UNDERSTANDING AND CHANGING SOCIAL PHYSIQUE ANXIETY

Understanding and Changing Social Physique Anxiety Among Women: Examining the Role of Cortisol and Exercise

By

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Abstract

The general purpose of this dissertation was to use a psychobiological approach to examine the psychosocial, biological and behavioural factors associated with social physique anxiety (SPA) in women. With this perspective in mind, the broad objectives of the present dissertation were as follows: (1) to examine the relationship between social physique anxiety and cortisol, (2) to implement an exercise intervention to change social physique anxiety and cortisol, and (3) to understand the mechanisms responsible for exercise-induced changes in social physique anxiety.

Specifically, in Study 1, the purpose was to experimentally manipulate physique evaluative threat in a controlled laboratory setting to determine if physique evaluative threat (i.e., social physique anxiety; SPA) produces concomitant changes in cortisol secretion. Additionally, this study examined if perceptions of physique evaluative threat were related to cortisol responses. Participants were 50 women who were randomly assigned to an experimental, or a control condition. Results indicated that post-manipulation, the experimental condition had higher cortisol levels than the control condition. Furthermore, regression analyses indicated that a post-manipulation measure of physique evaluative threat explained 7.2% of the variance in post-manipulation cortisol levels. Taken together, these findings suggest that acute changes in physique evaluative threat cause changes in cortisol levels and provide an empirical basis for studying cortisol's role in body image disturbance and related pathologies (e.g., eating disorders).

In Study 2, a controlled experimental design was used to compare the effects of an 8-week exercise (aerobic versus resistance) training intervention on changes in SPA and changes in cortisol. In addition, this study examined the physical and psychosocial mechanisms underlying

the effects of exercise training on SPA and explored the possible protective effects of exercise training on state SPA and cortisol responses to an acute physique evaluative threat situation. Forty six women were randomly assigned to one of two exercise conditions: aerobic or resistance training. Analyses indicated that the aerobic condition experienced greater improvements in trait SPA than the resistance training condition and both groups exhibited significant decreases in cortisol levels (compared to baseline). In addition, changes in aerobic self-efficacy and perceived physical endurance partially mediated the effect of the exercise intervention on trait SPA. Finally, the results demonstrated that 8-weeks of exercise training (regardless of mode) may buffer the state SPA response to a physique evaluative threat manipulation.

In summary, these studies provide a broader understanding of the factors associated with SPA. The results demonstrated that for women, situations that elicit physique evaluative threat elicit concomitant changes in cortisol. Exercise training is an effective strategy for improving SPA, reducing cortisol responses, and possibly providing a protective effect against the state SPA response among young women. Aerobic exercise training is more effective for improving SPA than resistance training and this is due in part to increases in aerobic self-efficacy and perceived physical endurance. The dissertation studies provide momentum for extending the scope of research on SPA and for determining the best approach for improving SPA among women.

List of Abbreviations

ACSM	American College of Sports Medicine
ANCOVA	analysis of covariance
ANOVA	analysis of variance
ANS	autonomic nervous system
AUC	area under the cortisol response curve
BCa CI	bias corrected and accelerated confidence interval
BDI-II	Beck Depression Inventory - 2
BMI	body mass index
CRH	corticotrophin-releasing hormone
EXSEM	Exercise and Self-Esteem Model
GLTEQ	Godin Leisure Time Exercise Questionnaire
HPA	hypothalamic pituitary adrenal axis
HR	heart rate
PAR-Q	Physical Activity Readiness Questionnaire
PET	physique evaluative threat
PSDQ	Physical Self- Description Questionnaire
PSS	Perceived Stress Scale
RM	repetitions maximum
SET	social evaluative threat
SSPT	Social Self-Preservation theory
SPA	social physique anxiety
SPAS	Social Physique Anxiety Scale
SPES	Self-Presentational Efficacy for Exercise Scale
SSPAS	state version of the Social Physique Anxiety Scale
STAI	State Trait Anxiety Inventory

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CHAPTER 1

Review of Literature

1.1 The Problem of Social Physique Anxiety among Women

Currently, many women experience some form of body dissatisfaction. In fact, studies indicate that 76% of female adolescents are dissatisfied with their current body shape (Geist, Heinmaa, Katzman & Stephens, 1999), 70-80% of university women express a desire to lose weight (Vohs, Heatherton, & Herrin, 2001) and 13% of women score in the range of clinical body dissatisfaction (Cook-Cottone & Phelps, 2003). In general, women experience body dissatisfaction because they perceive that their body shape/weight does not match the culturally accepted body ideal, which is typically a very thin, toned physique (Jackson, 2002). Women are motivated to achieve the "ideal body" in part to obtain positive evaluations about their bodies from others. When women doubt their ability to obtain positive evaluations they can experience a form of social anxiety that is specific to the physique, that is, social physique anxiety (SPA; Hart, Leary & Rejeski, 1989). SPA is defined as the apprehension or fear individuals experience when they are concerned about other's evaluations of their bodies (Hart et al., 1989).

Originally, SPA was conceptualized as a trait (dispositional construct) and the majority of research conducted has utilized SPA as a trait variable (Martin Ginis, Lindwall & Prapavessis, 2007). SPA is related to the concept of body image in that it is recognized as an affective component of body image (Hart et al., 1989). Although typically used as a trait measure, a few studies have conceptualized SPA as a state (situational) construct and have shown that SPA fluctuates across different situations (Amirthavasar & Bray, 2007; Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004; Martin Ginis, Prapavessis & Hasse, 2008; Martin Ginis, Murru, Conlin & Strong, 2009). For example, research has shown that women experience greater situational SPA when presented with the idea of exercising in a mixed-sex versus all-female exercise class (Kruisselbrink et al., 2004), and in exercise classes led by a male instructor rather

than a female instructor (Amirthavasar & Bray, 2007). It has been suggested that conceptualizing SPA as both a trait and state variable is consistent with conceptualizations of the related concept of body image (Martin Ginis et al., 2009). Although body image was originally conceptualized as a trait, research suggests that the way a person thinks or feels about his/her body also varies across different situations (Brinded, Bushnell, McKenzie, & Wells, 1990; Cash, Fleming, Alindogan, Steadman & Whitehead, 2002; Tiggemann, 2001).

With respect to the research on trait SPA, various studies have shown that women tend to experience higher levels of SPA compared to men (Eklund, Kelley, & Wilson, 1997; Frederick & Morrison, 1996; Kowalski, Mack, Crocker, Niefer, & Fleming, 2006). Concerns about one's physique typically develop during adolescence (Levine & Smolak, 2002); however, these concerns are not limited to this period of life. In fact, research has shown that college-aged (Bartlewski, VanRaalte, & Brewer, 1996; Lindwall & Lindgren, 2005; Martin Ginis, Eng, Arbour, Hartman & Phillips, 2005; Williams & Cash, 2001), middle-aged (McAuley, Bane, & Mihalko, 1995; McAuley, Bane, Rudolph, & Lox, 1995) and older women (Woodgate, Martin Ginis & Sinden, 2003) also experience SPA.

High levels of SPA are also associated with several negative health consequences. From a behavioural perspective, SPA has been shown to influence health-risk behaviours such as smoking, alcohol and drug use (Martin & Leary, 2004; Martin, Leary, and O'Brien, 2001), and pathological weight loss behaviours (e.g., compulsive exercise; Frederick & Morisson, 1996). Some investigators have found that SPA is negatively correlated with exercise behaviour, suggesting that people with higher levels of SPA are less likely to engage in physical activity (Crawford & Eklund, 1994; Eklund & Crawford, 1994, Hausenblas & Fallon, 2002; Hausenblas, Symons Downs, Fleming, & Connaughton, 2002; Lantz, Hardy, & Ainsworth, 1997). From a

psychological perspective, higher levels of SPA are associated with low self-esteem (Russell & Cox, 2002), drive for thinness (a key characteristic of eating disorders; Thompson & Chad, 2002), mood disorders such as depression and anxiety (Diehl, Johnson, Rogers & Petrie, 1998), and eating disorders (Mack, Strong, Kowalski & Crocker, 2007).

Taken together, research indicates that SPA plays a significant role in many behavioural and psychological health issues. However, little is known about the physiological consequences of SPA. Presumably, given that SPA is a form of social anxiety (Hart et al., 1989), it may have the same physiological consequences that have been shown in situations where social anxiety is elicited (Dickerson & Kemeny, 2004). In particular, research has shown that individuals with social anxiety experience exaggerated cortisol responses in reaction to psychological stress (Condren, O'Neill, Ryan, Barrett, & Thakore, 2002). Increased and prolonged activity of the cortisol response is indicative of problems in the hypothalamic pituitary adrenal axis and have many health implications.

1.2 The Hypothalamic Pituitary Adrenal Axis

The hypothalamic pituitary adrenal axis (HPA axis) is the neurobiological system that is responsible for regulating the stress response (Lowe-Ponsford, 2002). When a person is faced with a stressor (real or imagined; physical or psychological) the cortex (site of sensory centers, higher thinking, conscious thought/reasoning) sends a message to the amygdala to initiate the stress response. The amygdala releases the neurotransmitter, corticotropin-releasing hormone (CRH), to contact the autonomic nervous system (ANS). Activation of the ANS causes the adrenal cortex glands to secrete epinephrine and glucocorticoids (cortisol) to mobilize the body for fight or flight. In a feedback loop, the glucocorticoids then activate a brain region called the locus coeruleus (in the hippocampus), which sends a projection back to the amygdala through the

neurotransmitter norepinephrine. This results in a halting of the stress response. However, if continued exposure to the stressor persists, the amygdala sends out more CRH, which leads to the secretion of more epinephrine, norepinephrine and cortisol and the cycle begins again (Sapolsky, 2003).

1.3 What is Cortisol?

Cortisol is a hormone released by the adrenal glands in response to either physical or emotional stress and thus, is referred to as a stress hormone (Sapolsky, 2003). Cortisol is involved in the regulation of blood glucose homeostasis, blood pressure, immune function and inflammation (Bondy, 1985). Chronically high levels of cortisol can have serious physical and psychological health consequences. The physical consequences include (but are not limited to) visceral obesity, hypertension, cardiovascular disease and diabetes (Bjorntorp, 1997; Rosmond Dallman & Bjorntorp, 1998). In terms of psychological consequences, chronically high cortisol levels have been implicated in a variety of mood disorders including anxiety and depression (Chrousos & Gold, 1992; McEwen, 1998) and have also been associated with eating disorder symptomatology (Chrousos & Gold; Klein, Mayer, Schebendach & Walsh, 2007).

Cortisol levels can have both a positive and negative impact on the body. On the one hand, moderately stressful challenges (e.g., exercise at a moderate intensity) can elevate cortisol secretion, which enhances dopamine release, leading to a sense of well-being (Sapolsky, 2003). On the other hand, when a stressful situation arises and is perceived as threatening and more intense, the nervous system becomes overstimulated by increased glucocorticoids, resulting in anxiety (Sapolsky, 2003). As the stressful situation continues, and attempts at coping become useless, a transition occurs (i.e., from anxiety to depression). Prolonged exposure to cortisol translates into an individual becoming less attentive, less vigilant and less active (Sapolsky,

2003). Chronic psychological stress is believed to be the most important causal factor in depression aside from genetic influences (Sapolsky, 2003). Given the detrimental impact of excessive cortisol on the body, strategies must be employed to decrease cortisol responses to stress. One viable option for reducing cortisol levels, and in turn re-regulating the HPA axis, is exercise.

1.4 What is Exercise?

Exercise is defined as planned, structured, repetitive bodily movement produced by skeletal muscles, resulting in energy expenditure with the objective to maintain or improve physical fitness (Caspersen, Powell & Christenson, 1985). Participation in a regular program of exercise has many physical and psychological health benefits. The physical benefits include improved respiratory, cardiovascular, and muscular function, and reduced risk for diabetes, cardiovascular disease, obesity, and certain cancers (U.S. Department of Health and Human Services, 1996). The psychological benefits include a decreased risk for depression and anxiety, a better quality of life (U.S. Department of Health and Human Services, 1996), and also a better body image (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Martin & Lichtenberger, 2002).

1.5 Effects of Exercise on Trait SPA

One psychological benefit of exercise is that it can improve how people feel about their bodies (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Martin & Lichtenberger, 2002). With specific reference to SPA, several studies have shown that exercise training is an effective strategy for reducing trait SPA (e.g., Lindwall & Lindgren, 2005; Martin Ginis et al., 2005; McAuley et al., 1995b; Williams & Cash, 2001). To date, seven exercise training studies have been conducted using trait SPA as a dependent measure. These studies have employed

exercise training programs of various durations (e.g., 6 weeks; Williams & Cash, 2001; 6 months; McAuley, Marquez, Jerome, Blissmer & Katula, 2002), utilized different exercise modes (e.g., resistance training; Martin Ginis et al., 2005; aerobic endurance exercise; Lindwall & Lindgren, 2005), and sampled participants from different demographics (e.g., young men and women; Williams & Cash, 2001; older adults; McAuley et al., 1995). Despite different design characteristics, these studies have consistently demonstrated that exercise training has a positive impact on SPA.

1.6 Effects of Exercise on Cortisol

With regard to the physical benefits of exercise, several researchers have examined the effects of exercise on the stress response, specifically cortisol secretion. A few cross-sectional studies have demonstrated that exercise training may provide a buffering effect for the stress response in both animals and humans (Droste, Chandramohan & Reul, 2003; Traustadottir, Bosch & Matt, 2005; Wittert, Livesey, Espiner & Donald, 1996). For example, in one study (Wittert et al., 1996) the adaptive changes that occur in the HPA axis with exercise were examined in six male ultramarathon athletes and six non-active males. Results suggested that intense physical training (i.e., training for ultramarathon athletes) led to adaptive changes in the HPA axis, such that the cortisol response was attenuated. Another cross-sectional study (Traustadottir et al., 2005) found that older women, who were regular exercisers, had significantly lower cortisol responses to psychosocial stressors than older women who were non-exercisers.

If the HPA axis does indeed respond to exercise training, this may have important implications for treating individuals with mood disorders. Exercise training could be used to reduce cortisol levels and also alleviate symptoms of depression, anxiety, and stress. For

instance, one randomized controlled trial (Nabkasorn et al., 2005), demonstrated that 8 weeks of jogging was effective for reducing depressive symptoms, as well as reducing cortisol levels (when compared to baseline scores) among young women. In addition, another study (Foley et al., 2008) demonstrated that 12-weeks of aerobic exercise training were effective for reducing cortisol levels in both men and women. Therefore, initial evidence exists to suggest that exercise can re-regulate the HPA axis (identified through reduced cortisol levels) and, in turn, improve symptoms of mood disorders.

1.7 Are Cortisol Levels Related to SPA?

Given the relationship between cortisol and mood disorders that are related to SPA (i.e., social anxiety, depression), it is reasonable to hypothesize that cortisol levels might also be related to SPA. No research to date has examined the relationship between SPA and the cortisol response. However, one study has examined the association between cortisol levels and more general body image concerns (e.g., appearance beliefs and body image dysphoria; Putterman & Linden, 2006). In this cross-sectional study, the results indicated that the highest levels of cortisol were present among women who placed the greatest value on their physical appearance and who had the poorest body image. Additionally, body image concerns were only related to afternoon, but not morning cortisol levels. To explain these findings, the authors hypothesized that the women with poor body image may have been exposed to body-related environmental cues prior to providing the afternoon cortisol sample (e.g., thin media images, mirror reflections, and other body image stimuli), thereby eliciting body-related stress and increased cortisol responses. This hypothesis has yet to be tested experimentally.

Unfortunately, given the cross-sectional design of the Putterman & Linden (2006) study, the causal direction of the relationship between body image concerns and cortisol could not be

identified. On the one hand, chronically high levels of cortisol may be the result of chronic stress or a mood disorder (e.g., anxiety, depression; McEwen, 1998) that confounds measures of body image. On the other hand, situational body image concerns (such as SPA) may act as a psychosocial stressor that activate the stress response and increase cortisol responses. This latter notion is consistent with the tenets of Social Self-Preservation theory (Dickerson & Kemeny, 2004; Gruenewald, Dickerson, & Kemeny, 2007) which suggests that a key determinant of eliciting a cortisol response is the perception of social evaluative threat. Social evaluative threat (SET) occurs in situations where an important aspect of one's identity is, or could be, negatively evaluated by others (Dickerson & Kemeny, 2004). To date, all of the studies of the effects of social evaluative threat on cortisol have involved manipulations that place study participants in situations where their performance on a particular task is evaluated (e.g., public speaking, mental arithmetic, competitive ballroom dancing; Dickerson, Mycek & Zalidvar, 2008; Gruenewald, Kemeny, Aziz & Fahey, 2004; Rohleder, Beulen, Chen, Wolf & Kirschbaum, 2007). However, there are also non-performance based situations in which people may experience social evaluative threat. For example, many women experience feelings of apprehension or threat in response to others' evaluations of their bodies in contexts such as the exercise environment (e.g., SPA; Fredrikson, Roberts, Noll, Quinn & Twenge, 1998; Hart, Leary & Rejeski, 1989).

1.8 Development of Dissertation Studies

Given the established relationships between cortisol and mood disorders that are related to SPA (i.e., anxiety, depression) and perhaps even between body image and cortisol (Putterman & Linden, 2006) this dissertation sought to determine whether SPA was also related to cortisol. If a relationship was established, then exercise training would be explored as a viable strategy for decreasing SPA and cortisol. Therefore, for the present dissertation exercise, SPA and cortisol

were examined using a psychobiological approach. A fundamental assumption of the psychobiological approach is that health, illness and human behaviour are directly influenced by the interaction of biological, psychological and social factors (Suls & Rothman, 2004). Currently, no research in exercise science or the broader field of psychology has examined the relationships between exercise, SPA and cortisol. Thus, with the psychobiological perspective in mind, the objectives of the present dissertation were as follows.

In study one, the purpose was to experimentally manipulate physique evaluative threat in a controlled laboratory setting to determine if an increase in physique evaluative threat (i.e., SPA) produces concomitant changes in cortisol secretion. In addition, this study examined if perceptions of physique evaluative threat were related to cortisol responses.

In study two, the first purpose was to examine the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in trait SPA. The second purpose was to investigate what physical and psychosocial mechanisms underlie the effects of exercise training on trait SPA. The third purpose was to examine the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in cortisol levels. Finally, this study explored the possible protective effects of exercise training on state SPA and cortisol responses to an acute physique evaluative threat situation.

1.9 Importance of the Dissertation Studies

This dissertation is attempting the first studies to examine whether acute and exercise-related changes in SPA are related to concomitant changes in cortisol. To date, there has not been a single published study to examine this possibility in exercise psychology or the broader field of psychology. Discovery of a link between changes in SPA and changes in cortisol will provide researchers with an empirical basis for (a) studying cortisol's role in the general area of

body image disturbance and related pathologies (e.g., eating disorders), (b) developing exercise and other interventions to regulate cortisol levels as a potential strategy for improving SPA, and (c) expanding the current theoretical approach to studying and understanding SPA.

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CHAPTER 2

The Effects of Physique Evaluative Threat on Cortisol Responses in Young Women

Abstract

The purpose of this study was to experimentally manipulate physique evaluative threat to determine if physique evaluative threat elicits concomitant changes in cortisol. Participants were 50 women who were randomly assigned to an experimental, or a control condition. Post-manipulation, the experimental condition had higher cortisol levels than the control condition. Furthermore, regression analyses indicated that a post-manipulation measure of physique evaluative threat explained 7.2% of the variance in post-manipulation cortisol levels. Taken together, these findings suggest that acute changes in physique evaluative threat cause changes in cortisol levels and provide an empirical basis for studying cortisol's role in body image disturbance and related pathologies (e.g., eating disorders).

2.1 Introduction

Social Self-Preservation theory (Gruenewald, Dickerson, & Kemeny, 2007) posits that humans have an innate tendency to preserve the way they are viewed or evaluated by others, in order to maintain a desirable social image. When this social image is threatened, a psychobiological response is set in motion. This response, termed social self-preservation, is the concurrent activation of negative self-evaluative emotions (e.g., shame) and increased cortisol activity (Gruenewald, Dickerson, & Kemeny, 2007). It has been argued that not all stressors or threats activate the social self-preservation system (Dickerson & Kemeny, 2004). Indeed, with respect to preserving the social self, a key determinant of a stress response is the perception of social evaluative threat (Rohleder, Beulen, Chen, Wolf & Kirschbaum, 2007).

Social evaluative threat (SET) occurs when an important aspect of one's identity is, or could be, negatively evaluated by others (Dickerson & Kemeny, 2004). SET is more likely to occur in situations where there is an important goal to be obtained and the situation requires the presentation and evaluation of a valued skill (e.g., giving a conference presentation in front of an audience). In addition, SET occurs in situations where there is the possibility that the goal (e.g., presenting well) may be threatened, which could lead to a loss of social status (e.g., being viewed by others as incompetent), and in situations where uncontrollable factors may actually hinder goal attainment (e.g., technical difficulties with PowerPoint slides; Rohleder et al., 2007).

