demographic, health, and psychological characteristics of participants by intervention exposure sequence

	Group A Intervention First (mean/frequency)	Group B Intervention Second (mean/frequency)	Significance
Age	41	40.8	.922a
Race			.405b
Caucasian	21	20	
Noncaucasian	6	3	
Education			.044*c
High school graduate/some college	4	3	
College Graduate	6	13	
Graduate Degree	17	7	
Relationship status			.454b
Single	11	7	
Married/Partnered	16	16	
Number of dependents			.174c
0	18	10	
1	3	5	
2	3	7	
3+	3	1	
Work Status			.820b
Homemaker	1	3	
Works outside of home	26	20	
Body mass index			.159c
Normal or underweight	14	15	
Overweight or obese	13	7	
Number of prescription medications			.976b
0 daily	11	8	
1-3 daily	9	10	
4 or more daily	6	5	
Depressive symptoms score	11.4	9.1	.351a
Well-being total score	406.3	414.5	.577a
Mean baseline EDL (Ln)	.9	1.1	.253a
Mean baseline cortisol (Ln)	.1	.1	.711a
Breast Cancer Status			.629c
History of BrCA	17	11	
No history of BrCA	10	12	

a=ANOVA (Age, depressive symptoms, well-being, mean EDL, mean cortisol, breast cancer status),
b= Mann Whitney U test (Race, Education, Relationship Status, Number of Dependents, Work Status, Number of Prescription Medications), c=Pearson χ^2 (BMI), *=p<.05

Recovery results

Electrodermal level recovery

Data trends depicted in Figure 11 appear to demonstrate faster recovery in intervention trials than the no intervention trials. However, conclusions drawn from simple visual analysis are limited. The first 10 second segment of recovery was the time segment during which the participants appeared to have the greatest recovery response to the intervention. During this early period, the intervention appeared to have hastened recovery. The recovery pattern in the next segments although they were not statistically significant between intervention and no intervention trials, the intervention curve was consistently down-regulated based on the first recovery segment. The last recovery segment, 50-60 seconds, indicated an emerging difference between the groups. The intervention group was trending downward, although the trend without the intervention appeared stable at a level above that of the intervention. Although the intervention appeared to accelerate stress recovery as depicted in the visual analysis of Figure 11, high variability may have limited the significance of statistical tests which are presented later in this chapter. Findings of t-tests comparing paired raw mean EDL recovery and variability values by intervention and no intervention trials are provided in Table 13. Post hoc analysis of the standard deviations associated with means was pursued because of the appearance that there was less EDL variability in intervention trials than there was during trials without the intervention. There was a significant difference in the variability between the intervention (M=1.5, SD=.05) and no intervention (M=2.5, SD=0.06) trials; $t(5)=71.11$, $p = 0.00$. These results strongly suggest that the intervention did decrease the variability of EDL.

Figure 11: Electrodermal Level (raw) X Time X Intervention Status

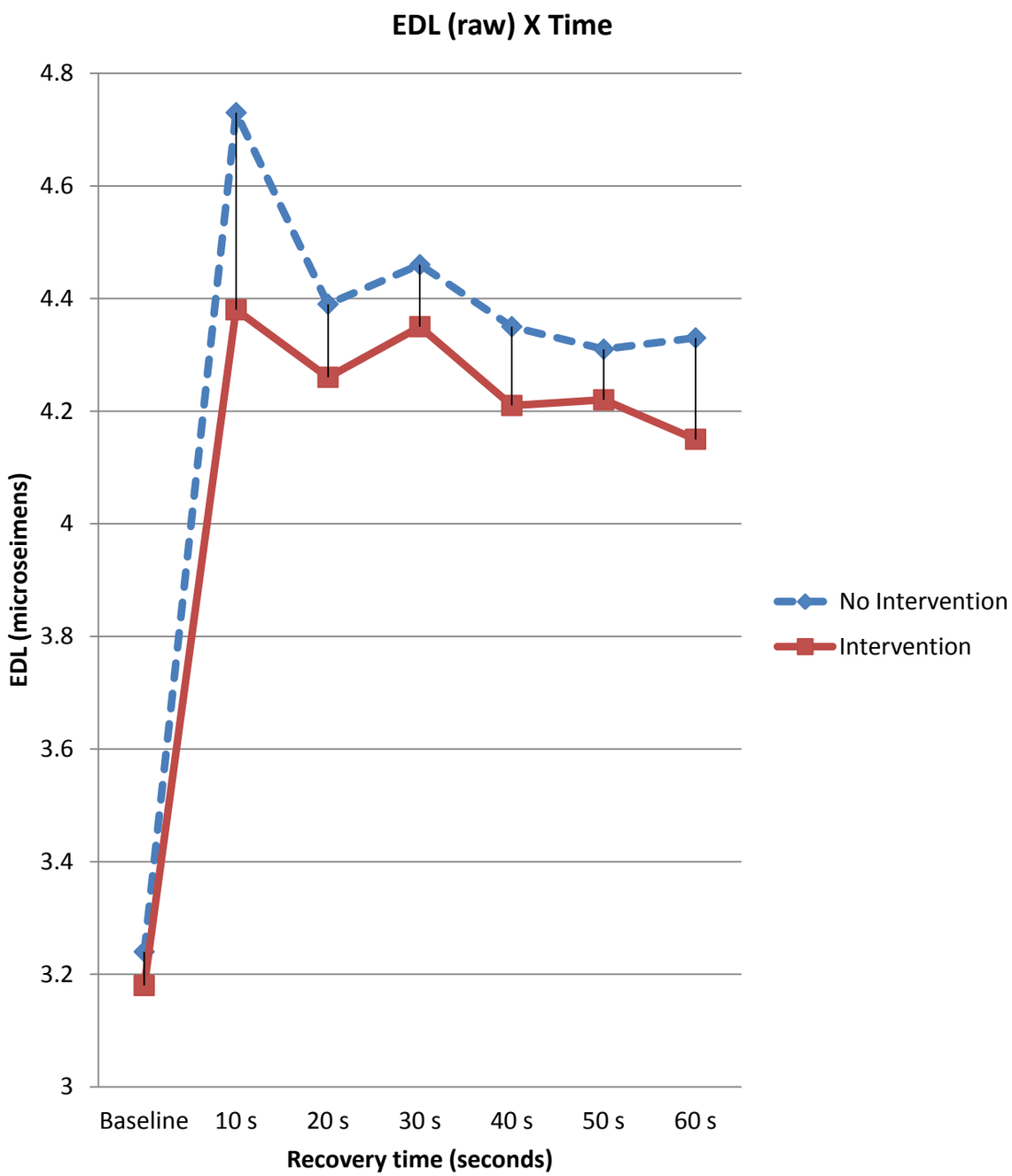


Table 13: Comparison of mean EDL recovery between no intervention and intervention groups at 10 second intervals

		Mean	N	Std. Deviation	T statistic	p
Pair 1	NoImean10	4.731	46	2.594	.895	.376
	Imean10	4.378	46	1.668		
Pair 2	NoImean20	4.393	46	2.574	.391	.698
	Imean20	4.263	46	1.625		
Pair 3	NoImean30	4.459	46	2.487	.345	.731
	Imean30	4.345	46	1.529		
Pair 4	NoImean40	4.347	47	2.476	.418	.678
	Imean40	4.214	47	1.557		
Pair 5	NoImean50	4.306	46	2.448	.255	.800
	Imean50	4.222	46	1.579		
Pair 6	NoImean60	4.325	45	2.483	.541	.591
	Imean60	4.149	45	1.541		

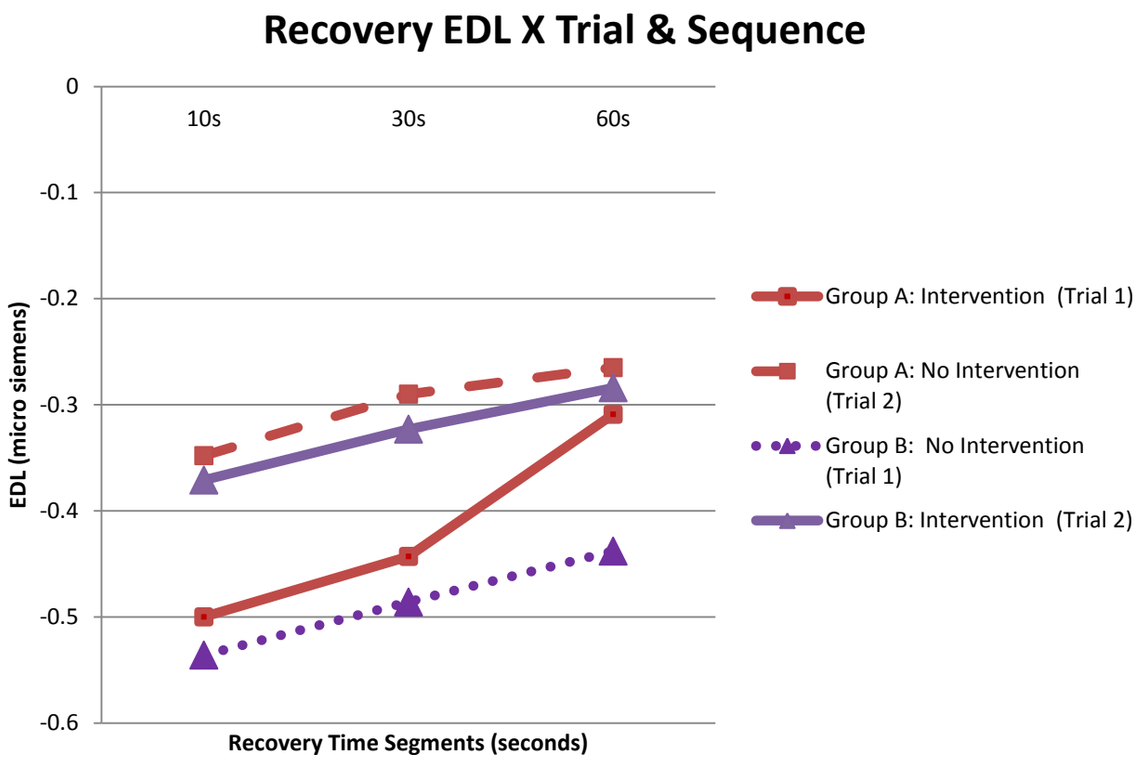
Next, an EDL recovery change measure was calculated by subtracting the natural log of mean EDL during recovery from the natural log of mean EDL at baseline. A positive change value meant that the recovery EDL was less than the baseline activity: higher change values reflect faster recovery than lower change values. The stress recovery of women with breast cancer history, in the absence of other variables, was not significantly different than that of women without breast cancer history $F(1) = .207$, $p=.651$. There was a significant effect found at the $p<.05$ level for the interaction of intervention and sequence (whether the intervention was presented in the first or second laboratory visit). There was a further group interaction effect found at the $p<.001$ level based on breast cancer history status, intervention, and trial sequence for seconds 20-30 and 50-60 and at the $p<.05$ level for seconds 10-20, 30-40, and 40-50. However, there was not a significant main effect for the intervention alone at 10 seconds ($F(1) = .121$, $p=.730$), 30 seconds ($F(1) = .000$, $p=.994$), or at 60 seconds ($F(1) = .386$, $p=.538$). These findings are grouped by exposure sequence in Table 14 to illustrates the significance of trial sequence.

