Feeling stressed? Emotions, stress, and the moderating role of physical activity in women treated for breast cancer

by

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Abstract

Diagnosis and treatment for cancer may increase experiences of stress among breast cancer survivors (BCS) by sensitizing individuals to changes in body image. Body-related self-conscious emotions may be modifiable sources of such stress, and moderate-to-vigorous physical activity (MVPA) may moderate this association. This study examined these associations using an experience sampling method. Twenty women provided measures of body-related emotions and psychological stress six times per day for seven days, and wore accelerometers to measure MVPA. Multilevel modeling was used to test for day-level time-varying predictors of psychological stress. Within-person daily variability in body-related guilt positively predicted within-person daily variability in stress. Body-related shame and pride were not significant predictors of stress and MVPA did not moderate the effect. The time by MVPA interaction with psychological stress was significant. Based on these results, body-related emotions and MVPA are important to target in interventions committed to reducing BCS' experiences of psychological stress.

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Preface

The Research Ethics Board at the University of Toronto granted ethics approval for this study (Protocol Reference #: 32897). This research was funded by a Canada Graduate Scholarship – Masters: Social Sciences and Humanities Research Council of Canada (SSHRC) and by a Canadian Institute of Health Research (CIHR) operating grant.

Chapter 1
Introduction

1 Introduction

Breast cancer is the most common cancer diagnosis among women, with one in eight Canadian women being diagnosed with breast cancer in her lifetime (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017). Due to advancements in cancer detection and treatment, survival rates from breast cancer have improved considerably, contributing to a large population of women who are living in the aftermath of breast cancer (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017). There are multiple definitions of a cancer survivor, and the following will be adopted for this research: a cancer survivor is an individual who had a cancer diagnosis and has completed primary cancer treatment (Courneya & Friedenreich, 2007). Moreover, the survivorship period refers to the time period following primary cancer treatment until end of life (Courneya & Friedenreich, 2007).

Survivorship is often associated with physical and emotional stress that lingers long after diagnosis and completion of treatment (Andrykowski, Lykins, & Floyd, 2008). For example, cancer survivors experience 1.5 times more stress than the general population, which is partly elicited by the changes to one's body as a result of cancer and it's treatment (Zabora, Brintzenhofeszoc, Curbow, Hooker, & Piantadosi, 2001; Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005; White, 2012). Increases in stress have been shown to elicit the hypothalamic pituitary adrenal (HPA) axis whereby the hormone cortisol is circulated throughout the body (Kemeny, 2003; Dickerson & Kemeny, 2004). The activation of cortisol is adaptive in short-term experiences, however when stressors persist, exposure may become maladaptive and lead to chronic stress (Kemeny, 2003). Chronic stress has been associated with negative health outcomes in healthy adults such as decreased immune function and acceleration of chronic diseases (e.g., cardiovascular disease; Kemeny, 2003). Given these negative implications, it is important to understand stress, especially in populations such as breast cancer survivors who may have experienced and continue to manage stress related to their cancer diagnosis, treatment, and survivorship.

Given that heightened stress among women treated for breast cancer is in part due to changes to the body (White, 2012), stress related to the body might be an important target as it may be modifiable with focused interventions. Body-related self-conscious emotions such as shame and guilt have been associated with stress in healthy women (Dickerson & Kemeny, 2004; Lazarus, 1999; Gruenewald, Kemeny, Aziz, & Fahey, 2004), yet they have not been studied among women treated for breast cancer. Body-related shame is a self-conscious emotion that occurs when an individual has a negative evaluation of their *global* self (Lewis, 1993; Tangney, 1998). Body-related guilt is a negative self-conscious emotion that occurs when an individual has a negative evaluation of his/her *behaviour* (Lewis, 1993; Tangney, 1998). Shame and guilt have been associated with depression, anxiety, and decreased self-esteem in the general adult population (Ashby, Rice, & Martin, 2006; Bessenoff & Snow, 2006; Bybee & Quilres, 1998; Lewis, 1971). However, since guilt is both negative but can also motivate reparative action, guilt has been associated with healthy behaviours such as adhering to a medical regimen (Lewis, 1993; Tangney, 1998; Bybee & Quiles, 1998). Alternatively, body-related pride is a self-conscious emotion that occurs when an individual has a positive evaluation of a behaviour or characteristic (Tracy & Robins, 2007; Fischer & Tangney, 1995). Drawing on global emotion literature, pride is associated with greater self-esteem and adaptive and prosocial outcomes such as volunteering (Williams & DeSteno, 2008). As such, body-related self-conscious emotions may present differential relationships with stress; shame may be associated with higher stress, guilt may be associated with higher or lower stress, and pride may be associated with lower stress (Tangney & Tracy, 2012; Dickerson & Kemeny, 2004). Women may experience differing levels of emotions and stress across days. Furthermore, given that both emotions and stress are affected quickly by situations and events, it is important to study these associations multiple times a day when specific emotions are experienced as fluctuations may occur over time. Little is known about how self-conscious emotions change within one day and across days.

Based on self-objectification theory, the internalization of feminine appearance ideals elicit body-related self-conscious emotions including body shame, which may in turn lead to maladaptive behaviours (Fredrickson & Roberts, 1997). Moreover, social self-preservation theory (Kemeny, Gruenewald, & Dickerson, 2004; Dickerson, Gruenewald, & Kemeny, 2004) posits that threats to one's social status may elicit psychological (i.e., emotions) and physiological (i.e., stress) outcomes. Given the premise of these theories, women treated for

breast cancer may be at risk for self-objectification and social threats, which could lead to increased stress. Therefore, understanding the relationship between emotions and stress is integral to understanding overall health and wellbeing among women treated for breast cancer, and identifying any modifiable factors that could mitigate this relationship is valuable in order to attempt to reduce stress. Furthermore, this agenda is extremely important since an increase in stress has been associated with physical and mental health disturbances, as well as an increased risk of cancer recurrence and mortality (Demark-Wahnefried et al., 2005; Cohen, Janicki-Deverts, & Miller, 2007; Sephton, Sapolsky, Kraemer, & Spiegel, 2000). Clearly, breast cancer survivors are a unique population requiring intervention strategies targeted at reducing body-related challenges and stress.

Physical activity may affect the relationship between body-related self-conscious emotions and stress. There is a multitude of benefits in relation to physical activity and it is an effective approach in decreasing negative emotions and stress in healthy adults (Guszkowska, 2004; Callaghan, 2004; McEwen, 1998). Specifically, physical activity has been associated with body-related self-conscious emotions (Castonguay, Wrosch, Pila, & Sabiston, 2017; Pila, Stamiris, Castonguay, & Sabiston, 2014; Sabiston et al., 2010) and correlates of stress in cancers survivors (e.g., Bélanger, Plotnikoff, Clark, & Courneya, 2012; Sabiston & Brunet, 2012; Brunet, Love, Ramphal, & Sabiston, 2014). Yet, researchers associating physical activity and body-related emotions have used self-report measures for assessing time spent in physical activity (e.g., Castonguay, Wrosch, & Pila, et al., 2017; Sabiston et al., 2010). Given the limitations of self-report measures, the present work will extend these findings by using an objective measure of physical activity. Relatedly, physical activity has been associated with reductions in stress and stress outcomes including depression among cancer survivors (e.g., Belanger et al., 2012; Sabiston & Brunet, 2012; Sylvester, Ahmed, Amireault, & Sabiston, 2017). In spite of the positive benefits of physical activity, the initiation of a physical activity program could facilitate negative body-related self-conscious emotions and stressful experiences in women treated for breast cancer. For example, the presence of others during physical activity provides an opportunity for social comparison, which could highlight body-related emotions (Gruenewald et al., 2004). Moreover, new physical activity experiences can heighten negative emotions (Kirschbaum & Hellhammer, 1989). However, the ongoing participation in physical activity may increase positive body-related emotions and decrease negative body-related emotions and stress.

In particular, low levels of physical activity may perpetuate the relationship between body-related self-conscious emotions and stress (Demark-Wahnefried & Jones, 2008), while high levels of physical activity may show protective benefits in the relationship between body-related self-conscious emotions and stress.

1.1 Purpose and Research Questions

Based on the theoretical tenets of self-objectification theory (Fredrickson & Roberts, 1997) and social self preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004), the purpose of this research was to identify body-related emotions as intrapersonal sources of psychological stress among physically active breast cancers survivors by examining: (1) the between- and within-associations (inter- and intra-individual effects) between body-related self-conscious emotions and stress, and (2) whether physical activity may moderate this relationship. These associations were studied with physically active breast cancer survivors during a seven-day period utilizing an experience sampling method (Hektner, Schmidt, & Csikszentmihalyi, 2007) to report on their experiences multiple times per day in order to uncover variation. The following research questions were proposed:

RQ1. Do body-related self-conscious emotions relate to psychological stress among breast cancer survivors?

RQ2. Does physical activity moderate the association between body-related self-conscious emotions and psychological stress?

Chapter 2
Review of Literature

2 Review of Literature

2.1 Breast cancer

Breast cancer is the most frequently diagnosed cancer in women, with one in eight Canadian women being diagnosed with breast cancer in her lifetime (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017). In Canada, an average of 72 Canadian women will be diagnosed and 14 will pass away from breast cancer every day, making breast cancer the second leading cause of cancer death in Canadian women (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017). Fortunately, with recent advances in detection and treatment, the five-year survival rate for breast cancer is currently 87% (DeFrank, Bahn Mehta, Stein, & Baker, 2007; Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017), leading to considerable increases in the breast cancer survivor population. There are many definitions of a cancer survivor, however the following will be adopted for this research: a cancer survivor is an individual who had a cancer diagnosis and has completed primary cancer treatment (Courneya & Friedenreich, 2007). As such, women diagnosed with and treated for breast cancer make up a significant segment of the Canadian population.

Breast cancer originates in the cells of the breast and creates a malignant tumor that has the possibility of spreading to other body parts (Bursein, Harris, Morrow, 2008; Foxson, Lattimer, & Felder, 2011). Breast cancer commonly occurs in the ducts that run from the glands to the nipple, and the lobules (groups of glands; Bursein et al., 2008; Foxson et al., 2011). Regardless of origination, breast cancer stage can range from in situ to stage IV: (a) in situ refers to tumors that are contained to the origination site; (b) stage I refers to an invasive tumor that is two centimeters or less in diameter; (c) stage II refers to an invasive tumor that is larger than two centimeters, but no larger than five; (d) stage III refers to an invasive tumor that is larger than five centimeters; and (e) stage IV refers to a tumor of any size that has spread to other parts of the body (Sobin, Gospodarowicz, & Wittekind, 2009). Although there are several staging algorithms, the present algorithm was adopted for this study as it is widely disseminated by the Canadian Cancer Society.

As numerous treatments for breast cancer exist, the patient and oncologist work together to select a treatment plan with consideration of factors such as stage of breast cancer, menopause status, health of the individual, and the patient's preferences as well as a number of individualized concerns (Bursein et al., 2008; Foxson et al., 2011). The most common treatment options include surgery (i.e., breast conserving surgery, single and/or double mastectomies, and axillary lymph node dissection), radiation therapy (required after breast conserving surgery), chemotherapy (usually offered for early stage breast cancer with a high recurrence risk), and hormonal therapy (usually offered for early stage breast cancer with a low recurrence risk; Bursein et al., 2008; Foxson et al., 2011). Treatment for breast cancer can have long lasting effects and may cause negative outcomes both physically (e.g., weight gain) and emotionally (e.g., changes in mood; Helms, O'Hea, & Corso, 2008; Demark-Wahnefried et al., 2005).

Following treatment, women have unique long-term health concerns specifically related to cancer survivorship (i.e., post-primary treatment until end of life; Demark-Wahnefried et al., 2005; Courneya & Friedenreich, 2007). Health concerns include an increased risk of long-term side effects (e.g., fatigue, pain, and decreased immune function), breast cancer recurrence, secondary cancers, mental and physical health comorbidity, decreases in functional abilities, and mortality (Demark-Wahnefried et al., 2005; Beisecker et al., 1997; Shapiro & Recht, 2001). Specifically, women treated for breast cancer are at increased risk of developing cardiovascular disease (Brown, Brauner, & Minnotte, 1993) and osteopenia (Ramaswamy & Shapiro, 2003). Additionally, breast cancer survivors may struggle with obesity, as weight gain has been associated with breast cancer and cancer treatment (Rock & Demark-Wahnefried, 2002; Chlebowski, Aiello, & McTiernan, 2002).

In addition to physical effects of breast cancer and its related treatment, women may experience psychological side effects from treatment including fear of recurrence, emotional distress, and mood changes (Burstein & Winer, 2000; Ward, Kuta, Sanborn, & Burt, 2003). Moreover, survivorship may present emotional support challenges for breast cancer survivors as they are no longer closely monitored by a health care team yet continue to experience difficulties navigating health choices and avoiding complications and recurrence (Sabiston & Brunet, 2012). Furthermore, women treated for breast cancer may experience distress caused by cancer and cancer treatment that may extend longer term into the survivorship period (Andrykowski et al., 2008). Thus, breast cancer survivors are a unique population who may present with increased

health risks and associated long-term distress. As such, it is important to understand this population, as elevated and persistent stress could affect their overall health and wellbeing.

2.2 Stress

Cancer diagnoses elicit greater distress than any other disease (Shapiro et al., 2001). Individuals with cancer report 1.5 times more psychological stress than the general population (Zabora et al., 2001). Research has shown that up to 80% of breast cancer patients report significant distress during primary treatment, 20-45% report psychological morbidity one to two years post-primary treatment, and 10% report severe disturbance up to six years post-primary treatment (Omne-Ponten, Holmberg, & Sjoden, 1994). Moreover, it is suggested that psychological stress influences the progression and recurrence of cancer, however more research is needed to determine the magnitude of this indication (Cohen et al., 2007). Nonetheless, stress is the most frequently reported characteristic of cancer patients; it can compromise treatment plans and decrease quality of life extending into later stages of the survivorship trajectory (Zabora et al., 2001; Andrykowski et al., 2008).

Cancer survivorship is associated with physical and emotional stress persisting long after cancer diagnosis and treatment (Andrykowski et al., 2008). Stress specific to cancer can be caused by fear of recurrence, infertility or sexual issues, financial strains related to cancer, and persisting and late effects of treatment (Andrykowski et al., 2008). Breast cancer survivors also endure body image issues as a result of changes to one's body from cancer and treatment such as breast surgery, hair loss, early menopause, and scarring, among others (Oktay, 1998; Shapiro et al., 2001; DeFrank et al., 2007). Body- and appearance-related side effects are often self-reported as more severe than chemotherapy side effects such as fatigue, insomnia, and nausea (DeFrank et al., 2007; Coates et al., 1983). Thus, the physical and psychological changes that occur during the course of cancer and in particular treatment may affect individuals into the survivorship period (Andrykowski et al., 2008). It is important to note that individual differences exist in relation to stress, as some individuals are affected more than others. For example, some survivors may recover and restore pre-stress levels, while others may never fully recover (Andrykowski et al., 2008). As such, it is critical to understand stress within women treated for breast cancer, as stress is likely not experienced uniformly.

A commonly cited definition of stress refers to the relationship between a person and their environment; “a situation that the average person would appraise as threatening and exceeding his or her ability to cope” (pp. 21; Lazarus & Folkman, 1984). Moreover, stressor has been defined as a circumstance that threatens a central goal (e.g., survival or safety; Lazarus & Folkman, 1984; Kirschbaum, Pirke, & Hellhammer, 1993). Stressors can be physical (e.g., threats to physical integrity) or psychological (e.g., threats to psychological wellbeing) in nature and can elicit physical (e.g., cortisol) and psychological (e.g., shame) responses that adjust homeostasis to enhance chances of survival (Chrousos & Gold, 1992; Kemeny, 2003).

Numerous models have been proposed to illustrate this relationship such as the generality model and the specificity model (Kemeny, 2003; Weiner, 1992). The generality model posits that stress is merely a stimulus and proposes that stressors lead to distress, which activates responding systems within the body (Kemeny, 2003). While this model does account for psychological or environmental factors that may intervene, it does not acknowledge the possibility of different types of stressors that may elicit specific physiological outcomes. And so, the specificity model, as proposed by Weiner (1992), takes into account specific stressors and individuals’ cognitive appraisals of those stressors, which then elicit a specific psychobiological response that involves emotions, motivations, and physiology (Kemeny, 2003). Alike the generality model, the specificity model also takes into account the environmental and psychological moderators (Kemeny, 2003). For example, novel threat situations may elicit negative emotional states such as anxiety and shame, motivate avoidance behaviours, and activate a coordinated physiological response. Conversely, threats that are not novel in nature may motivate action and physiological responses that foster active coping (Kemeny, 2003). As such, it is important to understand the specific moderators, as the emotional and physiological outcomes may differ depending on the available resources.

2.2.1 Stress responses

2.2.1.1 Psychological stress response

The appraisal of a stressor as threatening the achievability of a valued goal and exceeding one’s available resources can result in a psychological stress response (Cohen et al., 2007; Lazarus, 1993). Affective states including emotions are commonly elicited in response to a stressor or stressful event (Cohen et al., 2007; Dickerson, Mycek, & Zaldivar, 2008; Lazarus, 1993; Van

Eck, Nicolson, & Berkhof, 1998). Negative affect has been related to stress positively, while positive affect is negatively associated with stress (Zautra, Berkhof, & Nicolson, 2002). In terms of self-conscious emotions, shame may be elicited in response to failure; meanwhile pride is noted as a reaction towards success (Nesse & Ellsworth, 2009). These affective responses are thought to be an important factor leading to physiological responses of stress, whereby shame may in turn lead to greater physiological stress (Dickerson & Gruenewald, et al., 2004; Gruenewald et al., 2004; Kemeny et al., 2004; Van Eck et al., 1998).

2.2.1.2 Physiological stress response

Physiological systems that have been associated with stress responses include the autonomic nervous system, the hypothalamic-pituitary-adrenal (HPA) axis, and the immune system (Kemeny, 2003; McEwen, 1998). Specifically, numerous stressors that are present for short periods of time have elicited the main hormone cortisol through the HPA axis (Kemeny, 2003). Moreover, cortisol can be quickly and non-invasively measured through saliva, allowing for a convenient objective measure of stress. To release cortisol, a coordinated response occurs in various systems throughout the body in response to a real or anticipated stressor (Kemeny, 2003; Herman et al., 2003). First, when a stressful experience (stressor) is perceived in the hypothalamus, it releases corticotropin-releasing hormone (CRH). Next, CRH stimulates the anterior pituitary gland, which releases adrenocorticotropic hormone (ACTH). Finally, ACTH travels to the adrenal glands via peripheral circulation causing the adrenal cortex to release cortisol (Kemeny, 2003; Sapolsky, Romero, & Munck, 2000). This cohesive response transpires in minutes, with the peak response occurring 20 to 40 minutes post-stressor onset (Kemeny, 2003). Following the end of a stressor, cortisol returns to baseline levels in 40 to 60 minutes (Dickerson & Kemeny, 2004).

Cortisol is a stress hormone that is present in the body at varying degrees dependent upon the presence of stressful or non-stressful conditions (Herman et al., 2003). During conditions that are not perceived to be stressful, cortisol has a diurnal rhythm that peaks 20-45 minutes after awakening and then decreases throughout the day (Herman et al., 2003; Stone et al., 2001; Chida & Steptoe, 2009; Kirschbaum & Hellhammer, 1989). Alternatively, under perceived stressful conditions, cortisol is secreted in the aforementioned stress response (Kemeny, 2003; Herman et al., 2003). The release of cortisol activates certain systems, while suppressing others (Kemeny,

2003). For example, cortisol increases attention to threats, cardiovascular output, and respiration, protects from inflammation, helps with metabolism of carbohydrates and fats and the production of glucose, and alters immune functioning through the inhibition of cytokine production and innervation of lymphatic tissue (Cohen et al., 2007; Kemeny, 2003; Sapolsky et al., 2000; Kaltsas & Chrousos, 2007; Carrasco & Van de Kar, 2003; Dickerson, Kemeny, Aziz, Kim, & Fahey, 2004). Cortisol can be released by an exposure to both acute and chronic stressors (Kemeny, 2003; McEwen, 1998).

2.2.2 Chronic stress

Acute stress responses are adaptive in function, whereby cortisol normally is released several times throughout the day by means of the adrenal cortex turning on and off (Van Cauter, 1987). Acute stress responses have been associated with immune function and memory improvements (McEwen & Gianaros, 2011). However, when a stress response is recurrently activated or fails to terminate once a threat is no longer present, the response then becomes maladaptive and is termed allostatic load (Kemeny, 2003; McEwen, 1998; McEwen, 2002; Miller, Chen, & Zhou, 2007). Allostatic load refers to the toll put upon the body during chronic activation of the stress-related systems (chronic stress; Kemeny, 2003; McEwen, 1998). Specifically, four situations can generate chronic activation: (a) the presence of frequent stress; (b) the adaptation to recurrent stressors is insufficient; (c) the termination of the stress response does not occur following the end of a stressor; and (d) the responses in some stress systems are inadequate, resulting in compensatory increases in others (McEwen, 1998). Chronic stress has been associated with the reduction and abnormal levels of daily output of cortisol in combat soldiers, trauma victims, and parents of children with paediatric cancer (Bourne, Rose, & Mason, 1968; Friedman, Mason, & Hamburg, 1963; Yehuda, Resnick, Schmeidler, Yang, & Pitman, 1998). Relatedly, abnormal cortisol rhythms may also be a result of chronic stress due to cancer (McEwen, 1998). Researchers have shown that chronic stress may elicit a flattened diurnal rhythm resulting in lower cortisol levels over the course of the day; or the initial activation following chronic stress increases levels of cortisol, however after the stimulus diminishes, cortisol rebounds to below normal levels (Miller et al., 2007).

Chronic stress is thought to be severe as it may lead to long-term or permanent changes in emotional, physiological, and/or behavioural responses (Cohen, Kessler, & Gordon, 1995;

McEwen, 1998; Lopez, Akil, & Watson, 1999). This may in turn affect the vulnerability to and course of disease (McEwen, 1998; Lopez et al., 1999). In particular, chronic stress generates deleterious effects on the body and various organ systems, including atrophy in the hippocampus, impairment in growth and development, decreased immune functioning, increased susceptibility to certain mental illnesses (e.g., clinical episode of depression) and diseases (e.g., myocardial infarction and upper respiratory infections), and acceleration of chronic diseases (e.g., coronary heart disease; Kemeny, 2003; Kaltsas & Chrousos, 2007; Dickerson & Kemeny, et al., 2004; McEwen, 1998; Miller et al., 2007; Segerstrom & Miller, 2004; Raikkonen, Lassila, Keltikangas-Jarvinen, & Hautanen, 1996; Ito et al., 2004; Rozanski, Blumenthal, & Kaplan, 1999). In some cases, chronic stress has been associated with markedly increased risk (triple or quadruple) of adverse medical outcomes such as the common cold and asthma (Miller et al., 2007; Cohen et al., 1998; Sandberg, Jarvenpaa, Penttinen, Paton, & McCann, 2004).