Social evaluative threat has been shown to provoke necessary psychobiological adaptive changes to protect the social self (e.g., feelings of shame and increases in cortisol; Dickerson & Kemeny, 2004). It has been suggested that persistent exposure to social evaluative threat may have a negative impact on psychological and physical well-being (Dickerson, Gruenewald & Kemeny, 2004; Kemeny, 2007). Psychologically, social evaluative threat is associated with

negative emotions such as shame and embarrassment (cf. Gruenewald, Dickerson, & Kemeny, 2007) and negative self-concept such as low self-esteem (Crocker & Wolfe, 2001). Physiologically, social evaluative threat has been shown to activate the hypothalamic pituitary adrenal (HPA) axis which in turn produces the stress hormone cortisol (cf. Dickerson & Kemeny, 2004). Cortisol plays a critical role in regulating several bodily functions such as mobilizing energy sources to provide fuel for the body and increasing heart rate to prepare the body to deal with a stressor (Dickersen & Kemeny, 2004). However, prolonged exposure to cortisol can have several negative physical and psychological health effects such as suppression of the immune system, diabetes, hypertension, increased anxiety and depression (McEwen, 1998).

Research has demonstrated that social evaluative threat is a potent psychological elicitor of the cortisol response (Dickerson & Kemeny, 2004). In fact, a meta-analysis of 208 acute stressor studies found that cortisol increases were more likely to occur with psychological stressors that included aspects of social evaluative threat (e.g., public speaking) than those that did not (e.g., mental arithmetic tasks; Dickersen & Kemeny, 2004). These findings were supported in a subsequent study that examined the relationship between social evaluative threat, shame and cortisol (Gruenewald, Kemeny, Aziz & Fahey, 2004). The study demonstrated that participants who completed a speech and arithmetic task in front of an evaluative audience (social evaluative threat condition) displayed greater increases in shame and cortisol response compared to those who completed the same task alone (non-evaluative threat condition).

In addition, a recent study sought to clarify what specific aspects of social evaluative threat were responsible for inducing the cortisol response. Participants were randomly assigned to one of three conditions; performing a speech in front of an evaluative audience (social evaluative

threat condition), in the mere presence of others who were not evaluating the participants, or alone (Dickerson, Mycek & Zaldivar, 2008). Participants who performed the speech in front of an evaluative audience had elevated cortisol levels after the manipulation whereas those who performed the task alone or in the mere presence of others did not show increases in cortisol. Taken together, the results of this research demonstrate the strong effects of social evaluative threat on the cortisol response.

To date, virtually all studies of the effects of social evaluative threat on cortisol have involved manipulations that place study participants in situations where their performance on a particular task is evaluated (e.g., public speaking, mental arithmetic, competitive ballroom dancing; Dickerson et al., 2008; Gruenewald et al., 2004; Rohleder et al., 2007). However, there are also non-performance based situations in which people may experience social evaluative threat. For example, many women experience feelings of apprehension or threat in response to others' evaluations of their bodies (e.g., Fredrikson, Roberts, Noll, Quinn & Twenge, 1998; Hart, Leary & Rejeski, 1989). Exercise scientists have identified several situational factors that elicit feelings of physique evaluative threat in women. These situations include, but are not limited to, anticipating the presence of a male observer during an exercise session (Calogero, 2004), the expectation of wearing revealing exercise clothing in front of others (Gammage, Martin Ginis & Hall, 2004), and the possibility of exercising in a mixed-sex exercise environment (Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004). Similar to the results of studies of social evaluative threat, these situations that elicit physique evaluative threat have been shown to induce negative psychological states such as decreased self-efficacy (Katula, McAuley, Mihalko & Bane, 1998), increased social anxiety (Focht & Hausenblas, 2004; Gammage, Martin Ginis & Hall, 2004), and negative feeling states (Martin Ginis, Jung & Gauvin, 2003). However, it is not

known if exposure to situations that elicit physique evaluative threat have any influence on the cortisol response. It is important to know if contexts that involve physique evaluative threat are responsible for activating the cortisol response in order to broaden our understanding of the factors that elicit mobilization of the HPA axis. Moreover, this knowledge will help us inform interventions to potentially reduce the impact of physique evaluative threat and in turn reduce the negative health effects of chronic hyper concentrations of cortisol.

Therefore, the purpose of the present study was to experimentally manipulate physique evaluative threat in a controlled laboratory setting to determine if physique evaluative threat produces concomitant changes in cortisol secretion. It was hypothesized that women exposed to a situation designed to evoke physique evaluative threat would have higher cortisol levels than women exposed to a non-physique evaluative threat situation. It was also hypothesized that perceptions of physique evaluative threat would predict cortisol responses to the manipulation.

2.2 Method

2.2.1 Participants

Using web-based advertisements, 50 female university students were recruited from a Canadian university (M_{age} = 20.78 ± 2.48; 80% Caucasian, 12% Asian, 4% African-Canadian, 4% other; M_{BMI} = 23.36 ± 4.44). In previous research, manipulations of acute psychological stress have rendered large effects on women's cortisol levels (ES = .83; Kirschbaum, Wust & Hellhammer, 1992). These results were used as the basis for an a priori sample size estimation of 46, with 80% power to detect a similar effect in this study ($\alpha < .05$; Cohen, 1992). Volunteers were screened using the Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985), to ensure they did not meet Health Canada's (1998) recommended physical activity levels (i.e., ≥ 3 times per week of moderate intensity activity, for 30-60 minutes). Low-active women were

recruited because the physique evaluative threat manipulation involved exposure to an exercise environment. It was anticipated that low-active women would be more susceptible to the physique evaluative threat manipulation than highly active women because of their minimal exposure to, and presumably, greater discomfort in exercise environments. All women were screened for medication use and were included if they were not taking any anti-anxiety or anti-depressant medications in order to control for the influence of these medications on cortisol secretion (Pariante, Thomas, Lovestone, Makoff, & Kerwin, 2004). In order to control for hormonal fluctuations associated with menstrual phases, only women who were currently taking oral contraceptives were recruited (Altemus, Roca, Galliven, Romanos, & Deuster, 2001).

2.2.2 Measures

Demographic Information. Age, height, weight, cultural background, marital and educational status, and current medications were provided through self-report.

2.2.3 Outcome Measures

Physique Evaluative Threat. To assess situational physique evaluative threat, a state version of the Social Physique Anxiety Scale (SSPAS) was used in the present study. The trait version of the SPAS (Hart et al., 1989) has been shown to be a valid and reliable measure of physique evaluative threat (for a review see Martin Ginis, Lindwall & Prapavessis, 2007). The 9-item state version of the SPAS (Martin Ginis, Murru, Conlin & Strong, 2009) is a modified version of the 9-item trait SPAS (Hart et al., 1989; Martin, Rejeski, Leary, McAuley & Bane 1997), with items reworded to measure situational rather than dispositional SPA. Example items include "it would make me uncomfortable to know that other people in the room were evaluating my physique/figure" and "I would be bothered by thoughts that the other people in the room were evaluating my weight or muscular development negatively". Items were rated on a 5-point

Likert scale ranging from 1 (*not at all*) to 5 (*a great deal*). SSPAS scores were calculated by reverse scoring two items and then summing scores across the items, with higher scores reflecting more state social physique anxiety. Researchers have provided preliminary support for the factorial, convergent and discriminant validity for the SSPAS scores (Martin Ginis, Murru, Conlin & Strong, 2009). The SSPAS has been shown to be responsive to women's acute changes in evaluative threat in response to situations where they anticipate exercising in a mixed-sex environment (Kruessilbrink et al., 2004) or where a fitness instructor is perceived to be more attractive than themselves (Martin Ginis, Prapavessis & Hasse, 2008). The internal consistency reliability estimate for the SSPAS scores in the present study was adequate (Cronbach $\alpha = .93$; Cronbach, 1951).

Salivary Cortisol. Salivary cortisol is a valid assessment of the concentration of biologically active cortisol in the blood (Kirchbaum & Hellhammer, 1989). To collect salivary samples, participants were asked to passively drool approximately 2.0 ml of saliva into a small plastic cryovial. A baseline measure of cortisol was taken immediately upon participant's arrival at the lab. Because peak cortisol responses occur 21-40 minutes from the onset of acute psychological stressors (Dickerson & Kemeny, 2004), the post-manipulation measure of cortisol was taken 30 minutes after the manipulation. Saliva samples were stored at -20 °C and subsequently analyzed using Salimetrics Expanded Range High Sensitivity Enzyme Immunoassay (Salimetrics, PA).

2.2.4 Covariates

Research has shown that anxiety, perceived stress, depression and body mass index are associated with elevated cortisol levels (McEwen, 1998). Therefore, these variables were measured and tested as potential covariates in the analyses. In addition, dispositional concerns

about one's body have also been shown to be associated with cortisol responses in young women (Putterman & Linden, 2006). As a result, dispositional differences in physique evaluative threat were measured and controlled for because they could influence acute responses to the physique evaluative threat manipulation.

State-Trait Anxiety Inventory (STAI; Speilberger, Gorsuch, & Lushene, 1983). State and trait anxiety were measured using the 20-item form Y-1 (SAI) and the 20-item Y-2 (TAI) of the STAI. Participants responded to each item on a 4-point Likert scale ranging from 1 (*not at all*) to 4 (*very much so*). STAI item scores were summed with higher scores indicating higher anxiety. Preliminary research has demonstrated support for the reliability and validity of the STAI scores (Spielberger et al., 1983). In the current study, internal consistency reliability estimates of the SAI and TAI were adequate (Cronbach αs $\geq$ .88; Cronbach, 1951).

Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). The 14-item PSS was used to assess the extent to which individuals perceived their lives as unpredictable, uncontrollable, and overloading. Participants indicated on a 5-point Likert scale, ranging from 1 (*never*) to 5 (*very often*), how often in the past month they experienced stressful events. PSS scores were calculated by reverse scoring four items and then summing all item scores with higher scores indicating more perceived stress. Researchers have provided preliminary support for the reliability and validity of the PSS scores (Hewitt, Flett, & Mosher, 1992). In the present study the internal consistency reliability estimate of the PSS scores was adequate (Cronbach α = .84; Cronbach, 1951).

Beck Depression Inventory-2 (BDI-II; Beck, Steer & Brown, 1996). The 21-item BDI-II was used to measure characteristic attitudes and symptoms of depression. Each item was rated on a 4-point scale, ranging from 0 to 3. BDI scores were calculated by summing across the

items, with higher scores reflecting greater levels of depressive symptoms. Preliminary research has provided support for the reliability and validity of the BDI scores (Beck, Steer, Ball & Ranieri, 1996). In the present study, the internal consistency reliability estimate of the BDI scores was adequate (Cronbach α = .88; Cronbach, 1951).

Body Mass Index. Body mass index was assessed by using self-reported height and weight and by calculating kilograms/meters^2.

Trait Physique Evaluative Threat. The 9-item (Martin, Rejeski, Leary, McAuley, & Bane, 1997) Social Physique Anxiety Scale (SPAS; Hart et al., 1989) was used to assess the extent to which participants had a dispositional tendency to experience physique evaluative threat. Each item was rated on a 5-point Likert scale ranging from 1 (*not at all characteristic of me*) to 5 (*extremely characteristic of me*). SPAS scores were calculated by reverse scoring two-items and then summing scores across the items, with higher scores reflecting more social physique anxiety. Research has provided preliminary support for the concurrent, discriminant, factorial validity and test-retest reliability of the SPAS scores (for a review see Martin Ginis, Lindwall & Prapavessis, 2007). In the present study, the internal consistency reliability estimate of the SPAS scores was adequate (Cronbach α = .85; Cronbach, 1951).

2.2.5 Procedure

During recruitment, volunteers were led to believe that they would be required to perform a single bout of exercise, and therefore were asked to arrive at the experiment dressed in exercise attire (i.e., t-shirts and shorts), and appropriate footwear. Participants were scheduled for individual testing sessions between the hours of 12pm and 5pm, to control for diurnal variations in cortisol secretion (Dickerson & Kemeny, 2004). Testing was scheduled during the 21-day pill phase of the participant's menstrual cycle to control for fluctuating hormones (Arent, Landers,

Matt, & Etnier, 2005). Participants were asked to refrain from drinking alcohol 24 hours prior to the experiment and from eating or drinking 1 hour prior to the experiment so that their saliva samples would not be contaminated by food or beverage particles.

Upon arrival at the lab, participants were randomly assigned to one of two conditions – the experimental condition or the control condition. After providing informed consent, participants were told that they would be performing resistance training exercises. They were then asked to provide a baseline saliva sample and to complete a package of questionnaires containing the Beck Depression Inventory-2 (Beck et al., 1996), the State-Trait Anxiety Inventory (Speilberger et al., 1983), the Perceived Stress Scale (Cohen et al., 1983) and the Trait Social Physique Anxiety Scale (Hart et al., 1989; Martin et al., 1997).

In the experimental condition, participants were told that they would be performing the resistance training exercises at the campus exercise facility, which is a very public, mirrored fitness facility. This type of environment has been shown to increase women's physique evaluative threat (Focht & Hausenblas, 2004). They were also shown a sports bra and spandex shorts and were told that they would be required to wear the outfit during the exercise session. Previous research has found physique evaluative threat increase in anticipation of wearing this type of revealing exercise attire (Gammage et al., 2004). In addition, participants were told that the exercise session would be videotaped by a man, a manipulation that has been shown to increase physique evaluative threat among women (Gammage et al., 2004). Next, participants were taken on a 15-minute tour of the campus fitness facility and given a description of the exercises that they would be required to do in the mirrored weight-training section of the gym.

In the control condition, participants were told that they would be exercising in a private exercise room which had no mirrors because non-mirrored, private exercise settings have been

shown to have no effect on, or to decrease, physique evaluative threat (Martin Ginis et al., 2003; Spink, 1992). They were shown a baggy track suit and were told that they would be required to wear the outfit during the exercise session. They were also told that the session would not be videotaped. After receiving this information, participants went on a 15-minute tour of the private fitness room and were given a description of the exercises they would be required to do.

After the tour, participants in both conditions returned to the lab and completed the measure of physique evaluative threat (i.e., State SPAS). Because peak cortisol responses occur 21-40 minutes from the onset of acute psychological stressors (Dickerson & Kemeny, 2004), it was necessary to wait 30 minutes before taking the post-manipulation saliva sample. Participants were instructed to watch a 30-minute video on the history of video games (Iverson, 2007) and to rest quietly under the pretense that it was necessary to assess their resting heart rate before the exercise session could begin. Immediately following the video, the follow-up saliva sample was taken and the researcher announced that the experiment was over. Participants were then debriefed, told the true purpose of the experiment, and informed that they would not be performing the exercise bout. It was explained that deception was used to manipulate physique evaluative threat. Finally, participants were given $15 as compensation for their time.

2.3 Results

Data were screened for entry errors, missing data, and deviations from normality (Glass & Hopkins, 1996). Inspection of the cortisol data indicated that seven participants had cortisol levels that were either unconventionally high (> .8 $\mu g \cdot dl^{-1}$; n = 1) or low (< .08 $\mu g \cdot dl^{-1}$; n = 6) (Salimetrics, 2008)[1]. Presumably, these participants did not follow instructions to avoid eating

[1] Separate analyses were conducted including the outliers and the pattern of results was similar for both conditions.

or drinking prior to the experiment and their saliva samples were contaminated. Therefore, data for these participants were removed yielding a sample size of 43 participants in further analyses.

No significant differences were found between the experimental and the control condition on demographic variables (age, ethnicity, education, marital status), baseline trait social physique anxiety or baseline cortisol (all *p*s >.10). Thus, random assignment was deemed successful (see Table 1).

Next Pearson correlations were computed to examine relationships between baseline cortisol and the covariates (i.e., perceived stress, depression, anxiety, BMI). Results revealed no significant correlations. Therefore, these variables were not included as covariates in subsequent analyses (see Table 2).

In order to determine if the experiment had successfully manipulated physique evaluative threat, a one-way ANCOVA was conducted on the post-manipulation physique evaluative threat measure (SSPAS) and pre-manipulation dispositional physique evaluative threat was used as a covariate (SPAS). The results revealed a significant main effect for condition $F(1, 42) = 21.05$, $p < .001$). Further examination of the means indicated that the experimental condition reported significantly greater physique evaluative threat ($M = 31.95$, $SD = 8.53$) than the control condition ($M = 24.00$, $SD = 9.10$). Based on these results, the manipulation was considered successful. Therefore, the hypothesis that women in the experimental condition would have greater post-manipulation cortisol than women in the control condition was tested.

A 2 (condition) x 2 (time) repeated measures ANOVA was conducted to determine if the manipulation had differentially affected changes in salivary cortisol concentrations. Results revealed a significant condition x time interaction $F(1, 42) = 6.22$, $p = .02$, reflecting a different pattern of change in cortisol concentration across the two conditions. As illustrated in Figure 1,

women in the experimental condition experienced little change in pre- to post-manipulation cortisol levels, whereas the women in the control condition experienced a decrease in cortisol levels from pre- to post-manipulation. As hypothesized, post-manipulation, women in the experimental condition had significantly higher cortisol concentrations ($M = 0.24$ $\mu g \cdot dl^{-1}$, $SD = 0.16$) than women in the control condition ($M = 0.16$ $\mu g \cdot dl^{-1}$, $SD = 0.10$), $p < .05$.

Finally, a hierarchical multiple regression analysis was conducted to examine the relationship between physique evaluative threat experienced during the manipulation and changes in cortisol levels. Results are presented in Table 3. Baseline cortisol levels and dispositional physique evaluative threat were controlled for by entering them on the first step of the model. Dispositional physique evaluative threat was included as a covariate to control for the influence of how anxious women generally felt about physique evaluation at pre-testing. Physique evaluative threat was entered on the second step and post-manipulation cortisol concentration was the dependent variable. Results revealed that physique evaluative threat accounted for 7.2% of the variance in post-manipulation cortisol concentration levels ($p < .01$). Inspection of the beta coefficients in the final model, indicated that as hypothesized, after controlling for baseline cortisol levels and dispositional physique evaluative threat, greater physique evaluative threat was associated with higher cortisol levels ($\beta = .32$, $p < .01$).

2.4 Discussion

The purpose of the present study was to experimentally manipulate physique evaluative threat to determine if exposure to such a threat elicited changes in cortisol secretion. Women in the experimental condition experienced higher cortisol levels after the manipulation than those in the control condition. Furthermore, physique evaluative threat predicted post-manipulation cortisol.

According to Social Self-Preservation theory, situations involving social evaluative threat elicit negative self-evaluations and changes in cortisol (Dickerson, Gruenewald & Kemeny, 2004; Gruenewald, Dickerson & Kemeny, 2007). The findings from this study support this theory and previous research (Dickerson & Kemeny, 2004) insofar as women who were exposed to the experimental manipulation experienced greater physique evaluative threat and higher cortisol levels than those exposed to the control condition. This study adds to previous research by demonstrating that the effects of social evaluative threat on cortisol levels extend to situations that involve physique evaluative threat.

Although the hypothesized differences in cortisol levels between the two conditions were found, the pattern of results was somewhat different than expected. It was expected that women in the experimental condition would have an increased cortisol response after the manipulation, and women in the control condition would maintain their baseline levels throughout the experiment. However, participants in both conditions had elevated cortisol levels at baseline (M = .24 $\mu g \cdot dl^{-1}$) relative to cortisol levels typically reported for women (e.g., M = .14 $\mu g \cdot dl^{-1}$; Gruenewald, Kemeny, Aziz & Fahey, 2004; Stroud, Salovey, & Epel, 2002). Women in the experimental condition sustained these higher cortisol levels after the manipulation. For women in the control condition, cortisol declined after the manipulation. These data would suggest that participants in both conditions entered the experiment with some anxiety over the upcoming exercise bout (Mason et al., 1973). This is understandable given that the participants were not habitual exercisers and the mere anticipation of exercising with others (male or female) can elicit physique evaluative threat particularily among non-exercisers (Kruessilbrink et al., 2004). For the women in the experimental condition, the sense of threat was sustained during the manipulation, and so, their cortisol levels remained elevated. In contrast, women in the control

condition were apparently relieved by the non-threatening manipulation and so their cortisol levels decreased. Indeed, post-manipulation, women in the control condition (M= .16 $\mu g \cdot dl^{-1}$) had cortisol levels that were comparable to typical baseline levels observed in other studies of women (e.g., M = .14 $\mu g \cdot dl^{-1}$; Gruenewald, Kemeny, Aziz & Fahey, 2004; Stroud, Salovey, & Epel, 2002).

With regard to the second hypothesis, the results demonstrated that physique evaluative threat predicted post-manipulation cortisol. This is the first study to demonstrate a relationship between physique evaluative threat and cortisol. This finding is important because it suggests that the cortisol response can be elicited when women are exposed to situations in which they are worried about others' evaluations of their bodies. These results may have implications for understanding and treating body image concerns.