Table 14: Mean EDL Recovery by Intervention Trial Sequence, Group, and Recovery Time Period

	Intervention	**No Intervention**	**F**	**p**
Group A				
N=27				
10 seconds	**-.500**	**-.348**		
30 seconds	**-.443**	**-.290**		
60 seconds	**-.309**	**-.265**		
			8.084	**.007**
			7.268	**.010**
			4.503	**.040**
	No Intervention	**Intervention**		
Group B				
N=23				
10 seconds	**-.536**	**-.371**		
30 seconds	**-.486**	**-.323**		
60 seconds	**-.438**	**-.284**		

Analysis of trials and sequence together demonstrated that recovery in intervention trials was faster for Group B, marked with triangles in Figure 12, where the intervention was introduced in the second trial. Faster recovery was not evident in the intervention trial of Group A marked with squares. Figure 12 provides further evidence of an exposure sequence effect, rather than an intervention status effect, of faster recovery in the second exposure to the experiment.

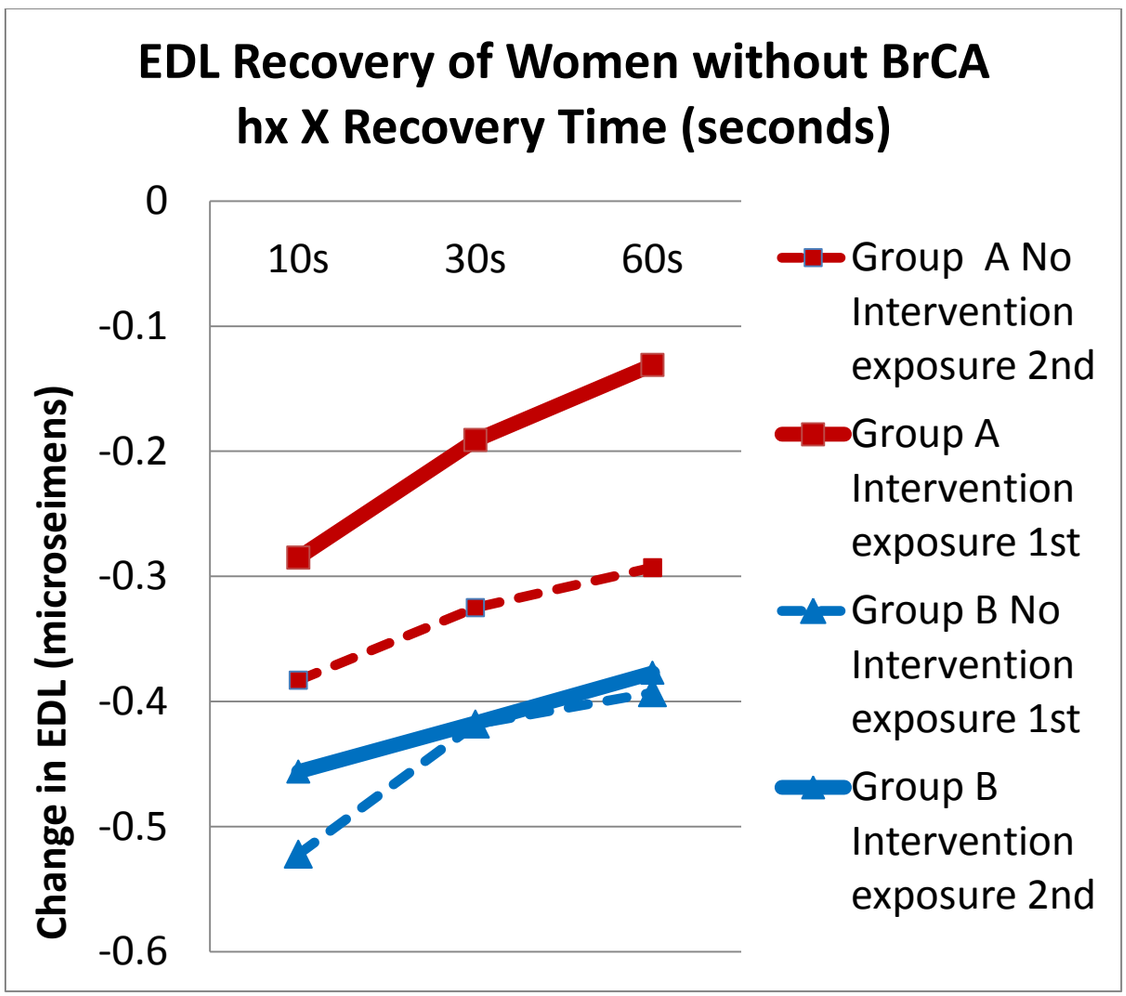
Figure 12: EDL Recovery by Trial and Sequence



Stress recovery and breast cancer status

Stress recovery was not significantly different based on breast cancer history status alone. Recovery findings may be best understood by considering the significant interaction effects of trial sequence and breast cancer history status. Women without breast cancer history had faster recovery in intervention trials than in trials without the intervention regardless of exposure sequence as indicated in Figure 13 where the solid lines are closer to 0 for both groups, “A” and “B”. Women in Group A who were exposed to the intervention in the first trial appeared to have the greatest benefit. This finding is the first indication that the intervention may have truly hastened recovery for a specific group.

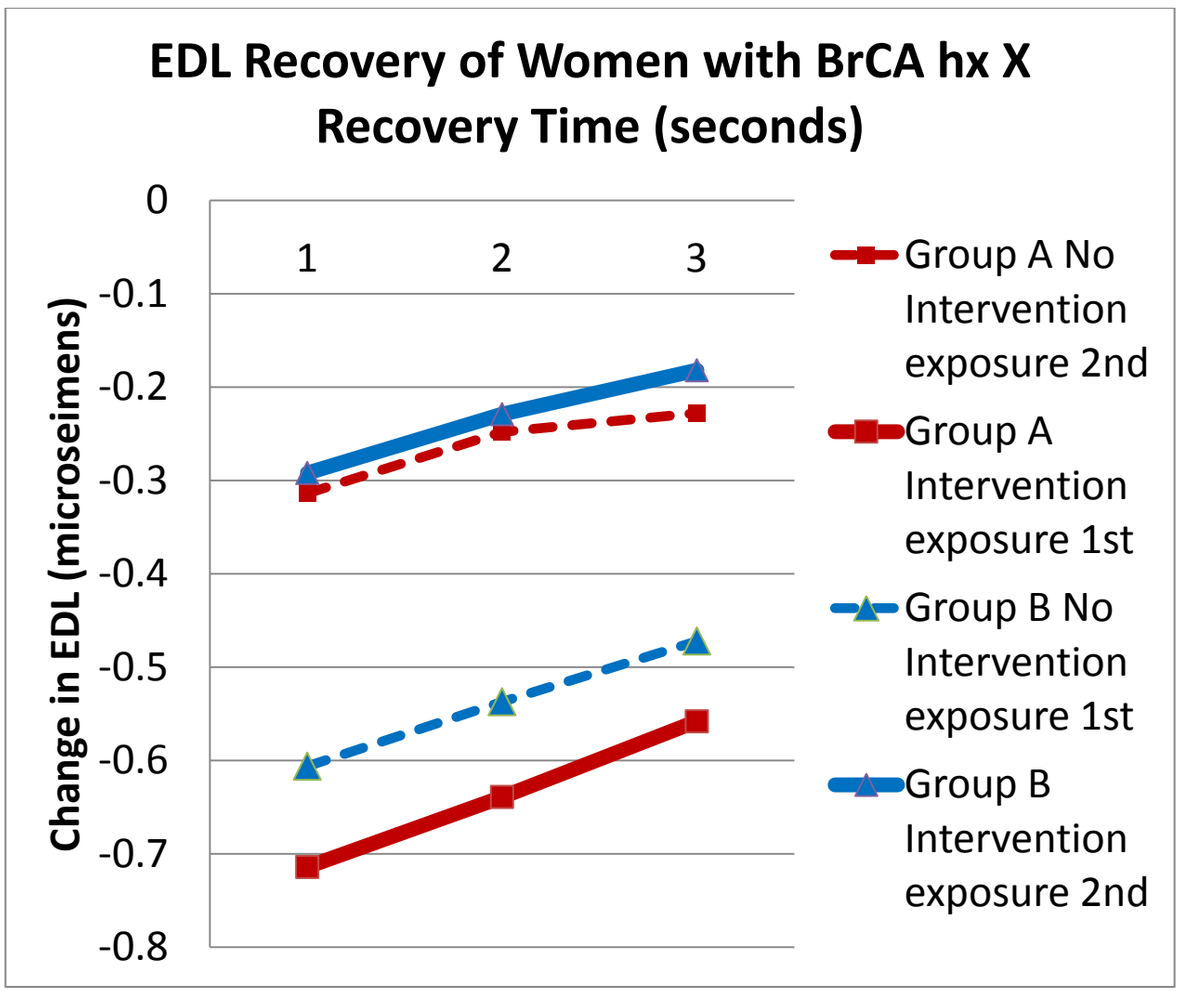
Figure 13: EDL Recovery of Women without Breast Cancer History X Recovery Time (seconds)



Women with breast cancer history who were exposed to the intervention in the first trial did not benefit from the intervention as indicated in Figure 14 where the Group A solid line is farther away from 0 than the Group A dashed line. Women with breast cancer history had faster stress recovery with the intervention when it was introduced in the second trial as indicated by the solid Group B line being closer to 0 than the dotted Group B line in Figure 14. This finding, however, is suspect because the

faster recovery occurs in the second trial. Previous findings, displayed in Figure 13, illustrate faster recovery in the second trials than in the first trials regardless of intervention status. Interestingly, recovery with the intervention presentation in the second trials for women with breast cancer history was similar to recovery for women without breast cancer history who were exposed to the intervention in the first trials. Nevertheless, the test of the effectiveness of the intervention on stress recovery among women with breast cancer history is inconclusive.