2.2.3 Stress and cancer

The implications that both acute and chronic stress has on health are vast and can be long-term (McEwen, 1998). Based on the limited research pertaining to stress and cancer, increases in physiological stress have been associated with decreases in immune parameters and increases in early mortality rates, while psychological stress has been associated with increases in depression and anxiety in breast cancer patients (Anderson, Anderson, & deProsse, 1989; Sephton et al., 2000). Furthermore, researchers have found an association between psychological and physiological stress and the development (McKenna, Zeyon, Corn, & Rounds, 1999; Lillberg et al., 2003) and progression of breast cancer (Kiecolt-Glaser & Glaser, 1995; Mormont & Levi, 1997), yet less is known about the survivorship period following diagnosis and treatment for breast cancer. It is important to understand stress in breast cancer survivors as reducing stress experiences may improve immune functioning, which could impact recurrence, morbidity, and mortality for this population (Fawzy et al., 1993). Also, an examination into stress-related factors is warranted. It is likely that a key stressor for women, which may exert influence both acutely and chronically, is body image (i.e., the way women feel about their physical self following cancer treatment; White, 2012). Women treated for breast cancer may experience greater psychological and physiological stress due to appearance related changes that affect women's body image (e.g., hair loss, scarring; White, 2012). Body image includes multiple dimensions including cognitive, affective, and behavioural facets that may be altered due to stress

(Fredrickson & Roberts, 1997; White, 2000; Grogan, 2006). In particular, affective body image is likely the most closely tied dimension to stress, as self-conscious emotions have been significantly associated with physiological and psychological stress in healthy women (Dickerson & Kemeny, 2004; Lazarus, 1999; Gruenewald et al., 2004).

2.3 Body-related self-conscious emotions

Body-related self-conscious emotions may be modifiable factors related to stress, therefore it is important to explore these emotions and their relationship with stress as altering felt emotions could decrease stress experiences. Self-conscious emotions (a subset of emotions; i.e., shame, guilt, and pride) are related to the self and are cognitively complex (Tracy & Robins, 2007; Izard, Ackerman, & Schultz, 1999). They are significantly involved in psychological functioning through processes such as being aware of the self, picturing the self, and evaluating the self (Fischer & Tangney, 1995; Tracy & Robins, 2007). Self-conscious emotions motivate and regulate individuals' cognitions, feelings, and behaviours and have a considerable impact on one's moral judgement and subjective well-being, deeming them important emotions to study (Sabiston et al., 2010; Campos, 1995; Fischer & Tangney, 1995; Tangney, Stuewig, & Mashek, 2007; Tracey, Cheng, Robins, & Trzesniewski, 2009). Tracy and Robins (2004) proposed a process model of self-conscious emotions that demonstrates how an individual experiences such emotions. Individuals must first be aware of their self-representations (i.e., actual or ideal) and assess whether the current event is congruent (i.e., experiences of pride) or incongruent (i.e., experiences of shame and/or guilt) with their identity goals. Next, they must ascribe the event to internal features, and either credit or blame the self, eliciting self-conscious emotions (Tracy & Robins, 2004). Self-conscious emotions provide motivation to protect or improve one's self-representations in order to preserve social stability and avoid rejection (Keltner & Buswell, 1997; Baumeister, Stillwell, & Heatherton, 1994; Tracy & Robins, 2004). Furthermore, self-conscious emotions may be experienced at varying degrees depending on individual characteristics (Lewis, 1971; Gilbert, 1997).

Researchers have identified that women may be more susceptible to feelings of shame and guilt than men (Lewis, 1971; Orth, Robins, & Soto, 2010). Moreover, individuals with disease may elicit negative body-related self-conscious emotions due to concerns related to appearance abnormalities such as disfigurement (Gilbert, 1997). As such, women treated for breast cancer

may be at an increased risk of experiencing negative emotions due to their sex, cancer diagnosis, and the associated side effects and outcomes (e.g., loss of breast; Lewis, 1971; Gilbert, 1997). Brunet, Sabiston, and Burke (2013) conducted a qualitative study to explore women's perspectives about their bodies post-treatment for breast cancer. The interviews revealed that women who experienced changes to their bodies as a result of cancer also experienced negative emotions related to their appearance and described feelings related to their changed bodies as disappointment, anger, and worry (Brunet et al., 2013). However, a handful of women who experienced positive emotions that were related to their strength, functioning, and appreciation to be alive described feeling courageous and accepting of themselves (Brunet et al., 2013). Given the findings related to general emotions and the outcomes associated with self-conscious emotions, it is important to understand body-related self-conscious emotions in women treated for breast cancer in order to reduce the occurrences of negative emotions and increase experiences of positive emotions. Furthermore, negative emotions may increase stress while positive emotions may lower stress. Thus, it is advantageous to understand the relationship between body-related self-conscious emotions and stress in breast cancer survivors, as it could help reveal potential ways to reduce stress. However, to my knowledge, the relationship between body-related self-conscious emotions and stress has not been studied in women treated for breast cancer.

Based on self-objectification theory, women who are sexualized internalize these ideals and begin to view themselves as objects, leading them to value themselves merely on appearance (Fredrickson & Roberts, 1997). These women monitor their bodies in order to meet perceived societal norms. This evaluation of the body is a central aspect of self-conscious emotions (Sabiston et al., 2010). Research with women treated for breast cancer demonstrated that women who had internalized gender specific ideals also experienced body shame (Boquiren, Esplen, Wong, Toner, & Warner, 2013). Women treated for breast cancer may be at an increased risk for self-objectification and subsequent negative body emotions and behaviours due to changes to their bodies resulting from cancer treatment (White, 2012). These changes tend to be especially troublesome as they are often associated with femininity, exacerbating their perceived failure to achieve the ideals (Fredrickson & Roberts, 1997; White, 2012). As a result, women may experience shame and guilt when they do not meet appearance ideals or alternatively feel pride when they meet the ideals (Fredrickson & Roberts, 1997; Gilbert, 1997).

Shame and guilt are negative self-conscious emotions that have been reported to be generally stable across the lifespan and can occur in public and private domains (Tangney, 1998; Lewis, 1993). Further, shame and guilt can be physiologically driven and occur unconsciously (Lewis, 1971). Although shame and guilt have been used in previous research interchangeably due to a lack of understanding on their unique aspects, it is now widely agreed that they are distinct emotions (Tangney, Miller, Flicker, & Barlow, 1996). The main difference between shame and guilt is the direction of the emotion: self vs. behaviour, respectively (Lewis, 1971).

In particular, shame involves the global self (e.g., *I* didn't exercise), is considered to be a more intense and acutely painful experience by nature, and elicits greater physiological changes such as increased heart rate, sweating, and blushing (Lewis, 1971; Tangney & Dearing, 2002; Tangney, 1998). Moreover, previous research suggests that shame is consistently maladaptive across the lifespan (Orth et al., 2010). Individuals experiencing shame feel greater self-consciousness and report feelings of inferiority, smallness, a desire to disappear, denial, and self- and other-directed anger (Lewis, 1971; Tangney, 1998). Shame elicits behaviours such as hiding (e.g., closed eyes, lowered head, and a hunched over upper body) and avoidance (e.g., running away; Lewis, 1971; Sabiston et al., 2010; Gilbert, 1997; Keltner & Buswell, 1996). To illustrate, individuals have reported wanting to 'sink into the floor' or 'die' when experiencing feelings of shame (Lewis, 1971). Specifically, body-related shame results from an innate human need to be viewed as attractive and the perceived failure to meet these appearance standards (Gilbert, 1997; Noll & Fredrickson, 1998; Tangney et al., 1996). For example, women experience greater body shame in situations where their bodies are on display (e.g., when wearing a swimsuit; Fredrickson, Roberts, Noll, Quinn, & Twenge, 1998; Quinn, Kallen, & Cathey, 2006). Importantly, body-related shame has been associated with negative outcomes such as depression, decreased self-esteem, and lower physical activity (Ashby et al., 2006; Bessenoff & Snow, 2006; Orth et al., 2010; Sabiston et al., 2010).

Contrastingly, guilt involves a negative evaluation of an individual's behaviour (e.g., I *didn't* exercise; Lewis, 1971; Tangney, 1998; Niedenthal, Tangney, & Gavanski, 1994). Feelings of guilt are responses to an individual taking responsibility for an action or failure to act (Lewis, 1971). Individuals who experience guilt tend to feel empathetic and thus are motivated to repair the situation and act morally in order to undo the damage (e.g., apologizing or confessing; Lewis, 1971; Tangney, 1993, 1998). Guilt tends to be less intense and painful when compared with

shame, but can still be harmful through experiences of tension, remorse, regret, and rumination (Tangney, 1998; Lewis, 1971; Gilbert, 1997). Moreover, guilt may have negative outcomes, as it has been associated with anxiety and depression (Bybee & Quiles, 1998; Harder, Cutler, & Rockart, 1992). However, it may also lead to positive outcomes, as previous research has demonstrated that guilt may only be maladaptive in combination with shame (Tangney, 1998; Tangney & Dearing, 2002; Tangney et al., 1996). For example, research has shown that body-related guilt can be adaptive, as it has shown to motivate healthy behaviours (e.g., participation in exercise; Bybee & Quiles, 1998; Sabiston et al., 2010). However, it is important to note that the individuals are participating in healthy behaviours as a result of body guilt (i.e., attempts to restore appearance) and not as a result of enjoyment or intrinsic motivation (Sabiston et al., 2010).

Pride is a positive self-conscious emotion that occurs when an individual has a positive evaluation of a behaviour (e.g., exercising) or characteristic (e.g., being physically fit; Fischer & Tangney, 1995; Tracy & Robins, 2007; Sabiston et al., 2010). Pride can be divided into two subsets (authentic and hubristic) based on the cognitive attributions present (Tracy & Robins, 2007; Castonguay, Gilchrist, Mack, & Sabiston, 2013). Authentic body-related pride is an adaptive self-conscious emotion and is characterized by an individual's response to a specific achievement or behaviour (e.g., I finished the run I *trained* for) that is related to the body (Castonguay et al., 2013; Tracy & Robins, 2007). Authentic body pride has been associated with motivation to participate in goal-directed behaviours such as physical activity (Carver, Sinclair, & Johnson, 2010; Sabiston et al., 2010; Williams & DeSteno, 2008). Furthermore, authentic pride has been associated with moral and prosocial behaviours such as volunteering (Hart & Matsuba, 2007; Tracy & Robins, 2004). Conversely, hubristic body-related pride is characterized by an individual's response to global aspects of the self (e.g., *I* am a healthy person) and is accompanied by grandiosity, self-aggrandizement, and superiority (Castonguay et al., 2013; Tracy & Robins, 2007). Hubristic pride is associated with adaptive behaviours (e.g., participating in physical activity), but is also related to maladaptive behaviours (e.g., participating in physical activity to show off; Carver et al., 2010; Castonguay et al., 2013; Tracy & Robins, 2007; Sabiston et al., 2010). Hubristic body-related pride is less closely aligned with positive body image when compared to authentic body-related pride (Pila, Brunet, Crocker, Kowalski, &

Sabiston, 2016). Overall, more research is needed to understand body-related self-conscious emotions in women treated for breast cancer and their potential relationship with stress.

2.3.1 Fluctuating emotions

It is of considerable interest to study the momentary experiences of body-related emotions in women treated for breast cancer. Researchers have studied affect, mood, and general emotions using the experience sampling method (Hektner et al., 2007) in order to uncover transient experiences at particular moments of time (e.g., Zautra et al., 2002; Van Eck et al., 1998; Zelenski & Larsen, 2000; Vansteelandt, Van Mechelen, & Nezlek, 2005). For example, researchers have measured university students' basic emotions experienced throughout the day and found that positive emotions (e.g., happy) were experienced more often and more intensely than negative emotions (e.g., sad; Zelenski & Larsen, 2000; Vansteelandt et al., 2005). As such, pride may be experienced more readily throughout the day, while shame and guilt may arise only during body-related and/or stressful experiences. Furthermore, researchers have explored the associations between affect and stress in adults (Van Eck et al., 1998; Zautra et al., 2002). For instance, Van Eck and colleagues (1998) researched fluctuations in affective states (i.e., negative affect, positive affect, and agitation) and their association with stressful events throughout the day. Researchers found that daily stressors elicited greater negative affect and agitation that persisted for over an hour after the stressor was no longer present (Van Eck et al., 1998). Similarly, Zautra and colleagues (2002) studied the relationship between positive and negative affect during stressful events. They found that negative affect was higher and positive affect was lower during stressful experiences (Zautra et al., 2002). These findings demonstrate the importance of measuring fluctuations of emotion and stress in order to better understand their occurrences and duration. Moreover, it may help to uncover the order at which they are experienced, which may aid in the formation of interventions targeted at the eliciting factor. In addition, researchers have indicated that negative emotions may maintain high stress (Van Eck et al., 1998), suggesting that strategies aimed at reducing negative emotions may be of value.

Experience sampling method (Hektner et al., 2007) allows researchers to identify which emotions are dominant at any particular time and the frequency that each emotion is experienced (Zelenski & Larsen, 2000). In terms of general emotions, Fleeson (2001) studied young adults and found that on average, individuals have high within-subject variability while also having

quite stable between-subject variability. For instance, an individual may experience many emotions over the course of the day but have generally the same average emotions overall (Fleeson, 2001). Body-related self-conscious emotions have not been studied using this method, thus little is known about how body-related self-conscious emotions change over the course of one day and across days. Furthermore, to my knowledge, an experience sampling method has not been utilized with women treated for breast cancer. As such, in order to understand inter- and intra-individual variations of body-related self-conscious emotions and stress in breast cancer survivors, an experience sampling method (Hektner et al., 2007) must be used.

2.4 Social Self Preservation Theory

Self-conscious emotions and stress can be elicited by a variety of threats, however one threat that has been extensively studied is situations that threaten one's social status (Dickerson & Kemeny, 2004; Gruenewald et al., 2004; Kemeny et al., 2004). This threat has been termed social self preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004) and it posits that individuals attempt to protect their position in the social hierarchy and when they feel that their social self is threatened (e.g., performance-related experiences), a psychobiological response occurs, where self-conscious emotions and cortisol are elicited (Dickerson & Kemeny, 2004; Gruenewald et al., 2004; Kemeny et al., 2004). It is hypothesized that shame and pride could be indicators of where one stands in the social hierarchy (Kemeny et al., 2004). When the social self is threatened, shame may be elicited in response to failure, whereas pride may be elicited in response to success (Nesse & Ellsworth, 2009).

Certain factors have been shown to elicit greater stress responses in humans (see Dickerson & Kemeny, 2004 for meta-analysis). Social evaluation, uncontrollability, novelty, and level of demand are extensively researched factors that have been shown to activate stress responses in humans (Kemeny, 2003; Shapiro et al., 2001; Dickerson & Kemeny, 2004; Gruenewald et al., 2004; Kirschbaum & Hellhammer, 1989). Social evaluation is perceived by an individual who feels that they are being negatively judged by others (Dickerson & Kemeny, 2004). Previous research indicates that when the opportunity for social evaluation is present greater stress responses occur. Women treated for breast cancer may feel they are being judged negatively due to body image changes and therefore elicit a stress response. Secondly, perceptions of uncontrollability occur when an individual cannot avoid failure regardless of their effort,

subsequently eliciting a stress response (Dickerson & Kemeny, 2004; Shapiro et al., 2001; Kemeny, 2003). A meta-analysis of cortisol responses to acute laboratory threats indicated that individuals are more likely to experience increases in plasma and salivary cortisol in response to uncontrollable situations as compared to controllable situations (Dickerson & Kemeny, 2004). Moreover, uncontrollable situations were associated with slower returns to baseline cortisol levels, indicating that uncontrollability, over time, could lead to chronic stress (Dickerson & Kemeny, 2004). Breast cancer may cause individuals to feel a loss of control (Andersen, Kiecolt-Glaser, & Glaser, 1994; Peterson & Stunkard, 1989), thus these women may be more vulnerable to chronic physiological and emotional stress. Thirdly, the novelty of the stressor has also been associated with increases in stress responses, whereby novelty and uncontrollability may co-occur, as novel situations could also be less controllable (Kemeny, 2003; Dickerson & Kemeny, 2004). Finally, the level of demand influences the corresponding response from the individual. Demands that are perceived to outweigh available resources are perceived to be threatening and thus initiate a stress response (Kemeny, 2003). However, when resources are perceived to outweigh the demands, they are not perceived as threatening, but instead as a challenge (Kemeny, 2003). More research is needed to understand how these factors present themselves in women treated for breast cancer.

Based on social self-preservation theory, researchers have demonstrated that increased shame is associated with increased cortisol levels (Dickerson & Gruenewald, et al., 2004; Dickerson et al., 2008; Gruenewald et al., 2004; Kemeny et al., 2004). Therefore, there may be a relationship between body-related self-conscious emotions and stress, whereby experiences of body shame may increase stress. Less is known about body-related guilt and pride in relation to the elicitation of stress responses therefore more research is needed (Dickerson & Gruenewald, et al., 2004). In previous research with healthy individuals, guilt has not been associated with stress markers such as cortisol (Dickerson & Kemeny, et al., 2004), however a negative affect composite score including guilt has been associated with greater cortisol in a sample of breast cancer survivors (Castonguay, Wrosch, & Sabiston, 2017). Yet, the association between body-related guilt and cortisol has not been studied in women treated for breast cancer. In a breast cancer survivor population, the association between body-related guilt and cortisol may be present due to higher stress and potential guilt from pressures to be healthy so as to not risk recurrence or mortality (Zabora et al., 2001; Cohen et al., 2007; Brunet et al., 2013). Generally, in response to social

evaluative threat conditions, self-conscious emotions may be a central affective factor associated with changes in cortisol (Dickerson et al., 2008). Self-reporting stress may help to better elucidate the relationship between the body-related emotions and overall stress (Andrykowski et al., 2008). Importantly, chronic experiences of social threats may lead to recurrent feelings of self-conscious emotions, which could lead to abnormalities in the HPA axis, resulting in health disturbances such as susceptibility to disease (McEwen, 1998; Kemeny et al., 2004). As such, it is important to understand the relationship between body-related self-conscious emotions and stress in women treated for breast cancer and identifying any modifiable factors that could mitigate this relationship is valuable.

2.5 Physical Activity

Physical activity may affect the relationship between body-related self-conscious emotions and stress. Researchers have suggested that physical activity has beneficial effects as it may decrease negative emotions and stress in healthy adults (Guszkowska, 2004; Callaghan, 2004; McEwen, 1998). Therefore, understanding the influence of physical activity on the relationship between body-related self-conscious emotions and stress in women treated for breast cancer is advantageous given that physical activity may produce protective effects. Specifically, greater physical activity may show positive effects on the relationship between body-related emotions and stress, while lower physical activity may show negative effects on this relationship.

Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure above basal requirements" (p. 126; Caspersen, Powell, & Christenson, 1985). There are four main types of physical activity (i.e., aerobic, resistance, flexibility, and sport) that can be performed alone or in concert with one another (Brunet, Sabiston, & Meterissian, 2012). Moreover, there are three intensities at which one can be physically active: light (slight increase in heart rate), moderate (increased heart rate and sweating, able to keep a conversation), and strenuous (or vigorous; considerable increase in heart rate, fast breath, cannot keep a conversation; Brunet et al., 2012). In addition, physical activity is measured in frequency (number of times per week) and duration (length of a physical activity session; Brunet et al., 2012).

Indeed, there are numerous health benefits associated with participation in physical activity. Women treated for breast cancer experience various physical and mental health benefits from

participating in physical activity that aid in their recovery, rehabilitation, prevention of morbidity, and promotion of health (Brunet et al., 2012; Courneya & Freidenreich, 2007). In particular, breast cancer survivors attain benefits related to physical health (e.g., increased physical fitness, improved body mass index, and circulating hormonal levels) and psychological health (e.g., increased body self-esteem and body image and decreased depression and anxiety; Courneya & Friedenreich, 1999; Courneya & Friedenreich, 2007; Demark-Wahnefried & Jones, 2008; Fong et al., 2012; Galvao & Newton, 2005; McTiernan, 2004). In terms of cancer-related outcomes, physical activity increases survival rates, decreases chances of breast cancer recurrence, and all cause and breast cancer specific mortality (Loprinzi, Cardinal, Winters-Stone, Smit, & Loprinzi, 2012; Holmes, Chen, Feskanich, Kroenke, & Colditz, 2005; Ogunleye & Holmes, 2009; Fontein et al., 2013). It is important to note that a commonly reported concern for participating in physical activity is increasing the severity of lymphedema (i.e., increased fluid that causes swelling in the arm), however previous studies have shown that lymphedema is not exacerbated by physical activity (e.g., Cheema & Gaul, 2006; Irwin et al., 2009; Schmitz et al., 2010). As such, it is important that women treated for breast cancer are engaging in physical activity, as there is a multitude of beneficial outcomes, which may help to protect them against increased stress.

Physical activity may have a positive effect on body self-esteem and body image in breast cancer survivors (Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005; Speck et al., 2009). For instance, the benefits of a home-based physical activity intervention for breast cancer patients were measured (Pinto et al., 2005). Researchers found that physical activity counselling and tip sheets increased participants' overall body esteem (Pinto et al., 2005). In addition, Speck and colleagues (2009) assessed a one-year strength training intervention for women treated for breast cancer. Findings indicate that after participating in one year of the intervention body image significantly improved from baseline (Speck et al., 2009). These studies provide evidence for the efficacy of physical activity in improving body self-esteem and body image in women treated for breast cancer. By increasing women's body image, body-related self-conscious emotions may be modified, whereby shame and guilt may decrease while pride may increase. The modification of these body-related emotions may elicit a reduction in stress (Tangney & Tracy, 2012; Dickerson & Kemeny, 2004). Therefore, it is important for women who have undergone treatment for breast

cancer to engage in physical activity, as the associated outcomes may positively influence their overall wellbeing.