Specifically, these results provide an empirical basis for studying and understanding cortisol's role in body image disturbance. Identification of a causal link between physique evaluative threat and cortisol will further our understanding of body image by expanding the array of psychosocial consequences of body image disturbance to include biological consequences. For example, measuring cortisol as a biological marker of body image concerns may help us identify susceptibility to other mood disturbances (e.g., anxiety, depression, eating disorders) that are related to cortisol (Chrousos & Gold, 1992; McEwen, 1998) and also often occur in conjunction with body image concerns (Kirkcaldy, Eysenck, Furnham & Siefen, 1998; Kosantski & Gullone, 1998). If elevated cortisol levels are detected, then interventions can be implemented to alleviate body image concerns and, in turn, reduce cortisol levels. One approach may be through exercise, which has been identified as an effective strategy for improving body image (Hausenblas & Fallon, 2006; Martin & Lichtenberger, 2002) and re-regulating the HPA

axis (Nabkasorn et al., 2005; Traustadottir, Bosch, & Matt, 2005; Wittert, Livesey, Espiner & Donald, 1996). However, as the results showed, researchers and fitness professionals need to be cautious about the physique evaluative threats that women may be exposed to in the exercise environment. Specifically, women should be encouraged to exercise in environments that are non-threatening by wearing loose, comfortable clothing, avoiding mirrors, exercising in a single sex exercise setting, and perhaps in a less public/crowded exercise facility (Martin Ginis et al., 2003; Spink, 1992).

This study is the first to experimentally demonstrate a link between physique evaluative threat and cortisol. However, one study limitation was that the measure of physique evaluative threat (State SPAS) was administered only after the manipulation. The SSPAS was inappropriate for pre-manipulation administration (i.e., the items would not have been meaningful to participants before exposure to the manipulation), and therefore restricted the ability to assess changes in physique evaluative threat before and after the manipulation. Nevertheless, the dispositional measure of physique evaluative threat (SPAS) was administered at pre-testing and it was included as a covariate in the analyses, therefore controlling for the influence of how anxious women generally felt about physique evaluations at pre-testing.

Another limitation was that the women came into the experiment with elevated cortisol levels which compromised an ability to manipulate and detect an increase in cortisol. Although the sampling of low-active women may maximize responsiveness to an exercise-related physique evaluative threat manipulation, future researchers should be aware of the effect of the mere anticipation of exercising on low-active women. It may be important to provide women with a quiet rest or relaxation period before starting the experiment to ensure that they are not anxious and have baseline cortisol levels reflective of a "normal" non-stressed state.

In terms of future directions, researchers should examine whether physique evaluative threat is related to cortisol changes in regular exercisers. Perhaps regular exercisers experience a buffering response to these physique evaluative threat situations because of the impact that exercise has on regulating the HPA axis. Also, it would be valuable to examine if exercise-related reductions in physique evaluative concerns are also related to exercise-related improvements in cortisol responses.

In conclusion, the results of this study suggest that for women, situations that elicit physique evaluative threat elicit concomitant changes in cortisol. Identification of a causal link between physique evaluative threat and cortisol has the potential to further our theoretical understanding of Social Self-Preservation theory (Dickerson & Kemeny, 2004; Gruenewald, Dickerson & Kemeny, 2007). The results demonstrated that there are other situational evaluative contexts that elicit the cortisol response, and suggest that physique evaluative threat is another possible consequence of the social self-preservation system. In addition, including cortisol as a biological marker of physique evaluative threat in future research may provide researchers with the ability to identify susceptibility to other mood disorders such as anxiety, depression and eating disorders.

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Table 1.

Descriptive Statistics for all Study Variables by Condition.

	Experimental Condition	Control Condition
	n = 24	*n* = 19
Variable	*M* (*SD*)	*M* (*SD*)
Baseline cortisol ($\mu g \cdot dl^{-1}$)	.25 (.14)	.24 (.14)
Post-manipulation cortisol ($\mu g \cdot dl^{-1}$)	.24 (.16)	.16 (.10)*
Physique evaluative threat	31.95 (8.53)	24.00 (9.09)***
Trait physique evaluative threat	25.75 (6.95)	27.79 (8.55)
State anxiety	32.00 (7.82)	36.47 (10.64)
Trait anxiety	35.20 (8.03)	42.38 (10.71)**
Perceived stress	15.04 (5.48)	19.73 (4.73)**
Depression	6.04 (5.83)	8.10 (6.75)
Body mass index	25.15 (4.74)	21.08 (2.74)*

Note. ***$p < .01$, **$p = .01$, *$p < .05$

Table 2.

Pearson's Correlations Between Potential Covariates and Cortisol

	Baseline Cortisol	Post-Manipulation Cortisol	Trait Anxiety	Perceived Stress	Depression	BMI	Trait Physique Evaluative Threat
Baseline Cortisol	1.00	.78**	-.08	-.09	.01	.06	-.15
Post-Manipulation Cortisol		1.00	-.21	-.24	-.11	.17	-.18
Trait Anxiety			1.00	.66**	.70**	-.37*	.31*
Perceived Stress				1.00	.68**	-.16	.27
Depression					1.00	-.17	.22
BMI						1.00	.05
Trait Physique Evaluative Threat							1.00

Note. $^{**}p < .001$; $^{*}p < .05$; BMI = Body mass index

Table 3.

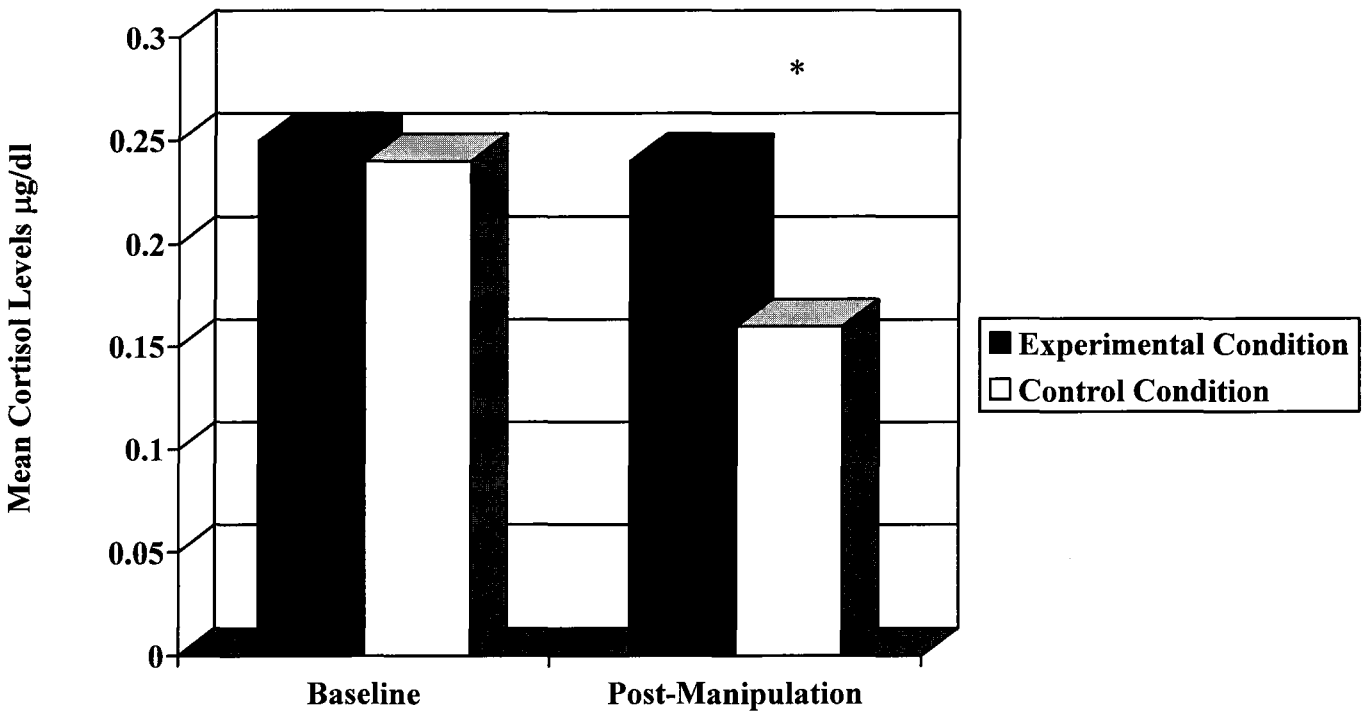
Hierarchical Multiple Regression Analysis Predicting Post-Manipulation Cortisol.

Predictor	R^2	Adjusted R^2	ΔR^2	β	p
Step One	.61	.59	.61		<.001***
Baseline Cortisol				.77	<.001***
Trait Physique Evaluative Threat				-.07	.50
Step Two	.68	.66	.07		<.01**
Baseline Cortisol				.76	<.001***
Trait Physique Evaluative Threat				-.24	.03*
Physique evaluative threat				.32	<.01**

Note. *** p <.001; **p <.01; *p <.05

Figure Caption

Figure 1. Cortisol Changes By Condition


Mean Cortisol Levels µg/dl
0.3
0.25
0.2
0.15
0.1
0.05
0
*
Baseline
Post-Manipulation
Experimental Condition
Control Condition

CHAPTER 3

An Experimental Investigation of the Effects of Exercise on Social Physique Anxiety and Cortisol Among Women

Abstract

This study compared the effects of an 8-week aerobic versus resistance training intervention on changes in social physique anxiety (SPA) and changes in cortisol, as well as the physical and psychosocial mechanisms underlying the effects of exercise training on SPA. The possible protective effects of exercise training on state SPA and cortisol responses to an acute physique evaluative threat manipulation were also examined. Forty six women (*M* age =21.52 years, *SD* = 2.93), were randomly assigned to one of two exercise conditions: aerobic or resistance training. Participants completed the trait and state Social Physique Anxiety Scales (Hart, Leary & Rejeski, 1989; Martin Ginis, Murru, Conlon & Strong, 2009), measures of potential psychosocial and physical mechanisms underlying changes in trait SPA, and provided several salivary cortisol samples. The women exercised 3 days/week for 8 weeks. Prior to and after the exercise training, the women were exposed to a physique evaluative threat manipulation. Analyses indicated that the aerobic condition experienced greater improvements in trait SPA than the resistance training condition and both groups exhibited significant decreases in cortisol levels (compared to baseline). In addition, changes in aerobic self-efficacy and perceived physical endurance partially mediated the effect of the exercise intervention on SPA. Finally, the results demonstrated that 8-weeks of exercise training (regardless of mode) may buffer the state SPA response to a physique evaluative threat manipulation. These findings suggest that participating in an 8-week aerobic exercise intervention is associated with greater improvements in trait SPA than resistance training. Furthermore, changes in aerobic self-efficacy and perceived endurance are partially responsible for improved trait SPA changes. Finally, exercise training may have protective benefits for acute emotional stress responses such as state SPA.

3.1 Introduction

Social physique anxiety (SPA) is defined as the anxiety that individuals experience when they are concerned about how others perceive and evaluate their bodies (in both real and imagined situations; Hart, Leary, & Rejeski, 1989). Traditionally, SPA has been conceptualized as a dispositional characteristic (Hart et al., 1989). However, as demonstrated in Study 1, SPA may also fluctuate across situations. Therefore, as a follow up to Study 1, the general purpose of Study 2 was to examine the effects of an exercise training program on trait and state SPA, and cortisol. The first part of the introduction focuses on exercise training, trait SPA and cortisol. The second part of the introduction focuses on exercise training, state SPA and cortisol.

3.1.1 Exercise training and trait SPA

Several studies have shown that exercise training is associated with decreases in trait SPA (e.g., Lindwall & Lindgren, 2005; Martin Ginis, Eng, Arbour, Hartman & Philips, 2005; McAuley, Bane, Rudolph, & Lox, 1995; Williams & Cash, 2001). However, the mode of exercise utilized in these studies has varied. Some interventions have focused on aerobic exercise, others have used resistance training, and one has compared aerobic versus resistance training.

To date, only four studies have examined the effects of aerobic exercise on SPA. Two of the studies (published from the same data set) found that a 20-week, brisk walking program was shown to be effective for improving SPA in sedentary, middle aged adults (McAuley et al., 1995 a & b). Another study found that among female college students, participation in a 10-week aerobic fitness program was effective for improving SPA (Bartlewski, VanRaalte & Brewer, 1996). And, in a sample of sedentary adolescents, a 6-month exercise intervention (focused

primarily on aerobic exercises) was successful for improving SPA (Lindwall & Lindgren, 2005). Together these studies indicate that aerobic exercise training is effective for improving SPA.

Only two studies have examined the effects of resistance training on SPA. The results of these studies were also positive. These studies showed that, among a group of male and female college students, participating in either a 6-week resistance training program (Williams & Cash, 2001) or a 12-week resistance training program (Martin Ginis et al., 2005) improved SPA.

Only one study has compared the effects of aerobic versus resistance training on SPA (McAuley, Marquez, Jerome, Blissmer & Katula, 2002). In this study, older adults (age 65+years), participated a 6-month aerobic walking program or a strength-training program using resistance bands. Results indicated that exercise participation was effective for improving SPA, but there were no significant differences found for exercise mode. Despite the positive results regarding improvements in SPA, this study had several limitations. First, the participants in the study were older adults and thus the results may not generalize to younger adults. Second, the level of exercise intensity in this study was low to moderate (Nelson et al., 2007) and perhaps not sufficiently intense enough to maximize improvements in SPA for either exercise mode. Finally, the types of exercises (brisk walking and resistance tube exercises) were selected as the tasks for this sample of sedentary older adults. It is not known if other more intense activities (i.e., running and weight lifting) would yield different results. Given these limitations, it is not yet clear which mode of exercise is more beneficial for improving SPA.

In summary, research has shown that exercise training (either aerobic or resistance) is effective for improving SPA. However, no research to date has directly compared an aerobic versus resistance training program among a group of young women. Research is needed in order to identify *what* mode of exercise is most beneficial for improving SPA so that effective exercise

prescriptions can be made. Thus, the first purpose of this study was to compare the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in trait SPA among young women. Based on previous research, it was hypothesized that both aerobic training and resistance training would be effective for improving SPA. However, given the current state of the exercise and SPA research, hypotheses regarding which mode of exercise would be superior for improving SPA could not be made (McAuley et al., 2002).

3.1.2 Mechanisms underlying the effects of exercise training on trait SPA

An additional issue that has received little research attention, is exactly *how* exercise exerts its effects on SPA. That is, what mechanisms are responsible for exercise-related improvements in SPA? To date, only five studies have examined this issue (c.f., Lindwall & Lindgren, 2005; Martin Ginis et al., 2005; McAuley et al., 1995a & b; McAuley et al., 2002). These studies have provided preliminary evidence to suggest that there are at least three different mechanisms--one physical and two psychosocial--that can explain the effects of exercise on SPA (Lox, Martin Ginis & Petruzzello, 2006). These mechanisms are: (1) changes in physical fitness (e.g., changes in body composition, physical endurance and muscular strength), (2) changes in perceived physical competencies (e.g., perceived changes in strength, endurance or body fat), and (3) changes in physical self-efficacy (e.g., the confidence to perform aerobic or resistance training activities).

Research has shown that participating in an exercise program will change many physical fitness characteristics such as body composition (McAuley et al., 1995), aerobic fitness (Lindwall & Lindgren, 2005), and muscular strength (Martin Ginis et al., 2005). Specifically, when people exercise, they may change their body shape or size, become stronger or increase their endurance. When their bodies change, people may feel better about their bodies, and

subsequently experience improved SPA. These physical improvements may explain why exercise improves SPA. However, only a handful of studies have examined the relationship between changes in body composition, aerobic fitness, physical strength and SPA. The research on physical fitness changes as a mechanism underlying the effects of exercise training on SPA has several limitations. .

With respect to body composition as a mechanism underlying the effects of exercise training on SPA, the results are equivocal. For instance, one study demonstrated that changes in body composition (e.g., changes in hip circumference) were weakly to moderately associated with changes in SPA (McAuley, Bane, Rudolph, & Lox, 1995), whereas another study showed changes in SPA occurred with little or no changes in body composition (e.g., body fat; McAuley et al., 2002). In terms of changes in aerobic fitness as a mechanism, one study (McAuley et al., 2002) found that improvements in aerobic capacity were weakly related to changes in SPA, whereas another study (Lindwall & Lindgren, 2005) found that changes in physical fitness were not linked to changes in SPA. Only one study (Martin Ginis et al., 2005) has examined changes in physical strength as a mechanism underlying the effects of exercise training on SPA. This study found that, for women only, strength changes were moderately associated with changes in SPA. Taken together, the evidence for physical fitness changes explaining the effects of exercise training on SPA is unclear. The research results are conflicting and often changes in SPA are experienced even when improvements in objective measures of physical fitness are not evident. This suggests that other variables may account for the effects of exercise on SPA.

Changes in psychosocial mechanisms may provide further insight into the effects of exercise training on SPA, although there is a limited amount of research conducted on this topic. One psychosocial mechanism that has received some research attention is perceived physical

competencies. Perceived physical competencies are an individual's evaluations of his/her own physical fitness (e.g., perceived strength, physical endurance; Sonstroem & Morgan, 1989). Only one study (Martin Ginis et al., 2005) to date has examined perceived physical competencies as a possible mechanism underlying the effects of exercise training on SPA. The study found that, for women, there were weak to moderate associations between post-exercise perceptions of decreased body fat, increased muscularity and strength, and exercise-induced improvements in SPA. Although this study was informative, it was limited in that these mechanisms were only assessed among women participating in a resistance training program. It is not known if changes in perceived physical competencies have any effect on changes in SPA for women participating in an aerobic exercise program.

Additional work examining psychosocial mechanisms in the exercise-SPA relationship has included studying self-efficacy (e.g., McAuley et al., 1995a). Self-efficacy is defined as people's beliefs in their capabilities to perform a specific task or behaviour (Bandura, 1994) and it is identified as an important cognitive mechanism mediating personal change (e.g., behavioural and psychological; Bandura, 2004). Research has found that for middle-aged and older adults, regular exercise participation can produce changes in walking and general physical self-efficacy; these changes were moderately associated with improvements in SPA (McAuley et al., 1995a; McAuley et al., 2002). Although this research confirmed the relationship between self-efficacy and SPA, it had some limitations. First, this study only examined middle-aged and older adults; therefore, it is not known if self-efficacy exerts any influence on SPA in younger women. In addition, the measures of self-efficacy were general physical self-efficacy and walking self-efficacy. Assessing other exercise-specific types of self-efficacy (e.g., exercise self-presentational efficacy, aerobic or strength self-efficacy), among a group of younger women,

would be informative to pinpoint the types of self-efficacy that would be necessary to change in order to improve SPA.

One other mechanism that has been proposed to influence the effects of exercise training on SPA is satisfaction with progress made toward one's goals (Martin Ginis et al., 2005). To date, no research has examined goal satisfaction as a mechanism underlying the effects of exercise training on SPA. However, if a person sets an exercise goal to improve her physical fitness, and achieves her goal, her satisfaction with attaining this goal may partly explain why exercise reduced her physique anxiety. Alternatively, her success at achieving her goal may yield a sense of self-satisfaction that contributes to more positive feelings about her body.

3.1.3 Theoretical framework for studying the effects of exercise training on trait SPA

To summarize, the limited amount of research on mechanisms has not yet adequately accounted for the effects of exercise on SPA. Furthermore, although the physical and psychosocial mechanisms have been tested in separate research studies, no research has examined all of the mechanisms simultaneously, utilizing a guiding theoretical framework. Recent research has begun to examine the mechanisms from various theoretical perspectives such as Cash's (2002) Cognitive Behavioral Model of body image (e.g., Martin Ginis et al., 2005), Sonstroem and Morgan's (1989) Exercise and Self-Esteem Model (e.g., Lindwall & Lindgren, 2005) and Bandura's (1977) Social Cognitive Theory (e.g., McAuley et al., 1995a; McAuley et al., 2002). Theories are important because they summarize and integrate existing knowledge, explain why a certain phenomenon occurs, and provide a blueprint to direct future research and interventions (Brawley, 1995; Christensen, 1997). As such, it was important to utilize a theoretical framework to guide the present study.

Currently there are no theoretical frameworks that describe how exercise improves SPA. However, a theoretical framework used in a related area, namely exercise and self-esteem, may shed some insight into the effects of exercise training on SPA. The Exercise and Self-Esteem Model (EXSEM; Sonstroem & Morgan, 1989) is a hierarchical model that organizes constructs leading to predictions of global self-esteem (see Figure 1; Sonstroem & Morgan, 1989). At the very bottom of the model are physical fitness changes -- such as changes in body composition, physical strength or endurance -- as the result of exercise participation. The next level up is physical self-efficacy, which is the belief in one's capabilities to perform a specific task or behavior (Bandura, 1997). As an example, physical self-efficacy could be described as the belief that an individual has in her ability to lift a 10 pound weight ten times or run for 30 minutes. Above physical self-efficacy is perceived physical competence, which is an individual's evaluations of his/her own physical fitness (Sonstroem & Morgan, 1989) such as having the stamina required to engage in endurance activities or the strength to lift weights. Beside perceived physical competence is physical acceptance, which reflects body satisfaction, a dimension of body image (Cash, 2004, pg.1; Sonestroem & Morgan, 1989). At the very top of the model is the construct of self-esteem.