Figure 14: EDL Recovery of Women with Breast Cancer History X Recovery Time (seconds)



Patterns of association between depressive symptoms and physical markers of stress varied between women with and without breast cancer history in the recovery time period. Among women with breast cancer history, during the recovery period of the intervention trial, depressive symptoms were associated with lower EDL (r= -.378, - .377, -.408). This lower EDL characterized faster stress

recovery than recovery in the trial without the intervention where there was no correlation between depressive symptoms and EDL. Among women without breast cancer history, depressive symptoms and stress recovery were positively associated (r = .394, .420, .452) in the trials without the intervention indicating that recovery rates were slower among women with more depressive symptoms than among those with fewer depressive symptoms. Fast stress recovery was associated with the intervention trials among women with breast cancer history. However, slow stress recovery was associated with the no intervention trials among women without breast cancer history.

Cortisol recovery

Stress recovery as measured by cortisol did not differ by intervention condition. An intervention X breast cancer history X sequence ANOVA was used to analyze the change in cortisol levels from baseline mean to recovery mean in the intervention and no intervention trials. There were no significant main intervention or interaction effects of trial sequence or breast cancer history status. Correlations between depressive symptoms and cortisol recovery varied between women with and without breast cancer history. Among women with breast cancer history, there were not strong correlations between depressive symptoms and cortisol recovery in either the intervention or no intervention condition. In women without breast cancer history, more depressive symptoms were associated (r = -.345) with slow cortisol recovery in the no intervention condition. There was not a significant correlation between depressive symptoms and cortisol recovery among women without breast cancer history in the intervention condition.

Summary

These analyses conditionally support the general hypothesis that the intervention would hasten recovery. However, intervention sequence and breast cancer history status differences and number of depressive symptoms resulted in the acceptance of 3 of the 5 specific hypotheses in Table 15. Among women without breast cancer history EDL recovery was faster in intervention trials for those in Group A where intervention exposure was in the first trials. Whereas, EDL recovery was faster in intervention trials for those women with breast cancer history in Group B where intervention exposure occurred in the second trials. This finding, however, is suspect based on faster recovery in second trials regardless of intervention status.

Physiological stress was differentially associated with higher numbers of depressive symptoms among women with and without breast cancer history. Specifically, EDL reactivity to the Stroop stressor was lower in the no intervention trials, overall cortisol reactivity was lower, and EDL reactivity to the dual task stressor was higher among women with breast cancer history who reported higher levels of depressive symptoms. In women without breast cancer, slow recovery (EDL and cortisol) was associated with the no intervention trial. Among women with breast cancer history, faster recovery was associated with the intervention trial, but no association was found between depressive symptoms and stress recovery in trials without the intervention. Women with breast cancer history did not have significantly different stress recovery compared to women without breast cancer history without the intervention. Therefore, the hypothesis comparing women with breast cancer history who used the intervention to women without breast cancer history who did not use the intervention was not tested. Nuances to these findings and connections to available evidence are discussed next.

Table 15: Aim 2 Hypothesis Test Results

Hypotheses	Test Results
2a) The intervention will reduce stress reactivity.	Hypothesis rejected
2b) Higher levels of depressive symptoms will be associated with lower stress reactivity in the trials without the intervention.	Hypothesis generally accepted for women with breast cancer history, but not for women without breast cancer history. Specifically, EDL reactivity to Stroop was lower in no intervention trials, overall cortisol reactivity was lower, and EDL reactivity to dual task was higher among women with breast cancer history who reported higher levels of depressive symptoms.
2c) Higher levels of depressive symptoms will be associated with slower stress recovery without the intervention.	Hypothesis accepted for women without breast cancer whose slow recovery (EDL and cortisol) was associated with the no intervention trial. Among women with breast cancer history, faster recovery was associated with the intervention trial.
2d) Recovery from the stressors in the intervention trials will be faster than in the no intervention trials.	Hypothesis conditionally accepted for EDL. **Women without breast cancer history-** In Group A, recovery was faster in the intervention trials. **Women with breast cancer history-** In Group B, recovery was faster in the intervention trials. This finding is however suspect based on earlier analyses.
2e) Women with breast cancer history who use the intervention will have similar stress recovery to women without breast cancer history who did not use the intervention.	Hypothesis not tested because women with and without breast cancer history did not have significantly different recovery without the intervention.

Discussion

Sequence was significantly correlated with EDL reactivity. Stress reactivity during the dual task stressor was lower when the no intervention trials were the second in sequence and was higher when the no intervention trials were the first in sequence. Sequence, rather than intervention status, is the most likely explanation for the difference in reactivity. The novelty of the experiment may have elicited higher stress reactivity in the first trial than the second trial. Differential effects based on sequence were evident in the intervention trials. EDL reactivity was higher with the intervention than without the intervention during the dual task stressor in the first trials, but EDL reactivity was lower in intervention trials than it was in the no intervention trials when the intervention was presented in the second trials. Reactivity in the no intervention trials was very similar across stressor type as seen in Figure 10 Stroop reactivity was slightly higher in the first trials and slightly lower in the second trials. The presentation sequence was more strongly correlated with EDL reactivity during the dual task stressor than during the Stroop stressor.

Stress reactivity was higher in first trials, regardless of intervention status. One explanation for this phenomenon may be anticipatory anxiety. Chua and colleagues conceptualize anticipatory anxiety as a negative appraisal of future events resulting in autonomic arousal (1999). It is possible that the idea of a stress challenge raised autonomic arousal resulting in higher stress reactivity during the first trials. The effect of anticipatory anxiety may have overshadowed the effects of the intervention on stress reactivity. The lower reactivity in second trials independent of intervention status precluded the determination of intervention effect on stress reactivity in the second trials.

Stress recovery with the intervention was faster only among women without breast cancer history. This conclusion was reached after many levels of analysis. It was not possible to determine if the intervention affected recovery in the second trials because recovery was always faster in the second trials. Recovery analysis was

potentially confounded by sequence effects like anticipatory anxiety, breast cancer history status, or other variables not identified in this study. However, the post hoc finding that the intervention significantly reduced EDL variability during recovery is important. The goal of the intervention was to improve recovery physiology. Analyzing the EDL variability rather than the EDL means suggests that self-regulation with the intervention may have been optimized. The differential effect of the intervention on women with and without breast cancer history raises questions about the responsiveness of women who have had breast cancer. The potential role of depression is discussed next to better understand these differential effects.

Among women with breast cancer, there were multiple associations between depressive symptoms and stress indices throughout the stress challenge. During the Stroop stressor, low electrodermal reactivity was associated with depressive symptoms. Higher electrodermal reactivity was associated with depressive symptoms during the dual-task stressor. And low cortisol reactivity was associated with depressive symptoms in reaction to the summation of the Stroop and the dual-task stressors. Among women with breast cancer history, faster stress recovery was associated with higher numbers of depressive symptoms in the intervention condition but there were no reportable correlations without the intervention.

These associations between women with breast cancer history with higher depressive symptoms and stress reactivity may be a window into stress management dysfunction. Depressive symptoms were associated with higher reactivity to the dual-task stressor which was designed to simulate multi-tasking, a common demand of the environment of many women. The “Dysfunctional reactivity” graph in Figure 4 may capture the allostatic nature of this higher reactivity. Women with higher levels of depressive symptoms seem to stay engaged, to the point of hypervigilance, with this stressor which was designed to be environmentally valid. Depressive symptoms were associated with low reactivity during the Stroop which is a highly challenging stressor, with lower environmental validity, requiring rule shifting and

short response time. Low reactivity during the Stroop may be a signal that women with higher levels of depressive symptoms were disengaged from the stressor. Reacting to stress by disengaging from the environment and down-regulating stress physiology is expected among women with more depressive symptoms. The "Dysfunctional hyporeactivity" graph in Figure 4 suggests this finding. These women also have low reactivity to the stressors overall in the no intervention trial as measured by down-regulated cortisol. Together, these findings suggest that both the SNS and the HPA may be exhibiting subtle signs of allostatic load among women with breast cancer history and depressive symptoms.

Among women without breast cancer history, there were fair correlations between depressive symptoms and slow stress recovery in the no intervention trial. An example of allostatic load slow recovery is illustrated in the "Dysfunctional recovery" graph in Figure 4. There were no correlations between depressive symptoms and stress recovery in the intervention trial. The lack of correlation between depressive symptoms and recovery may be interpreted positively in that the shift was from poor recovery without the intervention to neutral recovery with the intervention. There were no correlations between depressive symptoms and cortisol. Women without cancer who had higher levels of depressive symptoms did not appear to have as much physiological stress dysregulation as women with breast cancer history.