Based on physical and psychological health benefits of physical activity the following research-based recommendations were developed (Brunet et al., 2012). It is recommended that breast cancer survivors participate in three or more 30-minute sessions per week of moderate aerobic physical activity, two or three sessions per week of resistance physical activity (progressing from light to strenuous intensity), and three 50 to 60-minute sessions of light flexibility sessions per week (Brunet et al., 2012). Moreover, 150 minutes of moderate intensity, 75 minutes of vigorous intensity, or an equivalent combination of moderate and vigorous intensities are recommended for cancer survivors (Schmitz et al., 2010; Haskell et al., 2007).

Unfortunately, even with the reported benefits and recommendations, it has been objectively shown that the majority of breast cancer survivors (50-80%) are not sufficiently active, as time spent sedentary remained high and unwavering throughout the first year following treatment (Sabiston, Brunet, Vallance, & Meterissian, 2014; Schmitz et al., 2010). Moreover, these trends continue up to ten years into the survivorship trajectory, whereby many women (60.5-78.6%) are not meeting the recommended guidelines (Mason et al., 2013). Furthermore, research has shown that breast cancer survivors spend less than 2% of their day engaging in MVPA (Lynch et al., 2010; Sabiston et al., 2014) and that physical activity declines over the first year post-treatment (Sabiston et al., 2014).

The low levels of physical activity participation among women treated for breast cancer is concerning given the benefits associated with engagement in physical activity, and the possible effects that physical activity may have on the relationship between emotions and stress. Although the majority of women are not engaging in the recommended amount of physical activity after treatment for breast cancer, some women are meeting guidelines. It is imperative that these processes are understood in women who are active so engagement in physical activity can be promoted and the potentially protective aspects of physical activity can be identified. Physical activity may effect the relationship between body-related self-conscious emotions and stress since (a) previous research indicates body-related self-conscious emotions are associated with physical activity (Castonguay, Wrosch, & Pila, et al., 2017; Pila et al., 2014; Sabiston et al., 2010), and (b) physical activity is associated with stress in healthy adults (Callaghan, 2004;

McEwen, 1998; Salmon, 2001) and stress outcomes in cancer survivors (e.g., Bélanger et al., 2012; Sabiston & Brunet, 2012; Brunet et al., 2014). Importantly, research linking body-related self-conscious emotions and physical activity used self-report measures to gauge time spent in physical activity (e.g., Castonguay, Wrosch, & Pila, et al., 2017; Sabiston et al., 2010). Therefore, the present study's use of an objective physical activity measure may add to the body-related self-conscious emotion and physical activity literature by reducing the disadvantages that accompany self-report measures (Prince et al., 2008; Sallis & Saelens, 2010). Secondly, researchers suggest that participating in physical activity is a crucial factor in the self-management of stress (Brunet et al., 2014). Vigorous physical activity participation has been associated with decreased emotional distress (Steptoe & Butler, 1996). Moreover, the harmful effects that chronic stress yields may be reduced by moderate exercise (McEwen, 1998). In cancer survivors, research has shown that physical activity aids in the reduction of stress and may reduce sensitivity to stressors (Bélanger et al., 2012; Sabiston & Brunet, 2012; Brunet et al., 2014; McBride, Clipp, Peterson, Lipkus, & Demark-Wahnefried, 2000; Salmon, 2001). Physical activity may help reduce health risks (e.g., recurrence) and side effects (e.g., fatigue) associated with breast cancer treatment, as well as stress outcomes (e.g., depression) in female cancer survivors (Bélanger et al., 2012; Demark-Wahnefried & Jones, 2008; Sabiston & Brunet, 2012). The reduction of these factors may help to decrease negative emotions and stress related to the breast cancer outcomes endured. Despite these findings, more research is warranted on physical activity and body-related self-conscious emotions and the effects of physical activity on the emotion and stress relationship, especially in women treated for breast cancer.

Although there is some evidence that physical activity may be an effective practice for the reduction of stress, participation in a physical activity program could facilitate negative body-related self-conscious emotions and stressful experiences in women treated for breast cancer. First, the presence of others during physical activity could induce body-related emotions and stress by providing an opportunity for social comparison (Gruenewald et al., 2004; Martin Ginis & Bassett, 2012). However, Sabiston and Brunet (2012) suggest that group and community based physical activity programs are effective in fostering social support and connectedness among cancer survivors. Thus, cancer survivors may be a unique population, whereby feelings of social comparison are outweighed by social support. Secondly, Salmon (2001) contends that physical activity may induce negativity at the beginning of training. New physical activity

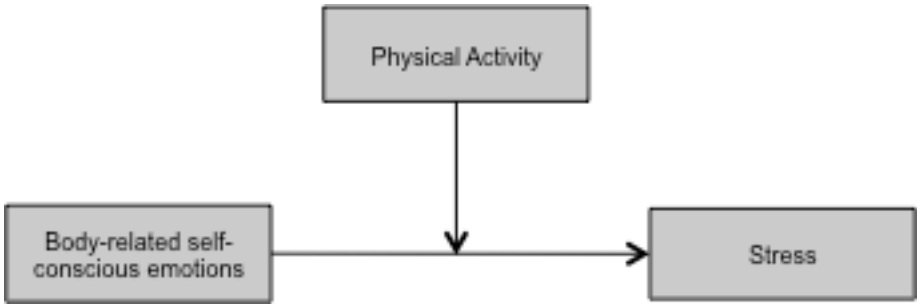
experiences can heighten negative emotions (Kirschbaum & Hellhammer, 1989) and may increase stress. Women who are new to a physical activity program or specific type of physical activity may experience negative outcomes due to temporary pain or discomfort and awareness of a lack of physical fitness and physical self-efficacy (Martin Ginis & Bassett, 2012). However, the ongoing participation in physical activity may have positive effects such as increases in positive body-related self-conscious emotions and decreases in negative body-related self-conscious emotions and stress (Salmon, 2001; Guszkowska, 2004; Callaghan, 2004). Furthermore, long-term physical activity may have non-specific therapeutic processes including psychological benefits such as mastery, which could have positive effects on both emotions and stress (Salmon, 2001). Thus, it is important to study women treated for breast cancer during participation in physical activity.

In addition to studying stress and emotions at the momentary level (Van Eck et al., 1998; Zautra et al., 2002), researchers have also demonstrated the importance of studying physical activity and feeling states using an experience sampling design (Gauvin, Rejeski, & Reboussin, 2000; Guerin, Fortier, & Sweet, 2013). In a study of active women, researchers found a positive relationship between positive affect and physical activity, whereby reports of positive affect increase after engagement in physical activity (Guerin et al., 2013). Furthermore, Gauvin and colleagues (2000) reported that on days where women were active (compared to days when they were inactive), they reported greater positive feeling states. These studies provide evidence for the value of studying physical activity and affective states using an experience sampling design. This type of design permits the examination of fluctuations in daily physical activity and how differing levels may affect the relationship between body emotions and stress. However, little is known about how changes in physical activity may affect the relationship between momentary emotions and stress. It is important to understand these associations within-individuals as their engagement in physical activity can change daily affecting psychological outcomes differently from one day to the next. It is also worthwhile to examine the associations at the between-person level as the relationships could change between individuals and characteristics specific to certain women may prove valuable to understanding these changes. Taken together, lower levels of physical activity may perpetuate the relationship between body-related self-conscious emotions and stress (Demark-Wahnefried & Jones, 2008), while higher levels of physical activity may show protective benefits for this relationship.

2.6 Summary

In conclusion, women treated for breast cancer are a unique population who may experience greater stress than the general population (Zabora et al., 2001; Demark-Wahnefried et al., 2005; White, 2012). In order to attempt to reduce stress occurrences, body-related self-conscious emotions may be a viable target. Moreover, physical activity may affect the relationship between body-related self-conscious emotions and stress as body-related self-conscious emotions have been associated with physical activity (e.g., Pila et al., 2014; Sabiston et al., 2010) and physical activity has been associated with stress in previous research (e.g., Bélanger et al., 2010; Callaghan, 2004; McEwen, 1998). Figure 2.1 illustrates these proposed associations between body-related self-conscious emotions and psychological stress with the moderating role of physical activity as drawn from the theoretical constructs of self-objectification theory (Fredrickson & Roberts, 1997) and social self preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004)[1]. Findings from this study will help uncover the psychobiological links between body-related self-conscious emotions, physical activity, and stress to aid in identifying potential intervention strategies with the main goal of improving breast cancer survivors overall health and wellbeing.

Figure 2.1. Proposed associations between body-related self-conscious emotions and psychological stress, with the moderating role of physical activity.



[1] It is important to note that physiological stress as measured through cortisol was assessed as the outcome in a separate analysis. Results with physiological stress can be found in Appendix A and will not be discussed in detail in the main manuscript.

Chapter 3
Manuscript

3 Manuscript

3.1 Abstract

Women treated for breast cancer may experience increased stress because the diagnosis and related treatment for cancer may sensitize individuals to changes in body image. Body-related self-conscious emotions (i.e., shame, guilt, pride) may be modifiable sources of such stress and physical activity may play an important role in buffering these relationships. Using an experience sampling method, the purpose of this study was to identify intrapersonal sources of stress among physically active breast cancer survivors by examining (a) the relationship between body-related self-conscious emotions and psychological stress and (b) whether physical activity moderates this association. Women (N = 20; Mean Age = 58 years) provided measures of body-related self-conscious emotions and stress six times a day for seven days. They also wore accelerometers to measure their time spent in moderate-to-vigorous physical activity (MVPA) for seven days. Multilevel modeling was used to test for day-level time-varying predictors of psychological stress, while controlling for age, stage of breast cancer at diagnosis, body mass index, and wear time of the accelerometers. Within-person daily variability in body-related guilt positively predicted within-person daily variability in stress ($p < .05$). Contrary to expectations, body-related shame and pride were not significant predictors of stress and MVPA did not moderate the effects of emotions and stress. However, the time by MVPA interaction was significant; therefore, between day within-person MVPA explained variability in the slopes for stress ($p < .05$). These findings suggest that body-related guilt may be an especially important self-conscious emotion to target in interventions committed to reducing experiences of stress among active women treated for breast cancer. Furthermore, participating in MVPA may provide a buffering effect for psychological stress after treatment for breast cancer. Our results provide support for the utilization of interventions for reducing breast cancer survivors' stress experiences by targeting body-related self-conscious emotions and physical activity.

3.2 Introduction

Marked improvements in detection and treatment of breast cancer have lead to a five-year survival rate of 87%, leaving many women in the aftermath of breast cancer (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017). Women treated for breast cancer face new challenges associated with changes to their bodies and body image (White, 2012). These changes may increase one's experiences of stress, which could persist long after completion of treatment (Andrykowski, Lykins, & Floyd, 2008). In fact, it is purported that cancer survivors experience 1.5 times more stress than the general population (Zabora, Brintzenhofeszoc, Curbow, Hooker, & Piantadosi, 2001). Given that cancer survivors may be at an increased risk for stress, especially in relation to the body, and that chronic stress may be associated with worsened health outcomes (Kaltsas & Chrousos, 2007; Kemeny, 2003; Miller, Chen, & Zhou, 2007; Segerstrom & Miller, 2004), it is important to identify potential modifiable factors associated with stress in women treated for breast cancer.

Body-related self-conscious emotions may be modifiable factors related to stress in this population. Specifically, body-related shame, guilt, and pride could be emotions that may be altered in body image and emotion interventions committed to reducing stress. Body-related shame is elicited when an individual perceives himself or herself negatively at a global level (e.g., I *am* an unhealthy person; Lewis, 1993; Tangney, 1998). Body-related guilt occurs when an individual negatively evaluates his/her behaviour (e.g., I *have* been unhealthy). Shame and guilt have been associated with depression, anxiety, and decreased self-esteem in the general adult population (Ashby, Rice, & Martin, 2006; Bessenoff & Snow, 2006; Bybee & Quiles, 1998; Lewis, 1993). Yet, body-related guilt, in the absence of body-related shame, may be related to adaptive outcomes including increased physical activity (Lewis, 1993; Bybee & Quiles, 1998). The contrasting effect is a result of the reparative nature of guilt (Lewis, 1993; Tangney, 1998). Body-related pride is elicited when an individual has a positive perception of a characteristic or behaviour (e.g., *I* am a healthy person) and it has been associated with increased self-esteem and prosocial outcomes (Williams & DeSteno, 2008). There are two facets of pride, authentic and hubristic, however the experiences of body-related authentic and hubristic pride are closely aligned in previous research (Castonguay, Pila, Wrosch, & Sabiston, 2015; Castonguay, Sabiston, Crocker, & Mack, 2014). Overall, the body-related self-conscious emotions could have differential relationships with stress whereby body-related shame may be related to greater

stress, body-related guilt may elicit higher or lower stress, and body-related pride may be associated with lower levels of stress (Tangney & Tracy, 2012; Dickerson & Kemeny, 2004).

Based on self-objectification theory (Fredrickson & Roberts, 1997), breast cancer survivors who experience and perceive changes to their body resulting from treatment may be at particular risk for experiencing body-related shame. Specifically, an internalization of feminine ideals related to appearance causes an increase in body-related self-conscious emotions, especially body-shame, which may lead to maladaptive behaviours and increases in stress (Fredrickson & Roberts, 1997). Although some researchers have indicated that women treated for breast cancer who internalize the ideals also feel greater body shame, less is known about body-related guilt and pride (Boquiren, Esplen, Wong, Toner, & Warner, 2013). As further evidence of an association between shame and stress, researchers guided by social self-preservation theory (Kemeny, Gruenewald, & Dickerson, 2004; Dickerson, Gruenewald, & Kemeny, 2004) have found that increases in shame are concurrently associated with increases in cortisol levels (Dickerson & Gruenewald, et al., 2004; Dickerson, Mycek, & Zaldivar, 2008; Gruenewald, Kemeny, Aziz, & Fahey, 2004). Less is known about the potential of body-related guilt and pride eliciting a stress response, especially with women treated for breast cancer, warranting further research (Dickerson & Gruenewald, et al., 2004). Furthermore, it is important to identify factors that might buffer the association between body-related emotions and stress responses.

Physical activity may affect the relationships between body-related self-conscious emotions and stress. Among healthy adults, physical activity has shown to decrease negative emotions and stress (Guszkowska, 2004; Callaghan, 2004; McEwen, 1998). Specifically, self-report physical activity has been associated with body-related self-conscious emotions in healthy adults (Pila, Stamiris, Castonguay, & Sabiston, 2014; Sabiston et al., 2010) and breast cancer survivors (Castonguay, Wrosch, Pila, & Sabiston, 2017). Furthermore, participation in physical activity may be related to increases or decreases in stress among cancer survivors (e.g., Belanger et al., 2012; Sabiston & Brunet, 2012; Gruenewald et al., 2004). Cancer survivors who engaged in physical activity have shown reductions in self-report stress (e.g., Belanger, Plotnikoff, Clark, & Courneya, 2012), yet the presence of others in physical activity settings may provide a gateway for social comparison, which could increase stress experiences (Gruenewald et al., 2004). However, ongoing participation in physical activity may demonstrate a positive influence on the body-related emotions to stress relationship (Demark-Wahnefriend & Jones, 2008). These

associations may be better elucidated in active women who may be reaping the protective effects physical activity may have on negative body emotions and stress, warranting an examination of active women treated for breast cancer.

Importantly, affective states and stress are transitory and therefore may fluctuate over time based on situations and events (Fleeson, 2001; Van Eck, Nicolson, & Berkhof, 1998; Zautra, Berkhof, & Nicolson, 2002). When an individual is confronted with a self-objective (Fredrickson & Roberts, 1997) or social (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004) threat, they may experience greater stress and negative affective states. In addition, previous research has found that individuals report greater negative affect and lower positive affect when they experience greater stress (Van Eck et al., 1998; Zautra et al., 2002). Therefore, examining momentary experiences of body-emotions and stress is a worthy avenue of research. Furthermore, physical activity levels change over time and so using an experience sampling design to examine how fluctuations in physical activity may affect the relationship between body-emotions and stress is valuable. It may also be beneficial to examine how these associations may differ across individuals as this may uncover key differences between women that may be a target of future interventions. Further, it is important to study these associations among active women who have completed treatment since they are likely accruing mental and emotional health benefits from physical activity, yet little is known about what the specific benefits are.

3.2.1 Present study

Based on self-objectification theory (Fredrickson & Roberts, 1997), social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004) and empirical evidence, the purpose of the present study was to identify body-related emotions as intrapersonal sources of psychological stress among physically active breast cancer survivors by examining: (1) the between- and within- associations (inter- and intra-individual effects) between body-related self-conscious emotions and stress, and (2) whether physical activity may moderate this relationship. In order to better understand the fluctuations of emotions and stress over time, an experience sampling method (Hektner, Schmidt, & Csikszentmihalyi, 2007) was used. This method allows for the study of participants within their natural environment permitting greater depth and understanding on individuals' experiences on a daily basis (Reis & Gosling, 2010). Drawing on

theoretical tenets, for between-group hypotheses it was expected that, (a) higher reports of body-related shame will be related to higher stress, and (b) higher reports of body-related pride will be related to lower stress. In terms of between-day hypotheses, (c) on days when women report higher than their average body-related shame they will report more stress, and (d) on days when women report higher than their average body-related pride they will report less stress. In terms of within-day hypotheses, (e) at times when women report higher than their average body-related shame they will concurrently report more stress, and (f) at times when women report higher than their average body-related pride they will concurrently report less stress. Given that guilt is both a negative emotion but also reparative in function (Lewis, 1993; Tangney, 1998) there are no a-priori hypotheses for body-related guilt. Lastly, it was anticipated that (g) greater physical activity will have a beneficial effect on the emotion to stress relationship, and (h) lower physical activity will have a harmful effect on the emotion to stress relationship.

3.3 Method

3.3.1 Participants

Based on sample size calculations relevant to the experience sampling method (Hektner, et al., 2007) and hierarchical models (Raudenbush & Bryk, 2002) and consistent with previous research utilizing multilevel modeling (Ong, Bergeman, Bisconti, & Wallace, 2006; Totterdell & Holman, 2003), 22 female cancer survivors were recruited from ongoing physical activity programs in the Greater Toronto Area through handouts, emails, and verbal announcements[2]. Women were screened via an online questionnaire to determine eligibility using the following criteria: (a) between the ages of 18 and 90 years old; (b) completed primary treatment for breast cancer; (c) participating in a physical activity program; (d) able to read and write in English; and

[2] Programs details are as follows: (a) The Survivor Training Program through the Running Room is a ten week program designed to train women who have endured breast cancer to walk or run in the CIBC Run for the Cure. Women attend one class for health education followed by a group run per week and have the option to attend two additional sessions per week; (b) dragon boating is a program that runs from spring to fall. Women participate in practices once or twice per week and competitions a few times per year; (c) Secondary Prevention and Rehabilitation Kinesiology (SPARK) is a thirteen week program run at the University of Toronto with adults from the community who have had cancer or cardiovascular disease. Individuals receive one-on-one weekly exercise sessions with a master's of professional kinesiology student; and (d) other programs include yoga classes and personal training that are participated in at the individual's preference.

(e) did not have any underlying medical concerns that would be a contraindication for participating in physical activity. Furthermore, women were included if they answered "no" to all items on the Physical Activity Readiness Questionnaire (PAR-Q and You; Canadian Society for Exercise Physiology, 2002) or if they answered "yes" to any items they provided written confirmation that their doctor approved participation in physical activity.

3.3.2 Measures

3.3.2.1 Baseline Measures

Following informed consent, participants completed baseline measures[3] to assess demographics, which included personal (e.g., age, height, and weight) and cancer related (e.g., stage of cancer at diagnosis) information.

3.3.2.2 State body-related self conscious emotions

An adaptation of Phenomenological Ratings of Self Conscious Emotions (Pila et al., 2014) was used to measure state body-related self-conscious emotions multiple times daily. Participants reported how they felt about their body (i.e., ashamed, guilty, proud[4], envious, and embarrassed) during the past few hours on a 5-point scale from 1 = *never* to 5 = *always*. Single-item measures of contextualized emotions have demonstrated adequate validity (Larsen & Fredrickson, 1999). For the current study, the Body and Appearance Self-Conscious Emotions Scale (BASES) and the Body-Related Self-Conscious Emotions Fitness Instrument (BSE-FIT) were measured at baseline in order to determine the validity of the present adapted body-related emotion measure. An average of the item scores for body-related shame, guilt, and pride were correlated with BASES and BSE-FIT scores (body-related shame and BASES shame: $r = .71$, $p < .05$; body-related shame and BSE-FIT shame: $r = .46$, $p = .05$; body-related guilt and BASES guilt: $r = .45$, $p = .05$; body-related guilt and BSE-FIT guilt: $r = .62$, $p < .05$; body-related pride and

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[3] Other baseline measures assessed in this study include Body and Appearance-related Self-Conscious Emotion Scales (Castonguay et al., 2014), Body Related Self Conscious Emotions Fitness Instrument (Castonguay, Sabiston, Kowalski, & Wilson, 2016), Behavioural Regulation in Exercise Questionnaire-3 (BREQ-3; Markland & Tobin, 2004; Wilson, Rodgers, Loitz, & Scime, 2006), and Body Areas Satisfaction Scale from The Multidimensional Body-Self Relations Questionnaire (Cash, 2000).

[4] State-level measurement of pride was measured using the word "proud" in order to reduce ambiguity, to simplify the multiple daily measure, and to reduce burden on participants.

BASES authentic pride: $r = .56$, $p < .05$; body-related pride and BASES hubristic pride: $r = .39$, $p > .05$; body-related pride and BSE-FIT authentic pride: $r = .15$, $p > .05$; body-related pride and BSE-FIT hubristic pride: $r = .02$, $p > .05$).

3.3.2.3 Psychological stress

A stress thermometer (adapted from NCCN Distress Thermometer for Patients, 2013) measured participants' psychological stress multiple times per day. Participants rated how stressed they had been in the past few hours on a scale of 0 = *not at all stressed* to 10 = *extremely stressed*. Using a single-item measure of distress is shown to be a valid assessment of distress in cancer settings (Mitchell, 2010).