The EXSEM posits that changes in physical fitness lead to increased physical self-efficacy. Changes in physical self-efficacy are postulated to lead to changes in perceived physical competence which leads to changes in physical acceptance. Although the EXSEM hasn't been used in SPA research, as the literature review indicated, there is evidence that all of the variables in the EXSEM (i.e., physical fitness; Lindwall & Lindgren, 2005; physical self-efficacy; McAuley et al., 1995a; perceived physical competencies; Martin Ginis et al., 2005) are related to changes in SPA which represents an affective dimension of body image. Therefore,

the present study was framed within part of the EXSEM. Figure 2 shows the framework employed. Because the temporal ordering of variables hasn't been demonstrated in EXSEM research and given the lack of previous research examining all of the mechanisms in a single study (Lindwall & Lindgren, 2005, Martin Ginis et al., 2005, McAuley et al., 1995a), the mechanisms were examined concurrently (see Figure 2).

In summary, research has shown that all of the proposed mechanisms (i.e., physical fitness; Lindwall & Lindgren, 2005; physical self-efficacy; McAuley et al., 1995a; perceived physical competencies; Martin Ginis et al., 2005) are related to changes in SPA. However, it is not known what mechanisms are most important to induce changes in SPA. Further research examining the psychosocial and physical mechanisms simultaneously is needed to inform future exercise interventions in terms of what specific mechanisms to target to change SPA. Therefore, the second purpose of this study was to examine what psychosocial and physical mechanisms underlie the effects of exercise training on SPA. Based on research showing the relationship between the mechanisms and changes in SPA, it was hypothesized that changes in the physical and psychosocial mechanisms would mediate the effects of the exercise intervention on SPA.

3.1.4 Exercise training and cortisol in women

Researchers have been interested in understanding how exercise training not only impacts psychological variables such as SPA, but also how exercise influences various physiological systems of the body. One physiological system that has received recent attention among exercise scientists is the hypothalamic-pituitary-adrenal (HPA) axis. As noted in the general introduction, the HPA axis is responsible for producing one of the most important hormones in the body; cortisol. Excessive amounts of cortisol in the body can impair HPA axis function and be detrimental both physically (e.g., increased risk for cardiovascular disease, diabetes; Bjorntorp,

1997; Rosmond, Dallman, & Bjorntorp, 1998) and psychologically (e.g., increased risk for depression, eating disorders; Chrousos & Gold, 1992). Therefore, it is imperative that interventions are developed to decrease high cortisol levels.

Preliminary evidence indicates that exercise training can re-regulate the HPA axis and, in turn, lower cortisol levels (e.g., Traustadottir et al., 2005). In fact, a recent review compared the effects of resistance versus endurance training on several hormonal responses among women (Consitt, Copeland, & Tremblay, 2002). For the results on cortisol, the review identified that both aerobic endurance and resistance training impacted this hormone differently. It was highlighted that among elite female athletes, aerobic endurance training either had little to no effect on cortisol levels (e.g., Hooper et al., 1993) or caused an increase in cortisol levels (e.g., Tsai et al., 1991). In contrast, it was reported that among young, active women, resistance training caused resting cortisol levels to either decrease (e.g., Kraemer et al.,1998; Marx et al., 2001) or not change at all (Hakkinen & Parakinen, 1994; Hickson et al., 1994). In addition, one study (Bell et al., 2000) compared the effects of either a resistance training or aerobic training program to a combined resistance and aerobic training program on cortisol levels among young, active, men and women. For women only, it was shown that after 12 weeks of training, there was a significant increase in cortisol levels in the combined resistance and aerobic program. There were no changes in cortisol levels for women participating in the aerobic only or resistance training only programs. The review concluded that, with respect to the effects of exercise training on cortisol among women, the results are equivocal and not completely understood.

Research not cited in the review has confirmed the varied results. For example, one study (Clearlock & Nuzzo, 2001), compared the effects of a 4-week aerobic exercise program on

cortisol levels among sedentary women in various age groups (e.g., 20-30; 40-50; 60-85). After the 4-week aerobic program, it was found that there were no significant differences in pre-post cortisol levels among or between the age groups. Another study (Vale et al., 2009) examined the effects of a resistance or aerobic training program on cortisol levels among a group of inactive elderly women. The study found that after the 12-week training programs, there were no pre-post differences in cortisol levels among or between the exercise conditions.

Taken together, the research reviewed makes it difficult to know what effect exercise training has on cortisol among women. The ambiguous results might be explained by considering a few limitations. For instance, it is difficult to compare studies when different samples of women were utilized in each study. Some research sampled elite athletes (e.g., Hooper et al., 1993) whereas other studies examined active, but non-resistance trained women (e.g., Kraemer et al.,1998 ; Marx et al., 2001), and still other research examined inactive elderly women (Vale et al., 2009). The different levels and types of baseline activity of the women across studies is problematic because cortisol levels have been shown to differ between those who are active versus inactive (e.g., Traustadottir et al., 2005) involved in competitive sports (e.g., Aubets & Segura, 1995) and of differing ages (Rohleder, Wolf & Kirschbaum, 2003). Next, most of the research employed small sample sizes which may indicate that the studies were underpowered to detect differences in cortisol levels between groups and over time.

Other reasons that may explain the conflicting results regarding exercise training and cortisol include the type of training program employed and cortisol measurement issues. For example, some of the studies focused on aerobic training (e.g., Clearlock & Nuzzo, 2001), whereas others focused on resistance training (e.g., Marx et al., 2001). Within those studies, various exercise intensities (e.g., high intensity vs. low intensity) and different program durations

(e.g., 4-weeks vs. 24-weeks) were used. Research has shown that training intensity impacts the cortisol levels (Arent, Landers, Matt & Etiner, 2005). An additional issue was how and when cortisol was measured in each study. Some studies utilized single time-point assessments of cortisol (e.g., Clearlock & Nuzzo, 2001) whereas others took multiple samples at different time points (e.g., Kraemer et al., 1998). Different sampling methods may explain why there are inconsistent findings between studies because cortisol levels are known to change over the course of the day (cf. Kirschbaum & Hellhammer, 1989).

One other issue, which was not considered in previous research, is the influence of exercise training on mood disorders such as depression and changes in cortisol. Only two studies were found that examined the effects of exercise training on cortisol levels among women with a pre-existing psychological condition. In one 16-week, two-way crossover randomized controlled trial (Nabkasorn et al., 2005), female university students with mild to moderate depression engaged in 8 weeks of jogging and 8 weeks of no jogging. After the jogging intervention, participants had a significant reduction in cortisol levels compared to baseline, and a decrease in depressive symptoms. In the other study (Foley et al., 2008), male and female participants with clinical depression were randomly assigned to either a 12-week aerobic or stretching program. After the intervention, both groups exhibited decreases in depressive symptoms. Reductions in cortisol levels were demonstrated at week 6 in both groups. However, at week 12, decreases in cortisol levels were only present in the aerobic exercise group. Based on these findings, it can be suggested that when exercise training leads to reduced cortisol levels, it also leads to concomitant reductions in depression.

Given the limitations identified, regarding the effects of exercise training on cortisol, and the positive findings of Nabkasorn et al. (2005) and Foley et al. (2008), it is reasonable to

suggest that under certain conditions, exercise training can reduce cortisol levels among those who also have symptoms of poorer psychological well-being (e.g., high SPA). Furthermore, it is still unclear as to what mode (aerobic versus resistance training) of exercise is more effective for improving cortisol levels among women. This information will be important to inform future exercise interventions aimed at reducing cortisol levels and improving psychological well-being among young women. As such, the third purpose of this study was to compare the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in cortisol among women with high SPA. Based on the equivocal research on exercise training and cortisol, it was hypothesized that both exercise groups would demonstrate decreases in cortisol levels after the 8-week exercise intervention. However, given that the current state of the exercise and cortisol research is unclear, hypotheses could not be made regarding what mode of exercise would be more effective for improving cortisol levels.

3.1.5 Exercise training, state SPA and cortisol

Although SPA is typically conceptualized as a trait, research on SPA has shown that it may fluctuate across situations (e.g., Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004). For example, one study compared the influence of an imagined all-male, all-female and mixed-sex exercise setting on state SPA responses (Kruisselbrink et al., 2004). The researchers found that women reported significant increases in situational SPA from the hypothetical all-female to mixed-sex to all-male exercise scenarios. In addition, results from Study 1 in this dissertation demonstrated that exposure to a physique evaluative threat manipulation (involving the exercise environment) influenced state SPA and cortisol responses. Specifically, women who were exposed to the physique evaluative threat condition (i.e., anticipated wearing revealing exercise attire, exercising in front of mirrors, in a public fitness facility, and being videotaped by the

opposite sex) experienced higher state SPA and cortisol after the manipulation than women in the control condition. These results suggest that exposure to an acute physique evaluative threat not only influences state SPA but also impacts the cortisol response. This is consistent with Social Self-Preservation theory (Dickerson, Gruenewald & Kemeny, 2004; Gruenewald, Dickerson & Kemeny, 2007) which posits that situations involving social evaluative threat (i.e., where one's identity is, or could be, negatively evaluated by others) will elicit negative self-evaluative emotions (e.g., SPA) and changes in cortisol. This is problematic because women with high state SPA may avoid exercising or shorten their exercise bouts when faced with an evaluative threat situation (Kruisselbrink et al. 2004) and thus be at risk for numerous physical health conditions as the result of a sedentary lifestyle. In addition, women who are exposed to evaluative threat situations may incur elevated cortisol levels and be at risk for developing psychological and physical health conditions such as depression or obesity (McEwen, 1998; Rosmond et al., 1998). Given the impact of physique evaluative threat on state SPA and cortisol, there is a need to understand what could buffer the state SPA and cortisol response.

No research to date has examined whether exercise training can buffer the effect of exposure to an acute physique evaluative threat on state SPA and cortisol. However, studies have examined the effects of exercise training on emotional and physiological responses to other types of acute stressors. For example, one study (Traustadottir et al., 2005) examined whether level of fitness impacted the cortisol response to a psychosocial stressor. The study compared a group of unfit ($\leq VO_2$ max average for respective age group) and fit women ($\geq VO_2$ max average for respective age group), and measured cortisol responses before and after a psychosocial stress task (a stroop task, mental arithmetic, anagram task, cold pressor task, and interpersonal interview). Results indicated that the fit women had significantly lower cortisol responses to the

stress tasks than the unfit women. The authors suggested that aerobic fitness blunted the cortisol response in the women.

Another study (Rimmele et al., 2007) examined whether level of fitness impacted psychological and cortisol responses to a psychosocial stressor. The study compared a group of fit (elite endurance athletes) and unfit men (exercised less than 2 hours per week) and measured cortisol and affective responses before and after a psychosocial stress task (public speaking and mental arithmetic task in front of an audience). Results indicated that the trained men exhibited lower cortisol responses, improved mood, and a trend toward lower state anxiety than the untrained men. This study suggests that aerobic fitness blunted the cortisol and psychosocial response to stress.

In addition, meta-analytic findings support the effects of exercise training on emotional and physiological stress responses. One such review examined the effects of aerobic exercise training on psychosocial stressors (Crews & Landers, 1987). The review contained 34 studies with 92 effect sizes across samples of both men and women. The results indicated that aerobic exercise was associated with nearly a one half of a standard deviation decrease in stress reactivity from baseline values. These changes were observed with different measures of stress, such as changes in muscle tension (ES = .87), galvanic skin response (ES = .67) and psychological self-report (ES = .57). The authors suggested that regardless of how the stress response was measured, aerobic fitness has stress-buffering effects. Given the effects of exercise training on acute emotional and physiological responses to a stressor, it is reasonable to suggest that exercise training could have an effect on state SPA (i.e., an emotional response) and cortisol responses (i.e., a physical response) to a physique evaluative threat. This was the fourth purpose of the present study. Based on research showing that exercise has stress buffering effects (e.g.,

Crews & Landers, 1987; Rimmele et al., 2007; Traustadottir et al., 2005) it was hypothesized that after 8-weeks of exercise training, the aerobic and resistance training condition would experience reduced state SPA and lower cortisol responses after exposure to an acute physique evaluative threat situation. Given the limited amount of research on the influence aerobic training and no research examining the influence of resistance training on acute emotional and cortisol responses, no hypotheses could be made regarding what mode of exercise would be more effective for buffering the state SPA and cortisol response.

3.1.6 Purpose & Hypotheses

To summarize, this study had several objectives. The first purpose was to compare the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in trait SPA. Second, this study investigated what physical and psychosocial mechanisms underlie the effects of exercise training on SPA. The third purpose was to compare the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in cortisol levels. Finally, this study explored the possible protective effects of exercise training on state SPA and cortisol responses to an acute physique evaluative threat situation.

This study tested several hypotheses. First, it was hypothesized that both the aerobic and resistance training condition would experience improvements in trait SPA after the 8-week exercise program. Next, it was hypothesized that changes in the psychosocial mechanisms and physical mechanisms would mediate the effects of the exercise intervention on trait SPA. It was also hypothesized that both the aerobic and resistance training groups would experience improvements in cortisol after the 8-week exercise program. Finally, it was hypothesized that after the 8-week exercise intervention, both the aerobic training and resistance training condition

would experience reduced state SPA and cortisol responses after exposure to the physique evaluative threat manipulation.

3.2 Method

Methodological overview

This project had two components. The first was an exercise training study which examined the effects of exercise on trait SPA, its mechanisms of change, and cortisol. For this part of the study, participants were randomly assigned to an aerobic or resistance training condition. All study measures were administered before exercise training began (pre-training) and at the end of the 8-week training program (post-training). The second component of this project examined the acute effects of a physique evaluative threat manipulation on women's state SPA and state cortisol levels. The manipulation and measures were administered at pre-training and again at the end of the 8-week study (post-training).

3.2.1 Participants

Forty six women (M_{age} = 21.52, SD = 2.93; ethnicity = 80% Caucasian; M_{BMI} = 22.96, SD = 3.89) were recruited from a university in southwestern Ontario, Canada. In order to obtain a sample of women with higher trait social physique anxiety, only volunteers who scored 27 or above on the 9-item (Martin, Rejeski, Leary, McAuley & Bane, 1997) Social Physique Anxiety Scale (Hart, Leary & Rejeski, 1989) were eligible to participate. This value represents an average score of at least a 3 "moderately characteristic of me" on the 5-point Likert SPA scale which ensured that participants experienced feelings associated with social physique anxiety. The mean SPA score for the women in the present study was 33.01 (out of a possible 45) with a standard deviation of 5.39. All volunteers were screened for physical activity levels using the Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985). Participants

who were included in the study were low-active individuals as defined by Health Canada's physical activity guidelines (1998), and had not engaged in a regular exercise training program (i.e., less than two sessions per week and ≤ 30 minutes a session) during the previous year. Low-active women with higher social physique anxiety were targeted because it is believed that they would be most responsive to an exercise training intervention to improve social physique anxiety (Martin & Lichtenberger, 2002). Finally, in order to ensure that participants were physically able to participate in an exercise program, they completed the Physical Activity Readiness Questionnaire (PAR-Q; Thomas, Reading & Shephard, 1992). Participants who responded "no" to all questions on the PAR-Q, which pertained to risk factors associated with cardiovascular, pulmonary or metabolic diseases, were eligible to participate.

3.2.2 Measures

Demographics. Relevant background information including participant's age, ethnic background, marital and educational status, and current medications was provided through self-report.

3.2.3 Trait measures for the exercise training study

Trait social physique anxiety. The 9-item (Martin, Rejeski, Leary, McAuley, & Bane, 1997) Social Physique Anxiety Scale (SPAS; Hart et al., 1989) was used to assess the extent to which participants experienced anxiety when they perceived their physique was being evaluated by others. Each item was rated on a 5-point Likert scale ranging from 1 (*not at all characteristic)* to 5 (*a great deal*). SPAS scores were calculated by reverse scoring two-items (5, 8), and then summing scores across the items, with higher scores reflecting greater social physique anxiety. Researchers have provided preliminary support for the concurrent, discriminant, factorial validity and test-retest reliability of the SPAS scores (for a review see

Martin Ginis et al., 2007). In the present study, the internal consistency reliability estimates (Cronbach's α, Cronbach, 1951) of the SPAS scores were adequate (pre-training α = .87; post-training α = .87).

Salivary cortisol. Participants passively drooled approximately 2.0 ml of saliva into a small plastic cryovial at 0, 1, 3, 6, and 9 hrs after waking over the course of a single day. Five cortisol samples were necessary to provide an indication of the total pre and post-training cortisol secretion for each participant. Saliva samples were stored at -20 °C until they were analyzed using Salimetrics Expanded Range High Sensitivity Enzyme Immunoassay (Salimetrics, PA).

Physical fitness mechanisms of SPA change

Body composition. Three measures of body composition were obtained: (1) weight (2) body mass index, and (3) waist-to-hip ratio. Weight was measured using a standard scale (Lifesource Precision Personal Health Scale) and recorded in kilograms. Body mass index was assessed by measuring height and weight using a tape measure and the standard scale and by calculating kilograms/meters^2. In accordance with ACSM (2008) guidelines, waist and hip circumference were measured in centimetres, using a tape measure, at the largest diameter of the waist and hip. Waist-to-hip ratio was then calculated by dividing the waist circumference by the hip circumference.

Aerobic fitness. The Astrand Rhyming Submaximal Fitness Test (Astrand & Rodahl, 1986; Legge & Banister, 1986) was used to assess aerobic fitness. Participants cycled on a stationary bicycle at a constant workload (50rpm) for seven minutes. Heart rate (HR) was measured every minute using a Polar Heart Rate monitor (Polar Electro Inc., New York), and the steady state heart rate at minutes 6 and 7 were averaged and compared to published nomogram

tables to determine an estimation of VO_{2max}. Previous research has shown steady state HR to be strongly associated with VO_{2max} (i.e., *rs* = 0.85-0.90; Fitchett, 1985).

Muscular strength. Muscular strength was assessed by 10 repetitions maximum (10-RM) tests, which represent the maximal weight that a person can lift for 10 repetitions. The 10-RM was used as opposed to the traditional 1-RM because in novice resistance-trainers it is considered to be a safer and more valid means of strength testing than the 1-RM (Baechle, Earle & Wathen, 2000). To target the major muscle groups of the upper and lower body, and represent a typical push/pull resistance training workout, 10-RMs for four exercises were tested: the chest/bench press, shoulder press, seated row, and leg press. This protocol involved a 5-minute warm-up on a stationary bicycle, followed by the completion of the four resistance-training exercises with progressively heavier weights. Additional weight was added until the participant could *only complete* 10 repetitions (participants were given up to a maximum of three attempts to achieve their maximum). A rest period of two minutes was allowed between sets in order to ensure adequate recovery from muscle fatigue.

Psychosocial mechanisms of SPA change

Perceived body fat. The 6-item Perceived Body Fat subscale of the Physical Self-Description Questionnaire (PSDQ; Marsh, Richards, Johnson, Roche, &Tremayne, 1994) was used with respondents indicating how well each item described them (e.g., ''I have too much fat on my body'') on a scale ranging from 1 (*false*) to 6 (*true*). All items were reverse scored and summed so that higher scores indicate less perceived body fat. Researchers have provided preliminary support for the validity and reliability of the Body Fat subscale scores (Asci, 2003; Marsh, Hey, Roche, & Perry, 1997). In the present study, the observed scores of the Body Fat

subscale had adequate internal consistency reliability estimates for pre and post-training measurement time points (Cronbach αs = .93; .95; Cronbach, 1951).

Perceived strength. The 6-item Body Strength subscale of the PSDQ (1994) was used with respondents indicating how well each item described them (e.g., "I am a physically strong person") using a scale ranging from 1 (*false*) to 6 (*true*). Items were summed and higher scores indicated greater perceived strength. Researchers have provided preliminary support for the validity and reliability of the Body Strength subscale scores (Asci, 2003; Marsh et al., 1997). In the present study, the internal consistency reliability estimates of the Body Strength subscale scores were adequate for both measurement points (Cronbach αs = .89; .90; Cronbach, 1951).

Perceived physical endurance. The 6-item Physical Endurance subscale of the PSDQ (1994) was used with respondents indicating how well each item described them (e.g., "I would do well in a test of physical endurance and stamina") using a scale ranging from 1 (*false*) to 6 (*true*). Items were summed and higher scores indicate greater perceived physical endurance. Researchers have provided preliminary support for the validity and reliability of Physical Endurance subscale scores (Asci, 2003; Marsh et al., 1997). In the present study, the internal consistency reliability estimates of the Physical Endurance subscale scores were adequate at both pre and post-training measurement points (Cronbach αs = .89; .90; Cronbach, 1951).