Women with breast cancer history had stronger associations between higher depressive symptoms and worse stress reactivity and recovery than all other women in the sample. This association may exemplify allostatic load as defined by McEwen (1998). Characteristics of those who received the most benefit from the intervention are reviewed in Chapter 6 where predictive recovery models are also explored.

Chapter 6: Models of Physiological Recovery

Models of physiological recovery were pursued to build hypotheses for future study. Stress responses, as measured during laboratory stress challenges, may be influenced by moderator variables like gender (Allen et al., 1993; Kudielka et al., 2009), age (Benschop et al., 1998; Kudielka et al., 2009; Uchino, Uno, Holt-Lunstad, & Flinders, 1999), and fitness level (Hamer & Steptoe, 2007; Traustadottir, Bosch, & Matt, 2005).

Although most cancer treatment side-effects are believed to be transient, some women who have had breast cancer treatment report long-term changes. These changes may affect quality of engagement in life activities for years following diagnosis (Hansen et al., 2008; Mathieson & Stam, 1995). For example, working women with breast cancer history (about 4 years post diagnosis) reported significantly more work limitations related to fatigue than well peers (Hansen, Feuerstein, Calvio, & Olsen, 2008). Fatigue, depressive symptoms, and changes in occupational patterns are reported by women at the end of their treatment regimen (Ganz et al., 2004). Higher fitness levels may moderate stress (Hamer & Steptoe, 2007). Fitness level may have an impact on the neuroendocrine changes associated with aging (Traustadottir et al., 2005). Traustadottir and colleagues found that fit older female subjects had significantly healthier cortisol responses to a laboratory stressor when compared to unfit older female subjects.

Central adipose tissues have heightened metabolic activity in response to cortisol increases (Veilleux et al. 2009). Men and women (N=207) who were an average of 52±3 years old with higher fitness levels (as measured by exercise heart rate) than same-age peers demonstrated lower stress reactivity as measured through heart rate variability in response to laboratory stressors (Hamer &

Steptoe, 2007). The literature suggests that demographic and health-related factors may contribute to a predictive model of intervention benefit.

Aim 3

The third aim of the larger study was to describe the intervention enhanced recovery physiology of the participants who benefited and to explore predictive models of stress recovery. One multiple regression model was generated for each dependent physiological variable, EDL and cortisol recovery. Research questions directed toward aim 3 were as follows.

3a) Is stress recovery faster in intervention trials than in no intervention trials among women with higher numbers of depressive symptoms?

3b) Is stress recovery faster in intervention trials than in no intervention trials among women with lower levels of resistance exercise frequency?

3c) Do higher daily prescription medication use and higher BMI predict slower stress recovery?

3d) Do higher numbers of depressive symptoms and lower well-being predict slower stress recovery?

Methods

Raw stress recovery change measures for EDL and cortisol were used to divide the participants into two groups for each variable. Differences in the predictor variables between women who did and did not benefit from the intervention were determined using t-tests for age, Chi^2 tests for nominal data (race, relationship status, and BMI) and Mann Whitney U tests for categorical data when cell sizes were less than 5 (educational attainment, number of dependents, work status, cardiovascular exercise frequency, resistance exercise frequency, number of prescription medications, depressive symptoms, and well-being). Two theoretically driven multiple linear regression models were created to predict stress recovery. The physical health model included BMI and the number of daily prescription medicines. The psychological health model included total well-being and a depressive symptoms score from the CES-D. After hypothesis testing, exploratory models were generated using the automatic modeling feature of SPSS. Variables identified by the modeler were entered into linear regression models. All models were run four times to predict stress recovery in the following variables: EDL in the intervention trials; EDL without the intervention; cortisol with the intervention; and cortisol without the intervention.

Results

Characteristics of participants who benefitted from the intervention

Women who recovered from stressors faster (based on simple comparisons) in the intervention trials were somewhat different from women who had faster recoveries without the intervention. Key differences were noted in some well-being, exercise, and health variables. Intervention benefit profiles for EDL recovery were not statistically different for demographic characteristics or on measures of psychological or physical health. Some measures were, however, marginally different as displayed in Table 16. Women who did not perform any resistance exercise were somewhat more likely ($p=.074$) to show benefit from the intervention than women who participated in resistance exercise at least twice weekly. Women who were

somewhat more depressed (p=.075) and had somewhat fewer positive relations with others (p=.075) were also more likely to benefit from the intervention than women who were less depressed and reported more positive relations with others.

Profiles of women who benefitted from the intervention with regard to cortisol recovery were different from those of women who did not benefit from the intervention as indicated by statistically significant higher total well-being ($p<.05$) and two sub-scales, autonomy ($p<.05$) and purpose in life ($p<.05$) as displayed in Table 17. Comparisons of women who did and did not benefit from the intervention as identified by cortisol recovery provided another view of stress recovery.

Table 16: Profiles of women who did and did not benefit from the intervention based on EDL Reactivity

	Intervention improved EDL recovery Mean/Mode N=21	Intervention did not improve EDL recovery Mean/Mode N=31	Significance
Age	41.67 SD 8.071	41 SD 7.742	.907c
Race NonCaucasian (0) Caucasian (1)	1 (0-1)	1 (0-1)	.785b
Education High School (1) College Graduate (2) Graduate Degree (3)	2 (1-3)	2 (1-3)	.799a
Relationship Status Unmarried/unpartnered (0) Married/partnered (1)	1 (0-1)	1 (0-1)	.174b
Number of Dependents 0 1 2 3+	0 (0-3)	0 (0-3)	.818a
Work Status Homemaker (1) Works Outside of Home (2)	2 (1-2)	2 (1-2)	.606a
Cardiovascular Exercise Weekly Frequency	2 (0-3)	2 (0-3)	.623a
Resistance Exercise Weekly Frequency	0 (0-3)	2 (0-3)	.074a
Body Mass Index Under or normal weight (1) Overweight or obese (2)	1.5 (1-2)	1 (1-2)	.572b
Number of Daily Prescription Medications	0 (0-10)	1 (0-5)	.507a
CES-D	9.5	5	.075a
Well-being (total)	403.5 (280-474)	426 (283-491)	.271a
Self acceptance	66	62	.735a
Positive relations with others	66b (38-80)	68b (43-84)	.075a
Autonomy	76.5 (57-83)	75 (52-84)	.938a
Environmental Mastery	68	73	.167a
Purpose in life	70 (44-82)	73 (45-84)	.120a
Personal growth	68	70	.549a

a=Mann Whitney , b=Chi^2, c=t-test

Table 17: Profiles of women who did and did not benefit from the intervention based on Cortisol Reactivity

	Intervention improved cortisol recovery N=21 mean/mode	Intervention did not improve cortisol recovery N=31 mean/mode	Significance
Age	41.24 SD 7.234	41.35 SD 8.285	925c
Race NonCaucasian (0) Caucasian (1)	1 (0-1)	1 (0-1)	.312b
Education High School (1) College Graduate (2) Graduate Degree (3)	3 (1-3)	2 (1-3)	.110a
Relationship Status Unmarried/unpartnered (0) Married/partnered (1)	1 (0-1)	1 (0-1)	.848b
Number of Dependents 0 1 2 3+	0 (0-2)	0 (0-3)	.491a
Work Status Homemaker (1) Works Outside of Home (2)	2 (1-2)	2 (1-2)	.447a
Cardiovascular Exercise Weekly Frequency	1 (0-3)	2 (0-3)	.135a
Resistance Exercise Weekly Frequency	2 (0-3)	0 (0-3)	.201a
Body Mass Index Under or normal weight (1) Overweight or obese (2)	1.5 (1-2)	1 (1-2)	.508a
Number of Daily Prescription Medications	1 (0-10)	1 (0-5)	.804a
CES-D	6	7	.530a
Well-being (total)	433 (280-491)	406 (283-493)	.049a
Self acceptance	66.5	62	.127a
Positive relations with others	68 (38-84)	65 (43-82)	.107a
Autonomy	78.5 (57-84)	73 (52-84)	.033a
Environmental Mastery	74	71	.505a
Purpose in life	74 (44-84)	71 (45-83)	.050a
Personal growth	76	69	.107a

a=Mann Whitney , b=Chi^2, c=t-test

Multiple linear regression models for physical and psychological models

Theoretically generated physical and psychological health multiple linear regression models were not significant. Statistics for physical health EDL recovery model were F(2)= .088, p=.916 for the no intervention trial and F(2)= .316, p=.713 for the intervention trials. Statistics for the psychological health EDL recovery models were F(2)=. 376, p=.689 for the no intervention trials and F(2)= 1.092, p=.345 for the intervention trials. Results of the physical health cortisol recovery model were F(2)=.015, p=.985 for the no intervention trials and F(2)=1.784, p=.181 for the intervention trials. For the psychological health cortisol recovery models findings were F(2)=.990, p=.379 for the no intervention trials and F(2)=.332, p=.719 for the intervention trials.

Because theoretical models failed to predict recovery, post-hoc models were created with the SPSS automatic linear regression modeler to inform further analysis. Predictor variables included all of those delineated in Tables 16 and 17. Dependent variables were cortisol recovery with and without the intervention and EDL recovery with and without the intervention.

Variables identified by the automatic modeler as significant predictors of stress recovery were used in subsequent exploratory models. The model for cortisol recovery with the intervention was significant F(3) = 3.53, p=.023 with three variables. Cardiovascular exercise frequency (β=.333, p=.025), the number of daily medications (β=.255, p=.087), and autonomy (β= -.219, p=.146) explain 20.5% of the variance. The model for cortisol recovery without the intervention was also significant F(3) = 3.982, p=.013. Twenty-one percent of the variance was explained by breast cancer history status (β=.337, p=.015), positive relations with others (β=.431, p=.016), and autonomy (β= -.279, p=.113). The model of the first 10 seconds of EDL recovery in the intervention trials was significant F(1) = 4.47, p=.04. Resistance exercise frequency (β=.307, p=.04) predicted 9.4% of the variance. The model for the first 10 seconds of EDL recovery without the intervention was not significant F(3)=2.2, p=.102. Variables in the model included education level (β= -.174, p=.239), environmental mastery (β= -.292, p=.066), and resistance exercise frequency (β= -.303, p=.054) which together predicted 13.6% of the variance, an insufficient amount to reach significance.