3.3.2.4 Objective physical activity

Participants wore Acitgraph GT3X accelerometers (Actigraph, Pensacola, Florida) on their hip during waking hours (except for when participating in water activities, e.g., swimming, showering) for seven days to assess time spent in MVPA. The data were downloaded in 60-second epochs and the intensities were calculated using established cut points (i.e., moderate = 1,952-5,724 counts/min, vigorous = ≥ 5,725 counts/min; Freedson, Melanson, & Sirard, 1998). Wear time of accelerometers was included as a covariate in the analysis; women wore their accelerometers for an average of 16.5 hours per day. Data were included if they were available for at least 600 minutes on four or more days and if there were no extreme counts (>20,000; Sabiston et al., 2014).

3.3.3 Procedure

Following university research ethics board approval, interested participants completed screening measures in order to assess eligibility. Eligible participants completed informed consent and received a package including an accelerometer and the study questionnaires if opting to complete manually (pen and paper rather than online). Prior to the seven-day data collection period, participants completed baseline questionnaires including demographics manually or online depending on preference.

Experience sampling method (Hektner et al., 2007) enables researchers to examine participants' experiences in their natural environment. And so, during the seven-day collection period, an

experience sampling method was used whereby women completed multiple daily self-report measures on body-related self-conscious emotions and psychological stress. A fixed interval-contingent sampling method was used whereby participants were signalled to complete the self-reports at the six time points each day for seven days (i.e., 10:00 am, 12:00 pm, 2:00 pm, 4:00 pm, 6:00 pm, and 8:00 pm; Reis & Gable, 2000; Scollon, Kim-Prieto, & Diener, 2003), totalling in 42 times points per participant. This type of sampling may be best for measuring affective states and other momentary experiences (Bolger, Davis, & Rafaeli, 2003) and importantly, it reduces burden on participants. In addition, participants wore accelerometers during all waking hours for the seven-day period. Participants filled out a Questionnaire Checklist to help them keep track of their completion of measures[5].

The multiple daily questionnaires were completed manually or electronically based on participant preference. If completed electronically, instructions were provided to them on how to use the website and they received reminders fifteen minutes before each scheduled collection point. Upon completion of the seven-day period, participants returned all study materials, were thanked for their participation, and compensated $50 cash.

3.3.4 Analytic Strategy

Multilevel modeling was used to assess if the relationships between body-related self-conscious emotions and psychological stress varied and whether physical activity levels modulated those relationships. Multilevel modeling is the ideal analytic strategy for these data as it permits the analysis of nested data. Missing values for within-person variables were accounted for using restricted full maximum likelihood estimation methods in multilevel modeling. There were no missing values for between-person variables. All analyses controlled for age, stage of breast cancer at diagnosis, body mass index, and wear time of accelerometers (e.g., Bennett, Compas, Beckjord, & Glinder, 2005; Carlson, Speca, Faris, & Patel, 2007; Verloop, Rookus, van der Kooy, & van Leeuwen, 2000). Effect size calculations were conducted by comparing the

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[5] Self-report physical activity was measured six times per day for seven days. Also, participants completed additional questionnaires in the mornings (sleep quality and quantity), evenings (effort, social comparisons, affect, and group-based emotions), and one at the end of the seven-day period (program adherence). These measures were not examined in the analyses. Participants also measured their salivary cortisol five times per day on three non-consecutive days. Physiological stress (cortisol) is not examined in the present analyses but is included as the outcome variable in a supplementary analysis (see Appendix A).

variance components in the model previous to the current model being tested. The final analysis sample consisted of 840 time points of data, nested within seven days, and within 20 people, which is consistent with sample size calculations applicable to the experience sampling method (Hektner, et al., 2007) and hierarchical models (Raudenbush & Bryk, 2002).

Consistent with the hierarchal structure of the data, analyses were estimated with Level 1 as repeated measures (within-day effects), Level 2 as days (between-days effects), and Level 3 as individuals (between-person effects). A three-level analysis was used in concordance with previous literature utilizing observations (level 1) nested within days (level 2) nested within individuals (level 3; Li & Hedeker, 2012; Nezlek, 2015; Nezlek, Holas, Rusanowska, & Krejtz, 2015). Growth curve models were conducted using SPSS MIXED (version 23). This analysis permits the simultaneous estimation of within-day, between-day, and between-person main effects, in addition to the estimation of variance components in both intercepts and slopes. Data were modelled using an unstructured matrix and tested with restricted full maximum likelihood estimation (Snijders & Bosker, 2012).

Preliminary analysis of the daily growth patterns indicted that a linear specification of psychological stress as a function of time best described the data[6]. Therefore, the multilevel model for change was expressed in terms of time, which was centred at the initial daily time point (i.e., 0, 1, 2, 3, 4, 5 for 10:00 am, 12:00, 2:00, 4:00, 6:00, and 8:00 pm). Body-related shame, guilt, and pride were measured at every time point making these variables time-varying predictors. These were within-day centred such that 0 equates to the daily mean and deviations from 0 equate to distance of each score from the daily mean in units of standard deviation. The three subscripts on the shame, guilt, and pride variables signify their time-varying nature:

Level 1 (repeated measures):

$$Y_{tdi} = \pi_{0di} + \pi_{1di}(\text{time})_{tdi} + \pi_{2di}(\text{shame})_{tdi} + \pi_{3di}(\text{guilt})_{tdi} + \pi_{4di}(\text{pride})_{tdi} + \pi_{5di}(\text{shame})(\text{time})_{tdi} + \pi_{6di}(\text{guilt})(\text{time})_{tdi} + \pi_{7di}(\text{pride})(\text{time})_{tdi} + \varepsilon_{tdi}$$

[6] Analyses were conducted for liner and quadratic effects, however stress was only significant as a linear outcome and therefore it was modeled in this way.

In this equation, π_{0di} represents the stress on day *d* for individual *i* at the initial time point when the time-varying variables are at the mean (i.e., 0); π_{1di} represents the initial linear slope or growth of stress on day *d* for individual *i*; π_{2di}, π_{3di}, and π_{4di}, are effects of the time-varying variables on concurrent values of stress at time *t* on day *d* for individual *i*; π_{5di}, π_{6di}, π_{7di}, represent interactions between the time-varying variables and time, permitting an assessment of whether there is a relationship between daily growth in stress and within-day deviations in the emotions; and ε_{tdi} is the difference between the predicted stress value for individual *i* at time *t* on day *d* and the actual stress value for individual *i* at time *t* on day *d* (within-day random error).

Level 2 (days):

$$\pi_{0di} = \beta_{00i} + \beta_{01i}(\text{MVPA})_{di} + \beta_{02i}(\text{shame})_{di} + \beta_{03i}(\text{guilt})_{di} + \beta_{04i}(\text{pride})_{di} + r_{0di}$$

$$\pi_{1di} = \beta_{10i} + \beta_{11i}(\text{MVPA})_{di} + \beta_{12i}(\text{shame})_{di} + \beta_{13i}(\text{guilt})_{di} + \beta_{14i}(\text{pride})_{di} + r_{1di}$$

$$\pi_{2di} = \beta_{20i} + \beta_{21i}(\text{MVPA})_{di} + \beta_{22i}(\text{shame})_{di} + \beta_{23i}(\text{guilt})_{di} + \beta_{24i}(\text{pride})_{di}$$

$$\pi_{3di} = \beta_{30i} + \beta_{31i}(\text{MVPA})_{di} + \beta_{32i}(\text{shame})_{di} + \beta_{33i}(\text{guilt})_{di} + \beta_{34i}(\text{pride})_{di}$$

$$\pi_{4di} = \beta_{40i} + \beta_{41i}(\text{MVPA})_{di} + \beta_{42i}(\text{shame})_{di} + \beta_{43i}(\text{guilt})_{di} + \beta_{44i}(\text{pride})_{di}$$

$$\pi_{5di} = \beta_{50i} + \beta_{51i}(\text{MVPA})_{di} + \beta_{52i}(\text{shame})_{di} + \beta_{53i}(\text{guilt})_{di} + \beta_{54i}(\text{pride})_{di}$$

$$\pi_{6di} = \beta_{60i} + \beta_{61i}(\text{MVPA})_{di} + \beta_{62i}(\text{shame})_{di} + \beta_{63i}(\text{guilt})_{di} + \beta_{64i}(\text{pride})_{di}$$

$$\pi_{7di} = \beta_{70i} + \beta_{71i}(\text{MVPA})_{di} + \beta_{72i}(\text{shame})_{di} + \beta_{73i}(\text{guilt})_{di} + \beta_{74i}(\text{pride})_{di}$$

The Level 2 model represents variation in stress growth between days within the same individual. It adds the main effects of between-day centred MVPA, shame, guilt, and pride, and cross-level interaction terms among the three time-varying variables. At level 2, MVPA, shame, guilt, and pride were between-day centred, such that 0 equates the individual's weekly mean and deviations from 0 equate to distance of each day from the individual's weekly mean in units of standard deviation. The term β_{00i} represents the mean intercept or average initial daily stress score for individual *i* when the between-day predictors are at the mean (i.e., 0); β_{01i}, β_{02i}, β_{03i}, and β_{04i}, represent the relationships between MVPA, shame, guilt, pride and the initial stress score on day *d* for individual *i* respectively; β_{10i} is the average daily linear growth in stress for individual *i*; β_{11i}, β_{12i}, β_{13i}, and β_{14i} represents the influence of MVPA, shame, guilt, and pride on the linear daily stress growth for individual *i* (time x MVPA; time x shame; time x guilt; time x pride interactions) respectively; r_{0di} is the difference between individual *i*'s intercept on day *d* and the average intercept for day *d* (between-day random intercept error); and r_{1di} is the difference between the estimated growth in stress for individual *i* on day *d* and the average growth for day *d*

(between-day random slope error). Apart from the intercept (β_{00i}) and slope (β_{10i}), all parameters in the Level 2 model were treated as fixed effects. It is conceivable that the intercept and slope of each day's stress will differ from day to day within persons, yet we do not assume that the slopes for MVPA on stress would behave the same. This is because between-day variation in MVPA is assumed to have a fixed effect on stress irrespective of day; if MVPA is high it will ameliorate stress irrespective of day and vice versa. The terms β_{21i}, β_{22i}, β_{23i}, β_{24i}, β_{31i}, β_{32i}, β_{33i}, β_{34i}, β_{41i}, β_{42i}, β_{43i}, and β_{44i}, are the two-way cross-level interactions of time-varying emotions and MVPA and the between-day emotions and assess whether within-day effects of shame, guilt, and pride on stress depend on between-day differences in MVPA, shame, guilt, and pride respectively; and β_{51i}, β_{52i}, β_{53i}, β_{54i}, β_{61i}, β_{62i}, β_{63i}, β_{64i}, β_{71i}, β_{72i}, β_{73i}, and β_{74i} are the three-way cross-level interactions between emotions, time, and MVPA, between-day shame, guilt, and pride and assess whether the effect of within-day emotions on growth in stress depends on between-day levels of MVPA, shame, guilt, and pride, respectively.

Level 3 (person):

$\beta_{00i} = \gamma_{000} + \gamma_{000}(\text{wear time}) + \gamma_{001}(\text{body mass index}) + \gamma_{002}(\text{stage}) + \gamma_{003}(\text{age}) + \gamma_{003}(\text{shame}) + \gamma_{003}(\text{guilt}) + \gamma_{003}(\text{pride}) + \gamma_{003}(\text{MVPA}) + u_{00i} \quad \beta_{01i} = \gamma_{010}$

$\beta_{10i} = \gamma_{100} + u_{10i} \quad \beta_{11i} = \gamma_{110}$

$\beta_{20i} = \gamma_{200} \quad \beta_{21i} = \gamma_{210}$

$\beta_{30i} = \gamma_{300} \quad \beta_{31i} = \gamma_{310}$

$\beta_{40i} = \gamma_{400} \quad \beta_{41i} = \gamma_{410}$

$\beta_{50i} = \gamma_{500} \quad \beta_{51i} = \gamma_{510}$

$\beta_{60i} = \gamma_{600} \quad \beta_{61i} = \gamma_{610}$

$\beta_{70i} = \gamma_{700} \quad \beta_{71i} = \gamma_{710}$

The Level 3 model adds controls for individual-level factors; Actigraph wear time, body mass index, stage of cancer at diagnosis, and age. It also adds between-individual shame, guilt, pride, and MVPA. These variables were grand mean centered, meaning they were centered based on the sample mean. The term γ_{000} reflects the mean stress value across all individuals at the initial daily time point when the covariates, emotions, and MVPA are at the mean (i.e., 0); γ_{000}, γ_{001}, γ_{002}, and γ_{003} represent the relationship between individual-level control variables, emotions, and MVPA and the sample mean initial daily value of stress; γ_{100} represents the average daily stress growth for the sample; u_{00i} is the difference between individual *i*'s intercept and the average

intercept for the sample (between-person random intercept variance); and u_{10i} is the difference between the sample average linear stress growth and the average linear stress growth for individual *i* (between-person random slope variance). Apart from the intercept (γ_{000}) and slope (γ_{100}), all parameters at Level 3 are treated as fixed.

For the current analyses, predictors of psychological stress were grouped into three categories: (a) time-varying predictors (shame, guilt, and pride) at Level 1, (b) between-day predictors (between-day MVPA, shame, guilt, and pride) at Level 2, and (c) person-level predictors and controls (between-person MVPA, shame, guilt, pride, wear time, body mass index, cancer stage, and age) at Level 3. We employed an iterative model building procedure to test our hypotheses. Model 1 examined variability in the intercepts and linear slopes of stress in the absence of any predictors. Model 2 expanded on the unconditional growth model by testing Level 1 effects of the time-varying predictors on stress. Model 3 added the between-day predictors to Model 2 allowing tests of the Level 2 main effects and cross-level interactions on psychological stress. Model 4 permitted the evaluation of the associations in Model 3 while holding the effects of person-level controls and between-person predictors constant.

3.4 Results

3.4.1 Preliminary Findings

The final sample consisted of 20 participants after one participant dropped out after day one and another participant was excluded from the analysis as they had a gynaecological cancer diagnosis. Participants ranged in age from 30 to 68 years, predominantly identified as being Caucasian (85%), married/common law (75%), and post-menopausal (70%), and were mostly classified as having normal weight based on their body mass index scores (M = 24.6). Furthermore, women were primarily diagnosed with stage I (35%) or II (40%) breast cancer on average seven years prior to data collection and received various forms of treatment. Further descriptive statistics for the final sample are presented in Table 3.1.

All participants wore accelerometers all seven days of the week (M = 7) and an average of 993 minutes (16.54 hours) per day. Women engaged in approximately 270 minutes of MVPA per week. Participants had satisfactory compliance, completing 94% of their self-report measures. Percentage of missing data for each self-report variable are as follows: shame = 4.28%, guilt =

4.28%, pride = 4.16%, and stress = 12.02% were missing. Missing data were accounted for in the analyses using restricted full maximum likelihood estimation. Normality indices for self-report measures were tested yielding the following results for body-related shame (skewness = 2.39, *SE* = .52; kurtosis = 5.07, *SE* = 1.01), body-related guilt (skewness = 1.47, *SE* = .52; kurtosis = .67, *SE* = 1.01), body-related pride (skewness = .97, *SE* = .52; kurtosis = -.16, *SE* = 1.01), and psychological stress (skewness = .54, *SE* = .55; kurtosis = -.23, *SE* = 1.06). The multiple daily measures design captured intraclass correlation coefficients for body-related shame (ICC = .07), body-related guilt (ICC = .39), body-related pride (ICC = .67), psychological stress (ICC = .24), and MVPA (ICC = .38). The ICCs can be interpreted such that the higher the ICC, the greater the between-person variability. Bivariate correlations for the main study variables are presented in Table 3.2.

Table 3.1.

Baseline descriptive information for women treated for breast cancer (N = 20).

Descriptive data	Range	Mean (*SD*) or percentage
Age, years	30-68	58.4 (9.15)
Body mass index	16.44-33.47	24.6 (3.73)
Race (% Caucasian)		85%
Education level (%)		
High school diploma		5%
Some post-secondary		10%
College/technical diploma/certificate		45%
University undergraduate degree		30%
Post-graduate degree		10%
Marital status (%)		
Single		0%
Married/common-law		75%
Separated		5%
Divorced		15%
Widowed		5%
Menopause (%)		
Pre-menopause		15%
Peri-menopause		15%
Post-menopause		70%
Stage of breast cancer at diagnosis (%)		
0		5%
I		35%
II		40%
III		5%
IV		15%
Type of treatment (% yes)		
Surgery		60%
Lumpectomy		75%
Lymph or axillary node dissection		60%
Chemotherapy		60%
Radiotherapy		90%
Hormonal therapy		40%
Reconstructive surgery		20%
Physical activity program		
Survivor Training Program		20%
Dragon boating		55%
SPARK		20%
Other		5%
Time since diagnosis, months	5-200	81.35 (57.58)
Time since treatment, months	1-188	77.4 (53.23)
Body-related shame (weekly)	1-5	1.12 (0.26)
Body-related guilt (weekly)	1-5	1.34 (0.48)
Body-related pride (weekly)	1-5	2.30 (1.14)
MVPA, min/week	59-618	270.08 (152.20)
Accelerometer wear time, min/week	927.57-1089.14	992.54 (43.58)
Psychological stress (weekly)	0-10	1.93 (1.39)

Note. Surgery = single mastectomy or double mastectomy; Physical activity program = physical activity program that the individual was recruited by the researcher from; SPARK = Secondary Prevention and Rehabilitation Kinesiology; MVPA = moderate-to-vigorous physical activity.

Table 3.2.

Bivariate correlations for the main study variables.

	1	2	3	4	5	6	7	8	9
1. Body-related shame (Mean)	-								
2. Body-related guilt (Mean)	.85**	-							
3. Body-related pride (Mean)	-.03	-.11	-						
4. MVPA (Mean)	-.20	.02	-.10	-					
5. Psychological stress (Mean)	.59**	.60**	-.02	.01	-				
6. Age	.02	-.19	.29	-.25	-.31	-			
7. Stage	.30	.26	.33	.22	-.01	.13	-		
8. BMI	-.22	-.33	.00	.06	-.27	.13	.29	-	
9. Wear Time (Mean)	-.31	-.14	-.23	.30	-.09	.07	.10	.18	-

Note. Weekly averages of body-related guilt, body-related shame, body-related pride, MVPA, and psychological stress were used to calculate correlations; MVPA = moderate-to-vigorous physical activity; Stage = stage of breast cancer at diagnosis; BMI = body mass index; Wear Time = wear time of accelerometers.

* $p < .05$. ** $p < .001$.

3.4.2 Main Findings

Tables 3.3 and 3.4 display the estimates for the fitted growth models of psychological stress. The unconditional growth model (Model 1) showed that the average initial daily stress value was 2.05 and that stress tended to decrease with time but this decrease was not significant ($\beta = -0.04$, $SE = .04$, $p > .05$). The variance components for the intercepts and slopes at Level 2 were statistically significant ($r_0 = 1.30$, $p < .001$; $r_1 = 0.10$, $p < .001$). However, only the variance components for the intercepts were significant at Level 3 ($u_{00} = 2.03$, $p < .05$) and, thus, in subsequent models only intercepts were permitted to vary randomly.

Across the successive models, the decrease in the deviance statistic was significant at $p < .05$ until Model 4, which did not improve above and beyond Model 3. The person-level control variables and the between-person predictors therefore do not account for effects in Model 3, which provided the best fit of all the models. In Model 3, time-varying guilt positively predicted concurrent values of psychological stress ($\beta = 0.46$, $SE = .16$ $p < .05$) but no other main or interaction effects emerged at Level 1. This finding indicates that on measurement occasions when individuals reported above mean deviations in body-related guilt they also tended to report a higher value of psychological stress. At Level 2, there was a significant cross-level interaction of MVPA and time ($\beta = -0.11$, $SE = .04$, $p < .05$) but no additional main or three-way interactions emerged. To decompose this interaction, the conditional mean of the within-day trajectory slopes and 95% confidence bands for stress were plotted across the range of between-day deviations in MVPA (see Figure 3.1). MVPA had no influence on the trajectory slopes for stress between values of -3.22 and 0.18. Beyond these values, there was a significant positive trajectory slope for stress that strengthened as MVPA decreased and a significant negative trajectory slope for stress that strengthened as MVPA increased.

As can be seen in Table 3.3, Models 2 and 3 demonstrated reductions in variance components. In Model 2, after adding the time-varying predictors, variances at Level 1 and 2 were reduced. Likewise, in Model 3, the inclusion of between-day and between-person predictors at Level 2 and Level 3 reduced the Level 3 (between-person) variances. Significant and negative correlations between intercepts and slopes suggested that on days when individuals reported initially higher stress scores they tended to report more rapid decreases in stress over time.

Table 3.3.

Fitted multilevel models for changes in stress (Models 1-3).

Estimates	Model 1		Model 2		Model 3	
	ß (*SE*)	95% *CI*	ß (*SE*)	95% *CI*	ß (*SE*)	95% *CI*
Fixed Effects						
Intercept	2.05 (0.34)	1.33 to 2.77	2.04 (0.33)	1.36 to 2.71	2.16 (0.33)	1.48 to 2.84
Time	-0.04 (0.04)	-0.13 to 0.04	-0.04 (0.04)	-0.12 to 0.03	-0.05 (0.04)	-0.12 to 0.03
Shame			-0.23 (0.24)	-0.70 to 0.23	-0.27 (0.25)	-0.76 to 0.21
Guilt			**0.44 (0.15)**	**0.14 to 0.74**	**0.46 (0.16)**	**0.15 to 0.78**
Pride			-0.10 (0.12)	-0.33 to 0.12	-0.10 (0.12)	-0.33 to 0.14
Shame x Time			0.15 (0.08)	-0.01 to 0.31	0.17 (0.08)	0.00 to 0.33
Guilt x Time			-0.07 (0.05)	-0.17 to 0.04	-0.07 (0.05)	-0.18 to 0.03
Pride x Time			-0.04 (0.04)	-0.12 to 0.04	-0.04 (0.04)	-0.12 to 0.04
MVPA					0.22 (0.14)	-0.05 to 0.48
BD Shame					0.06 (0.27)	-0.48 to 0.59
BD Guilt					0.32 (0.24)	-0.15 to 0.79
BD Pride					-0.25 (0.14)	-0.52 to 0.03
MVPA x Time					**-0.11 (0.04)**	**-0.19 to -0.04**
MVPA x Time x Shame					-0.00 (0.04)	-0.08 to 0.08
MVPA x Time x Guilt					-0.02 (0.03)	-0.08 to 0.04
MVPA x Time x Pride					-0.02 (0.03)	-0.07 to 0.04
Random Effects						
Level 1: Residual	1.52 (0.10)	1.34 to 1.72	1.49 (0.10)	1.31 to 1.69	1.58 (0.11)	1.39 to 1.80
Level 2: Intercept	1.30 (0.28)	0.84 to 1.99	1.29 (0.28)	0.84 to 1.98	1.35 (0.31)	0.86 to 2.12
Level 2: Slope	0.10 (0.03)	0.06 to 0.16	0.09 (0.02)	0.05 to 0.15	0.08 (0.02)	0.05 to 0.15
Level 2: Correlation	-0.27 (0.08)	-0.41 to -0.12	-0.25 (0.07)	-0.39 to -0.11	-0.25 (0.08)	-0.41 to -0.10
Level 3: Intercept	2.03 (0.77)	0.97 to 4.26	1.79 (0.63)	0.90 to 3.56	1.68 (0.61)	0.82 to 3.42
Level 3: Slope	0.00 (0.01)	0.00 to 3.60				
Level 3: Correlation	-0.08 (0.08)	-0.24 to 0.07				
Model Summary						
-2 log likelihood	2712.60		2707.50		2603.52	

Note. Model 1 is an unconditional growth model. Model 2 adds the main effects of the time-varying covariates as well as their interaction with time. Model 3 adds the between-day predictor. MVPA = moderate-to-vigorous physical activity; BD = between day; BI = between individuals; BMI = body mass index; Stage = stage of breast cancer at diagnosis; Wear Time = wear time of accelerometers.