Self-efficacy. Two types of self-efficacy were measured -- self-presentational efficacy and exercise task self-efficacy. *Self-presentational efficacy* was assessed using the 5-item Self-Presentational Efficacy for Exercise Scale (SPES; Gammage et al., 2004). This scale measures the extent to which an individual has the confidence to present oneself as an exerciser (e.g., to self-present as being fit and coordinated). Participants' confidence was rated on a scale ranging from 0% (*not at all confident*) to 100% (*completely confident*). Preliminary support for the

validity and reliability of SPE scores has been found in previous research (Strong & Martin Ginis, 2007) and in the present study, the internal consistency reliability estimates (Cronbach, 1951) of the SPES scores were satisfactory for pre- ($\alpha = .89$) and post-training ($\alpha = .89$). *Task self-efficacy* was assessed with five scales that related to a person's confidence to perform aerobic and resistance training exercises. For the Aerobic Self-Efficacy Scale, participants indicated how confident they were, on a scale ranging from 0% (*not at all confident*) to 100% (*completely confident*), to jog on a treadmill for 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, and 60 minutes. For the Resistance Training Self-Efficacy Scales, participants indicated how confident they were to lift a weight ten times for the following resistance training exercises: bench press, shoulder press, seated row, and leg press on individual scales for each exercise ranging from 0% (*not at all confident*) to 100% (*completely confident*). The items on the Resistance Training Self-Efficacy Scale were arranged in five pound increments for the upper body exercises and by 10-pound increments for the lower body exercise (see Appendix B.6 for the specific items). It should be noted that these self-efficacy items were developed for the present study. However, the items were based on a measure of task self-efficacy that has been used in previous exercise research (e.g., Rodgers & Gauvin, 1998) and the format of the scales was consistent with Bandura's (1997) self-efficacy measurement guidelines. Internal consistency reliability estimates for the Aerobic Self-Efficacy Scale and the Resistance Self-Efficacy Scales scores were adequate at both measurement time points (Cronbach αs = .89 - .96; Cronbach, 1951)

Goal satisfaction. Participants were provided with a form and were asked to indicate what their exercise goals were for participating in the 8-week exercise program. At post-training, participants indicated how satisfied they were with attaining these exercise goals. Goal

satisfaction was rated on a scale from 1= (*very dissatisfied*) to 5 = (*very satisfied*), with higher scores reflecting more goal satisfaction.

Exercise adherence. Data on adherence to the exercise program were obtained from log books. For the aerobic condition, participants recorded the duration of each exercise bout, the type of activity completed (i.e., walk/jog on treadmill or elliptical), and the intensity of each exercise bout by means of recording their heart rate every 10 minutes. For the resistance training condition, participants recorded the type of exercise they completed (i.e., seated row, leg press, bicep curl), the amount of weight they used for each set, and the number of repetitions they completed. Each entry in the participant's log book was verified by the personal trainer who supervised the exercise session.

3.2.4 State measures for the physique evaluative threat manipulation study

State social physique anxiety. To assess situational social physique anxiety, a state version of the Social Physique Anxiety Scale (SSPAS) was used in the present study. The trait version of the SPAS (Hart et al., 1989) has been shown to be a valid and reliable measure of physique evaluative threat (for a review see Martin Ginis, Lindwall & Prapavessis, 2007). The 9-item state version of the SPAS is a modified version of the 9-item trait SPAS (Hart et al., 1989; Martin, Rejeski, Leary, McAuley & Bane 1997; Martin Ginis et al., 2009), with items reworded to measure situational rather than dispositional SPA. Example items include "I am uncomfortable to know that other people in the room are evaluating my physique/figure" and "I am bothered by thoughts that the other people in the room are evaluating my weight or muscular development negatively". Items were rated on a 5-point Likert scale ranging from 1 (*not at all characteristic of me*) to 5 (*extremely characteristic of me*). SSPAS scores were calculated by reverse scoring two items and then summing scores across the items, with higher scores

reflecting more state social physique anxiety. Researchers have provided preliminary support for the factorial, convergent and discriminant validity of SSPAS scores (Murru, Martin Ginis & Strong, 2007). The SSPAS has been shown to be responsive to women's acute changes in evaluative threat in response to situations where they anticipate exercising in a mixed-sex environment (Kruessilbrink et al., 2004) or where a fitness instructor is perceived to be more attractive than themselves (Martin Ginis, Prapavessis & Hasse, 2008). In the present study, internal consistency reliability estimates for the SSPAS scores were adequate at all time points (Cronbach αs = .81-.88; Cronbach, 1951).

State salivary cortisol. Participants passively drooled approximately 2.0 ml of saliva into a small plastic cryovial at two different time points. First, a baseline measure of cortisol was taken upon participant's arrival at the lab. Second, because peak cortisol responses occur 21-40 minutes from the onset of acute psychological stressors (Dickerson & Kemeny, 2004), the post-manipulation measure of cortisol was taken 30 minutes after the manipulation. Saliva samples were stored at -20 °C and subsequently analyzed using Salimetrics Expanded Range High Sensitivity Enzyme Immunoassay (Salimetrics, PA).

3.2.5 Procedure

Women who expressed interest in the study were sent a letter of information. The women were told that the study involved an 8-week exercise program (either resistance training or aerobic training), testing sessions which included a body composition assessment, physical fitness and strength tests, completing questionnaires regarding their thoughts and feelings about their body and their mood, and collecting 14 cortisol samples over the study period. Those interested in participating were sent a screening questionnaire via email to determine whether they met the specified inclusion criteria (i.e., existing social physique anxiety, low physical

activity levels, eligible to participate in an exercise program). Eligible participants were then scheduled for two individual pre-training assessment sessions.

Pre-training assessment session one. Upon arrival at the laboratory, the women were asked to provide a baseline cortisol sample (for the physique evaluative threat manipulation study). Participants completed the pre-training questionnaire package containing the demographic and social physique anxiety measures (state and trait), as well as the psychosocial mechanisms measures.

Physique evaluative threat manipulation. Next, participants were asked to change into their exercise attire. Participants were required to wear a tank top and shorts, and underwent a body composition assessment by a fitness trainer. Body composition assessments, by way of a skinfold caliper test, have been shown to elicit stress in women with high trait social physique anxiety (Hart et al., 1989). Thus, a body composition assessment was used as the physique evaluative threat manipulation in the present study. The trainer used skinfold calipers and pinched the subcutaneous fat on the participant's body at seven different skinfold sites: the chest, subscapular, midaxillary xiphoid process of sternum, suprailiac iliac crest, abdomen, thigh, and tricep (Jackson & Pollock, 1985). Immediately following the skin fold assessment, participants completed the state social physique anxiety scale again. Measurements of height (cm), weight (kg), and waist and hip circumference (cm) were taken by the trainer post-manipulation.

Then, participants were given an orientation to the 8-week exercise program. The orientation began with a tour of the exercise facilities where the women would be exercising. The women were given a demonstration of how to use the various exercise machines (e.g., treadmill, elliptical) and the weight training equipment. Next, the women were provided with an exercise log book and were given instructions on how to record their exercise sessions. After the

orientation was over, the women returned to the laboratory and a final cortisol sample (30 minutes post-manipulation) was collected.

Finally, participants performed the submaximal aerobic fitness test. The aerobic self-efficacy measure was administered immediately after the test. Before leaving the laboratory, the women were given five saliva vials to take home and were instructed to collect saliva samples at 0, 1, 3, 6, 9 hours after waking on a day between the first and second assessment session. Overall, this first session lasted 90 minutes: 30 minutes to complete the questionnaires, 15 minutes to complete the body composition assessments, 30 minutes to complete the orientation and tour, and 15 minutes to complete the physical fitness test.

Pre-training assessment session two. The second assessment session was completed within a week of the first assessment. For this session, participants returned to the laboratory to complete a series of 10-RM tests to establish pre-training physical strength. Upon completing the 10-RM testing, the resistance training self-efficacy measures were administered. Overall, the second assessment took one hour to complete, and participants were given $25 for completion of the two pre-training assessment sessions.

3.2.6 Exercise training programs.

Immediately following the second assessment, participants were randomized using a random numbers table to either the aerobic or resistance training condition. For both conditions, participants were required to exercise 3 days per week for 8 weeks, with the goal of completing 24 exercise sessions. Participants were informed that they were required to complete 20 of the 24 sessions in order to obtain the $50 remuneration. All exercise sessions were supervised by female certified personal trainers, and the participants were required to wear shorts and t-shirts for their exercise sessions.

The exercise training protocols were based on the American College of Sports Medicine (Haskell et al., 2007) exercise prescription recommendations for adults under the age of 65. For the aerobic training condition, participants exercised initially at 65% of their maximum heart rate (moderate intensity), progressing to a more strenuous intensity (i.e., 85%) by the end of the 8 weeks. Exercise intensity was monitored by the participant, by taking her pulse every 10 minutes during the 30-minute exercise bout. All exercises were performed using a treadmill or elliptical machine and each exercise session began with a 5 minute warm up, followed by 30 minutes performed in the target heart rate zone, and ended with a 10 minute cool down. All aerobic exercises were performed in the campus fitness facility where both men and women were present.

For the resistance training condition, participants began exercising at 70% of their 10-RM, and progressed to a more strenuous exercise intensity of 80% by the end of the 8 weeks. Exercises were performed using a combination of resistance machines and free weights for upper and lower body exercises. All exercises were completed on alternating days (e.g., upper body on Monday, lower body on Wednesday, upper body on Friday), and progressed from three sets of eight repetitions to three sets of 12 repetitions by the end of the 8-week program. Exercises were performed in the following order: Upper body -- bench press, seated row, shoulder press, lat pull down, tricep extension, and bicep curls; Lower body -- leg press, quadriceps extension, hamstring curls, abdominal crunches, and lower back extensions. Resistance training sessions began with a 5 minute warm-up on a bike or treadmill, followed by 30 minutes of training and ended with a 10 minute cool down. All resistance training exercises were performed in the exercise research and testing laboratory where both men and women were present.

Post-training assessments session one. Upon completion of the 8-week exercise program, participants were scheduled for their post-training assessment sessions. During the first session, participants completed the same package of questionnaires (i.e., trait and state social physique anxiety and psychosocial mechanisms) as administered at pre-training. Next, the women were exposed to the same physique evaluative threat manipulation (i.e., skin fold testing) as in the pre-training session. The trainer was unaware of which condition the participant had been assigned to. Instead of a tour and orientation of the fitness facility, participants were asked to quietly rest for 30 minutes in the laboratory after the manipulation was completed. In addition, participants provided two saliva samples; one before and one 30-minutes after the manipulation. Finally, participants completed the submaximal fitness test and completed the aerobic self-efficacy questionnaire.

Post-training assessments session two. Within the next seven days, participants completed the 10-RM tests to establish post-training physical strength. The 10-RM procedures were identical to those outlined during the pre-training assessment session. Following the 10-RM test, participants completed the final resistance training self-efficacy measures. Upon completion of this session, participants were given $50 for their participation.

3.3 Results

3.3.1 Preliminary analyses

Six women withdrew from the study before the end of the 8-week program (two before the assessment sessions, three before training began, and one midway through training). Thus, the final sample consisted of 23 women in the resistance training condition and 17 women in the aerobic condition (see Figure 3). On average, participants completed 90% of their prescribed exercise sessions (i.e., 22 out of the prescribed 24 sessions).

Data were screened for entry errors, missing data, and deviations from normality (Glass & Hopkins, 1996). Inspection of the cortisol data indicated that two participants had trait cortisol levels that were unconventionally high (> .8 $\mu g \cdot dl^{-1}$; n = 1) or low (< .08 $\mu g \cdot dl^{-1}$; n = 1) (Salimetrics, 2008). Presumably, these participants did not follow instructions to avoid eating or drinking prior to collecting the samples and their saliva samples were contaminated. Therefore, data for these participants were removed yielding a sample size of 38 participants for the trait cortisol analyses (n = 16 aerobic condition and n = 22 resistance condition).

Separate *t*-tests indicated there were no significant differences between the conditions for the demographic variables or exercise adherence (all *p*s >.05; see Table 1) or on pre-training trait SPA, cortisol, body composition, or aerobic fitness variables (all *p*s >.05; see Table 2). However, for the 10-RM tests at pre-testing, the women in the resistance training condition lifted more weight than the aerobic condition on the bench press (p <.05), shoulder press (p <.05) and leg press exercises (p <.05). These differences were controlled for when comparing strength changes between the conditions.

Separate Pearson correlation coefficients were computed between potential covariates BMI, body fat, waist and hip circumference and the outcome variables (i.e., trait and state SPA and cortisol). Results indicated no significant relationships between any of these variables (all *p*s >.05; see Table 3). Thus, it was not necessary to control for body composition or demographic variables in subsequent analyses of SPA or cortisol.

3.3.2 Exercise training study analyses

Effects of exercise training on trait SPA. A 2 (time: pre-post training) x 2 (condition: resistance training or aerobic training) repeated measures ANOVA was conducted on trait SPA scores. A significant main effect for time was found, $F(1, 39) = 80.78$, p <.001, indicating that

there was a significant decrease in SPA after the 8-week exercise intervention. There was no main effect for condition ($p > .05$). However, there was a significant time x condition interaction, $F(1, 39) = 9.41, p < .01$. Post-hoc analyses indicated that women in the aerobic condition reported lower SPA ($M = 25.00$, $SD = 5.75$) than the resistance training condition ($M = 29.00$, $SD = 7.59$) at the end of the 8-week exercise program.

Effects of exercise training on cortisol. A 2 (time: pre-post training) x 2 (condition: resistance training; aerobic training) repeated-measures ANOVA was conducted on total cortisol secretion. In order to do this, the area under the cortisol response curve (AUC) was calculated[2]. AUC was used as the dependent variable. A significant main effect for time emerged for AUC, $F(1,37) = 67.00, p < .001$, indicating that participants in both conditions exhibited decreases in total cortisol secretion over the course of the 8-week exercise program. There was however, no main effect for condition and no significant time x condition interaction (*ps* >.05).

Relationships between changes in SPA and changes in cortisol. Residualized change scores were calculated for pre-and post-training SPA to control for individual differences and measurement error (cf., Cohen, Cohen, Aiken & West, 2003). Residuals were calculated by regressing the post-training score for SPA on the pre-training score for SPA. For AUC, simple change scores were calculated by subtracting pre-training AUC from post-training AUC.

Next, a Pearson's correlation coefficient was calculated to examine the relationship between changes in SPA and changes in AUC. The results indicated that there was no significant relationship between change in SPA and change in AUC ($r = -.18, p > .05$).

Effects of exercise training on mechanism variables. Separate 2 (time: pre-post training) x 2 (condition: resistance training vs. aerobic training) repeated measures ANOVAs were

[2] Area under the curve (AUC) was calculated using the following formula and reported in μg/dl:
(½(time 1 – time 2) x (sample 1 + sample 2)) + (½(time 2 – time 3) x (sample 2 + sample 3)) + (½(time 3 – time 4) x (sample 3 + sample 4)) + (½(time 4 – time 5) x (sample 4 + sample 5)

conducted on the measures of body composition (weight, body fat, waist and hip circumference), aerobic fitness, strength (bench press 10RM, shoulder press 10RM, seated row 10RM and leg press 10RM), self-efficacy (self-presentational, aerobic, strength), goal satisfaction, perceived body fat, perceived strength and perceived physical endurance. Results are presented in Table 2.

Several main effects emerged for time. With regard to the physical fitness mechanisms, participants in both conditions showed significant increases in aerobic fitness and strength (*ps* <.05). With regard to the psychological mechanisms, participants in both conditions showed significant increases in self-presentational efficacy, aerobic self-efficacy, bench press, shoulder press, seated row, and leg press self-efficacy, perceived a reduction in body fat, and perceived increases in physical strength and endurance over the course of the 8-week program (*ps* <.05).

In addition, there were several main effects for condition. For the physical fitness mechanisms, the resistance training condition lifted more weight than the aerobic condition across both time points (*ps* <.05). For the psychological mechanisms, the resistance training condition had higher strength self-efficacy (bench press, seated row, leg press; *ps* <.05) than the aerobic training condition across both time points (*ps* <.05).

There were also significant time x condition interactions for bench press, shoulder press, and seated row strength, aerobic self-efficacy and perceived physical endurance (*ps* <.05). Post-hoc analyses indicated the resistance training condition experienced greater increases on the strength variables than the aerobic condition (*ps* <.05). The aerobic condition experienced greater increases in both aerobic self-efficacy (p<.01) and perceived physical endurance than the resistance training condition (p <.01).

With regard to goal satisfaction, an ANOVA demonstrated no significant differences between the two conditions (p >.05).

Relationships between changes in mechanisms and changes in SPA. Simple change scores were calculated for each of the physical measures by subtracting the pre-training value from the post-training value. For the psychosocial measures, residualized change scores were calculated to control for individual differences and measurement error (cf., Cohen et al., 2003) by regressing the post-training score on the pre-training score and saving the residuals. Pearson's bivariate correlation coefficients were then computed to examine relationships between changes in SPA and changes in the physical and psychosocial mechanisms over the 8 weeks (see Table 4 for correlations among all change variables).

As shown in Table 4, the correlational pattern indicated improvement in SPA was significantly correlated with post-training goal satisfaction, increases in aerobic self-efficacy, perceived endurance and perceived decreases in body fat (all *ps* <.05).

Testing the potential mechanisms underlying the effects of exercise on SPA. As per Baron and Kenny's (1986) recommendations, to test for mediation, four conditions were examined through a series of separate hierarchical regression analyses: (1) the exercise program (coded as 0 = resistance training, 1 = aerobic) is a significant predictor of the outcome variable (i.e., change in SPA; Path C), (2) the exercise program is a significant predictor of the mediator (Path A), and (3) the mediator is a significant predictor of the outcome variable (Path B). If these three conditions were met, the strength of the effects of the exercise program on SPA when the mediator was controlled for in the model (Path C') was tested. If Path C' was reduced to zero, then this would indicate a fully mediated relationship. However, if Path C' was significantly smaller than Path C, then this would indicate partial mediation (Baron & Kenny, 1986). Based on the tests for the effects of the exercise program on SPA and the mechanisms, and the relationships between the changes in the mechanisms and changes in SPA, the mechanisms that

met Baron & Kenny's (1986) criteria to test for mediation were aerobic self-efficacy and perceived physical endurance. Therefore, in the following section, aerobic self-efficacy and perceived physical endurance were the only mediators tested in the regression models.

First, as indicated in Figures 4a & b, the exercise program (coded as 0 = resistance training, 1 = aerobic) was a significant predictor of changes in SPA (Path C: $\beta = -.44, p < .01$). Thus, the aerobic training group reported greater decreases in SPA than the resistance training group. Next, the exercise program was a significant predictor of changes in aerobic self-efficacy (Path A: $\beta = .57, p < .001$; see Figure 4a) and changes in perceived physical endurance (Path A: $\beta = .43, p < .01$; see Figure 4b), with the aerobic training group reporting greater increases in aerobic self-efficacy and perceived physical endurance over the 8-week program than the resistance training condition (see Table 2 for *Ms* and *SDs*). Next, a significant relationship was found between changes in SPA and changes in aerobic self-efficacy (Path B: $\beta = -.45, p < .01$, see Figure 4a) and changes in perceived physical endurance (Path B: $\beta = -.56, p < .01$, see Figure 4b). Thus, greater increases in aerobic self-efficacy and perceived physical endurance were associated with greater decreases in SPA. Finally, to test Path C', Figure 4a shows that after controlling for changes in aerobic self-efficacy, the exercise program was no longer a significant predictor of changes in SPA (before $\beta = -.44, p < .01$; after $\beta = -.27, p = .12$). As shown in Figure 4b, after controlling for changes in perceived physical endurance, the exercise program was no longer a significant predictor of changes in SPA (before $\beta = -.44, p < .01$; after $\beta = -.24, p = .09$). These results indicate that these two mechanisms partially mediated the effects of exercise training on SPA.

To test the significance of the mediated effects, a Sobel test was conducted for each mediator whereby the products of the unstandardized regression coefficients of Paths A and B

were divided by a standard error term (i.e., a *z* score). For aerobic self-efficacy the difference between Path C (β = .-.88) and Path C' (β = -.54) was not significant (*z* score = 1.40; p = .08). For perceived endurance the difference between Path C (β = .-.88) and Path C' (β = -.49) was not significant (*z* score = 1.50; p = .06). However, given that the Sobel test is a very conservative test that lacks power when sample sizes are less than 400 (Dearing & Hamilton, 2006), the magnitude of the mediating effects was also calculated. For the model shown in Figure 4a, 57% of the effect of exercise on SPA was mediated by aerobic self-efficacy. For the model shown in Figure 4b, 54% of the effect of exercise on SPA was mediated by perceived physical endurance.