Summary

Although neither the physical nor psychological health multiple linear regression models significantly predicted stress recovery, post-hoc analysis provided some insights into alternative explanatory models. Rather than exclusively physical or mental health predicting stress recovery, models reflecting mixed variables emerged as best predicting stress recovery. Cortisol models included exercise frequency, daily medication use, and breast cancer history for recovery following the intervention. In addition to breast cancer history, autonomy and positive relations with others appear to play a role in recovery without the intervention. EDL models included resistance exercise, educational attainment, and environmental mastery; however, exercise was the only variable that emerged as explaining variance in the recovery process and only in the intervention condition. Simple comparisons of the demographic, physical, and psychological health profiles of women who had faster recovery with the intervention provide further support for considering measures of physical and psychological health in future stress recovery models. Results of hypothesis testing are presented in Table 18.

Table 18: Aim 3 – Hypothesis Test Results

Hypotheses	Test Results
3a) Higher numbers of depressive symptoms will be associated with faster stress recovery with, rather than without, the intervention	Hypothesis upheld.
3b) Lower frequency of resistance exercise will be associated with faster stress recovery with, rather than without, the intervention.	Hypothesis upheld.
3c) Higher daily prescription medication use and higher BMI predict slower stress recovery.	Hypothesis not upheld.
3d) Higher numbers of depressive symptoms and lower well-being predict slower stress recovery.	Hypothesis not upheld.

Discussion

Despite the lack of significant findings supporting a brief isometric exercise as an effective stress intervention for women with breast cancer, some women appeared to benefit while others did not. Post–hoc statistical modeling was undertaken in an attempt to more clearly understand the characteristics of women for whom the intervention appeared to have an effect. The models were generated to provide a basis for building hypotheses for future studies. Cortisol stress recovery models which included indicators of both physical and psychological health explained about 21% of the variance. Overall physical health, marked by the number of prescription medicines taken daily and breast cancer status, as well as well-being, specifically positive relations with others and autonomy, warrant further study because of their potential influence on stress recovery. These findings, although limited by sample size

may be beneficial to future investigators interested in developing models of interventions for managing stress.

Prescription medication use has been a recurring variable of interest in developing a model of stress recovery since the earliest pilot research that preceded this study. Participants who are experiencing disease processes that require daily prescription medications may already have indications of allostatic load and associated low-level chronic inflammatory states. Certainly, women who have a history of breast cancer may benefit from minimizing allostatic load. Limiting stress hormone exposure through faster stress recovery may be particularly important for these individuals because low-level chronic inflammatory states are fertile microenvironments for disease. Women requiring daily medication may be less fit and less likely to engage in conventional exercise. Because weekly exercise frequency is known to be a health promoting behavior, exercise frequency and mode must continue to be included in models of stress recovery. Women who experienced faster stress recovery with the intervention tended to be more depressed and performed less resistance exercise than those who did not experience faster recovery with the intervention. The qualities of the intervention in the current study may have particular appeal to these women because the intervention has fewer barriers than conventional cardiovascular or resistance exercise.

Comparisons between women who did and did not recover faster with the intervention enhanced understanding of women who were most likely to benefit from the intervention. Stress recovery benefits from the intervention, as measured by EDL, were marginally better among women who did not exercise, reported more depressive symptoms, and had fewer positive relations with others. Based on cortisol as an indicator of stress recovery, individuals with high levels of well-being appeared most likely to benefit. It is likely that those with high levels of well-being had healthier recoveries independent of the intervention.

Although findings from the stress recovery models are based on insufficient numbers to provide strong evidence for the effectiveness of the brief isometric intervention used in this study, they do identify characteristics of individuals who may be susceptible to lower levels well-being and health if their stress is not managed. Women commonly seen in occupational therapy practice often exhibit characteristics that are associated with depressive symptoms such as low levels of perceived well-being, poor health, high medication use, and low levels of physical activity. This intervention may warrant further testing with a larger sample to best match the intervention to a population most likely to benefit. The intervention may be more readily adopted by women who identify barriers to conventional exercise and other currently available supports for managing stress. The qualities of this intervention may have particular appeal to these individuals and facilitate enhanced stress recovery. Meaningful engagement in desired life occupations is expected to follow more rapid stress recovery which in turn is expected to contribute to higher levels of well-being and health.

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Chapter 7: Conclusion

The general health of women with breast cancer history appeared to be worse than that of women without breast cancer history. Although demographic and psychological profiles of women did not vary based on breast cancer history status, BMI, and daily medication use was higher among women with breast cancer history. Faster stress recovery was observed for women without breast cancer history in intervention trials than in trials without the intervention. Depressive symptoms were important to understanding the physiological response of women throughout the experiment. Through exploratory analyses models of combined physical and psychological factors predictive of stress recovery were identified. Major findings of the hypotheses accepted in this study are summarized in Table 19.

Table 19: Accepted Study Hypotheses

Accepted Hypotheses
1a) Women had similar demographic profiles (education level, work status) independent of breast cancer history status.
1b) Women with breast cancer history had higher BMIs than women without breast cancer history.
1c) Women with breast cancer history reported more daily medication use than women without breast cancer history.
1f) Women with breast cancer history who reported more depressive symptoms had more evidence of baseline stress than women without breast cancer history who reported more depressive symptoms.
2b) Higher levels of depressive symptoms were associated with less stress reactivity without the intervention.
2c) Higher levels of depressive symptoms were associated with slower stress recovery without the intervention.
2d) Faster stress recovery was observed for women without breast cancer history during the intervention trials than during the trials without the intervention.
3a) Higher numbers of depressive symptoms were marginally associated with faster stress recovery with the intervention than without the intervention.
3b) Lower frequency of resistance exercise was marginally associated with faster stress recovery with the intervention than without the intervention.

Characteristics of women at baseline

Women with breast cancer history seemed to be affected by disease processes that required daily medication at higher rates than women who did not have breast cancer. The substrate for many chronic diseases requiring daily medication is low-level inflammation which can be initially associated with higher levels of baseline cortisol and over time can be associated with lower than average cortisol (McEwen, 1998). Women with breast cancer history had significantly lower baseline cortisol than women without breast cancer history. Correlational analyses uncovered differences between the baseline stress indices of women with depressive symptoms based on breast cancer history status. Baseline dysregulation as indicated by associations between higher cortisol and lower EDL among women with breast cancer history who reported more depressive symptoms may predispose these women to dysfunctional stress management. This pattern may be best reflected in the "Advanced Dysfunctional Hyporeactivity" graph in Figure 4. In contrast, among women without breast cancer history, depressive symptoms were associated with elevated baseline EDL but not with cortisol. The correlation with elevated EDL suggests that women without breast cancer history were maintaining a hypervigilent state as illustrated in Figure 4 in the "Dysfunctional Recovery" graph. Women reporting higher levels of depressive symptoms present with physiological patterns reflecting allostatic load (McEwen,1998). However, women with breast cancer history who report higher levels of depressive symptoms appear further progressed in the allostatic load continuum.

Evolving allostatic theory identifies cortisol and catecholamines (represented in this study as EDL) as primary mediators and inflammation as a primary effect that contributes to secondary outcomes (McEwen & Seeman, 1999). These secondary outcomes are commonly measured by biomarkers such as blood pressure, cholesterol, and glycosylated hemoglobin. These biomarkers are among indicators of

cardiovascular disease and other ubiquitous diseases like diabetes. So this study's correlational evidence that women with breast cancer history and higher levels of depressive symptoms have indications of stress at baseline, must be kept in context. Indicators from this study are minor in the context of disease outcomes. They serve only to distinguish subtle differences between women with and without breast cancer history. Evidence from this study combined with allostatic load theory suggests that women with breast cancer history and more depressive symptoms may be more vulnerable to the physiological effects of stress than women without breast cancer history.

Indeed, there were women with and without breast cancer history who fit the criterion for subthreshold depression. However, it is the concomitant disease history that may put those women with breast cancer history at greater risk for less successful aging (Vahia et al., 2010). Higher levels of daily prescription medicine use among women with breast cancer may also indicate that they experience more disease and subsequently a higher allostatic load than women without breast cancer history. BMI is also higher among women with breast cancer than it is among those without breast cancer. Higher levels of metabolically active adipose tissue are associated with higher BMIs (Veilleux et al. 2009). Cells in this tissue may sustain the stress response longer than in individuals with less adipose tissue. Together, higher BMI and depressive symptoms, may promote dysregulated stress physiology in women who have had breast cancer.

Intervention effects

The intervention showed beneficial effects for hastening stress recovery only for women without breast cancer history. Trial sequence, breast cancer status, and depressive symptoms appear to have confounded the efficacy of the intervention. Depressive symptoms were associated with low reactivity and slow EDL recovery without the intervention in women without breast cancer history. However, the intervention trials were associated with faster EDL stress recovery among women with breast cancer history who had higher numbers of depressive symptoms. Cortisol recovery was unchanged by the intervention.

Again, depressive symptoms lent insight to understanding these differential effects through correlational analysis. Stress management dysfunction was evident in women with breast cancer history as indicated by associations between breast cancer history, depressive symptoms, and stress reactivity. These women had particularly intense reactivity to the dual-task stressor which was designed to simulate the multitasking common to this cohort of young to middle-aged women. This same group appeared to be disengaged from the Stroop stressor which is not environmentally salient, but has highly challenging qualities. Cortisol was down-regulated in women with breast cancer history in the absence of the intervention. Taken together, these findings suggest both SNS and HPA dysregulation. Slow EDL recovery was associated with depressive symptoms in trials without the intervention among women without breast cancer history. With the intervention, recovery was not associated with depressive symptoms. This is a subtle indication that the intervention may have improved stress recovery among women without breast cancer history.