Table 3.4.

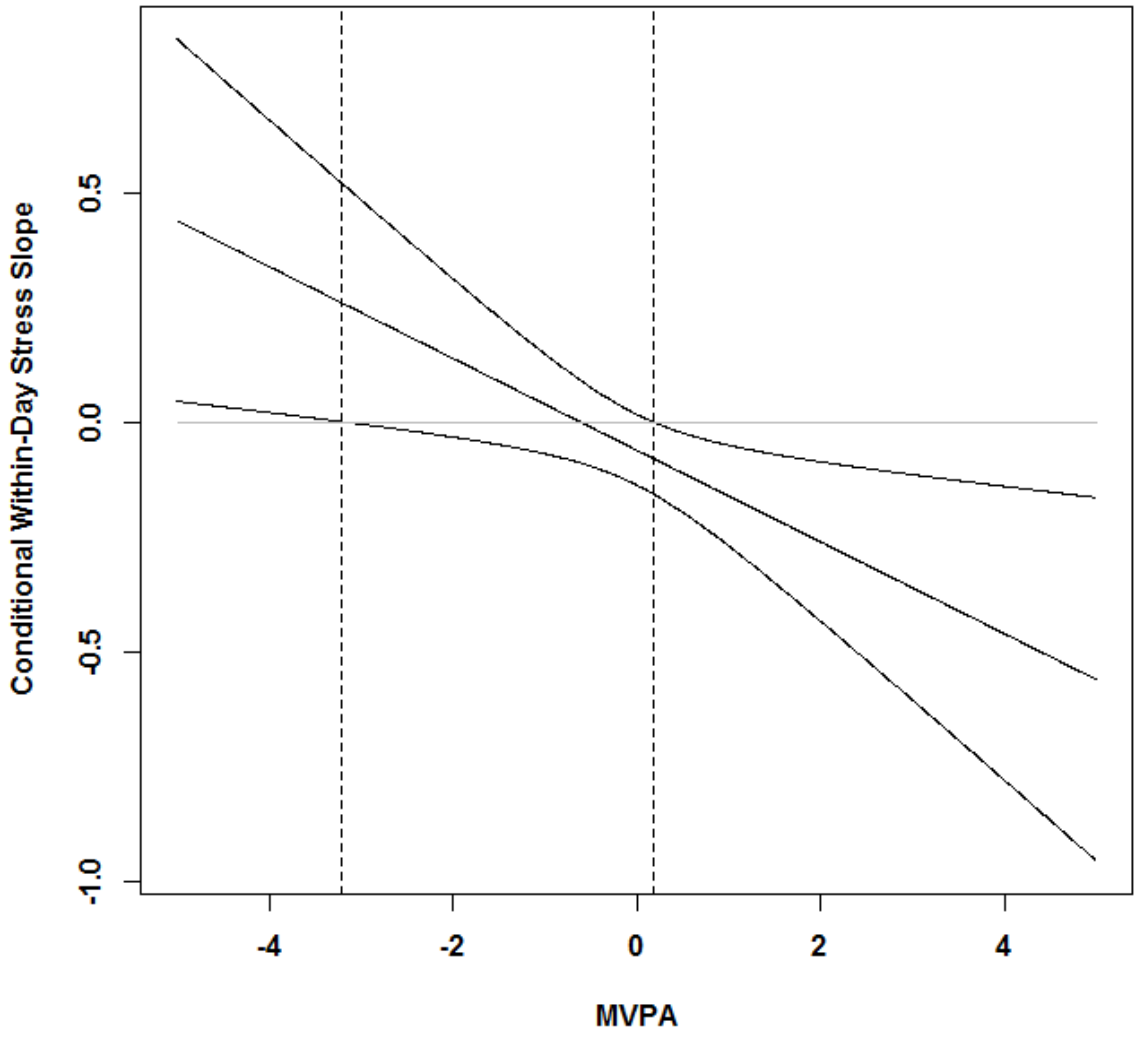
Fitted multilevel model for changes in stress (Model 4).

Estimates	Model 4	
	ß (*SE*)	95% *CI*
Fixed Effects		
Intercept	2.21 (0.28)	1.61 to 2.80
Time	-0.05 (0.04)	-0.12 to 0.03
Shame	-0.28 (0.25)	-0.76 to 0.21
Guilt	**0.46 (0.16)**	**0.15 to 0.78**
Pride	-0.09 (0.12)	-0.32 to 0.15
Shame x Time	0.17 (0.08)	0.00 to 0.33
Guilt x Time	-0.08 (0.05)	-0.18 to 0.03
Pride x Time	-0.05 (0.04)	-0.13 to 0.04
MVPA	0.22 (0.14)	-0.05 to 0.48
BD Shame	0.06 (0.27)	-0.48 to 0.59
BD Guilt	0.32 (0.24)	-0.15 to 0.79
BD Pride	-0.25 (0.14)	-0.52 to 0.04
MVPA x Time	**-0.11 (0.04)**	**-0.19 to -0.04**
MVPA x Time x Shame	0.00 (0.04)	-0.08 to 0.08
MVPA x Time x Guilt	-0.02 (0.03)	-0.08 to 0.04
MVPA x Time x Pride	-0.02 (0.03)	-0.07 to 0.04
BI Shame	1.30 (0.58)	-0.01 to 2.61
BI Guilt	-0.19 (0.57)	-1.46 to 1.09
BI Pride	0.38 (0.31)	-0.31 to 1.07
BI MVPA	0.27 (0.31)	-0.42 to 0.95
Age	-0.43 (0.28)	-1.06 to 0.20
BMI	0.05 (0.30)	-0.61 to 0.71
Stage	-0.67 (0.36)	-1.47 to 0.13
Wear Time	0.34 (0.29)	-0.31 to 0.98
Random Effects		
Level 1: Residual	1.58 (0.11)	1.39 to 1.80
Level 2: Intercept	1.34 (0.31)	0.85 to 2.10
Level 2: Slope	0.08 (0.02)	0.05 to 0.15
Level 2: Correlation	-0.25 (0.08)	-0.40 to -0.10
Level 3: Intercept	1.04 (0.53)	0.38 to 2.84
Level 3: Slope		
Level 3: Correlation		
Model Summary		
-2 log likelihood	2592.54	

Note. Model 4 adds the person-level control variables. MVPA = moderate-to-vigorous physical activity; BD = between day; BI = between individuals; BMI = body mass index; Stage = stage of breast cancer at diagnosis; Wear Time = wear time of accelerometers.

Figure 3.1.

The conditional mean of the within-day trajectory slopes for psychological stress across between-day MVPA (standardized).



Note. Lines either side of the conditional mean represent non-simultaneous 95% confidence bands. The vertical dashed line demarcates the point at which the confidence bands cross zero (i.e., the region of significance). MVPA = moderate-to-vigorous physical activity.

3.5 Discussion

This study of physically active women treated for breast cancer identified body-related emotions as intrapersonal sources of psychological stress by examining the relationship between body-related self-conscious emotions (i.e., shame, guilt, and pride) and stress, and the modulation effect of physical activity on these associations. Based on the findings, within day increases in body-related guilt predicted within day increases in stress, yet body-related shame and pride were not significantly associated with psychological stress and MVPA did not moderate this relationship. Moreover, as women engaged in more MVPA than their own average, their self-reported stress levels decreased over time, and when women engaged in less MVPA than their own average, their psychological stress levels increased over time. Taken together, these findings provide support for the importance of intervention strategies aimed at reducing negative body-related emotions and maintaining MVPA engagement for active women treated for breast cancer.

Contrary to expectations and previous research guided by social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004), within day body-related shame was not a significant predictor of within day psychological stress. Researchers have suggested that increased shame is associated with increased stress levels (Dickerson & Kemeny, 2004; Gruenewald et al., 2004; Dickerson et al., 2008) and correlates of stress, including greater reports of depression in healthy women (Ashby et al., 2006; Lewis, 1993). Yet, this relationship was not present within this sample of physically active breast cancer survivors at the within-day level. There are a few possible explanations for this null finding. First, the majority of participants reported that they never felt shame, which led to low variability in the scores. Low variability may be attributed to the women experiencing little to no body-related shame since they were several years post-diagnosis and treatment and may not be affected by any changes to the body attributed to breast cancer. Given the time that has passed, any treatment-induced changes may be managed or subsided and may not elicit body shame. Also, shame is a strong negative emotion that is tied to the person, with attributions of stable and uncontrollable features (Lewis, 1993; Tangney, 1998). The emotion may therefore be much stronger than is experienced regularly by this group of physically active women. A second reason for the lack of relationship between body-related shame and psychological stress may be explained from a measurement perspective. Body-related shame is an inherently aversive emotion (Tangney, 1998) and therefore may be more difficult to measure due to social desirability bias. Third, there may be no

association between body-related shame experiences and perceived stress. Previous findings have not focused on the body or women treated for breast cancer and studies did not measure the association multiple times per day (Dickerson & Kemeny, 2004; Gruenewald et al., 2004; Dickerson et al., 2008). Furthermore, since shame is contextualized and stress is not, this could impact the construct-indicator relationship, warranting future research measuring body contextualized stress in physically active women treated for breast cancer along various stages of the survivorship trajectory.

There was a significant association between body-related guilt and psychological stress. Researchers have shown that in general guilt can induce psychological outcomes such as tension and rumination (Gilbert, 1997; Tangney, 1998) and it has been associated with correlates of stress including depression and anxiety (e.g., Bybee & Quiles, 1998; Harder, Cutler, & Rock, 1992). Furthermore, women treated for cancer may feel greater body-related guilt and stress due to pressures regarding potential ill health and cancer recurrence (Zabora et al., 2001; Cohen, Janicki-Deverts, & Miller, 2007; Brunet, Sabiston, & Burke, 2013). Although body-related guilt has been associated with adaptive outcomes in previous literature (i.e., intrinsic motivation for physical activity), women who are participating in activities out of feelings of 'needing to' are likely more prone to feeling greater stress (Sabiston et al., 2010). In support of this, previous research with women treated for breast cancer found that a negative affect composite score that included guilt was associated with greater cortisol levels (Castonguay, Wrosch, & Sabiston, 2017). The present finding adds to the social self-preservation theory, body-related guilt, and stress literature by indicating that within this sample of active breast cancer survivors, when body-related guilt is higher than an individual's daily average, their concurrent stress levels are also higher. In addition, it highlights the importance of studying these variables at the within-person level in order to capture the momentary changes in emotions and stress. Body-related guilt may be an especially important self-conscious emotion to target in interventions committed to reducing experiences of stress among women treated for breast cancer. One strategy to reduce feelings of body-related guilt could be self-compassion as this may be the antidote to self-criticism (Neff, 2003). Since the self-conscious emotions are rooted in self-criticism, those who learn to practice self-compassion by observing their thoughts and emotions with empathy and kindness may experience reductions in negative self-conscious emotions such as guilt (Neff, 2003; Przezdziecki et al., 2013).

Contrary to hypotheses, body-related pride was not a significant predictor of lower levels of stress. Although in previous literature body-related pride has been associated with adaptive and pro-social behaviours including increased physical activity and volunteering (Sabiston et al., 2010; Williams & DeSteno, 2008), body-related pride has not been related to stress. More generally, results are mixed in studies examining the relationship between positive affect and stress (Van Eck et al., 1998; Zautra et al., 2002). In one study of males, positive affect was not related to self-report stress (Van Eck et al., 1998), meanwhile Zautra and colleagues (2002) found that in males, positive affect was lower during stressful experiences. For women, positive affect and self-report stress were negatively related (Jacobs et al., 2007). It is possible that positive affect but not body-related pride is associated with stress since positive affect includes feelings elicited in relation to the environment and include higher-activated states including excitement, while body-related pride are feelings elicited in response to a positive perception of one's characteristic or behaviour (Clark, Watson, & Leeka, 1989; Williams & DeSteno, 2008). Furthermore, the use of general stress and not contextualized stress could have impacted the null finding with body-related pride. Future research is needed to investigate whether this relationship differs when pride is separated into the two facets of authentic and hubristic pride.

In opposition to the hypotheses that higher reports of shame will be related to higher stress, higher or lower reports of guilt will be related to stress, and higher reports of pride will be related to lower stress, between-day and between-individual body-related shame, guilt, and pride were not significant predictors of psychological stress. First, within-day analyses may be more appropriate with these variables since emotions and stress fluctuate momentarily (Fleeson, 2001; Van Eck et al., 1998; Zautra et al., 2002) and therefore should be measured and analyzed at this level. Secondly, these null findings may be a result of a small sample size, which may have resulted in an inability to detect sufficient power in the associations between emotions and stress. Future work should attempt to test these associations with a larger sample size in order to increase power and the potential for significant relationships.

It was hypothesized that MVPA would moderate the relationship between body-related self-conscious emotions and psychological stress, however MVPA did not moderate the effects of guilt, pride, or shame on stress. This is surprising given the previous findings that self-report physical activity is associated with body-related self-conscious emotions in healthy adults and breast cancer survivors (Castonguay, Wrosch, & Pila, et al., 2017; Sabiston et al., 2010) and that

physical activity has been associated with decreased stress in cancer survivors (Belanger et al., 2012). However, the lack of moderation in the present study may be due to a ceiling effect occurring as a result of the active sample used. Women who are relatively inactive may accrue benefits more readily than those who are active (Furedy & Scher, 1989; Lord & Castell, 1994; Loprinzi, Cardinal, Winters-Stone, Smit, & Loprinzi, 2012; Vallance, Courneya, Plotnikoff, & Mackey, 2008), which may be why MVPA did not affect the relationship between emotions and stress in this active sample. Additionally, women who are more active may be less likely to associate their body-related guilt to physical activity because of their activity levels and therefore they may feel more positive towards their bodies (Courneya & Friedenreich, 1999; Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005; Speck et al., 2009).

In the present study, there was a significant time by MVPA interaction with psychological stress. Specifically, when women engaged in less MVPA than their average, psychological stress increased over time, whereas when women engaged in more MVPA than their average, psychological stress decreased over time. This is aligned with previous research whereby physical activity has been related to better mental health outcomes in breast cancer survivors (e.g., reduced symptoms of depression and emotional distress; Belanger et al., 2012; Brunet, Love, Ramphal, & Sabiston, 2014; Sabiston & Brunet, 2012). Furthermore, researchers suggest that physical activity participation reduces sensitivity to stressors and aids in the self-management of stress in cancer survivors (Bélanger et al., 2012; Sabiston & Brunet, 2012; Brunet et al., 2014; McBride, Clipp, Peterson, Lipkus, & Demark-Wahnefried, 2000; Salmon, 2001). This association between physical activity and psychological stress may be a result of various mechanisms including social support and biological processes (Brunet et al., 2014; Salmon, 2001), thus future research is warranted to study potential mechanisms that may be affecting this relationship. Findings from the present study indicate that when active women decrease their amount of MVPA they feel more stressed, meanwhile when they increase their engagement in MVPA, their stress decreases. The present finding is novel as it suggests that participating in MVPA may provide a buffering effect for psychological stress after treatment for breast cancer. The women in the present sample were quite active compared to other studies with women treated for breast cancer (Lynch et al., 2010; Sabiston, Brunet, Vallance, & Meterissian, 2014), thus the women's average MVPA in this sample is higher than the usual breast cancer survivor. Findings may be even more pronounced when examining a less active sample of

women, as they may accrue benefits more readily when they engage in greater MVPA than they usually do (Furedy & Scher, 1989; Loprinzi et al., 2012; Vallance et al., 2008). These results are promising for intervention strategies to promote engagement in MVPA after treatment for breast cancer.

3.5.1 Limitations, Future Directions, & Conclusion

Despite the novel findings within this sample of breast cancer survivors, the present study's limitations should be noted. First, participants self-selected into the study, which may have offered a sample that was homogenous, limiting the generalizability of the findings. Moreover, in this sample, there was a wide range in the time since women completed primary treatment for breast cancer. Although their breast cancer diagnosis and treatment may have been some time ago, the changes to their body may be permanent and remain a factor in the psychological response to a stressor. Future work should attempt to recruit women through all stages of survivorship to tease apart the influence of breast cancer diagnosis and treatment on these findings. Secondly, the use of self-report measures allows for the possibility of common limitations that accompany this type of measure including social desirability and reporting biases (Prince et al., 2008; Sallis & Saelens, 2010). However, the experience sampling method provides advantages over typical self-report methods as it increases ecological validity and reduces retrospective recall bias (Shiffman et al., 2008). Finally, causal inference cannot be ascertained, as the present study did not use an experimental design, however non-laboratory methods help to advance our knowledge of the relationships between the variables studied. Future work is warranted to further disentangle these relationships.

Notwithstanding the aforementioned limitations, this is the first study of its kind to examine body-related self-conscious emotions using an experience sampling method, allowing for a study of transitory changes in body-related emotions, reducing biases related to retrospection. Secondly, experience sampling method has not been regularly used with women treated for breast cancer nor active breast cancer survivors, permitting the study of this sample in their natural environment to better understand their experiences post-cancer treatment. Lastly, the use of objective physical activity allowed for a more robust measure of participants' engagement in MVPA.

These findings provide support for the integration of self-objectification theory (Fredrickson & Roberts, 1997) and social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004) for researchers studying body-related emotions and stress, and factors affecting this relationship. Furthermore, this study's findings promote the implementation of intervention strategies for reducing breast cancer survivors' stress experiences by targeting negative body-related self-conscious emotions through the use of self-compassion techniques and maintenance of MVPA by means of educational awareness and the adoption of individualized physical activity programs. In conclusion, understanding active women treated for breast cancer at the individual momentary level may be the key to fostering their physical and psychological health and well-being.

Chapter 4
General Discussion

4 General Discussion

One in eight Canadian women will be diagnosed with breast cancer during her lifetime (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017). With pronounced improvements in breast cancer detection and treatment, the number of women who are surviving breast cancer is growing (Canadian Cancer Society's Advisory Committee on Cancer Statistics, 2017). Yet, women treated for breast cancer experience new challenges associated with changes to their bodies, which may provoke experiences of body-related self-conscious emotions (i.e., shame, guilt, and pride) and stress (Andrykowski et al., 2008; Gilbert, 1997; White, 2012; Zabora et al., 2001). Negative body-related emotions have been associated with decreased self esteem, depression, and anxiety (Ashby et al., 2006; Bessenoff & Snow, 2006; Bybee & Quiles, 1998; Lewis, 1993), and stress has been associated with decreases in immune parameters, and increases in early mortality rates, depression, and anxiety (Anderson et al., 1989; Sephton et al., 2000), highlighting the importance of studying emotion and stress processes within this population. Furthermore, physical activity could play a crucial role in moderating the relationship as it may provide protective effects of emotion on stress. The current body of research attempted to fill gaps within the literature.

The present study utilized an experience sampling method (Hektner et al., 2007) to identify body-related emotions as intrapersonal sources of psychological stress among physically active women treated for breast cancer by examining the between- and within- associations (inter- and intra-individual effects) between body-related self-conscious emotions and psychological stress, and whether physical activity moderated this relationship. Women treated for breast cancer that reported greater body-related guilt also reported greater stress at the same time point. This finding was likely a result of perceived pressures to be healthy that motivate these women to make healthful choices, and their failure to do so, leads to greater feelings of guilt and stress (Zabora et al., 2001; Cohen et al., 2007; Sabiston et al., 2010). In addition, when women engaged in greater MVPA than they usually did, their stress levels decreased over time, while when they engaged in less MVPA than they usually did, their stress levels increased over time. This finding may be due to physical activity participation aiding in the management of stress experiences and

reactivity to stressful situations and events (Bélanger et al., 2012; Sabiston & Brunet, 2012; Brunet et al., 2014; McBride et al., 2000; Salmon, 2001). Taken together, these findings provide support for promoting interventions aimed at reducing negative self-conscious emotions and promoting sustainable physical activity programming for women treated for breast cancer.

4.1 Theoretical Implications

The present study offers valuable insights and advancements for self-objectification theory (Fredrickson & Roberts, 1997), the process model of self-conscious emotions (Tracy & Robins, 2004), and social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004). Self-objectification theory (Fredrickson & Roberts, 1997) helped to explain why the body related emotions were experienced and why these emotions were related to stress. Similarly, the process model of self-conscious emotions (Tracy & Robins, 2004) also explained why the body emotions were experienced; meanwhile social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004) covered the elicitation of stress and the relationship between body-related emotions and stress. The integration of constructs and mechanisms from the theories and models helped to explain the associations that were examined in the present study.

4.1.1 Self-objectification theory

In the present study, there was an emphasis on self-objectification theory (Fredrickson & Roberts, 1997) as a framework for understanding the occurrence of body-related self-conscious emotions. Self-objectification theory stipulates that due to the sexualisation of women in society, women view themselves as objects and evaluate themselves based on their physical appearance (Fredrickson & Roberts, 1997). Based on this evaluation, women engage in body monitoring and make attempts to conform to societal appearance norms. This process may lead to feelings of body shame, stress, and negative behavioural outcomes including depression (Fredrickson & Roberts, 1997). For the current study, the values of self-objectification theory offered an explanation for the reports of negative body-related self-conscious emotions, namely shame and guilt. Nonetheless, women in the current study reported low scores on the shame measures at the trait and state level. And so, this active cohort of women treated for breast cancer may not experience body shame from sexualisation and internalization that self-objectification theory

posits. Instead, this sample may experience lower shame, as they may not have negative feelings of the self but rather negative feelings associated with their behaviour.