For exploratory purposes, multiple mediation procedures were employed to examine what mechanism was the strongest predictor of the effects of exercise on SPA. For this analysis, Preacher and Hayes' (2007) bootstrapping procedure was employed (Preacher & Hayes, 2008). The recommended bootstrap sample of 5000 (k = 5000; Preacher & Hayes, 2008) was used for the current analysis. The bootstrapping procedure produces point estimates and a 95% bias corrected and accelerated confidence interval (BCa CI; Efron, 1987; Efron & Tibshirani, 1993) which reduces the Type I error rates. Mediation occurs if the BCa CI does not contain zero (Preacher & Hayes, 2008). Specific indirect effects are also examined through the use of BCa CIs to examine the unique contribution of each potential mediator in the model.

Results of the bootstrapping procedure to test for multiple mediation for the effects of exercise training on SPA revealed that the model (Adjusted R^2 = 0.31, p <.001) was mediated by aerobic self-efficacy and perceived physical endurance (point estimate = -0.41; BCa CI = -1.00 to -0.02; see Figure 5). Further analysis revealed that perceived physical endurance emerged as the only significant contributor to the model (point estimate = -0.37; BCa CI = -0.87 to -0.09)

whereas aerobic self-efficacy was not a significant contributor (point estimate = -0.03; BCa CI = -0.39 to 0.42). Results are shown in Figure 5.

3.3.3 Effects of exercise training on state SPA and state cortisol

Inspection of the state cortisol data indicated that seven participants had cortisol levels that were unconventionally high (> .8 $\mu g \cdot dl^{-1}$) or low (< .08 $\mu g \cdot dl^{-1}$) (Salimetrics, 2008). Therefore, data for these participants were removed from subsequent analyses yielding a sample size of 31 participants.

Manipulation check

To ensure that the body composition assessment did indeed have an effect on state SPA and cortisol responses, separate 2 (time: pre-post manipulation) x 2 (condition: aerobic; resistance training) repeated measures ANOVAs were conducted to examine the effects of the manipulation at pre-training and again 8-weeks later, at post-training. Results are shown in Table 5.

At pre-training, significant main effects for time emerged for state SPA and cortisol (*ps* <.01) indicating that participants in both conditions exhibited increases in state SPA and decreases in cortisol in response to the PET manipulation. For state SPA, there was no significant main effect for condition (p >.05) nor a time x condition interaction (p >.05). For cortisol, a significant time x condition interaction (p <.05) emerged, indicating that the resistance training condition experienced a greater decrease in the cortisol response than the aerobic condition. There was no significant main effect for condition (p >.05).

At post-training, significant main effects for time emerged for state SPA (p <.05) and cortisol (p <.01). These results indicated, again, that participants in both conditions exhibited increases in state SPA and decreases in the cortisol response after the PET manipulation. For

both state SPA and cortisol, there were no significant main effects for condition ($p > .05$) nor time x condition interactions ($p > .05$).

In sum, state SPA increased both at pre-training and post-training in response to the PET manipulation, however cortisol decreased indicating that cortisol was not responsive to the manipulation. Therefore, testing the hypothesis regarding the effects of exercise training on cortisol responses to the physique evaluative threat manipulation could not be conducted because the manipulation did not have the anticipated effect on cortisol.

Does exercise training reduce the state SPA response to a physique evaluative threat situation?

A 2 (time: pre-post training) x 2 (condition: aerobic; resistance training) repeated-measures ANOVA was conducted examining changes in state SPA over the course of the 8-week exercise program. A significant main effect for time emerged, $F(1,30) = 4.61$, $p < .05$, indicating that participants in both conditions (aerobic $M = 2.47$, $SD = 4.62$; resistance $M = 4.65$, $SD = 4.57$) exhibited decreases in state SPA in response to the PET manipulation, over the course of the 8-week exercise program (aerobic $M = .82$, $SD = 4.81$; resistance $M = 2.39$, $SD = 4.66$). There was no significant main effect for condition and no significant time x condition interaction ($p > .05$).

3.4 Discussion

This study compared the effects of an 8-week exercise (aerobic versus resistance) training intervention on changes in trait SPA and changes in cortisol. Next, the physical and psychosocial mechanisms underlying the effects of exercise training on trait SPA were examined. In addition, this study examined the possible protective effects of exercise training on state SPA and cortisol responses after exposure to an acute physique evaluative threat situation. The results of this study demonstrated, that among young women, 8-weeks of aerobic exercise

training were more effective for improving trait SPA than resistance training. Aerobic self-efficacy and perceived physical endurance partially mediated the effects of exercise training on trait SPA. Exercise training, regardless of modality, was effective for reducing total cortisol levels and may buffer the state SPA response to a physique evaluative threat situation. Each of these results will be discussed in turn.

3.4.1 Effects of exercise training on trait SPA

The first objective was to compare the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in trait SPA. This study demonstrated that among young women, an 8-week aerobic exercise program was more effective for improving trait SPA than a resistance training program. This finding is consistent with previous research showing the effectiveness of aerobic exercise for decreasing trait SPA. For example, research has shown that aerobic exercise programs, of various durations, are effective for improving trait SPA among young women (e.g., Bartlewski et al., 1996; Lindwall & Lindgren, 2005). However, this is the first randomized controlled study to demonstrate that aerobic exercise training is more effective than resistance training for improving trait SPA. Previous research that compared different exercise modes (i.e., resistance tube exercises versus brisk walking) demonstrated that regardless of the exercise mode employed, improvements in trait SPA were elicited (McAuley et al., 2002). Unlike McAuley et al's study, this study may have found a superior effect for aerobic exercise because the participants took part in well-controlled exercise programs that adhered to ACSM (Haskell et al., 2007) exercise prescription guidelines. The women exercised at an appropriate intensity (i.e., moderate to strenuous) and utilized appropriate types of exercises (i.e., treadmill jogging; resistance machines and free weights) to ensure improvements in aerobic fitness and strength were obtained. In contrast, McAuley et al's study employed exercise programs at a low

to moderate intensity and utilized less intense exercise types such as brisk walking and resistance tube exercises which may explain why they did not find any differences in trait SPA changes between exercise groups. Participating in an aerobic exercise program that adheres to ACSM prescription guidelines (Haskell et al., 2007) may be more likely to elicit improvements in trait SPA because the intensity of the activity may be strong enough to stimulate the mechanisms underlying the effects of exercise training on SPA.

This was also the first study to examine the effects of exercise training on trait SPA among young women with pre-existing body image concerns. No exercise study to date has examined this influence. Thus, this study adds to the existing literature on the effects of exercise training on trait SPA, by demonstrating that aerobic exercise training is effective for improving trait SPA among women with pre-existing body image concerns. This has important implications in that aerobic exercise training could be considered as an alternate form of treatment to aid in changing how women feel about their bodies.

3.4.2 Mechanisms underlying the effects of exercise on trait SPA

The second objective was to investigate the physical and psychosocial mechanisms underlying the effects of exercise training on trait SPA. Results from this study demonstrated that changes in aerobic self-efficacy and changes in perceived physical endurance partially mediated the effects of exercise training on trait SPA. These results partially supported the hypothesis, that changes in physical fitness, perceived physical competencies and physical self-efficacy would mediate exercise induced changes in trait SPA. These results parallel past research showing that changes in walking and physical self-efficacy and changes in physical competencies were moderately associated with improvements in SPA (Martin Ginis et al., 2005; McAuley et al., 1995a; McAuley et al., 2002). However, this study extends previous research by

demonstrating that changes in aerobic self-efficacy and perceived physical endurance are statistical mediators of the effects of exercise on trait SPA.

The mechanisms that emerged as significantly influencing the effects of exercise training on trait SPA are also consistent with the guiding model and their identification makes an important contribution to the literature on exercise and SPA. Currently there are no theoretical frameworks that describe how exercise improves SPA. However, this study was framed within part of the EXSEM because there is evidence that all of the mechanism variables in the EXSEM are related to changes in SPA (i.e., physical fitness; Lindwall & Lindgren, 2005; physical self-efficacy; McAuley et al., 1995a; perceived physical competencies; Martin Ginis et al., 2005). This study demonstrated that two of the three proposed mechanisms (i.e., changes in physical self-efficacy and perceived physical competencies) are related to changes in SPA. This information is important because the results demonstrated that a specific type of self-efficacy (i.e., aerobic self-efficacy) and a specific type of perceived physical competence (i.e., perceived physical endurance) are the most vital mechanisms for improving trait SPA among young women. A strength of this study was that several different types of self-efficacy (i.e., self-presentational self-efficacy, strength self-efficacy and aerobic self-efficacy) and also several types of physical competencies (i.e., perceived physical endurance, perceived body fat, perceived strength) were tested; therefore, it is now clear what type of self-efficacy and perceived physical competence are the most influential for changing SPA.

There are several reasons why, among young women, aerobic self-efficacy and perceived physical endurance would emerge as significant mechanisms. In general, women place greater value on and participate in more aerobic activities than any other types of exercise (Jakicic, Winters, Lang, & Wing, 1999; Pritchard & Tiggeman, 2008; Wilbur, Miller, Chandler &

McDevitt, 2003; USDHHS, 1996). Women participate in more aerobic activities for appearance-based reasons such as weight loss (Pritchard & Tiggeman). Therefore, when the women in this study gained confidence in their ability to do aerobic activities they may have felt better about their bodies because they also thought they were going to lose weight and change their body shape. Second, women have reported that exercising with others is their most preferred exercise context (Burke, Carron & Eys, 2005). Aerobic exercise activities (e.g., walking, jogging) may be more amenable to social interaction than resistance training. When women are more socially invested in aerobic activities they can experience decreased concerns regarding what others think about their bodies because they feel competent at the activity they are engaging in.

Moreover, increases in aerobic self-efficacy and perceived physical endurance may have challenged the women's negative body image assumptions and thus improved the way the women felt about their bodies. For instance, women with negative body image assumptions view themselves and their body negatively and can only see things (e.g., comments from others, the way clothes fit, physical capabilities) that consistently confirm this negative self-perception (Cash, 2008). As an example, Cash (2008) proposes that women who have a negative body image tend to place their self-worth in appearance-based assumptions. That is, a person's self-worth is dependent on how she feels about her physical appearance. In this study, it is possible that the women changed the way they felt about their bodies because they realized that they were capable of performing aerobic exercise and developed an increased awareness of their capabilities to do other aerobic activities outside of the exercise program (e.g., walking to the grocery store or to the university campus, cycling to work/school, jogging with a friend). These increases in aerobic self-efficacy and perceived physical endurance may have disconfirmed the women's underlying negative body image assumptions because they realized that they were

capable and competent in a specific physical domain (i.e., aerobic exercise) which, in turn, led the women to feel more positive about their bodies.

When both aerobic self-efficacy and perceived physical endurance were tested as mechanisms in the same model of the effects of exercise training on trait SPA, perceived physical endurance emerged as the strongest predictor. This is consistent with the EXSEM (Sonestroem & Morgan, 1989) as perceived physical competencies (i.e., perceived physical endurance) are a more proximal determinant of physical acceptance than physical self-efficacy. According to the EXSEM (Sonestroem & Morgan), physical self-efficacy is specific to the situation or context (i.e., performing aerobic exercise) where the behavior is being performed. Physical self-efficacy feeds into more general perceived physical competencies which capture how one evaluates his or her overall physical fitness (Sonestroem & Morgan, 1989). In this study, the most important aspect of perceived physical competence that emerged was physical endurance.

Contrary to what was hypothesized, no physical fitness mechanisms emerged as mediators of the effects of exercise training on trait SPA. These findings are not in alignment with what was proposed in the guiding model. However, previous research has shown that among women, changes in physical fitness (e.g., body composition, aerobic endurance, muscular strength) are not necessary to elicit improvements in SPA (Lindwall & Lindgren, 2005; Martin Ginis et al., 2005; McAuley et al., 2002). The women in this study did not experience significant changes in the body composition measures of body weight, body mass index or waist to hip circumference. However, the women did experience significant changes in their aerobic fitness and physical strength but these variables did not meet the criteria for mediation. As a result these physical fitness mechanisms were not tested as mediators. Therefore, the results confirm

previous research and suggest that researchers can now rule out an emphasis on changing body composition as a requirement for changing SPA.

3.4.3 Effects of exercise training on cortisol

The third objective was to examine the effects of an 8-week exercise training intervention (aerobic versus resistance training) on changes in cortisol. This study demonstrated that among young women, an 8-week exercise training program was effective for reducing cortisol levels, regardless of exercise mode. It was hypothesized that both the aerobic and resistance training groups would experience improvements in cortisol. It was found that both exercise groups demonstrated reduced cortisol levels after 8-weeks of training but there were no between-groups differences in the reduction. Other studies, that have focused on single exercise modes, have found that both aerobic endurance training (e.g., Foley et al., 2008; Nabkasorn et al., 2005) and resistance training are effective for reducing cortisol levels (e.g., Kraemer et al., 1998; Marx et al., 2001) among active women and women with depression. This study is the first to directly compare the effects of a well-controlled (aerobic versus resistance) exercise training program among women with high SPA and demonstrate a reduction in cortisol levels in both groups. Thus, these results extend previous research to show that exercise training, regardless of mode, is one viable option for reducing cortisol levels among young women with high SPA.

There are several reasons why the exercise interventions reduced women's cortisol levels. First, young women with high SPA who were relatively inactive were the target population. These characteristics could make participants more responsive to an exercise training intervention. Second, the women in this study engaged in well-controlled exercise programs that adhered to ACSM (Haskell et al., 2007) exercise guidelines. The program duration was 8 weeks in length, exercise intensity was prescribed at a moderate to high intensity and the women were

monitored by personal trainers to ensure that the exercises were performed appropriately. Participating in an exercise program that adheres to ACSM prescription guidelines (Haskell et al., 2007) may be more likely to reduce cortisol levels because the intensity of the activity may be strong enough to stimulate improved regulation of the HPA axis. Third, multiple cortisol samples were collected over the course of a 24-hr period which gives an overall indication of the total daily cortisol concentration. In contrast, previous research (e.g., Clearlock & Nuzzo, 2001) employed single time-point assessments of cortisol which is problematic because cortisol levels are known to change over the course of the day (Kirschbaum & Hellhammer, 1989). To summarize, under these conditions, both aerobic and resistance training exercises could have a positive effect on cortisol levels among young women with high SPA. This is important because reduced cortisol levels have been shown to be related to positive psychological outcomes such as lower depression and anxiety (Foley et al., 2008; Nabkasorn et al., 2005) and positive physical outcomes such as reduced risk for diabetes, hypertension and obesity (Bjorntorp, 1997; Rosemond et al., 1998).

3.4.4 Effects of exercise training on state SPA and acute cortisol responses

The final objective was to explore the possible protective effects of exercise training on state SPA and cortisol responses to an acute physique evaluative threat situation. It was hypothesized that both the aerobic and resistance training conditions would experience improvements in state SPA and cortisol. With regard to state SPA, it was found that exercise training buffered the state SPA response, regardless of exercise mode. This is the first study that has demonstrated that exercise training may reduce the state SPA response after exposure to an acute physique evaluative threat. This finding is consistent with previous research demonstrating that exercise has stress-buffering effects (Crews & Landers, 1987).

Alternatively, the women may have had lower state SPA responses after exercise training because it was the second time they were exposed to the physique evaluative threat manipulation. As a result, the women may have become habituated to the stressor and knew what to expect from the manipulation (same assessments and assessors as at post-testing) and were subsequently less anxious about the evaluation of their physiques. To rule out this explanation, future investigations could utilize different physique evaluative threat manipulations before and after the training program. In addition, future research could employ a no-exercise control condition which would determine if exercise in and of itself is effective for improving state SPA responses.

The hypothesis regarding the effects of exercise training on the state cortisol response could not be tested because there was no effect of the physique evaluative threat manipulation on the cortisol response. It is possible that the social evaluative threat in the manipulation was weaker than the one utilized in Study 1. As a result, the pre-post changes in state SPA in this study were insufficiently large to elicit concomitant increases in cortisol. In Study 1, changes in state SPA were quite large (*ES* = .90) whereas in this study, the changes in state SPA were smaller (*ES* = .19-.33). These differences may be due to differences in the type of manipulation used to elicit the cortisol response. In the present study, the manipulation consisted of a body composition assessment (i.e., skin fold caliper test) performed by a fitness trainer – a manipulation shown to elicit stress in women with high trait SPA (Hart et al., 1989). However, in Study 1, the physique evaluative threat manipulation was much more extensive and included strong social evaluative threat components such as the anticipation of wearing revealing exercise attire, exercising in a public facility in front of mirrors, and being videotaped by a man. According to Social Self-Preservation theory (Dickerson, & Kemeny, 2004), a key determinant

of eliciting a physiological stress response is the perception of social evaluative threat (Rohleder, Beulen, Chen, Wolf & Kirschbaum, 2007). The evaluative threat of having a body composition assessment conducted by a fitness trainer in a private room may have not been potent enough to elicit a cortisol response in the women in the present study.

3.4.5 Implications

This study has provided important insights into the effects of exercise on SPA and cortisol, with subsequent implications. First, this study has clearly demonstrated that among young women, aerobic exercise training is more effective for improving trait SPA than resistance training. Researchers who are developing exercise interventions, or those working in the fitness industry, should utilize a well-controlled aerobic exercise program that adheres to ACSM (Haskell et al., 2007) guidelines to improve young women's trait SPA.

Second, very little is known about the mechanisms underlying the effects of exercise on trait SPA. A strength of this study was that several hypothesized mechanisms were addressed and this study was able to identify two mediated effects of exercise on trait SPA, specifically changes in aerobic self-efficacy and changes in perceived physical endurance. Understanding the important role of these mechanisms will aid in the development of theories regarding the effects of exercise on SPA and will inform exercise interventions. In particular, regarding the guiding theoretical framework (the modified EXSEM), it can now be suggested that the variables that are most important for improving trait SPA are aerobic self-efficacy and perceived physical endurance. This is an important informative step toward the development of a theory regarding the nature of the effects of exercise on trait SPA.

Third, regarding exercise interventions, it is now clear that the variables one should target to have the greatest impact on improving trait SPA among women are aerobic self-efficacy and

perceived physical endurance. In an exercise intervention, one might target the four sources of self-efficacy: past performance, vicarious experiences, verbal/social persuasion, and attention to physiological/affective arousal. For example, beginner exercisers could be reminded about past experiences in similar exercise modalities (focus on past experiences). In addition, having women exercise in a public fitness facility will expose them to other women engaged in the same exercises (vicarious experiences). Fitness trainers could provide women with positive encouragement to stick with their exercise programs (verbal persuasion) and teach the women to monitor their physiological and emotional responses to exercise (arousal). According to the EXSEM, changes in physical self-efficacy will lead to changes in perceived physical competencies (Sonestroem & Morgan, 1989). In other words, changing the way women think about their ability to do aerobic exercise will further enhance how they see themselves engaging in other endurance activities. As an example, women could be encouraged to think about their capabilities to perform aerobic exercises at the gym and encouraged to think about how this will transfer into their everyday life (e.g., walking to the grocery store, playing with children, or biking with friends).

Fourth, an important contribution of the present study was that the results suggest that exercise training may have buffered the state SPA response to a physique evaluative threat manipulation. Therefore, this study has expanded previous research by demonstrating that exercise is related to a specific psychosocial stressor, namely physique evaluative threat.

Finally, this study also demonstrated that among young women, exercise training (regardless of modality) was effective for improving cortisol levels. This finding has several implications. Specifically, exercise training can be recommended for improving cortisol levels which can aid in preventing and treating several other physical and psychological health

conditions (e.g., heart disease, diabetes, obesity, depression, anxiety, eating disorders). Exercise training is a relatively affordable, easily implemented, non-invasive treatment option that has many health benefits. If health professionals begin to prescribe exercise training as a treatment option to reduce cortisol levels, the byproduct of this treatment will not only be reduced stress but will also carry over to include improvements in physical fitness. Improvements in physical fitness could also contribute to improved psychological well-being and reduced susceptibility to health conditions such as diabetes, obesity, and cardiovascular disease.

3.4.6 Limitations & Future Directions

While the insights provided by the present study are important, several limitations must be considered. To begin with, this study did not include a no-exercise control group or compare exercise groups to other forms of treatment such as Cognitive Behavioural Therapy. Therefore, it cannot be conclude that exercise is better than other treatments for improving SPA and cortisol levels. A no-exercise control group was not included in this study for ethical reasons because of the sensitive nature of the population studied (i.e., women with high SPA). It was believed that it was unethical to recruit women for an exercise training study and ask women with pre-existing body image concerns not to exercise for the study period. Future research examining the influence of exercise training on SPA and cortisol would be informative if it compared the effects of exercise to other, more traditional, psychological forms of treatment for body image concerns such as Cognitive Behavioural therapy.

Second, the mechanisms underlying the effects of exercise training on trait SPA that were assessed in the present study were measured concurrently with the outcome variables. Therefore, it cannot be concluded that any of the mechanisms *caused* the observed changes in trait SPA. However, identification of the current mechanisms will inform future studies. Future

research should target the identified mechanisms for change, in order to determine if these mechanisms cause concomitant changes in trait SPA. However, one challenge is knowing when to measure the mechanisms or when the mechanisms change. It is not known if the mechanisms responsible for improving SPA change at the beginning, mid-way through, or closer to the end of an 8-week exercise training program. Therefore, future research should measure mechanisms weekly in order to determine at what point the mechanisms change and when they influence SPA. This information will inform future exercise interventions as to when it is appropriate to target the mechanisms in order to improve trait SPA.