Women with breast cancer history and higher depressive symptoms seem to have profiles of less healthy stress reactivity and recovery than all other women in this sample. The concept of allostatic load appears to be consistent with the stress physiology of women with breast cancer history and higher

levels of depressive symptoms. Allostatic load could explain their stress profiles of apparent disengagement from a stressor that exceeds their capacity such as that represented in the "Dysfunctional hyporeactivity" graph in Figure 4 it may also explain their vigilant engagement with a stressor that has familiar qualities but requires a high level of interaction from a compromised stress system as represented in the "Dysfunctional recovery" graph. Task accuracy data, not analyzed as part of this study, may confirm this explanation. The intervention appears to have mitigated the potential long-term effects of the stress challenge that may have been expected with elevated cortisol levels.

Models of physiological recovery and characteristics of those who benefitted from the intervention

Exploratory post-hoc models of stress recovery identified key variables for future study. Cardiovascular exercise frequency, the number of daily medications, and autonomy predicted 20.5% of the cortisol recovery variance in the intervention trials while 21% of cortisol recovery without the intervention was determined by breast cancer history status, positive relations with others, and autonomy. EDL recovery models provided different information. Resistance exercise frequency predicted 9.4% of the variance in EDL recovery with the intervention. The EDL recovery model for trials without the intervention was not significant.

Those who benefitted from the intervention appear to be those in greatest need for an intervention as demonstrated by lower levels of participation in resistance exercise and higher numbers of depressive symptoms. Less participation in resistance exercise may address one underlying mechanism of the intervention. The intentional low intensity of this isometric resistance intervention is logically insufficient to significantly modulate the physiology of women who regularly perform resistance exercise. However, more depressive symptoms and fewer positive relationships with others are notable. Depressive symptoms were linked with dysregulated stress modulation and well-being was negatively correlated with depressive symptoms elsewhere in this report. In fact, the negative correlation between positive relations with others and depressive

symptoms was the strongest among all of the well-being subscales. Allostatic load in the group that experienced faster recovery with the intervention would be expected to be higher relative to the group who did not benefit from the intervention through connections made in the Chapter 5 discussion. Earlier, it was reported that cortisol recovery was not affected by the intervention. Therefore, significant benefits of the intervention may be an inept title for these findings. Rather, these comparisons were purely based on relative rather than significantly different recovery cortisol values. Profiles of women who had faster recovery in the intervention had higher total well-being. Two sub-scales, autonomy and purpose in life, were particularly salient. The most likely explanation for women with higher well-being to have experienced faster stress recovery was that they indeed did have higher levels of health and well-being. It is unlikely that they benefitted appreciably from the intervention. Correlational analysis reported previously lends additional support to this understanding of stress recovery.

Resistance exercise frequency was predictive both in the EDL model and as a characteristic identified through comparing women who did to those who did not benefit from the intervention. Cortisol recovery was predicted by a model that reflected poorer health and exercise frequency. The intervention appears to benefit those who have lower levels of health and exercise participation thereby providing an alternative means of managing stress for those with apparent barriers to higher levels of exercise participation.

Conclusion

The breast cancer experience ripples yet in the bodies of women participating in this study. By this study's overt measures, women who have had breast cancer do not stand out in most physiological, psychological or stress response characteristics from women who have not shared the breast cancer experience. Indeed, before breast cancer these two groups of women were likely quite similar. Because of these similarities, women with breast cancer history may desire patterns of occupation that are similar to women without breast cancer history. These women, like those studied by Zebrak and colleagues, seem positively engaged in life (2007). However, a negative parallel in health and well-being is also

emerging from the women in this study. Women with breast cancer history who report higher levels of depressive symptoms appear to have more allostatic load than all other women in this study. These women may have been fundamentally, albeit subtly, changed by their breast cancer. The brief isometric exercise intervention introduced in this study interacted with depressive symptoms to differentiate women with breast cancer history from those without breast cancer history. The prevention of depression may be of particular importance to the health and well-being of women who have had breast cancer. An intervention that is brief, involves physical activity and has the potential to alter physiological state holds promise for altering the effect that the environment has on women with breast cancer history. This intervention may support their healthy engagement in meaningful occupations.

Limitations

This study was limited by a within-subjects design because of the potential for practice and carryover effects. However, this design was selected to best reveal intervention rather than inter-subject variability (Portney & Watkins, 2000). Randomizing the presentation of the intervention to the first or second laboratory visit and randomizing presentation screens imbedded in the stressors attempted to counterbalance practice and carryover effects. The design also minimized the environmental validity of the study. Controlling internal experimental validity by conducting the stress challenge in a laboratory was prioritized because of the novelty of the intervention.

The external validity of this study's findings was limited by using a convenience sampling strategy. Recruiting women for a stress intervention study may have biased the sample of women in the comparison group without cancer history toward those who were currently experiencing stress. Women with breast cancer history who enrolled in this study may have been higher functioning than women who did not respond to recruitment efforts. Although attempts were made to minimize recruitment bias and to oversample ethnic minority populations, the sample is comprised primarily of well-educated Caucasian

women. The breast cancer history sample was drawn both from the general community and cancer-specific organizations to minimize the effect of targeting only women already socially connected with the cancer community.

Intervention efficacy may have been biased by the researcher's decision to allow women to continue taking daily medications. Although individuals who required orally ingested steroids were excluded from participation due to the effect of these substances on HPA functioning, most other women qualified for inclusion. The rationale for including women in the control group of women without breast cancer history was to provide a reasonable comparison for the women who had breast cancer history. Medication use among women is unfortunately ubiquitous.

Finally, this study was limited by sample size. Although recruitment attempts were comprehensive, finding women in whom breast cancer was diagnosed prior to menopause who were interested and able to participate in this study was very challenging. However, a larger sample is essential to future studies because stress research is complicated by individual variability. Larger numbers of participants would allow larger groupings of response patterns for further analysis.

Strategies employed to counteract this study's limitations in design, recruitment, and sample were successful in optimizing internal validity. The findings are trustworthy although they have limited external validity due primarily to small sample size and the homogeneity of participants.

Future directions

The current study provided initial evidence about a novel, simple stress intervention. Preliminary evidence suggests that women who exercise less, take daily prescription medicine, and experience lower levels of well-being may benefit most from this isometric protocol. Along with providing answers to

specific questions set forth in this study, the analyses embedded in each chapter raised questions for future inquiry.

The demographics of participants in this study were limited to those who volunteered for the study in the area surrounding Madison Wisconsin. African American women were not well represented despite deliberate outreach attempts through formal and informal networks of African American women. The second wave of Midlife Development in the U.S. (MIDUS) data collection includes 592 African Americans from Milwaukee Wisconsin. Describing the impact of cancer on African American women in this dataset could provide evidence to best target the population represented by this group who would have theoretically higher levels of allostatic load than the women represented in the current study.

Evidence would certainly be strengthened by testing the intervention with greater numbers of participants. Women with breast cancer history were the focus of the current study because of the researcher's previous experience with the clinical population and the scholarly suspicion that this group would demonstrate evidence of higher allostatic load than their counterparts without breast cancer history. However, refocusing future studies on a well population would enhance recruitment numbers and build a body of evidence more rapidly. Information gathered through a larger study, would inform future study of populations perceived to carry higher allostatic load such as women as they are at greatest risk of poor health outcomes. A well-informed study of women with breast cancer history could then be undertaken.

Greater numbers of participants would inform models of intervention benefit. Future modeling efforts should include both linear and logistical regression methods with effect size calculations based on the results of this study. Data collected, but not analyzed for this study, will be considered for inclusion in future analyses. Variables which may have some bearing on the effects of the intervention include medication class, cardiac data, Sympathetic Nervous System Assessment Scale, Brief Stress

Interview, and the Canadian Occupational Performance Measure. Relationships of these measures with allostatic load will be explored as they arise in the data.

Finally, several potential small future studies are of interest. The first study of interest would be a case involving twins, one twin who had breast cancer history and the other who did not. The next study would compare African American and Hispanic women to Caucasian and Asian women. In preliminary analyses, these groups appeared to cluster and would be the topic of a small descriptive study. A single case of cancer recurrence approximately a year following data collection for this study is also of interest for insights into physiological stress functioning at this metabolically sensitive time. Finally, questions particular to the women with breast cancer history should be explored to determine if pilot studies are appropriate focusing on cancer stage, years since diagnosis, lymphedema, sleep disturbance, fatigue, or depressive symptoms. This is a rich data set with many analytical possibilities. Numerous descriptive studies are possible and of future exploratory interest.

Appendix A

Telephone Participant Screening Tool and Visit Log

Name	Address (Street, Phone, and e-mail)	Cancer Free?	Significant Untreated Medical Conditions (Ex: Hypertension, Diabetes)	Not Pregnant	Not Taking Beta Blocking Medication (for hypertension or migraines)	Not taking steroids autoimmune	Participant Number	Lab Visit 1 Date	Lab Visit 2 Date	Phone Follow-up Date

Appendix B

Lab Visit Activity Log

Did you have a typical night's sleep last night? Yes □
No □ How was your night different than usual? _____

Since awakening today, have you…….

	Yes When	Type Amount	No	Never
…had caffeine?				
…taken medications?				
…performed exercise?				
…smoked?				

How did you get to the lab today?

How many minutes?

Walk _____

Bike _____

Bus _____

Drive _____

Appendix C

Please check boxes or write in requested information. We will review this form with you and answer any questions at our first meeting. Thank you.