Furthermore, self-objectification theory helps to explain the relationship between the body emotions and psychological stress. While the findings associating guilt and stress were aligned with self-objectification theory, the mechanisms outlined within the theory were not tested empirically. Specifically, internalization of others' evaluations of the body was not measured within this study. Some women treated for breast cancer may experience a loss of femininity due to the disfigurement or loss of one or both breasts, a body part that is closely tied to femininity and sexuality in a social and societal context (Helms et al., 2008). In light of the fact that women may receive various treatments for breast cancer and may choose to have reconstructive surgery, it would be valuable for future researchers to study the internalization of feminine ideals to uncover whether internalization is a mechanism by which greater negative body emotions and subsequent stress are experienced. Similarly, body surveillance and its potential association with psychological outcomes through the mechanism of body-emotions were not measured. Future work should attempt to measure self-reported body surveillance in order to better elucidate the cause of experiencing body-related self-conscious emotions, which may further inform interventions designed to reduce occurrences of negative body-related emotions in women treated for breast cancer. Active women may not uniformly experience internalization and body surveillance post-treatment since they are likely adaptively coping with their diagnosis and treatment, therefore, studying these mechanisms may counter tenets of this theory and thus are worthwhile avenues for future research.

4.1.2 Process model of self conscious emotions

As proposed by Tracy and Robins (2004), the process model of self-conscious emotions, demonstrates how an individual experiences self-conscious emotions in general. This model can be used to understand how body-related shame and guilt are provoked. The process model posits that shame is elicited in response to stable, controllable, and global internal attributions causing avoidance, while guilt is elicited by unstable, uncontrollable, and specific internal attributions leading the individual to want to resolve the situation or event that caused this feeling (Tracy & Robins, 2004; 2006). And so, guilt may motivate reparative action and adaptive outcomes, while shame may motivate maladaptive outcomes. Little is known about whether body-related guilt

can elicit adaptive outcomes similar to guilt in general (Calogero & Pina, 2011). Body-related guilt has been associated with behaviours such as increased physical activity; however engaging in physical activity out of feelings of body-related guilt is inherently maladaptive and likely unsustainable (Sabiston et al., 2010). In the present study increases in body-related guilt were associated with increases in psychological stress, supporting the notion that body-related guilt can produce maladaptive outcomes. This finding lends to the need for the inclusion of body-related emotions in the model since the experience of body-related guilt may yield greater negative consequences than guilt in general (Calogero & Pina, 2011).

Body-related shame was not greatly experienced by the women in the present study, but body-guilt and pride were experienced more readily. Therefore, the controllable and global attributions cited by the process model, as elicitors of body shame were likely not present in this sample of active women. The women in this study had overcome cancer and it is conceivable that they do not have negative feelings surrounding the self but rather just their behaviour. It would be worthwhile to study the attributions experienced by the women in order to better understand why they did not experience body-related shame. Furthermore, findings from this study suggest the need to continue researching the body-related emotions to tease apart their behavioural outcomes acutely and longitudinally.

4.1.3 Social self-preservation theory

Much research examining self-conscious emotions and stress has utilized social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004). This theory suggests that individuals attempt to protect their position in the social hierarchy, and when they feel that this position may be threatened, a psychobiological response occurs, whereby psychological (e.g., shame) and physiological (e.g., cortisol) responses are elicited. Psychologically, shame may be elicited in response to perceived failure to maintain one's social status, while pride may be elicited in response to perceived success for social status maintenance or moving up the social hierarchy (Nesse & Ellsworth, 2009). Yet, general shame has been more commonly studied using the social self-preservation theory than pride and guilt, and no studies have researched body-related emotions using this theory. The present research applied social self-preservation theory to body-related emotions and stress levels in women treated for breast cancer. In support of this theory, increases in body-related guilt were associated with concurrent increases in

psychological stress. These findings support the use of social self-preservation theory with negative body-related self-conscious emotions and provide opportunity for extending the psychological responses to include body-related guilt. Future research is needed to examine the potential inclusion of body-related envy and embarrassment as the occurrences of these negative emotions may be associated with stress and could be elicited by social status factors.

4.1.4 Integration of theoretical frameworks

Taken together, the present study's findings informed the integration of self-objectification theory (Fredrickson & Roberts, 1997), the process model of self-conscious emotions (Tracey & Robins, 2004; 2007), and social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004) in women treated for breast cancer. The integration of theories provides a more effective approach to understanding factors that influence outcomes in health research. Through this integration, the essential variables are used to better inform interventions (Hagger, 2009). First, the tenets of self-objectification theory (Fredrickson & Roberts, 1997) helped to elucidate how body-related changes from cancer treatment perceived through internalizations of female appearance norms may have influenced the elicitation of body-related self-conscious emotions. Additionally, the process model of self-conscious emotions (Tracey & Robins, 2004; 2007) highlights how an individuals' perception of the changes to their body lead to guilt. Finally, social self-preservation theory (Kemeny et al., 2004; Dickerson & Gruenewald, et al., 2004) is suitable to explain how a stressor provokes the experience of body-related self-conscious emotions and stress, how these variables are associated, and how factors may impact the elicitation of them. Integrating these three theories is a worthwhile endeavour for researchers interested in the association between body-related emotions and stress, and factors that may influence this relationship. Future research is warranted to measure the surveillance and internalization principles of self-objectification theory, the attributions of the process model, the possible mediating factors between body-guilt and stress, and to examine how the present associations may affect physical and psychological health outcomes.

4.2 Methodological implications

The present study is the first attempt to examine the natural momentary associations between body-related emotions and psychological stress and the moderating role of physical activity within women treated for breast cancer. There are a number of methodological implications

based on the current work. First, the sample was purposeful and targeted active women. The emphasis on women who were part of a physical activity program was due to the need to understand processes that may limit maintenance or sustainability of activity. Since physical activity tends to occur in a social and judgment based context (Gruenewald et al., 2004; Martin Ginis & Bassett, 2012; McDonough, Sabiston, Ullrich-French, 2011), it was important to explore the emotions that are reported during a week, how they relate to stress, and how active lifestyles may modulate the association.

A second methodological advancement is the use of accelerometers to measure physical activity, which allowed for an objective account of time spent in MVPA. This measurement protocol reduces limitations of self-report measures including social desirability (Prince et al., 2008). Additionally, the test of state-level body-related emotions (two negative and one positive emotion) multiple times per day permitted the measurement of these transient emotions over time in response to acute situations and events. The phenomenological body-related emotions measure (adapted from Pila et al., 2014) that was used enabled women to answer simply and quickly in order to reduce burden, while also removing the use of scenarios that are found in other measures of self conscious emotions but may not be applicable to women treated for breast cancer (Thompson, Dinnel, & Dill, 2003). It is important to note that there is no standard recognized for measuring body-related emotions at the momentary level, therefore future research is warranted to assess the presently used measures and to test their validity within women treated for breast cancer.

Studies that examine data collected within the participant's natural environment over a period of time have several advantages when compared with typical self-report methods (Shiffman et al., 2008). Strengths of this method include a reduction in retrospective recall bias, systematic and random sources of measurement error, and an increase in ecological validity (Bolger et al., 2003; Duncan, Jones, & Moon, 1998; Shiffman et al., 2008; Stone & Shiffman, 2002). It also provides the opportunity to examine the temporal ordering of emotions and psychological stress (Shiffman et al., 2008). Furthermore, this method aids in the understanding of the between- and within-person differences in the association of body-related emotions on stress levels. Multilevel modeling is used in order to gain insights on the overall effect as well as individual variation in the associations and it considers the complexity of the data (Curran & Bauer, 2011; Duncan et

al., 1998). Overall, the present study has numerous methodological strengths and can impact the emotion and stress literature in women treated for breast cancer.

4.3 Practical implications

4.3.1 Body-related self-conscious emotions interventions

The experiences of negative body-related emotions may lead to maladaptive health outcomes so their reduction or management is necessary as this may have a beneficial impact on an individual's overall wellbeing. Although there were low levels of reported body shame in the present sample, women's feelings of body-related guilt were associated with concurrent experiences of stress, warranting the implementation of body-related self-conscious emotions interventions.

Interventions designed to reduce negative body-related self-conscious emotions would benefit from teaching and practicing self-compassion. Self-compassion is a method used to internally cope by recognizing one's suffering and being understanding of shortfalls and failures while acknowledging that others also experience similar feelings (Neff, 2003). By practicing to be more self-compassionate, an individual will become aware of their emotions, be kind through that acknowledgement, and be less critical and avoidant of them (Neff, 2003). Previous research has shown that self-compassion training is associated with reduced shame in a clinical population with various psychological diagnoses (Gilbert & Procter, 2006) and researchers suggest that it may be useful to use with women treated for cancer (Przezdziecki et al., 2012).

Interventions that are focused on compassion may prove useful since self-compassion can replace negative emotions with more positive emotions, especially when enduring a stressful situation or event (Thompson, 1994). Women treated for breast cancer may find self-compassion interventions to be valuable for learning how to properly react to their treatment-related bodily changes. The skills developed through this intervention may help women to recognize that the changes to their body are a result of treatment and that this is a usual outcome of breast cancer. Facing one's feelings and emotions head-on is a step in becoming more self-compassionate and can often be done through mindfulness (Neff, 2003). Mindfulness requires flexibility in one's mentality (Langer, 1989) and can help provide greater clarity in an individual's experiences. When an individual is not practicing mindfulness their negative emotions are associated with

failure or inadequacies (Neff, 2003). Therefore, by implementing a more mindful and self-compassionate attitude could greatly benefit women after breast cancer. Since women in the present study who experienced greater guilt also experienced more stress, they are likely to benefit greatly from developing a more compassionate attitude towards their actions. Furthermore, by adopting a self-compassionate outlook women treated for breast cancer may reduce their negative body-related emotional experiences and in turn lessen their stress levels, decreasing their chances of developing numerous negative physical and mental health outcomes. Interventions that may be beneficial to implement could consider including self-directed writing exercises (Mosewich & Kowalski, 2011) and the use of technology.

4.3.2 Physical activity interventions

Tailoring physical activity interventions to the specific individual may prove to be beneficial. The present study found that physical activity at a moderate-to-vigorous intensity was a buffer for psychological stress over time. Therefore, utilizing interventions that focus on education and individualization may help to maintain women's MVPA. The efforts of this intervention need to be focused on maintaining women's activity levels so they can continue to experience positive health outcomes. Active women treated for breast cancer could benefit from educational strategies aimed at explaining the benefits of engaging in MVPA, such as the reduction in perceived stress. In addition to educational training, interventions can include individualized sessions focused on choosing physical activities based on enjoyment and brainstorming strategies to overcome potential or experienced barriers specific to each woman, such as feelings of higher guilt. Recently, researchers have been utilizing education and personalized approaches to increase physical activity in cancer survivors (Kuijpers, Groen, Aaronson, & van Harten, 2013), however, using these intervention strategies for maintenance of physical activity with women treated for breast cancer would be a novel approach. By providing further education and tailoring programs to the individuals' preferences and needs, women treated for breast cancer may maintain their high levels of physical activity.

4.3.3 Leveraging technology

Women treated for breast cancer may experience greater stress therefore utilizing interventions designed to maintain physical activity and decrease negative body-related emotions may increase their overall wellbeing. In the current study, the women were asked to complete an online

questionnaire multiple times per day. As such, technology could be harnessed for delivering interventions for self-compassion and physical activity. Technology-based interventions could be delivered during any part of the survivorship trajectory by a multidisciplinary team including individuals such as kinesiologists, nurses, and researchers.

First, self-compassion interventions delivered through the Internet have shown promise for reducing body dissatisfaction and increasing self-compassion in healthy adult women (e.g., Albertson, Neff, & Dill-Shackleford, 2014). As such, utilizing a web- or app-based design could allow for efficient delivery of information regarding self-compassion. Interventions designed to reduce negative body-related emotions could focus on education and practicing self-compassion. Short self-compassion and mindfulness interventions have been shown to be effective, therefore a short technology-based intervention could be implemented from this study's findings (e.g., Gluck & Maercker, 2011). Intervention strategies could focus on learning meditation and practicing mindfulness and self-compassion through exercises in order to increase kindness towards oneself. This may be done online through a website and/or through a compatible app on ones personal phone. Women may complete educational sessions three times per week and have exercises to complete four times per week. Moreover, women could have access to an online chat system whereby an expert in self-compassion is present to answer any questions the women may have or barriers they may be experiencing to completing the tasks. Through the use of technology, self-compassion interventions may be readily implemented with the main goal of increasing self-compassion and decreasing negative body related emotions.

Secondly, numerous web- and app-based designs have recently been used for delivering physical activity interventions in chronic disease populations (Kuijpers et al., 2013). One method that can be used to provide a physical activity intervention incorporating knowledge and tailored programs may be through technology. From a knowledge standpoint, women could access information on physical activity benefits and related information (e.g., physical activity types, intensities, example exercises, etc.) for breast cancer survivors in an interactive way. Additionally, from a tailored program standpoint, a map could be incorporated whereby individuals locate physical activity opportunities in their area, as well as detailed information on them (e.g., credentials of trainer who leads the program, approximate cost, type and intensity of physical activity offered, schedule, how to get involved, etc.). Furthermore, individuals can have access to an expert who can answer any questions and help the women problem solve when

barriers are experienced. Many women in the present study were receptive to using technology to answer questionnaires; therefore it is reasonable to presume that women treated for breast cancer would be accepting of using technology for interventions. Overall, technology can be used to enrich self-compassion and physical activity interventions, making it a tool worthy for future research to implement and examine.

4.4 Limitations and Future Directions

Despite the strengths of the present study, there are limitations that need to be acknowledged. First, the method of sampling chosen (i.e., fixed interval) may have induced systematic bias rather than randomly capturing the emotions and stress throughout the day, yet this method was preferred among the present sample and may have improved response rates. Additionally, although the anticipation of the diary report may have lead participants to change behaviours or become more aware of their affective states and stress levels (Bolger et al., 2003), research suggests this type of sampling produces minimal problems (e.g., Conti, 2000; Hufford, Shields, Shiffman, Paty, & Balabanis, 2002). Therefore, it is recommended that researchers consider their participants when choosing their method of sampling. Secondly, state level pride was measured simply as ‘proud’ rather than separating the two facets of authentic and hubristic pride (Pila et al., 2014). This was done to reduce ambiguity, simplify the measure that was collected six times per day, and reduce burden on participants. However, future research would benefit from utilizing both facets of pride and in order to increase understanding of the distinction between the two facets, researchers should consider having a short information session, as well as including simple definitions and examples for participants to take home. Third, since the presence of supportive others may provide protective effects by attenuating stress responses (Lepore, 1998; Uchino, 2006) future work in this area should include a measure of social support to better understand the mechanisms between body-related emotions, physical activity, and stress. Finally, a comparison control group of age matched women without a cancer diagnosis was not included in the present study, however including a control group in future research would help to tease apart the cancer-related factors that contribute to the associations found in this study.

4.5 Conclusion

In conclusion, the present study provided important contributions to the literature by theoretical, methodological, and practical means. The utilization of an experience sampling design is a

highly desirable method for examining changes in emotion and stress experiences within and between individuals over time. The present findings make a substantial contribution to the literature since this is the first study to assess within- and between-person fluctuations in body-related emotions and psychological stress with women treated for breast cancer. This work demonstrates that negative body-related self-conscious emotions are related to psychological stress post-treatment and that engagement in physical activity may be an avenue used to protect against stress experiences. These findings can be used to inform interventions designed to reduce negative body-related self-conscious emotions by using compassionate-focused strategies and to continue participation in MVPA through the use of tailored education and program maintenance techniques. Overall, the present work aids in uncovering strategies to promote physical and psychological health and well-being among women treated for breast cancer.

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Appendix A: Supplementary Analysis

In order to test body-related emotions (i.e., shame, guilt, pride) as intrapersonal sources of physiological stress among physically active women treated for breast cancer, the between- and within- associations (inter- and intra-individual effects) of body-related self-conscious emotions and physiological stress and the potential moderation effect of physical activity on this relationship were examined. Diurnal cortisol was measured as an indication of physiological stress during normal daily activities on three non-consecutive days. Non-consecutive days were used in an attempt to minimize the possibility of uncommon stressful experiences that may occur on one particular day (Stewart & Seeman, 2000). Participants were asked to measure their cortisol five times per day (i.e., at awakening, 30 minutes after awakening, 2 p.m., 4 p.m., and before bedtime) and record the exact time of cortisol collection. Measurements were taken multiple times per day in order to assess the typical diurnal rhythm of cortisol (Stewart & Seeman, 2000; Miller et al., 2007).

Importantly, participants were asked to not eat or brush their teeth immediately prior to saliva collection to prevent contamination with food or blood. Salivettes® (Sarstedt, Nümbrecht, Germany) were used to measure cortisol and were stored in participants' refrigerators until the seven-day period was over, upon which participants returned the samples to the laboratory. Samples were stored in a -80°C laboratory freezer until they were assayed in duplicate at the University of Trier (Dressendorfer, Kirschbaum, Rohde, Stahl, Strasburger, 1992). Intra-assay coefficient of variation was 4.80% and the inter-assay variability from cortisol analyses performed in this laboratory has been consistently below 10% (e.g., Lieb et al., 2004). The area under the curve (AUC) of the cortisol secretion was calculated for each day using the trapezoidal method (Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). When a single saliva sample was missing it was replaced by the sample mean for that time of day. Furthermore, the 30-minute post-wake up measurement was excluded from the AUC calculations since researchers suggest it is independent from the diurnal rhythm of cortisol (Chida & Steptoe, 2009).

Multilevel modeling was used to test the relationship of between day body-related self-conscious emotions and physiological stress and whether between person MVPA moderated the relationship. The analyses were estimated with Level 1 as days (between-day effects) and Level

2 as individuals (between-person effects) and controlled for age, stage of breast cancer at diagnosis, body mass index, and wear time of accelerometers. Growth curve models were conducted using SPSS MIXED (version 23) and were tested with restricted full maximum likelihood estimation (Snijders & Bosker, 2012).

Means, standard deviations, and bivariate correlation coefficients are presented in Table A.1. On average, women secreted about 10.5 log nmol/Lxh of cortisol. Estimates for the fitted growth models of physiological stress are displayed in Table A.2. The unconditional growth model (Model 1) showed that the average initial daily stress value was 10.60 and that stress tended to decrease with time but that this decrease was not significant (β = -0.05, SE = .28, $p > .05$). At level 1 no main or interaction effects emerged. At Level 2, between-day pride positively predicted between-day physiological stress (β = 1.69, SE = .76 $p < .05$), indicating that on days when individuals reported above mean deviations in pride they tended to experience higher stress. In addition, there was a significant interaction of between-day pride and time (β = -0.62, SE = .29, $p < .05$), demonstrating that on days when women reported above mean deviations in pride they experienced less stress over time. Moreover, between-person MVPA negatively predicted physiological stress (β = -1.46, SE = .61, $p < .05$) suggesting that when women engaged in greater MVPA than the sample mean, they experienced less stress. Lastly, between-person pride negatively predicted between-day physiological stress (β = -2.16, SE = .81 $p < .05$), indicating that when individuals reported greater pride than the sample mean, they experienced less stress. No additional main or three-way interactions emerged.

These supplementary results suggest that active women treated for breast cancer that have higher levels of between day body pride also have higher physiological stress on the same day, yet over time their stress levels decrease and when they feel greater trait body-related pride they experience lower physiological stress. Furthermore, when the active women are engaging in greater MVPA they experience less physiological stress, suggesting that implementing interventions aimed at maintenance of MVPA is a worthwhile avenue of research. These findings lend to the importance of teasing apart authentic and hubristic pride as they may differently relate to pride at the state and trait level. Hubristic pride experienced on one day may increase stress, yet authentic pride may be more adaptive and may decrease physiological stress. Therefore, future research is needed to measure authentic and hubristic body-related pride within

and between active women treated for breast cancer and to implement interventions to maintain women's higher levels of physical activity at the moderate to vigorous intensity.

Table A.1

Means, standard deviations, and bivariate correlations for the variables (N = 20).

	M (SD)	1	2	3	4	5	6	7	8	9
1. Body-related shame (Mean)	1.10 (0.35)	-								
2. Body-related guilt (Mean)	1.30 (0.67)	.87**	-							
3. Body-related pride (Mean)	2.32 (1.26)	-.03	-.03	-						
4. Objective MVPA, min/week	270.08 (149.60)	-.11	-.01	-.11	-					
5. Physiological stress	10.58 (2.23)	-.07	-.10	-.14	-.30*	-				
6. Age	58.4 (9.15)	.05	-.11	.28*	-.25	-.10	-			
7. Stage	1.90 (1.12)	.20	.16	.39**	.22	.03	.13	-		
8. BMI	24.6 (3.73)	-.18	-.28*	.33	.06	-.04	.13	.29*	-	
9. Wear Time (Mean)	992.54 (43.58)	-.11	-.13	-.24	.07	.43**	-.06	.05	.11	-

Note. Weekly averages of body-related guilt, body-related shame, body-related pride, and objective MVPA were used to calculate correlations; MVPA = moderate-to-vigorous physical activity; Stage = stage of cancer at diagnosis; BMI = body mass index; Wear Time = wear time of accelerometers.

* $p < .05$. ** $p < .001$.

Table A.2

Fitted multilevel models for changes in stress.