With respect to exercise training effects on cortisol levels, no differences were found between the exercise groups. Both aerobic and resistance training were effective for reducing cortisol levels. Future research should include a no-exercise control group to determine if exercise per se is responsible for improving cortisol levels among young women with high SPA. It would also be interesting for future research to examine what mechanisms are responsible for the effects of exercise on cortisol.

Finally, with regard to the physique evaluative threat manipulation, this study was limited in that the manipulation was strong enough to induce and detect changes in state SPA, but not changes in state cortisol responses. As identified earlier, perhaps a stronger manipulation that includes a more distinct social evaluative threat component (e.g., body composition assessment in front of a crowd) would be necessary to elicit and detect increases in the cortisol response. Future research should therefore include more salient evaluative threat manipulations in order to elicit the acute cortisol response.

3.4.7 Conclusion

In summary, the results suggest that exercise training is effective for improving trait SPA, reducing cortisol levels, and providing a protective effect against the state SPA response among young women. Aerobic exercise training is more effective for improving trait SPA than resistance training and this is due, in part, to increases in aerobic self-efficacy and perceived physical endurance. Therefore, when the goal is to improve trait SPA, an 8-week aerobic exercise training program that is focused on improving aerobic self-efficacy and perceived physical endurance should be employed. When the goal is to decrease cortisol levels, a program of either aerobic or resistance exercise training can be recommended as an effective and viable option.

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Table 1.

Pre-training means, standard deviations, and percentages for demographic characteristics

Measure	Resistance training condition (n = 23)	Aerobic training condition (n = 17)
Age	21.68 (2.44)	21.00 (3.60)
Ethnicity		
Caucasian	85%	72%
African-Canadian	3.8%	--
Asian	3.8%	11%
Other	7.7%	16.7%
Education level		
Undergraduate	73%	89%
Graduate	27%	11%
Marital status		
Single	88.5%	94.4%
Married	3.8%	5.6%
Common-law	7.7%	--

Means, standard deviations, and significance tests for trait measures and mechanisms.

Measure	Resistance training condition (n = 23)		Aerobic training condition (n=17)		F (df = 1, 39)		
	Pre-training	Post-training	Pre-training	Post-training	Time	Condition	Time x condition
Trait measures							
Social physique anxiety	33.19 (4.98)	29.00 (7.59)	32.83 (5.80)	25.00 (5.75)	80.78**	.32	9.41*
Cortisol (AUC) $\mu g \cdot dl^{-1}$	46.46 (13.02)	23.36 (12.09)	41.00 (13.19)	23.23 (11.27)	67.00**	.76	1.13
Psychosocial mechanisms							
Self-presentational efficacy	38.12 (17.59)	59.71 (15.54)	43.38 (19.42)	68.47 (11.87)	92.28**	.22	.31
Aerobic self-efficacy	49.95 (27.18)	62.71 (18.91)	42.91 (19.79)	78.31 (16.65)	59.05**	.21	17.20**
Bench press self-efficacy	62.90 (23.00)	78.04 (17.03)	46.07 (23.25)	49.48 (22.26)	6.93*	16.02*	1.33
Shoulder press self-efficacy	50.98 (25.34)	63.12 (21.02)	42.28 (28.16)	51.83 (21.11)	4.71*	3.27	.01
Seated row self-efficacy	82.26 (17.83)	98.04 (3.91)	69.01 (34.88)	82.06 (17.59)	10.19*	7.59*	.16
Leg press self-efficacy	70.19 (21.77)	84.18 (13.42)	53.09 (30.08)	62.46 (24.63)	17.15**	7.97*	.77
Goal satisfaction	---	3.41 (.80)	---	3.67 (.40)	---	1.46	---
Perceived body fat	3.41 (1.60)	3.68 (1.73)	3.41 (1.43)	4.27 (1.31)	15.60**	.59	2.96
Perceived strength	3.00 (.93)	4.02 (.85)	2.65 (1.19)	3.71 (1.03)	71.18**	1.17	.01

Perceived endurance	2.31 (1.01)	2.92 (.96)	1.88 (.88)	3.56 (1.03)	58.57**	.35	10.17*
Physical fitness mechanisms							
Weight (kg)	65.67 (14.41)	65.61 (14.66)	59.90 (10.86)	59.81 (10.93)	.02	1.94	.00
Body mass index (kg/m^2)	23.04 (3.90)	23.20 (4.29)	22.84 (3.89)	22.61 (4.00)	.00	.16	.09
Waist circumference (cm)	75.55 (9.15)	73.89 (10.15)	74.08 (9.60)	72.75 (8.33)	4.08*	.27	.27
Hip circumference (cm)	98.87 (9.62)	99.46 (9.90)	97.06 (8.59)	96.62 (8.47)	.04	.91	.01
$V0_2$ max	2.00 (.33)	2.23 (.42)	1.92 (.33)	2.25 (.39)	31.64**	.10	1.37
10-RM bench press	30.96 (10.19)	46.74 (11.04)	24.86 (9.48)	28.82 (7.81)	57.47**	16.88**	20.06**
10-RM shoulder press	24.04 (12.57)	33.69 (10.79)	17.22 (6.69)	18.52 (8.79)	12.89**	13.36**	7.77*
10-RM seated row	49.81 (8.77)	59.34 (7.87)	46.11 (8.49)	47.35 (8.31)	16.86**	11.82**	10.97*
10-RM leg press	145.58 (46.41)	216.30 (43.75)	113.33 (51.13)	167.06 (63.66)	116.97**	6.65*	3.02

Note. AUC = area under the curve; 10-RM = 10 repetitions maximum; For AUC $df(1, 37)$; * $p \leq .05$; ** $p \leq .001$

Table 3.

Bivariate correlations among potential covariates and outcome variables.

Variable	1.	2.	3.	4.	5.	6.	7.	8.
1. Body fat percentage	1.00	.53**	.42**	.12	.09	.01	.04	-.13
2. Body mass index		1.00	.34*	-.14	-.06	.03	-.02	-.27
3. Waist to hip ratio			1.00	.07	.04	-.11	-.14	.14
4. Age				1.00	.22	-.03	-.22	-.23
5. Pre-training trait SPA					1.00	.04	.43*	.00
6. Pre-training trait cortisol $\mu g \cdot dl^{-1}$						1.00	.10	-.16
7. Pre-training state SPA							1.00	.10
8. Pre-training state cortisol $\mu g \cdot dl^{-1}$								1.00

Note. SPA = social physique anxiety; * $p \leq .05$; ** $p \leq .01$

Table 4.

Bivariate correlations among changes in trait SPA, cortisol and mechanism variables.

Changes in	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Social physique anxiety	1.00	-.18	-.22	-.42**	-.18	-.22	.25	.15	-.54**	-.57*	-.16	-.56*	.02	-.07	-.19	-.12	-.12	.21	-.12	.25	-.04
2. Cortisol (AUC) $\mu g \cdot dl^{-1}$		1.00	-.16	.33*	-.03	.34*	-.13	-.03	.16	.06	-.20	.05	.16	-.15	.05	-.16	.19	-.06	.10	.06	.12
3. Self-presentational efficacy			1.00	.24	.18	.00	-.07	-.01	.20	.30	.40**	.33**	.31	-.26	.16	.03	-.27	.00	-.02	-.40**	.05
4. Aerobic self-efficacy				1.00	.09	.12	-.36*	-.12	.20	.41**	-.04	.48**	.13	-.09	.05	-.26	.02	-.27	-.09	-.28	.10
5. Bench press self-efficacy					1.00	.67**	.40*	.22	.24	.26	.04	.13	-.03	.12	.21	.24	-.17	.18	.29	.25	-.01
6. Shoulder press self-efficacy						1.00	.40*	.11	.14	.29	-.12	.12	.17	-.09	.37*	.05	.05	-.06	.26	.23	-.07
7. Seated row self-efficacy							1.00	.49**	.25	-.15	.23	-.13	.10	-.07	.24	.03	-.11	.29	.25	.40*	.05
8. Leg press self-efficacy								1.00	.15	-.05	.30	-.13	.01	-.03	-.32*	-.02	-.02	.56**	.38*	.35*	.24
9. Goal satisfaction									1.00	.49**	.25	.25	.04	-.07	.23	-.09	.00	.07	.37*	-.20	.07
10. Perceived body fat										1.00	.19	.55**	.14	-.08	.00	-.05	-.18	-.10	-.01	-.31*	-.08
11. Perceived strength											1.00	-.01	.07	-.08	.03	.07	.00	.19	.25	.13	.02
12. Perceived endurance												1.00	-.07	.12	.19	-.01	-.06	-.15	-.12	-.02	.01
13. Weight													1.00	-.96**	.01	-.15	-.25	.05	-.00	-.11	.11
14.Body mass index														1.00	.04	.26	.22	-.05	-.02	.11	-.07
15.Waist circumference															1.00	.05	.06	-.17	-.08	-.02	-.13
16.Hip circumference																1.00	.24	.09	.04	-.04	.03
17.VO_2 max																	1.00	-.08	.23	.15	.12
18. 10RM bench press																		1.00	.52**	.60**	.44**

19. 10RM shoulder press	1.00	.52**	.36*
20. 10RM seated row		1.00	.24
21. 10RM leg press			1.00

Note. AUC = area under the curve; 10RM= 10 repetitions maximum; * $p \leq .05$; ** $p \leq .01$

Table 5.

Means, standard deviations, and significance tests for state measures.

Measure	Resistance training condition (n = 18)		Aerobic training condition (n=13)		F (df = 1, 30)		
	Pre-manipulation	Post-manipulation	Pre-manipulation	Post-Manipulation	Time	Condition	Time x condition
Pre-training							
State SPA	22.53 (4.41)	26.57 (5.86)	23.33 (5.02)	25.83 (5.98)	21.04**	.00	1.16
Acute cortisol $\mu g \cdot dl^{-1}$	.39 (.20)	.28 (.17)	.46 (.20)	.37 (.18)	5.57**	1.77	3.01*
Post-training							
State SPA	23.82 (7.20)	26.21 (7.37)	20.78 (4.94)	21.70 (5.31)	4.51*	3.74	1.07
Acute cortisol $\mu g \cdot dl^{-1}$	.31 (.16)	.24 (.16)	.41 (.21)	.32 (.16)	24.82**	1.83	.59

Note. SPA = social physique anxiety; **p <.01; *p <.05

Figure Captions

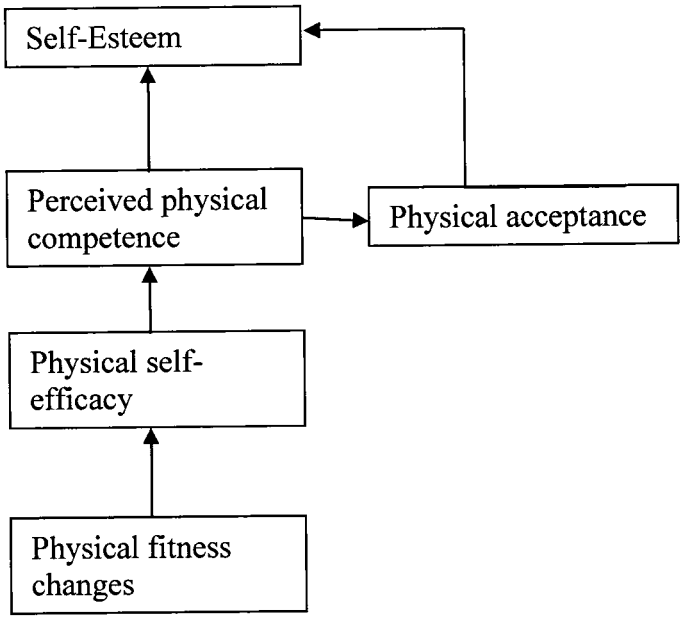
Figure 1. *Sonstroem and Morgan's (1989) Exercise and Self-Esteem Model*

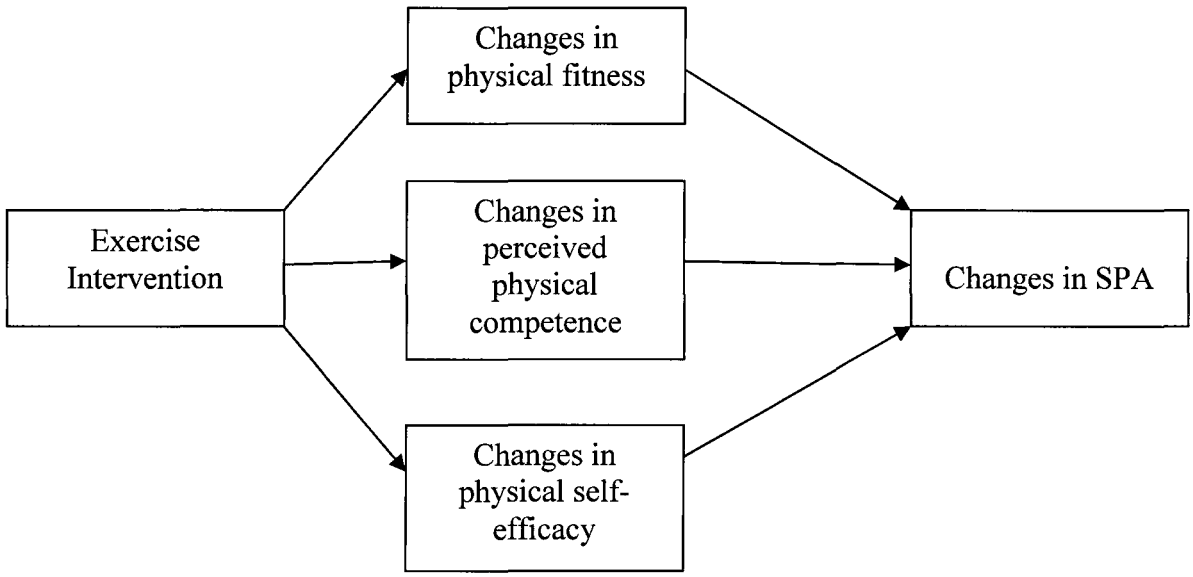
Figure 2. *Modified Exercise and Self-Esteem Model*

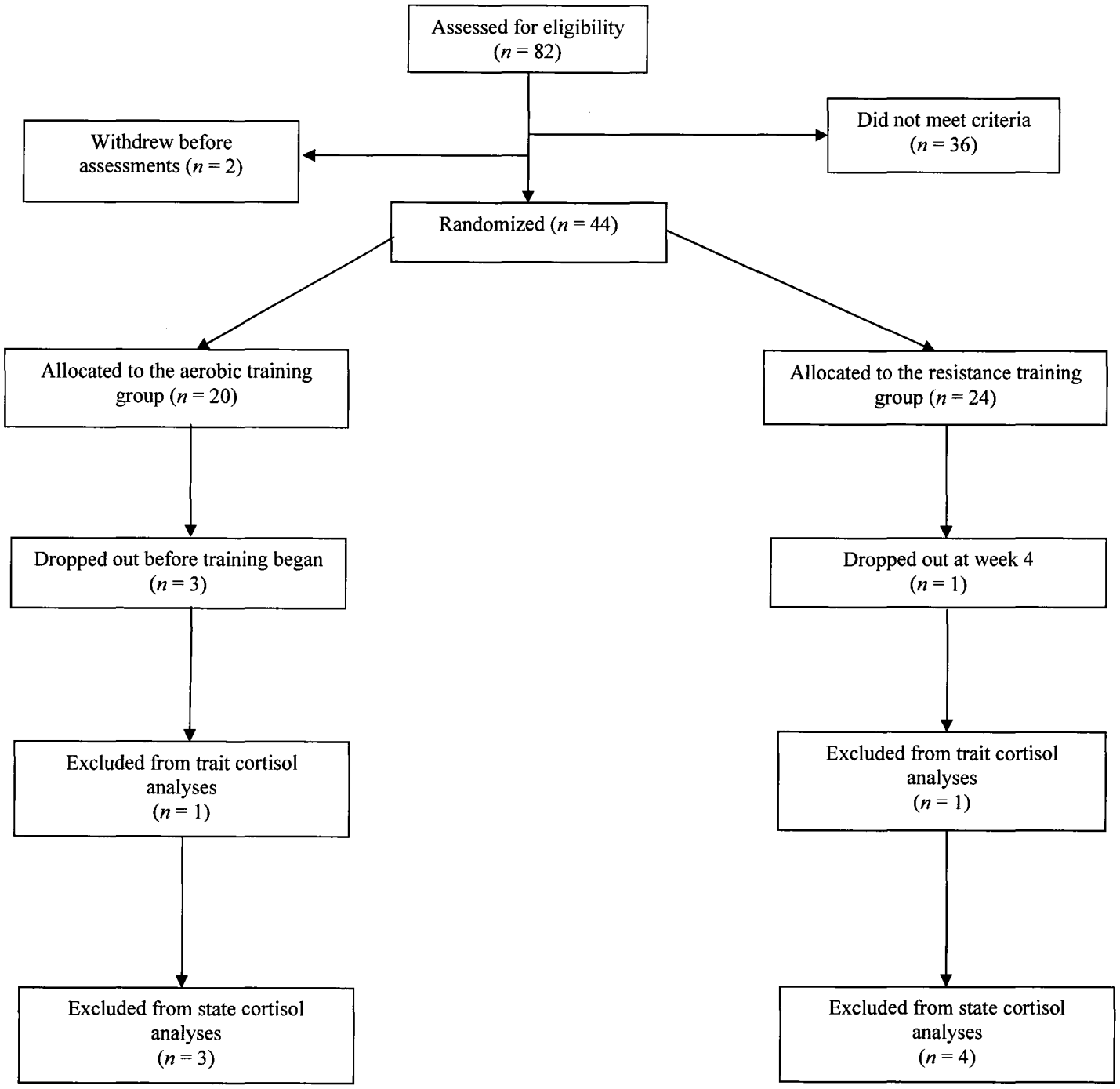
Figure 3. *Flow chart of participants from recruitment to the end of the 8 week randomized controlled trial.*

Figure 4. *Mediation model for the effects of exercise training on changes in trait SPA.*

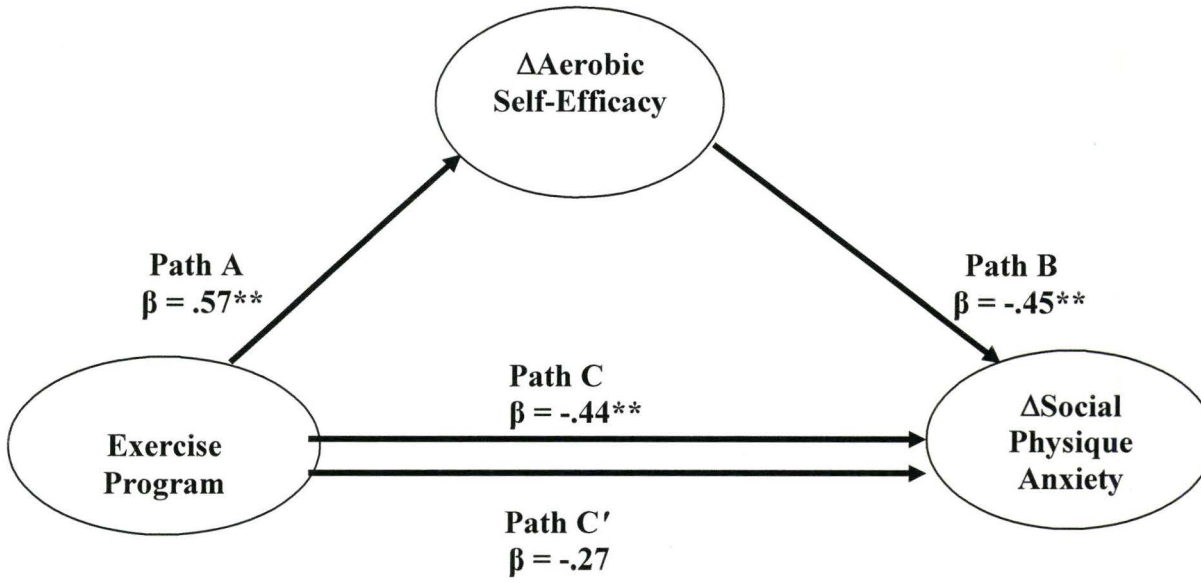
Figure 5. *Multiple mediation model for the effects of exercise training on changes in trait SPA.*


Self-Esteem
Perceived physical competence
Physical acceptance
Physical self-efficacy
Physical fitness changes


Changes in physical fitness
Exercise Intervention
Changes in perceived physical competence
Changes in SPA
Changes in physical self-efficacy