Date of Birth __/___/___	**Race (please list) _____**	**Age at diagnosis____ ___**
Members of your household	**Relationship** ***Spouse/*** ***Partner Yes*** **□ *No* □** ***Children Yes*** **□ *No* □** ***Other family Yes*** **□ *No* □** ***Friend/*** ***roommate Yes*** **□ *No* □**	**Age (s)** **____, ____, _____, ____**
Education	**High School Graduate □** **Some College □**	**College Graduate □** **Graduate Degree □**
Breast Cancer History	**Yes □**	**No □ Skip to Medical section**
Diagnosis Date	**_____ _____**	
Tumor	**_____**	

Appendix C

Stage and Type	**_____**	
Treatment		
Surgery		
Mastectomy	**Yes □ No □**	**Date _____**
	Yes □ No □	**Date _____**
Lumpectomy	**Yes □ # (+ nodes)_____**	**Date _____**
Lymph node Dissection	**No □**	
	Yes □ No □	**Dates _____, _____**
Reconstruction		
Radiation	**Yes □ No □**	**Date Complete _____**
Chemotherapy	**Yes □ No □**	**Date Complete _____**
Hormone therapy - maintenance	**Yes □ No □**	**Date Start _____** **Date End _____**

Appendix C

Do you have current side-effects of your cancer treatment?	**Yes □ No □**	**Current side-effects**
Do you have ongoing swelling on the side of your cancer (arm/hand/breast)?	**Yes □ No □**	**Details**
Can you use the arm/hand on the side of your cancer to do all that you want to do?	**Yes □ No □**	**Details**
Medical Conditions	**Height_____**	**Weight_____**

Appendix C

Usual Blood Pressure	**High Blood Pressure** □	**Heart Attack** □
____/_____	**Arrhythmia**	**Blood clot** □
Usual Heart Rate_____	**Heart Beat fast** □	**Cardiovascular Disease** □
	Heart Beat Slow □	**Stroke** □
	Heart Beat Irregular □	
Diabetes □	**Thyroid disorder** □	**High cholesterol** □
Kidney Disease □	**Adrenal Insufficiency** □	

Appendix C

Respiratory Condition □

_____

_____

Autoimmune Condition □

_____

_____

Arthritis □

Type_____

_____

Sites_____

_____

Osteoporosis □

Gastrointestinal □

_____

_____

Reproductive □

Surgery_____

_____

Menopausal Status

Pre □ **Menopausal**

Peri □ **Menopausal**

□ **Menopausal**

Neurological Condition □

Appendix C

Headaches
□

Allergies
□

_____

_____

_____

Mental Illness
□

Depression
□

Anxiety
□

Other
_____

_

Medications – Prescribed	**Condition Treating**	**Time(s) of Day Taken**

Appendix C

Medications and Supplements - Over the Counter	**Do you take this every day?**	**Time(s) of Day Taken**
	Yes □ No □	
	Yes □ No □	
	Yes □ No □	
	Yes □ No □	
	Yes □ No □	
	Yes □ No □	
Lifestyle	**Do you use this every day?**	**Time(s) of Day Used**
Caffeinated drinks	**Yes □ No □**	
Tobacco	**Yes □ No □**	
Alcohol	**Yes □ No □**	
Sleep	**Do you have frequent problems with sleep?**	**How long have you had these problems?**
	Yes □ No □	

Appendix C

Activity

Average Daily activity level	**Please check 1** **Sedentary** □…….. **Light** □……. **Moderate** □…….. **Heavy** □……..	**Do you work outside of your home?** **Yes** □ **No** □ **If yes, what is your job title?** _____ _____
Cardiovascular	**None** □ **Walking** □ **Running** □ **Biking** □ **Swimming** □ **Class** □ **Other**_____ _____	**0** □ **1 or 2** □ **3 – 5** □ **More than 5** □
Resistance	**Weight lifting** □	**0** □

Appendix C

	Resistance Bands □ **Other_____ _____**	**1** □ **2** □ **3 or more** □
Other Exercise (Classes,	**Pilates** □ **Spin** □ **Yoga** □	**0** □ **1 or 2**

Please include any other information that you think would be helpful.

Thank you very much for completing this questionnaire.

Appendix D

The following set of questions deals with how you feel about yourself and your life. Please remember that there are no right or wrong answers.

Circle the number that best describes your present agreement or disagreement with each statement.	Strongly Disagree	Disagree Somewhat	Disagree Slightly	Agree Slightly	Agree Somewhat	Strongly Agree
1. Most people see me as loving and affectionate.	1	2	3	4	5	6
2. Sometimes I change the way I act or think to be more like those around me.	1	2	3	4	5	6
3. In general, I feel I am in charge of the situation in which I live.	1	2	3	4	5	6
4. I am not interested in activities that will expand my horizons.	1	2	3	4	5	6
5. I feel good when I think of what I've done in the past and what I hope to do in the future.	1	2	3	4	5	6
6. When I look at the story of my life, I am pleased with how things have turned out.	1	2	3	4	5	6
7. Maintaining close relationships has been difficult and frustrating for me.	1	2	3	4	5	6
8. I am not afraid to voice my opinions, even when they are in opposition to the opinions of most people.	1	2	3	4	5	6
9. The demands of everyday life often get me down.	1	2	3	4	5	6
10. In general, I feel that I continue to learn more about myself as time goes by.	1	2	3	4	5	6
11. I live life one day at a time and don't really think about the future.	1	2	3	4	5	6
12. In general, I feel confident and positive about myself.	1	2	3	4	5	6
13. I often feel lonely because I have few close friends with whom to share my concerns.	1	2	3	4	5	6
14. My decisions are not usually influenced by what everyone else is doing.	1	2	3	4	5	6

Appendix D

Circle the number that best describes your present agreement or disagreement with each statement.	Strongly Disagree	Disagree Somewhat	Disagree Slightly	Agree Slightly	Agree Somewhat	Strongly Agree
15. I do not fit very well with the people and the community around me.	1	2	3	4	5	6
16. I am the kind of person who likes to give new things a try.	1	2	3	4	5	6
17. I tend to focus on the present, because the future nearly always brings me problems.	1	2	3	4	5	6
18. I feel like many of the people I know have gotten more out of life than I have.	1	2	3	4	5	6
19. I enjoy personal and mutual conversations with family members or friends.	1	2	3	4	5	6
20. I tend to worry about what other people think of me.	1	2	3	4	5	6
21. I am quite good at managing the many responsibilities of my daily life.	1	2	3	4	5	6
22. I don't want to try new ways of doing things - my life is fine the way it is.	1	2	3	4	5	6
23. I have a sense of direction and purpose in life.	1	2	3	4	5	6
24. Given the opportunity, there are many things about myself that I would change.	1	2	3	4	5	6
25. It is important to me to be a good listener when close friends talk to me about their problems.	1	2	3	4	5	6
26. Being happy with myself is more important to me than having others approve of me.	1	2	3	4	5	6
27. I often feel overwhelmed by my responsibilities.	1	2	3	4	5	6
28. I think it is important to have new experiences that challenge how you think about yourself and the world.	1	2	3	4	5	6
29. My daily activities often seem trivial and unimportant to me.	1	2	3	4	5	6
30. I like most aspects of my personality.	1	2	3	4	5	6
31. I don't have many people who want to listen when I need to talk.	1	2	3	4	5	6

Appendix D

Circle the number that best describes your present agreement or disagreement with each statement.	Strongly Disagree	Disagree Somewhat	Disagree Slightly	Agree Slightly	Agree Somewhat	Strongly Agree
32. I tend to be influenced by people with strong opinions.	1	2	3	4	5	6
33. If I were unhappy with my living situation, I would take effective steps to change it.	1	2	3	4	5	6
34. When I think about it, I haven't really improved much as a person over the years.	1	2	3	4	5	6
35. I don't have a good sense of what it is I'm trying to accomplish in life.	1	2	3	4	5	6
36. I made some mistakes in the past, but I feel that all in all everything has worked out for the best.	1	2	3	4	5	6
37. I feel like I get a lot out of my friendships.	1	2	3	4	5	6
38. People rarely talk me into doing things I don't want to do.	1	2	3	4	5	6
39. I generally do a good job of taking care of my personal finances and affairs.	1	2	3	4	5	6
40. In my view, people of every age are able to continue growing and developing.	1	2	3	4	5	6
41. I used to set goals for myself, but that now seems like a waste of time.	1	2	3	4	5	6
42. In many ways, I feel disappointed about my achievements in life.	1	2	3	4	5	6
43. It seems to me that most other people have more friends than I do.	1	2	3	4	5	6
44. It is more important to me to "fit in" with others than to stand alone on my principles.	1	2	3	4	5	6
45. I find it stressful that I can't keep up with all of the things I have to do each day.	1	2	3	4	5	6
46. With time, I have gained a lot of insight about life that has made me a stronger, more capable person.	1	2	3	4	5	6
47. I enjoy making plans for the future and working to make them a reality.	1	2	3	4	5	6
48. For the most part, I am proud of who I am and the life I lead.	1	2	3	4	5	6

Appendix D

Circle the number that best describes your present agreement or disagreement with each statement.	Strongly Disagree	Disagree Somewhat	Disagree Slightly	Agree Slightly	Agree Somewhat	Strongly Agree
49. People would describe me as a giving person, willing to share my time with others.	1	2	3	4	5	6
50. I have confidence in my opinions, even if they are contrary to the general consensus.	1	2	3	4	5	6
51. I am good at juggling my time so that I can fit everything in that needs to be done.	1	2	3	4	5	6
52. I have a sense that I have developed a lot as a person over time.	1	2	3	4	5	6
53. I am an active person in carrying out the plans I set for myself.	1	2	3	4	5	6
54. I envy many people for the lives they lead.	1	2	3	4	5	6
55. I have not experienced many warm and trusting relationships with others.	1	2	3	4	5	6
56. It's difficult for me to voice my own opinions on controversial matters.	1	2	3	4	5	6
57. My daily life is busy, but I derive a sense of satisfaction from keeping up with everything.	1	2	3	4	5	6
58. I do not enjoy being in new situations that require me to change my old familiar ways of doing things.	1	2	3	4	5	6
59. Some people wander aimlessly through life, but I am not one of them.	1	2	3	4	5	6
60. My attitude about myself is probably not as positive as most people feel about themselves.	1	2	3	4	5	6
61. I often feel as if I'm on the outside looking in when it comes to friendships.	1	2	3	4	5	6
62. I often change my mind about decisions if my friends or family disagree.	1	2	3	4	5	6
63. I get frustrated when trying to plan my daily activities because I never accomplish the things I set out to do.	1	2	3	4	5	6
64. For me, life has been a continuous process of learning, changing, and growth.	1	2	3	4	5	6