Estimates	Model 1		Model 2		Model 3	
	ß (*SE*)	95% *CI*	ß (*SE*)	95% *CI*	ß (*SE*)	95% *CI*
Fixed Effects						
Intercept	10.60 (0.80)	8.94 to 12.25	10.74 (0.69)	9.29 to 12.19	10.48 (0.58)	9.02 to 11.94
Time	-0.05 (0.28)	-0.60 to 0.51	-0.12 (0.33)	-0.81 to 0.57	-0.01 (0.33)	-0.71 to 0.69
Shame			1.42 (1.43)	-1.48 to 4.32	-0.74 (1.64)	-4.17 to 2.71
Guilt			-0.96 (0.90)	-2.78 to 0.86	-0.10 (1.09)	-2.29 to 2.10
Pride			0.66 (0.59)	-0.54 to 1.86	**1.69 (0.76)**	**0.14 to 3.24**
Shame x Time			-0.98 (0.77)	-2.60 to 0.64	-0.12 (1.07)	-2.30 to 2.07
Guilt x Time			0.59 (0.65)	-0.92 to 2.11	055 (0.93)	-1.35 to 2.45
Pride x Time			-0.49 (0.31)	-1.14 to 0.15	**-.62 (0.29)**	**-1.23 to -0.01**
MVPA					**-1.46 (0.61)**	**-2.90 to -0.02**
MVPA x Time					0.26 (0.28)	-0.36 to 0.88
MVPA x Time x Shame					-0.05 (0.60)	-1.85 to 1.74
MVPA x Time x Guilt					-0.21 (0.52)	-2.27 to 1.86
MVPA x Time x Pride					0.16 (0.33)	-21.42 to 41.75
BI Shame					0.59 (1.02)	-4.16 to 5.35
BI Guilt					-1.24 (1.03)	-4.92 to 2.44
BI Pride					**-2.16 (0.81)**	**-4.21 to -0.12**
Age					-0.53 (0.50)	-8.31 to 7.25
BMI					-0.71 (0.57)	-2.51 to 1.09
Stage					1.21 (0.61)	-1.40 to 3.83
Wear Time					0.72 (0.31)	-0.48 to 1.92
Random Effects						
Level 1: Residual	2.84 (0.65)	1.82 to 4.44	2.92 (0.95)	1.55 to 5.52	2.38 (0.87)	1.16 to 4.86
Level 2: Intercept	6.08 (3.50)	1.96 to 18.79	3.65 (3.72)	0.50 to 26.86	1.95 (5.06)	0.01 to 317.32
Level 2: Slope	-0.73 (0.75)	-2.20 to 0.74	-0.48 (1.91)	-4.23 to 3.27	-0.22 (4.28)	-8.60 to 8.16
Model Summary						
-2 log likelihood	265.36		258.76		231.62	

Note. Model 1 is an unconditional growth model. Model 2 adds the between-day predictors. Model 3 adds the person-level predictors and control variables. MVPA = moderate-to-vigorous physical activity; BD = between day; BI = between individuals; BMI = body mass index; Stage = stage of breast cancer at diagnosis; Wear Time = wear time of accelerometers.

Appendix B: Information form and informed consent

Information form

UNIVERSITY OF TORONTO
FACULTY OF KINESIOLOGY & PHYSICAL EDUCATION

Title of Study: Emotions, physical activity, and stress among breast cancer survivors

Researchers: Madison Vani, BA; Catherine Sabiston, PhD

Dear Participant,

Introduction: The investigators are members of the Health Behaviour and Emotion Lab at the University of Toronto with an interest in physical activity behaviour and wellbeing. This study will be apart of Madison Vani's Master's thesis. For this study, we are looking at how the relationship between emotion and stress is affected by physical activity among breast cancer survivors in physical activity programs.

Purpose: The purpose of this study is to better understand the relationship between emotions and stress in breast cancer survivors, and how physical activity may affect this relationship. Attention to the role of emotion and stress in breast cancer survivors' lives is important for their overall wellbeing. This research is being conducted because current findings show that breast cancer survivors experience more stress than the general population. Moreover, emotions may play a role in experiences of stress. Furthermore, physical activity may impact the relationship between emotions and stress. As such, understanding these relationships is necessary, as it is important to understand how to reduce stress in breast cancer survivors.

Involvement: Your involvement would be greatly appreciated and will help to further our understanding of how emotions and stress may be impacted by participation in physical activity.

You can participate in this study if you: (a) are between the ages of 18 and 99; (b) have completed primary treatment (i.e., surgery, chemotherapy, and radiotherapy) for cancer; (c) are a participant in a physical activity program; (d) able to read and write in English; (e) do not have any underlying medical concerns that would impact physical activity; (f) are not currently taking anti-depressants or corticosteroids; and (g) do not currently smoke.

Should you choose to participate, we will ask that you complete a short questionnaire package at the beginning of your training program **that will take approximately 20 minutes to complete**. In addition, your participation in this study will involve completing multiple daily questionnaires that will take **approximately 3-4 minutes of your time per questionnaire**. Questionnaires will be completed six times a day for seven days. In addition, during this seven-day period, you will be required to wear accelerometers daily and measure your stress (cortisol) via saliva samples five times per day on three non-consecutive days. We ask that you wear accelerometers daily to track your physical activity patterns during these times. Finally, we are asking that you take

measures of your stress hormone cortisol through saliva samples, as we are interested in how your physiological stress levels may change with physical activity involvement.

Participation in this study is voluntary and individuals may decline answering any question(s) that you choose. Please also note that choosing to participate (or not) in the study will not negatively impact you in any way in terms of your participation in the physical activity program or association to the organizing sites. You may choose to decline or withdraw your participation at any time throughout the course of the study up until the data have been merged and personally identifying information have been erased.

Finally, we are offering everyone who volunteers to be a participant in our project $50 for their time and effort with the study. Compensation will be offered at the completion of the study. If participants withdraw early, they will receive $5 per completed day.

Benefits and Risks: There are a number of benefits associated with participating in this study. First, participation in this research study may translate into increased knowledge regarding your emotional experiences, and the associations between emotions, physical activity, and stress. Such information may be useful in increasing your overall wellbeing. Secondly, information gained may benefit the larger community by providing information that will likely be used to improve the lives of breast cancer survivors. Finally, the information gained from this study can be used to implement interventions designed to improve breast cancer survivors overall wellbeing. As with any research study, there are risks that are not known. It is possible that upon reflection of your experiences, the questions may lead to some positive or negative emotions. You are under no obligation to answer every question in the survey.

Confidentiality: Any information that is provided from participants will be treated with confidentiality and access to all information that might identify participants will be limited to members of the research team. The study findings will be disseminated in academic journals and conference presentations; however, the specific identity of any participant in the study will not be disclosed in these outlets. In this way, the information you provide is protected and details will not be shared or published in any way. Anonymity will be possible once all data is collected, however we are asking for your date of birth and email address in order to connect the responses you share over the seven-day period. After these time points have been matched, any identifying information will be erased from the data file. Once the data have been de-identified, they can no longer be removed from the database upon request. All recorded data will **be encrypted and kept on a password-protected computer** accessible only to members of the research team. Consistent with guidelines that control the collection and storage of scientific information in Canada, all data collected for this study will be destroyed five years following the completion of the investigation.

The study has been reviewed and has received ethics clearance through the Research Ethics Board at the University of Toronto (File # 32897).

Should you have any further questions concerning the study in general, please feel free to contact: Madison Vani by e-mail at madison.vani@mail.utoronto.ca.

Informed consent

UNIVERSITY OF TORONTO
FACULTY OF KINESIOLOGY & PHYSICAL EDUCATION

Informed Consent

Title of Study:	Emotions, physical activity, and stress among breast cancer survivors
Researchers:	Madison Vani, BA, University of Toronto; Dr. Catherine Sabiston, PhD, University of Toronto

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You have been invited to participate in a research study. The purpose of this study is to better understand the associations between emotions, physical activity, and stress in breast cancer survivors.

I understand that:

- I have read the Information Form provided to me through members of the research team conducting the research.
- I understand that participation will involve completing questionnaires multiple times daily during a physical activity program, wearing accelerometers, and taking saliva samples.
- **I understand that participation in the initial questionnaires will take approximately 20 minutes to complete and the daily questionnaires will take approximately three to four minutes to complete.**
- I understand that background information requires the disclosure of personal information.
- I understand that there is no obligation to answer any question that I do not wish to answer.
- I understand that members of the research team have secured procedures to ensure participant confidentiality.
- I understand the data are not anonymous insofar as individual data points will be identifiable for the duration of the data collection
- I understand that all personal information will be kept strictly confidential
- I understand that the results of this study will be distributed in academic journal articles and conference presentations
- I understand that my participation in this study is voluntary and that I may withdraw from the study at any time and for any reason without penalty.
- I understand that only members of the research team named above will have access to the data **and the data will be encrypted and stored on a password-protected computer.**
- I understand that data will be destroyed five years following completion of the study.

- I understand that choosing to participate (or not) in the study will not negatively impact me in any way in terms of my participation in the physical activity programs or association to the organizing sites.

This study has been explained to me and I accept the terms of this study. I have made this decision based on the information I have read in the Information and Consent Form. I have had an opportunity to ask questions and my questions have been answered to my satisfaction. I understand that I may withdraw this consent at any time without any loss. I voluntarily agree to participate in this study. I have signed and received a copy of this form for my records.

If you have any questions about this study or require further information, please contact the researchers using the contact information provided on the Information Form. This study has been reviewed and received ethics clearance through the Research Ethics Board at the University of Toronto (File# 32897). If you have any comments or concerns about your rights as a research participant, please contact the Research Ethics Office at (416) 946- 3273, ethics.review@utoronto.ca.

_____	_____	_____
Date	Participants signature	Printed name

_____	_____	_____
Date	Investigator/Co-investigator's signature	Printed name

Appendix C: Instructions, Schedules, Checklists, and Surveys

Online Questionnaire Use and Instructions

UNIVERSITY OF TORONTO
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Thank you for your participation. Please follow the instructions to complete the online surveys:

- An email will be sent to you with a link to complete the survey (surveys will be completed through the online survey tool SurveyMonkey)
- Please click on the link in the email, which will take you to a website where you can complete the survey (Please note that internet access is needed in order to load and complete the survey)
- Please answer questions carefully and submit your survey on the web page by pressing 'done' when you are complete

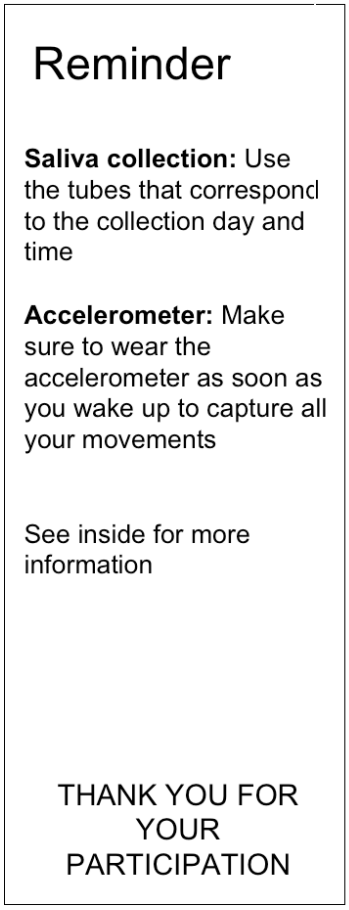
Extra Information

- Surveys will be sent to you twice before the beginning of the 7-day collection period. During the 7-day period surveys will be sent six times per day (please see daily schedule) for all seven days. Please complete the surveys as closely to the scheduled time as possible
- You can only take each survey once
- Questions marked with an asterisk (*) are required – this study only includes mandatory questions for screening purposes and to match participant responses using email and date of birth. All other questions are voluntary and you may decline to answer any question(s) that you choose.

Please do not hesitate to contact Madison Vani at madison.vani@mail.utoronto.ca if you have any problems or require further information. We really appreciate your participation!

Thank you,
Madison Vani, BA,
MSc Candidate,
University of Toronto

Instructional Pamphlet



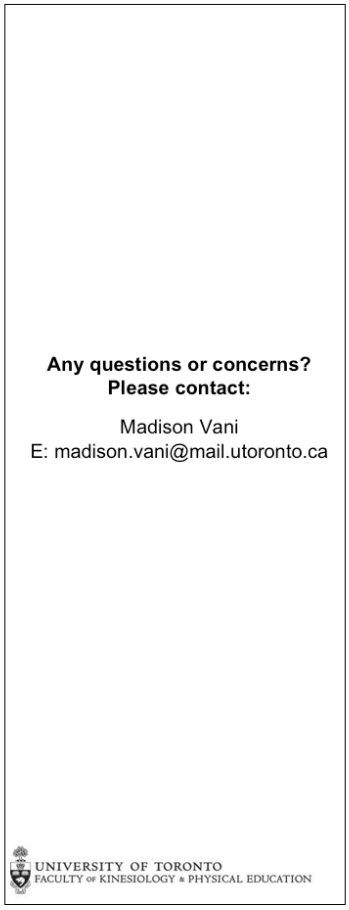
Reminder

Saliva collection: Use the tubes that correspond to the collection day and time

Accelerometer: Make sure to wear the accelerometer as soon as you wake up to capture all your movements

See inside for more information

THANK YOU FOR YOUR PARTICIPATION



Any questions or concerns? Please contact:

Madison Vani
E: madison.vani@mail.utoronto.ca

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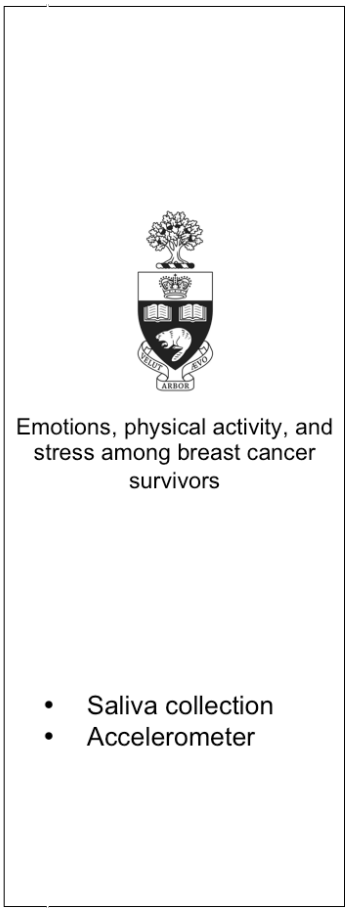


Emotions, physical activity, and stress among breast cancer survivors

- Saliva collection
- Accelerometer

Saliva Collection

Purpose: To evaluate your cortisol levels (a stress marker).

How do I collect saliva?

Collect the saliva on the day and time indicated on the “Saliva sampling checklist” included in the plastic bags in your research package.

Use the tubes that correspond to the collection day and time, e.g., “A1” for the first day sample at awakening and “A2” for the second sample 30 minutes after awakening… (Refer to checklist). The tubes are colour coded with the checklist for your convenience.

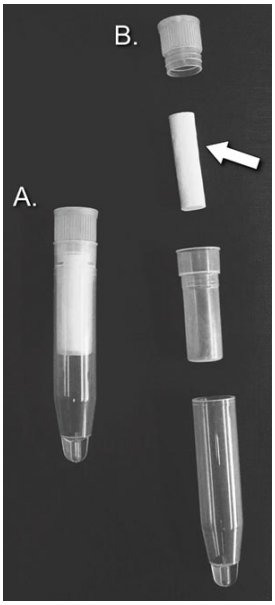
In the morning: Saliva should be collected before you brush your teeth or have anything to drink/eat. During the day: **Please allow for at least 30 minutes to pass after eating or drinking before providing saliva samples.**

Open the collecting tube: pop the swab into your mouth without using your hands and move it around for one minute without chewing it. **Do not swallow the swab.**

Return the saturated swab to the tube without using your hands and close the tube firmly with the stopper. Please return all pieces of the tube.

If you forget to collect a sample please indicate on the sheet which sample was not taken.

Please keep the tubes refrigerated once saliva is collected.



Accelerometer

Purpose: To measure physical activity levels.

How do I use an accelerometer?

Make sure to put the accelerometer around your waist as soon as you wake up so that all of your movement in the day is measured.

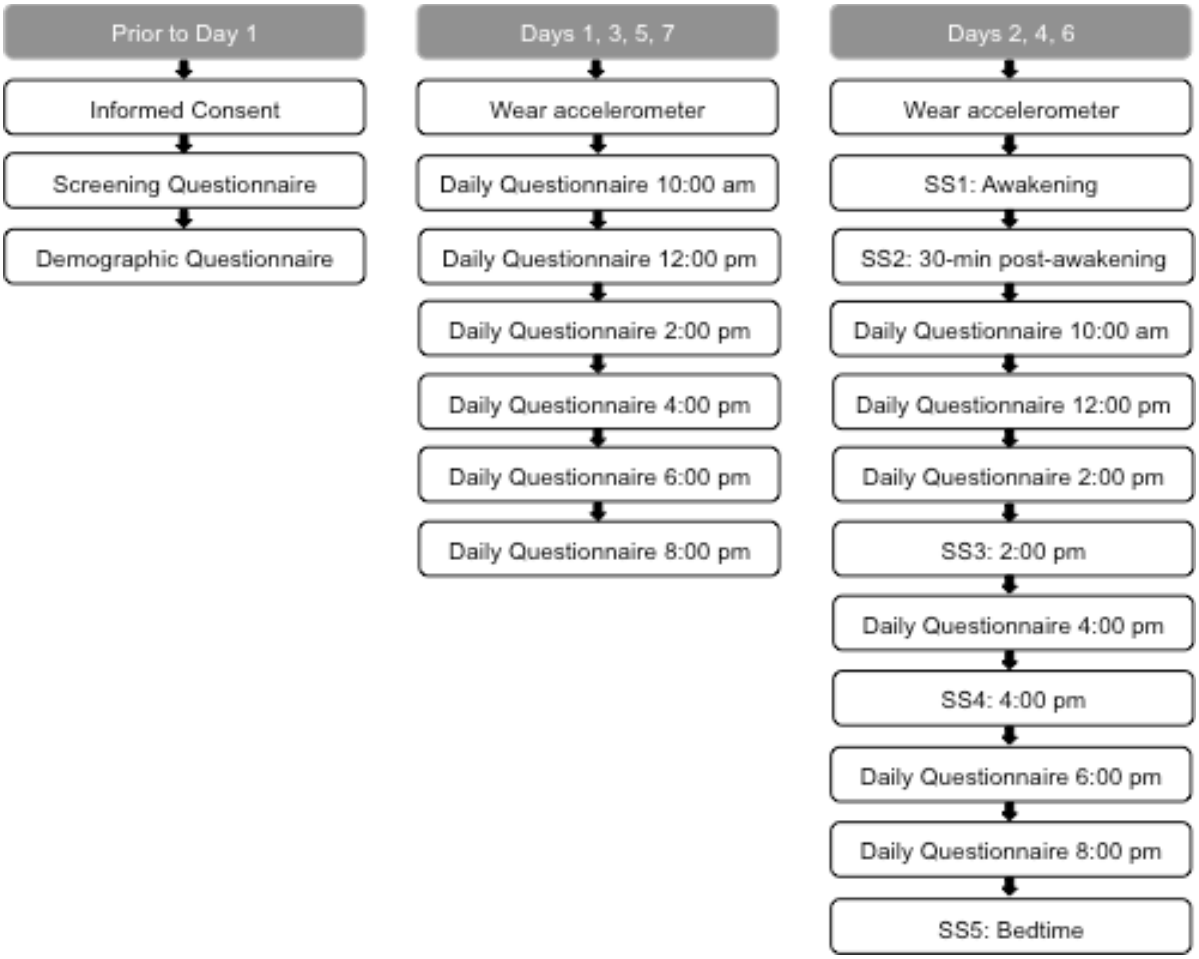
Attach the accelerometer to your waist using the elastic belt and align it **directly above your knee on the same side as the hand you normally write with.** The device can be worn either over or under your clothing (see picture below).

Make sure that the accelerometer remains upright and close to your body.

Do not wear the accelerometer during water activities (e.g., bath, shower, swimming, etc.) since it is not waterproof. You can wear it during your usual activities (it is sweat proof and water resistant).

After wearing the accelerometer for seven consecutive days, please store it in a safe place until it is returned to the research team. Since these monitors are very expensive, please take extra care with them!

Data collection schedule



Weekly Completion of Measures Schedule

Here is a weekly schedule to remind you when to complete the measures.

Measures	Day 1	Day 2 (A)	Day 3	Day 4 (B)	Day 5	Day 6 (C)	Day 7
Multiple daily questionnaires	X	X	X	X	X	X	X
Cortisol		X		X		X	
Accelerometer	X	X	X	X	X	X	X

Daily Completion of Measures Schedule

Here is a schedule to remind you when to complete the multiple daily questionnaires and saliva sampling. Note: accelerometers are worn every day from awakening to bedtime.

DAY 1

Time of day	Questionnaires	Cortisol
At awakening		
30 minutes after awakening		
10 o'clock in the morning	X	
12 o'clock in the afternoon	X	
2 o'clock in the afternoon	X	
4 o'clock in the afternoon	X	
6 o'clock in the afternoon	X	
8 o'clock in the afternoon	X	
At bedtime		

DAY 2 (A)

Time of day	Questionnaires	Cortisol (BLACK)
At awakening		X
30 minutes after awakening		X
10 o'clock in the morning	X	
12 o'clock in the afternoon	X	
2 o'clock in the afternoon	X	X
4 o'clock in the afternoon	X	X
6 o'clock in the afternoon	X	
8 o'clock in the afternoon	X	
At bedtime		X

DAY 3

Time of day	Questionnaires	Cortisol
At awakening		
30 minutes after awakening		
10 o'clock in the morning	X	
12 o'clock in the afternoon	X	
2 o'clock in the afternoon	X	
4 o'clock in the afternoon	X	
6 o'clock in the afternoon	X	
8 o'clock in the afternoon	X	
At bedtime		

DAY 4 (B)

Time of day	Questionnaires	Cortisol (RED)
At awakening		X
30 minutes after awakening		X
10 o'clock in the morning	X	
12 o'clock in the afternoon	X	
2 o'clock in the afternoon	X	X
4 o'clock in the afternoon	X	X
6 o'clock in the afternoon	X	
8 o'clock in the afternoon	X	
At bedtime		X

DAY 5

Time of day	Questionnaires	Cortisol
At awakening		
30 minutes after awakening		
10 o'clock in the morning	X	
12 o'clock in the afternoon	X	
2 o'clock in the afternoon	X	
4 o'clock in the afternoon	X	
6 o'clock in the afternoon	X	
8 o'clock in the afternoon	X	
At bedtime		

DAY 6 (C)

Time of day	Questionnaires	Cortisol (BLUE)
At awakening		X
30 minutes after awakening		X
10 o'clock in the morning	X	
12 o'clock in the afternoon	X	
2 o'clock in the afternoon	X	X
4 o'clock in the afternoon	X	X
6 o'clock in the afternoon	X	
8 o'clock in the afternoon	X	
At bedtime		X

DAY 7

Time of day	Questionnaires	Cortisol
At awakening		
30 minutes after awakening		
10 o'clock in the morning	X	
12 o'clock in the afternoon	X	
2 o'clock in the afternoon	X	
4 o'clock in the afternoon	X	
6 o'clock in the afternoon	X	
8 o'clock in the afternoon	X	
At bedtime		

Saliva Sampling Checklist

Here is a schedule to remind you when to provide saliva samples on 3 non-consecutive days. Please fill out actual time of provision below.