Appendix D

Circle the number that best describes your present agreement or disagreement with each statement.	Strongly Disagree	Disagree Somewhat	Disagree Slightly	Agree Slightly	Agree Somewhat	Strongly Agree
65. I sometimes feel as if I've done all there is to do in life.	1	2	3	4	5	6
66. Many days I wake up feeling discouraged about how I have lived my life.	1	2	3	4	5	6
67. I know that I can trust my friends, and they know they can trust me.	1	2	3	4	5	6
68. I am not the kind of person who gives in to social pressures to think or act in certain ways.	1	2	3	4	5	6
69. My efforts to find the kinds of activities and relationships that I need have been quite successful.	1	2	3	4	5	6
70. I enjoy seeing how my views have changed and matured over the years.	1	2	3	4	5	6
71. My aims in life have been more a source of satisfaction than frustration to me.	1	2	3	4	5	6
72. The past had its ups and downs, but in general, I wouldn't want to change it.	1	2	3	4	5	6
73. I find it difficult to really open up when I talk with others.	1	2	3	4	5	6
74. I am concerned about how other people evaluate the choices I have made in my life.	1	2	3	4	5	6
75. I have difficulty arranging my life in a way that is satisfying to me.	1	2	3	4	5	6
76. I gave up trying to make big improvements or changes in my life a long time ago.	1	2	3	4	5	6
77. I find it satisfying to think about what I have accomplished in life.	1	2	3	4	5	6
78. When I compare myself to friends and acquaintances, it makes me feel good about who I am.	1	2	3	4	5	6
79. My friends and I sympathize with each other's problems.	1	2	3	4	5	6
80. I judge myself by what I think is important, not by the values of what others think is important.	1	2	3	4	5	6

Appendix D

Circle the number that best describes your present agreement or disagreement with each statement.	Strongly Disagree	Disagree Somewhat	Disagree Slightly	Agree Slightly	Agree Somewhat	Strongly Agree
81. I have been able to build a home and a lifestyle for myself that is much to my liking.	1	2	3	4	5	6
82. There is truth to the saying that you can't teach an old dog new tricks.	1	2	3	4	5	6
83. In the final analysis, I'm not so sure that my life adds up to much.	1	2	3	4	5	6
84. Everyone has their weaknesses, but I seem to have more than my share.	1	2	3	4	5	6

Appendix E

Center for Epidemiologic Studies Depression Scale (CES-D), NIMH

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

	During the Past Week			
	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a Moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me.	☐	☐	☐	☐
2. I did not feel like eating; my appetite was poor.	☐	☐	☐	☐
3. I felt that I could not shake off the blues even with help from my family or friends.	☐	☐	☐	☐
4. I felt I was just as good as other people.	☐	☐	☐	☐
5. I had trouble keeping my mind on what I was doing.	☐	☐	☐	☐
6. I felt depressed.	☐	☐	☐	☐
7. I felt that everything I did was an effort.	☐	☐	☐	☐
8. I felt hopeful about the future.				
9. I thought my life had been a failure.	☐	☐	☐	☐
10. I felt fearful.	☐	☐	☐	☐
11. My sleep was restless.	☐	☐	☐	☐
12. I was happy.	☐	☐	☐	☐
13. I talked less than usual.	☐	☐	☐	☐
14. I felt lonely.	☐	☐	☐	☐
15. People were unfriendly.	☐	☐	☐	☐
16. I enjoyed life.	☐	☐	☐	☐
17. I had crying spells.	☐	☐	☐	☐
18. I felt sad.	☐	☐	☐	☐
19. I felt that people dislike me.	☐	☐	☐	☐
20. I could not get "going."	☐	☐	☐	☐

SCORING: zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.

Appendix F

Sympathetic Nervous System Arousal Scale

Right now, I feel...	Strongly disagree	disagree	agree	Strongly agree
1. like I can't do anything (frozen)	1	2	3	4
2. like I'm super aware of everything around me	1	2	3	4
3. like I usually do	1	2	3	4
4. like running away	1	2	3	4
5. my muscles tense	1	2	3	4
6. my heart pounding	1	2	3	4
7. like there are butterflies in my stomach	1	2	3	4
8. like hitting something	1	2	3	4
9. relaxed	1	2	3	4
10. my head ache	1	2	3	4

Appendix G

CANADIAN OCCUPATIONAL PERFORMANCE MEASURE

Authors:
Mary Law, Sue Baptiste, Anne Carswell,
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The Canadian Occupational Performance Measure (COPM) is an individualized measure designed for use by occupational therapists to detect self-perceived change in occupational performance problems over time.

Client Name:		
Age:	Gender:	ID#:
Respondent (if not client):		
Date of Assessment:	Planned Date of Reassessment:	Date of Reassessment:

Therapist:
Facility/Agency:
Program:

Published by CAOT Publications ACE
Printed in Canada

Appendix G

STEP 1:
IDENTIFICATION OF OCCUPATIONAL PERFORMANCE ISSUES

To identify occupational performance problems, concerns and issues, interview the client, asking about daily activities in self-care, productivity and leisure. Ask clients to identify daily activities which they want to do, need to do or are expected to do by encouraging them to think about a typical day. Then ask the client to identify which of these activities are difficult for them to do now to their satisfaction. Record these activity problems in Steps 1A, 1B, or 1C.

STEP 2:
RATING IMPORTANCE

Using the scoring card provided, ask the client to rate, on a scale of 1 to 10, the importance of each activity. Place the ratings in the corresponding boxes in Steps 1A, 1B, or 1C.

STEP 1A: Self-care

IMPORTANCE

Personal Care
(e.g., dressing, bathing, feeding, hygiene)

Functional Mobility
(e.g., transfers, indoor, outdoor)

Community Management
(e.g., transportation, shopping, finances)

STEP 1B: Productivity

Paid/Unpaid Work
(e.g., finding/keeping a job, volunteering)

Household Management
(e.g., cleaning, laundry, cooking)

Play/School
(e.g., play skills, homework)

Appendix G

STEP 1C: Leisure

		IMPORTANCE
Quiet Recreation (e.g., hobbies, crafts, reading)		
Active Recreation (e.g., sports, outings, travel)		
Socialization (e.g., visiting, phone calls, parties, correspondence)		

STEPS 3 & 4: SCORING - INITIAL ASSESSMENT and REASSESSMENT

Confirm with the client the 5 most important problems and record them below. Using the scoring cards, ask the client to rate each problem on performance and satisfaction, then calculate the total scores. Total scores are calculated by adding together the performance or satisfaction scores for all problems and dividing by the number of problems. At reassessment, the client scores each problem again for performance and satisfaction. Calculate the new scores and the change score.

Initial Assessment:			**Reassessment:**	
OCCUPATIONAL PERFORMANCE PROBLEMS:	PERFORMANCE 1	SATISFACTION 1	PERFORMANCE 2	SATISFACTION 2
1.				
2.				
3.				
4.				
5.				
SCORING:	PERFORMANCE SCORE 1	SATISFACTION SCORE 1	PERFORMANCE SCORE 2	SATISFACTION SCORE 2
Total score = Total performance or satisfaction scores / # of problems	/ =	/ =	/ =	/ =

CHANGE IN PERFORMANCE = Performance Score 2 [ ] – Performance Score 1 [ ] = [ ]

CHANGE IN SATISFACTION = Satisfaction Score 2 [ ] – Satisfaction Score 1 [ ] = [ ]

Appendix G

ADDITIONAL NOTES AND BACKGROUND INFORMATION

Initial Assessment:

Reassessment:

Appendix H

Brief Stress Questionnaire

Please complete the sentences based on your first reaction. You will have 5 minutes to complete the questionnaire. Try to complete all items. We will discuss your responses and clarify items as necessary.

Please circle the number that describes your stress level right now									
Low									High
1	2	3	4	5	6	7	8	9	10

When I have a conflict with my spouse/partner, This item does not apply to me □

I feel _____.

I do _____.

After I do _____, I feel _____.

Please circle the number that describes your ability to quickly (within a few minutes) move on to your next activity									
Low									High
1	2	3	4	5	6	7	8	9	10

Please circle the number that describes your stress level right now									
Low									High
1	2	3	4	5	6	7	8	9	10

Appendix H

When I have a conflict with my children, This item does not apply to me □

I feel _____.

I do _____.

After I do _____, I feel _____.

Please circle the number that describes your ability to quickly (within a few minutes) move on to your next activity									
Low									High
1	2	3	4	5	6	7	8	9	10

Please circle the number that describes your stress level right now									
Low									High
1	2	3	4	5	6	7	8	9	10

Appendix H

When I have a conflict with a coworker or superior, This item does not apply to me □

I feel _____.

I do _____.

After I do _____, I feel _____.

Please circle the number that describes your ability to quickly (within a few minutes) move on to your next activity									
Low									High
1	2	3	4	5	6	7	8	9	10

Please circle the number that describes your stress level right now									
Low									High
1	2	3	4	5	6	7	8	9	10

Appendix H

When I have a conflict with a health care provider, This item does not apply to me □

I feel _____.

I do _____.

After I do _____, I feel _____.

Please circle the number that describes your ability to quickly (within a few minutes) move on to your next activity

Low High

1 2 3 4 5 6 7 8 9 10

Please circle the number that describes your stress level right now

Low High

1 2 3 4 5 6 7 8 9 10

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