DAY A- Day 2: Tubes BLACK

Samples	Time of day	Actual time of provision
A1	**At awakening**	
A2	**30 minutes after awakening**	
A3	**2 o'clock in the afternoon**	
A4	**4 o'clock in the afternoon**	
A5	**At bedtime**	

DAY B- Day 4: Tubes RED

Samples	Time of day	Actual time of provision
B1	**At awakening**	
B2	**30 minutes after awakening**	
B3	**2 o'clock in the afternoon**	
B4	**4 o'clock in the afternoon**	
B5	**At bedtime**	

DAY C- Day 6: Tubes BLUE

Samples	Time of day	Actual time of provision
C1	**At awakening**	
C2	**30 minutes after awakening**	
C3	**2 o'clock in the afternoon**	
C4	**4 o'clock in the afternoon**	
C5	**At bedtime**	

Questionnaire Time of Provision Checklist

Here is a schedule to remind you of when to respond to questionnaires on all seven days. Please fill out actual time of provision below. **Please note:** Please fill out informed consent and the background and demographics questionnaire prior to Day 1 at 10:00 am. Thank you!

Day	Time	Actual time of provision
1	10:00 am	
1	12:00 pm	
1	2:00 pm	
1	4:00 pm	
1	6:00 pm	
1	8:00 pm	

Day	Time	Actual time of provision
2	10:00 am	
2	12:00 pm	
2	2:00 pm	
2	4:00 pm	
2	6:00 pm	
2	8:00 pm	

Day	Time	Actual time of provision
3	10:00 am	
3	12:00 pm	
3	2:00 pm	
3	4:00 pm	
3	6:00 pm	
3	8:00 pm	

Day	Time	Actual time of provision
4	10:00 am	
4	12:00 pm	
4	2:00 pm	
4	4:00 pm	
4	6:00 pm	
4	8:00 pm	

Day	Time	Actual time of provision
5	10:00 am	
5	12:00 pm	
5	2:00 pm	
5	4:00 pm	
5	6:00 pm	
5	8:00 pm	

Day	Time	Actual time of provision
6	10:00 am	
6	12:00 pm	
6	2:00 pm	
6	4:00 pm	
6	6:00 pm	
6	8:00 pm	

Day	Time	Actual time of provision
7	10:00 am	
7	12:00 pm	
7	2:00 pm	
7	4:00 pm	
7	6:00 pm	
7	8:00 pm	

Return Check List

At the end of the week, the following items are to be placed in the envelope to be returned to the researchers.

- ❑ Accelerometer
- ❑ 15 saliva collection tubes in 3 plastic bags (please don't forget them in the fridge ☺)
- ❑ Saliva Sampling Checklist
- ❑ Questionnaires (if not completed online, including Background & Demographics Questionnaire)

Pre-Study Questionnaires

Screening Questionnaire

Date (day/month/year): _____
Time (hours/minutes): _____

Personal Identification

1. What is the date of your birth? _____

2. What is your email address? _____

3. Which physical activity program are you currently registered for?

- ☐ Survivor Training Program (Running Room)
- ☐ Cancer Exercise Program (Wellspring)
- ☐ Other: _____
- ☐ N/A

4. Are you planning on participating in the CIBC Run for the Cure?

- ☐ Yes
- ☐ No

If **Yes**, please indicate which event you are registered/will register for:

- ☐ 5Km Run/Walk
- ☐ 1Km Run/Walk
- ☐ N/A

5. Have you completed primary treatment for breast cancer (i.e., surgery, chemotherapy, radiotherapy)?

- ☐ Yes
- ☐ No

6. Are you a first-time participant of the Survivor Training Program, Cancer Exercise Program, **or** other previously indicated program?

- ☐ Yes
- ☐ No

If **No**, how many years have you been a participant? _____

7. Do you have any underlying medical concerns that may impact your participation in physical activity?

- ☐ Yes
- ☐ No

If **Yes**, please specify: _____

8. Are you currently taking anti-depressants or corticosteroids?

- ☐ Yes
- ☐ No

If **Yes**, please specify: _____

9. Do you currently smoke?

- ☐ Yes
- ☐ No

10. Do you have Wi-Fi access?

- ☐ Yes
- ☐ No

Physical Activity Readiness

Please read the questions carefully and answer each one honestly by checking YES or NO.

	YES	NO
1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?	☐	☐
2. Do you feel pain in your chest when you do physical activity?	☐	☐
3. In the past month, have you had chest pain when you were not doing physical activity?	☐	☐
4. Do you lose balance because of dizziness or do you ever lose consciousness?	☐	☐
5. Do you have bone or joint problem (for example, back, knee, or hip) that could be made worse by a change in your physical activity?	☐	☐
6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?	☐	☐
7. Do you know of <u>any other reason</u> why you should not do physical activity?	☐	☐

Baseline Questionnaires

Background and Demographics

This survey is about your demographic information, emotions, motivation, and performance goals. The information you provide will help us better understand experiences of cancer survivors. We want your personal responses on the questions. This is NOT a test. There are no right or wrong answers. This questionnaire will take approximately 20 minutes to complete. Your answers are very important to us, so please make sure you complete all questions honestly. Your answers will be kept private and confidential by using your email and birthdate only. All data that is collected will be encrypted and stored on a password-protected computer. Thank you for supporting this research.

1. What is your date of birth?

Date (day/month/year): _____

2. What is your email address?

Email Address: _____

3. What week of the program are you currently participating in? _____

4. What is your height (in feet and inches)? _____

5. What is your weight (in pounds)? _____

6. What is your current marital status?

- ☐ Married/Common Law
- ☐ Widowed
- ☐ Separated
- ☐ Divorced
- ☐ Single/Never Married

7. How would you describe your ethnic background?

- ☐ White/Caucasian
- ☐ Chinese
- ☐ Japanese
- ☐ Korean
- ☐ Filipino
- ☐ Aboriginal/First Nation (e.g., North American Indian, Metis, Inuit)
- ☐ Spanish/Hispanic/Latino
- ☐ South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
- ☐ South East Asian (e.g., Cambodian, Indonesian, Vietnamese)
- ☐ Black (e.g., African, Haitian, Jamaican, Somali)

- ☐ Arab
- ☐ West Asian/Middle East (e.g., Afghani, Iranian)
- ☐ Other (please specify): _____

8. What is your highest level of education completed?

- ☐ High school Diploma
- ☐ Some post-secondary, but did not complete diploma or degree
- ☐ College or technical diploma or certificate
- ☐ University undergraduate degree
- ☐ Post-graduate degree
- ☐ None of the above

9. Which of the following describes you:

- ☐ I have no children
- ☐ I have children
- ☐ I have grandchildren

10. Please describe your physical activity levels during the following times in your life. If your current age is in the middle of an age range, complete the question for that particular range. For example, if you are 42 years old, you would still offer a response for the age range 40-49 years.

	Not active at all	A little active	Very active	Not applicable
In the last year				
During treatment(s) for cancer				
After treatment(s) for cancer				
Childhood (up to 12 years of age)				
Adolescence (13 to 18 years)				
19 to 29				
30 to 39				
40 to 49				
50 to 59				
60 to 69				
70 to 79				
80 to 89				
90+ years				

Cancer Information

11. What is the site of your most recent cancer diagnosis?
- ☐ Breast
- ☐ Gynecological (ovarian, endometrial, cervical)
- ☐ Other (please specify) _____

12. What is the date that you were diagnosed? (mm/yyyy) _____

13. What stage of cancer were you diagnosed with?

- ☐ Stage 0
- ☐ Stage I
- ☐ Stage II
- ☐ Stage III
- ☐ Stage IV

14. Indicate which medical treatments you have received for cancer:

- ☐ Surgery
- ☐ Lumpectomy
- ☐ Lymph or axillary node dissection
- ☐ Chemotherapy
- ☐ Radiotherapy
- ☐ Hormonal therapy
- ☐ Reconstructive surgery
- ☐ Other (please specify): _____

15. Are you currently being treated for cancer, not including hormonal therapy?
- ☐ Yes
- ☐ No

16. If your cancer treatments have finished, approximately what was the month and year of your last treatment, not including hormonal therapies.

If you are currently being treated for cancer, not including hormonal therapies, please skip this question.

Cancer treatment completion: Month: _____ Year: _____

17. Are you:

- ☐ Pre-menopausal
- ☐ Menopausal
- ☐ Post-menopausal

Body-Related Self-Conscious Emotions

We are interested in people's emotions. Listed below are a variety of statements. Using a 5-point scale (1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = always), please indicate how often you have generally experienced the emotions. There are no 'right' or 'wrong' answers.

In general I have felt…

	Never	**Rarely**	**Occasionally**	**Frequently**	**Always**
Ashamed of the way I look	1	2	3	4	5
Proud that I am more attractive than others	1	2	3	4	5
Proud of the effort I place on maintaining my appearance	1	2	3	4	5
Guilty that I do not do enough to improve the way I look	1	2	3	4	5
Inadequate when I think about my appearance	1	2	3	4	5
Proud that I am a great looking person	1	2	3	4	5
Guilty that I look the way I do	1	2	3	4	5
Ashamed of my appearance	1	2	3	4	5
Proud of my superior appearance	1	2	3	4	5
Proud about my effort to improve the way I look	1	2	3	4	5
Regret that I do not work on improving my appearance	1	2	3	4	5
Proud that I have achieved my appearance goals	1	2	3	4	5
Regret that I do not put effort into my appearance	1	2	3	4	5
Proud of my appearance efforts	1	2	3	4	5
Proud that I am an attractive person	1	2	3	4	5
Ashamed that I am a person who is unattractive	1	2	3	4	5

Body-Related Self-Conscious Emotions: Fitness

Please note that although the questions below are similar to the survey you just completed, the current questions involved fitness rather than appearance.

We are interested in people's emotions. Listed below are a variety of statements. Using a 5-point scale (1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = always), please indicate how often you have generally experienced the emotions. There are no 'right' or 'wrong' answers.

In general I have felt…

	Never	**Rarely**	**Occasionally**	**Frequently**	**Always**
Ashamed about what my body can do physically	1	2	3	4	5
Guilty that I do not do enough for my fitness	1	2	3	4	5
Proud of the effort I place on my fitness	1	2	3	4	5
Proud of my superior fitness	1	2	3	4	5
Inadequate when I think about my fitness	1	2	3	4	5
Regret that I do not take action to improve my fitness	1	2	3	4	5
Proud of my fitness efforts	1	2	3	4	5
Proud that I am more physically fit than others	1	2	3	4	5
Ashamed that I am a person who is unfit	1	2	3	4	5
Guilty that I do not do enough to improve my fitness	1	2	3	4	5
Proud about my effort to improve my fitness	1	2	3	4	5
Proud of myself when I compare my fitness to others	1	2	3	4	5
Inadequate about my fitness	1	2	3	4	5
Regret that I do not work on improving my fitness	1	2	3	4	5
Proud of my fitness accomplishments	1	2	3	4	5
Proud that I am a person who is fit	1	2	3	4	5

Motivation for Physical Activity

We are interested in the reasons underlying peoples' decisions to engage or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

	Not true for me		**Sometimes true for me**		**Very true for me**
It's important to me to exercise regularly	0	1	2	3	4
I don't see why I should have to exercise	0	1	2	3	4
I exercise because it's fun	0	1	2	3	4
I feel guilty when I don't exercise	0	1	2	3	4
I exercise because it is consistent with my life goals	0	1	2	3	4
I exercise because other people say I should	0	1	2	3	4
I value the benefits of exercise	0	1	2	3	4
I can't see why I should bother exercising	0	1	2	3	4
I enjoy my exercise sessions	0	1	2	3	4
I feel ashamed when I miss an exercise session	0	1	2	3	4
I consider exercise part of my identity	0	1	2	3	4
I take part in exercise because my friends/family say I should	0	1	2	3	4
I think it is important to make the effort to exercise regularly	0	1	2	3	4
I don't see the point in exercising	0	1	2	3	4
I find exercise a pleasurable activity	0	1	2	3	4
I feel like a failure when I haven't exercised in a while	0	1	2	3	4
I consider exercise a fundamental part of who I am	0	1	2	3	4
I exercise because others will not be pleased with me if I don't	0	1	2	3	4
I get restless if I don't exercise regularly	0	1	2	3	4
I think exercising is a waste of time	0	1	2	3	4
I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
I would feel bad about myself if I was not making time to exercise	0	1	2	3	4
I consider exercise consistent with my values	0	1	2	3	4
I feel under pressure from my friends/family to exercise	0	1	2	3	4

Body Areas Satisfaction Scale

Use this 1 to 5 scale (1 = very dissatisfied, 2 = mostly dissatisfied, 3 = neither satisfied nor dissatisfied, 4 = mostly satisfied, 5 = very satisfied) to indicate how dissatisfied or satisfied you are with each of the following areas or aspects of your body:

	Very dissatisfied	**Mostly dissatisfied**	**Neither satisfied nor dissatisfied**	**Mostly satisfied**	**Very satisfied**
Face (facial features, complexion)	1	2	3	4	5
Hair (colour, thickness, texture)	1	2	3	4	5
Lower torso (buttocks, hips, thighs, legs)	1	2	3	4	5
Mid torso (waist, stomach)	1	2	3	4	5
Upper torso (chest or breasts, shoulders, arms)	1	2	3	4	5
Muscle tone	1	2	3	4	5
Weight	1	2	3	4	5
Height	1	2	3	4	5
Overall appearance	1	2	3	4	5

Training Goals

1. What are your goals for this training program?

_____
_____
_____
_____

2. What are your training goals for this week?

_____
_____
_____
_____

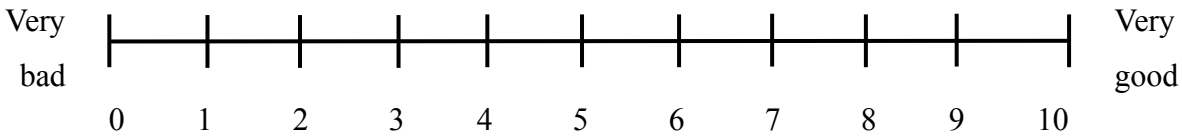
Once Daily Questionnaires: Morning

Sleep Quantity and Quality

1. At approximately what time did you fall asleep? _____

2. At approximately what time did you wake up? _____

3. Rate the quality of your sleep:

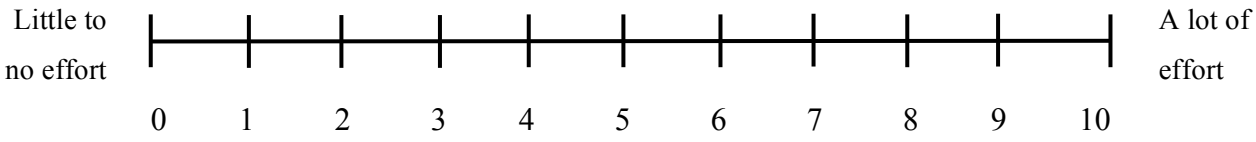


Once Daily Questionnaires: Evening

Effort

1. Did you train today?
   - ☐ Yes
   - ☐ No

2. How much effort did you put into your training today?



Social Comparisons

1a). Today, how many comparisons did you make with people who are **worse off** than you in some way?

_____

1b). How many of these comparisons to others were related to the body, physical appearance, or physical features?

_____

2a). Today, how many comparisons did you make with people who are **better off** than you in some way?

_____

2b). How many of these comparisons to others were related to the body, physical appearance, or physical features?

_____

Affect

Thinking about yourself and how you feel, to what extent do you currently feel:

	Never	Rarely	Occasionally	Frequently	Always
Upset	1	2	3	4	5
Hostile	1	2	3	4	5
Alert	1	2	3	4	5
Ashamed	1	2	3	4	5
Inspired	1	2	3	4	5
Nervous	1	2	3	4	5
Determined	1	2	3	4	5
Attentive	1	2	3	4	5
Afraid	1	2	3	4	5
Active	1	2	3	4	5

Group-Based Emotions

1. Did train with others today?
   - ☐ Yes
   - ☐ No

If **Yes**:

a) Approximately how many people were you training with today? _____

b) Recall how you felt while training with others. To what extent did the people you were training with make you feel:

	Never		**About half of the time**		**Always**
Ashamed	1	2	3	4	5
Guilty	1	2	3	4	5
Proud	1	2	3	4	5
Envious	1	2	3	4	5
Embarrassed	1	2	3	4	5

Multiple Daily Questionnaires

Body-Related Self-Conscious Emotions

Recall how you felt about your body since the last time you reported your emotions. Please indicate to what extent you have felt this way during the past few hours on the scale provided. During the past few hours, I felt…

	Never		**About half of the time**		**Always**
Ashamed	1	2	3	4	5
Guilty	1	2	3	4	5
Proud	1	2	3	4	5
Envious	1	2	3	4	5
Embarrassed	1	2	3	4	5

Physical Activity

Since the last survey:

1. What type of physical activity have you participated in? (e.g., running, walking, resistance training, etc.)? Leave blank if none _____

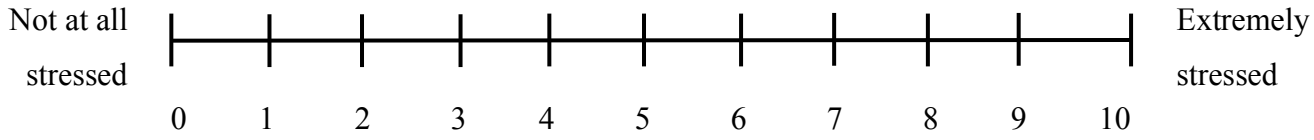
2. How long did you participate (in minutes)? _____

3. Rate your physical activity intensity:
   - ☐ Strenuous Exercise (Heart Beats Rapidly; e.g., running, jogging, squash, vigorous swimming, vigorous bicycling)
   - ☐ Moderate Exercise (Not Exhausting; e.g., fast walking, easy bicycling, easy swimming)
   - ☐ Mild Exercise (Minimal Effort; e.g., yoga, taking the stairs, bowling, housework, easy walking)

4. Rate the enjoyment of your participation:
   - ☐ Not at all enjoyable
   - ☐ Slightly enjoyable
   - ☐ Moderately enjoyable
   - ☐ Very enjoyable

Stress

Recall the past few hours. Indicate how stressed you were on the scale below:



End of Week Questionnaire

Program Adherence

1. How many training runs (walks, dragon boats, etc.) did you do this week? _____

2. How many of these runs (walks, dragon boats, etc.) did you do with the training group? _____

Appendix D: Ethics Certificate and Renewal Approval

UNIVERSITY OF TORONTO

OFFICE OF THE VICE-PRESIDENT, RESEARCH AND INNOVATION

PROTOCOL REFERENCE # 32897

May 1, 2016

Dr. Catherine Sabiston
FACULTY OF KINESIOLOGY AND PHYSICAL EDUCATION

Ms. Madison Vani
FACULTY OF KINESIOLOGY AND PHYSICAL EDUCATION

Dear Dr. Sabiston and Ms. Madison Vani,

Re: Your research protocol entitled, "Emotions, physical activity, and stress among breast cancer survivors"

ETHICS APPROVAL	**Original Approval Date: April 29, 2016** **Expiry Date: April 28, 2017** **Continuing Review Level: 1**

We are writing to advise you that the Health Sciences Research Ethics Board (REB) has granted approval to the above-named research protocol under the REB's delegated review process. Your protocol has been approved for a period of **one year** and ongoing research under this protocol must be renewed prior to the expiry date.

Any changes to the approved protocol or consent materials must be reviewed and approved through the amendment process prior to its implementation. Any adverse or unanticipated events in the research should be reported to the Office of Research Ethics as soon as possible.

Please ensure that you submit an Annual Renewal Form or a Study Completion Report 15 to 30 days prior to the expiry date of your current ethics approval. Note that annual renewals for studies cannot be accepted more than 30 days prior to the date of expiry.

If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your research.

Yours sincerely,

Research Oversight and Compliance Office - Human Research Ethics Program
McMurrich Building, 12 Queen's Park Crescent West, 2nd Floor, Toronto, ON M5S 1S8 Canada
Tel: +1 416 946-3273 ● Fax: +1 416 946-5763 ● ethics.review@utoronto.ca ● http://www.research.utoronto.ca/for-researchers-administrators/ethics/

UNIVERSITY OF TORONTO

OFFICE OF THE VICE-PRESIDENT, RESEARCH AND INNOVATION

PROTOCOL REFERENCE # 32897

April 24, 2017

Dr. Catherine Sabiston
FACULTY OF KINESIOLOGY AND PHYSICAL EDUCATION

Ms. Madison Vani
FACULTY OF KINESIOLOGY AND PHYSICAL EDUCATION

Dear Dr. Sabiston and Ms. Madison Vani,

Re: Your research protocol entitled, "Emotions, physical activity, and stress among breast cancer survivors"

ETHICS APPROVAL	**Original Approval Date: April 29, 2016** **Expiry Date: April 28, 2018** **Continuing Review Level: 1** **Renewal: Data Analysis Only**

We are writing to advise you that you have been granted annual renewal of ethics approval to the above-referenced research protocol through the Research Ethics Board (REB) delegated process. Please note that all protocols involving ongoing data collection or interaction with human participants are subject to re-evaluation after 5 years. Ongoing research under this protocol must be renewed prior to the expiry date.

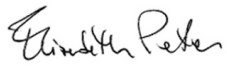
Any changes to the approved protocol or consent materials must be reviewed and approved through the amendment process prior to its implementation. Any adverse or unanticipated events should be reported to the Research Oversight and Compliance - Human Research Ethics Program as soon as possible. If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Please ensure that you submit an Ethics Renewal Form or a Study Completion/Closure Report 15 to 30 days prior to the expiry date of your protocol. Note that ethics renewals for studies cannot be accepted more than 30 days prior to the date of expiry as per our guidelines.

Please note, all approved research studies are eligible for a routine Post-Approval Review (PAR) site visit. If chosen, you will receive a notification letter from our office. For information on PAR, please see http://www.research.utoronto.ca/wp-content/uploads/documents/2014/09/PAR-Program-Description-1.pdf.

Best wishes for the successful completion of your research.

Yours sincerely,



Elizabeth Peter, Ph.D.
REB Chair

Research Oversight and Compliance Office - Human Research Ethics Program
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