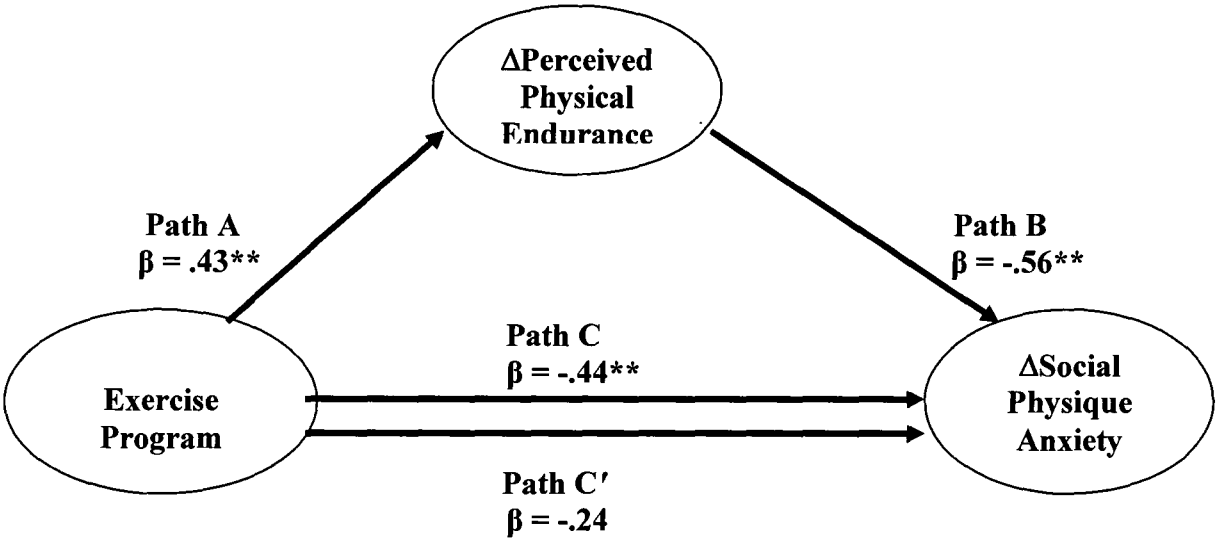

Assessed for eligibility
(n = 82)
Withdrew before
assessments (n = 2)
Did not meet criteria
(n = 36)
Randomized (n = 44)
Allocated to the aerobic training
group (n = 20)
Allocated to the resistance training
group (n = 24)
Dropped out before training began
(n = 3)
Dropped out at week 4
(n = 1)
Excluded from trait cortisol
analyses
(n = 1)
Excluded from trait cortisol
analyses
(n = 1)
Excluded from state cortisol
analyses
(n = 3)
Excluded from state cortisol
analyses
(n = 4)

(a)

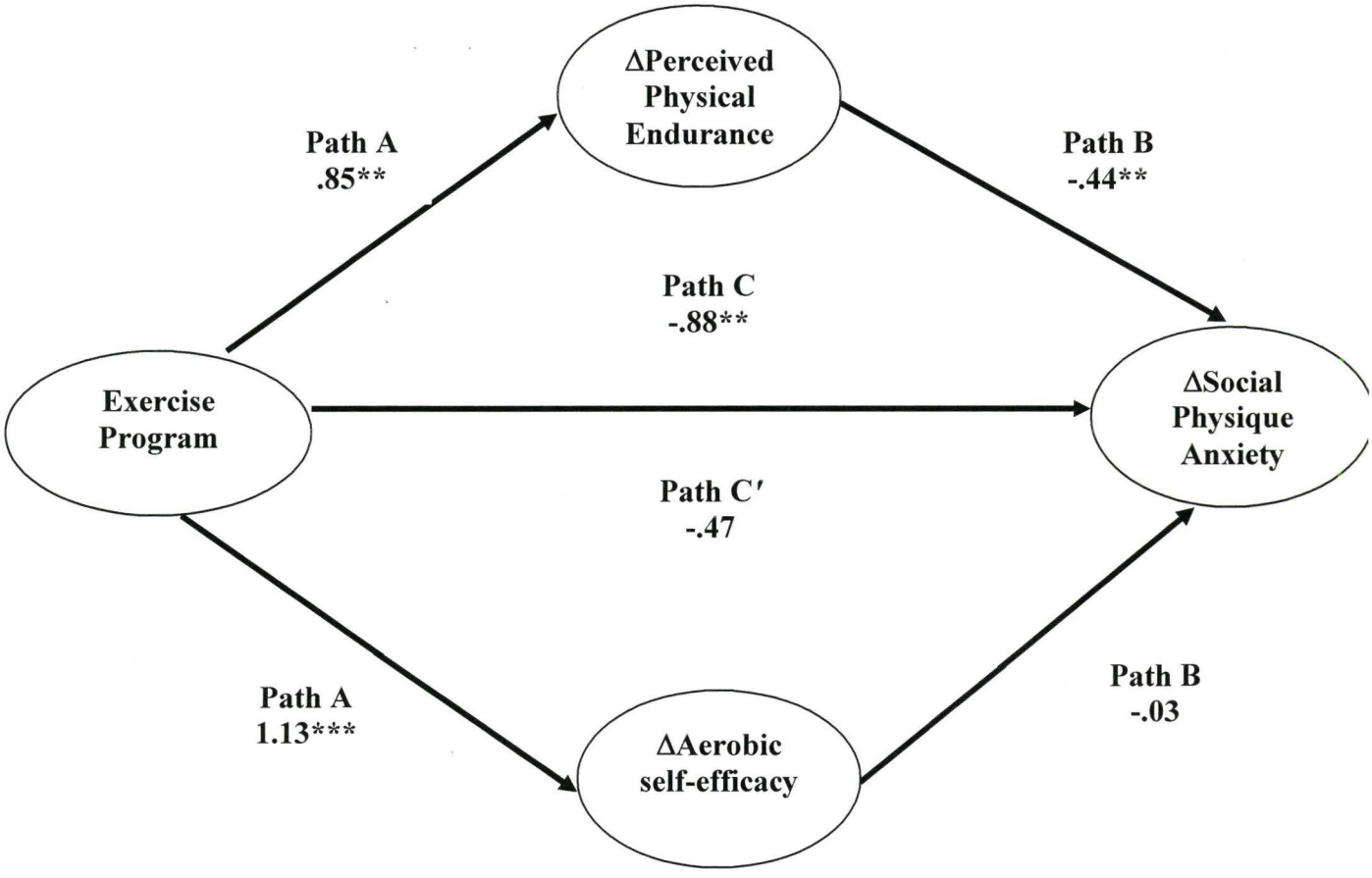


Note. Numbers represent standardized beta coefficients. For Figure 4a, c' = controlling for change in aerobic self-efficacy; $^{**}p < .01$

(b)



Note. Numbers represent standardized beta coefficients. For Figure 4b, c' = controlling for change in perceived physical endurance;**p <.01.



Note. Numbers represent unstandardized beta coefficients. c = total effect of exercise program on changes in SPA; c' = direct effect of exercise program on change in SPA. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

CHAPTER 4

General Discussion

Many, if not most women experience some form of body dissatisfaction over the course of their lifetime (Tiggeman & Lynch, 2001). Given that body image concerns are prevalent, and are related to many negative health outcomes (e.g., depression, smoking, alcohol use; Diehl, Johnson, Rogers & Petrie, 1998; Martin Ginis & Leary, 2004; Martin, Leary & O'Brien, 2001), it is imperative that research is conducted in order to understand the factors related to the development of body image concerns and to develop interventions to attempt to alleviate these concerns. Using a psychobiological perspective, this dissertation examined psychosocial and biological factors associated with a specific aspect of body image concerns, namely social physique anxiety (SPA). There were several objectives of this dissertation. First, Study 1 examined the association between state SPA and the cortisol response. Next, Study 2 examined if exercise training was a viable strategy for decreasing trait SPA and explored mechanisms that underlie the effects of exercise training on trait SPA. Then, Study 2 examined if exercise training reduces cortisol levels and provides a protective effect for the state SPA and cortisol response to a physique evaluative threat manipulation.

The results of Study 1 demonstrated that acute changes in physique evaluative threat (state SPA) predicted changes in the cortisol response among young women. The results of Study 2 confirmed that aerobic exercise training was more effective for improving trait SPA than resistance training and both exercise modes were important for reducing cortisol levels among young women with high trait SPA. In addition, changes in aerobic self-efficacy and perceived physical endurance partially mediated the effect of the exercise intervention on trait SPA. Finally, the results of Study 2 suggested that exercise training (regardless of mode) was effective for buffering the state SPA response to a physique evaluative threat manipulation. Together, these studies have contributed to the advancement of knowledge by broadening our

understanding of (a) the effects of physique evaluative threat on the cortisol response, (b) the conceptualization of SPA as a state construct, (c) the effects of exercise training on SPA, (d) the mechanisms responsible for exercise induced changes in trait SPA and (e) the effects of exercise training on cortisol levels. Each of these contributions will be discussed in turn.

4.1 Contributions to Research on the Effects of Physique Evaluative Threat on Cortisol

In Study 1, physique evaluative threat was experimentally manipulated to determine if exposure to such a threat elicited changes in cortisol secretion. This study found that women who were exposed to the physique evaluative threat manipulation maintained a higher cortisol response after the manipulation than those in the non-threatening condition. Furthermore, physique evaluative threat predicted post-manipulation cortisol. This was the first study to examine an association between physique evaluative threat and cortisol. Previous research had made a preliminary connection between body image concerns and cortisol (Putterman & Linden, 2006), however it was limited by a cross-sectional design. Study 1 was able to provide preliminary evidence of a causal relationship between physique evaluative threat and cortisol responses through the controlled experimental design. Furthermore, previous research had suggested that women may have to be exposed to body-image related stimuli in order for the cortisol response to be elicited (Putterman & Linden). In line with this reasoning, Study 1 demonstrated that women who were exposed to a physique evaluative threat situation maintained an elevated cortisol response. Taken together, the results of Study 1 extend previous research and confirm that acute increases in body-related evaluative concerns precede elevated cortisol responses.

The results from Study 1 have theoretical and practical implications. With respect to theory, the findings suggest that Social Self-Preservation theory (Dickerson & Kemeny, 2004;

Gruenewald, Dickerson, & Kemeny, 2007) should be extended to include physique-related threats. According to Social Self-Preservation theory, situations involving social evaluative threat elicit negative self-evaluative emotions and changes in cortisol (Dickerson, Gruenewald & Kemeny, 2004; Gruenewald, Dickerson & Kemeny, 2007). Study 1 demonstrated that women who where exposed to the physique evaluative threat situation experienced greater state SPA and a higher cortisol response than those exposed to a non-threatening situation. This study adds to previous research by demonstrating that among women, there are other possible negative self-evaluative emotions (i.e., state SPA) that result from threatening social situations and other types of situations (i.e., physique specific) that elicit the cortisol response. This suggests that physique evaluative threat is another possible consequence of the social self-preservation system. This finding is important because it opens new avenues for researchers to expand their focus from performance-based social evaluative threat situations (e.g., public speaking), to appearance-based situations (e.g., exercising at public fitness centers) and also to explore other negative self-evaluative emotions (e.g., state SPA) that result from perceived situational threats.

In addition, the findings from Study 1 suggest that cortisol could be considered as a biomarker of women's body image concerns. Study 1 has provided an important link between social physique anxiety (an affective component of body image), and a biological marker of stress, namely cortisol. This finding is important because it provides an empirical basis for studying and understanding cortisol's role in body image disturbance. Identification of a causal link between physique evaluative threat and cortisol will further our understanding of body image by expanding the array of psychosocial consequences of body image disturbance to include biological consequences. From a practical perspective, if cortisol is measured as a biological marker of body image concerns this may be helpful in identifying individuals who not

only experience higher levels of body dissatisfaction but who are also susceptible to other mood disturbances (e.g., anxiety, depression, eating disorders) that often act in conjunction with, or are a consequence of, body image concerns (Kirkcaldy, Eysenck, Furnham & Siefen, 1998; Kosantski & Gullone, 1998), and are related to cortisol (Chrousos & Gold, 1992; McEwen, 1998). If elevated cortisol responses are detected, then interventions can be implemented to alleviate body image concerns and, in turn, reduce cortisol. One approach may be through exercise, which has been identified as an effective strategy for improving body image (Hausenblas & Fallon, 2006; Martin & Lichtenberger, 2002) and re-regulating the HPA axis (Nabkasorn et al., 2005; Traustadottir, Bosch, & Matt, 2005; Wittert, Livesey, Espiner & Donald, 1996).

4.2 Contributions to Research on the Conceptualization of SPA

The studies conducted for this dissertation also contribute to research on how SPA is conceptualized. Traditionally, SPA has been conceptualized as a trait, however these studies demonstrated that SPA not only has trait characteristics but also includes state elements. In particular, Study 1 utilized a controlled-experimental study design and demonstrated that the state SPA response is influenced by exposure to a physique evaluative threat manipulation. This study found that women who were exposed to the manipulation experienced greater state SPA even after controlling for the influence of trait SPA. This study is important because it extends previous research on state SPA (Amirthavasar & Bray, 2007; Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004; Martin Ginis, Prapavessis & Hasse, 2008), and provides further support for the notion that SPA is sensitive to different situational influences.

In Study 2, it was shown that state SPA can change over time. Specifically, it was found that a physique evaluative threat manipulation influenced the state SPA response and that after 8-

weeks of exercise training, the state SPA response was reduced. These findings suggest that exercise training may buffer the state SPA response. However, it is also possible that this finding could be due to the fact that over time, the women became habituated to the physique evaluative threat manipulation and thus, experienced reduced state SPA.

The notion that SPA is sensitive to situational changes is important because exercise researchers have studied SPA as a trait since Hart et al. (1989) published their seminal paper. Recently, attention has been given to the idea that SPA may not only differ from individual to individual but also from situation to situation (Martin Ginis et al., 2009). Like body image concerns (Cash, Fleming, Alindogan, Steadman & Whitehead, 2002; Tiggeman, 2001), people may have more or less SPA in different situations or environments. The results from these studies would suggest that if researchers are examining SPA as a dependent measure in an exercise intervention then the trait SPA scale would be an appropriate measure to use. However, if researchers are interested in examining how different situations or contexts (e.g., the exercise environment) impact SPA then the state SPA scale should be employed.

4.3 Contributions to Research on the Effects of Exercise Training on SPA

In Study 2, the results demonstrated that among young women aerobic exercise training was more effective for improving trait SPA than resistance training. This study was the first well-controlled experiment to compare the effects of different modes of exercise training on SPA among young women. These findings have important implications because previous meta-analytic findings on the exercise-body image relationship have been inconsistent regarding what mode of exercise is most effective for inducing body image changes. For example, the results of one meta-analysis demonstrated that exercise mode did not moderate the effects of exercise on body image (Campbell & Hausenblas, 2009). Other meta-analyses have shown larger effects for

combined aerobic and anaerobic exercise programs (Hausenblas & Fallon, 2006) and for anaerobic exercise programs (Reel et al., 2007) than for aerobic training programs. In addition, only one previous study had compared the effects of resistance training and aerobic training on SPA and demonstrated no between-groups differences (McAuley, Marquez, Jerome, Blissmer & Katula, 2002). Study 2 brings some clarity to this issue by demonstrating, through the use of a well-controlled experimental design, that an aerobic exercise training program should be employed if the goal is to improve trait SPA in young women.

These findings also provide some direction for exercise prescriptions to reduce trait SPA. Specifically, based on American College of Sports Medicine (ACSM; Haskell et al., 2007) exercise prescription guidelines, it can be suggested that women should jog or run, 3 times a week, for a minimum duration of 8 weeks, for 45 minutes (5 minute warm-up, 30 minutes of exercise, 10 minute cool-down) per session, beginning at a moderate intensity (65% of maximum heart rate) and progressing to a strenuous intensity (85% of maximum heart rate). Although this information is preliminary, it is important information that can be used to guide future exercise interventions that are aimed at changing the way young women feel about their bodies.

Study 2 was also the first study to examine the influence of exercise on trait SPA among women with pre-existing high SPA concerns. This finding has important implications for the treatment of body image concerns. Traditionally, Cognitive Behavioural approaches have been the most widely used form of treatment for body image concerns (Butters & Cash, 1987; Grant & Cash, 1995). Cognitive behaviour therapy is typically conducted by a mental health professional and usually involves high costs and limited access (i.e., once a week sessions with often long waiting lists). Exercise, on the other hand, is quite affordable, easily carried out without the guidance of a professional, and can be done in the comfort of one's own home or

neighbourhood. In addition, exercise can be incorporated daily. Therefore, it can be suggested that health practitioners should consider and promote exercise as an alternative form of treatment for body image concerns among women.

4.4 Contributions to Research on the Mechanisms of Exercise-induced Changes in SPA

Demonstrating that aerobic exercise training is effective for improving SPA is a step forward for advancing knowledge on the effects of exercise training on SPA. The next question becomes *why* was aerobic exercise training better than resistance training for improving SPA? In Study 2, it was found that changes in aerobic self-efficacy and perceived physical endurance were partially responsible for the effects of the exercise intervention on SPA. This was the first study to properly test the effects of exercise training on SPA and the mechanisms underlying exercise-induced changes in SPA.

Study 2 utilized a well-controlled experimental design whereby outcomes and mediators were assessed for change over time. In addition, this study demonstrated that two mechanisms (aerobic self-efficacy and perceived physical endurance) were statistical mediators of the exercise-SPA relationship (Barron & Kenny, 1986). Study 2 extends previous research on the mechanisms underlying the effects of exercise on SPA by clarifying, through proper design and statistical approaches, what two mechanisms are important in this relationship.

Aerobic self-efficacy and perceived physical endurance emerged as partial mediators underlying the effects of exercise on SPA. This finding is important because two important mechanisms have been identified to explain how exercise improves SPA. By highlighting these two mechanisms this study ruled out the influence of several other types of self-efficacies (e.g., strength and self-presentational) and perceived physical competencies (e.g., perceived body fat and strength). It can now be suggested that aerobic self-efficacy and perceived physical

endurance are two important mechanisms to target in an exercise intervention in order to change the way young women feel about their bodies.

An additional contribution of Study 2, was to rule out the need for physical fitness changes (e.g., changes in body composition) to occur in order for women to feel better about their bodies. The women in Study 2 did not experience significant changes in their body weight, body mass index or waist to hip circumference. Therefore, it can now be suggested that changes in body composition are not necessary to target in an exercise program in order for women to feel better about their bodies. Practically, it could be recommend that fitness professionals (fitness instructors, personal trainers, Kinesiologists) working with women should encourage women to feel better about their bodies by having them focus on building their confidence for doing the exercises themselves, instead of focusing on the weight they can lose.

With regard to theory, there are several contributions that Study 2 has made. To date, there are no theoretical frameworks that have been developed to explain how exercise improves SPA. Previous research has employed different theoretical approaches to explain the effects of exercise on SPA (e.g., Cognitive Behavioural Model of body image; Cash, 2002; Exercise and Self-esteem Model; Sonestroem & Morgan, 1989) but this research was limited in its scope. Study 2 made a major contribution by testing several different types of self-efficacy, perceived physical competencies, and physical fitness mechanisms and by identifying two that emerged as important for improving SPA, specifically aerobic self-efficacy and perceived physical endurance. This is an important informative step toward the development of a theory regarding the effects of exercise on SPA. Based on the findings from Study 2, it can be suggested that researchers should start building theories to guide exercise-SPA research. A good place to start would be to build on previous psychosocial theories that incorporate similar mechanisms (i.e.,

self-efficacy, perceived physical competencies) such as the EXSEM (Sonestroem & Morgan, 1989) or Social Cognitive Theory (Bandura, 1977). In doing so, researchers can begin to delineate what mechanisms are most important for improving SPA and, in turn, guide future research on exercise and SPA.

With respect to practical contributions, it is recommended that aerobic self-efficacy and perceived physical endurance should be targeted in exercise interventions to improve young women's SPA. Specifically, for researchers designing an exercise intervention, or for those in this fitness industry, one might want to increase aerobic self-efficacy by targeting the four sources of self-efficacy (Bandura, 1997) and to target perceived physical endurance. According to the EXSEM, changes in physical self-efficacy will lead to changes in perceived physical competencies (Sonestroem & Morgan, 1989). Thus, to begin with, women should be challenged to change the way women think about their physical abilities, with respect to aerobic exercise, and this will further enhance how they see themselves engaging in other endurance activities. Based on the findings from Study 2, targeting these two mechanisms in exercise interventions should change the way women feel about their bodies.

4.5 Contributions to Research on the Effects of Exercise Training on Cortisol

In study 2, the results demonstrated that exercise training (regardless of mode) was effective for reducing cortisol levels among women. This finding is important because it suggests that exercise can be used as a viable strategy to regulate cortisol levels. Based on these findings and ACSM (Haskell et al., 2007) exercise guidelines, women should exercise using aerobic or resistance training exercises, 3 times per week for at least 8 weeks, at a moderate to heavy intensity, for 45minute session durations (5 minute warm up, 30 minutes of exercise, 10 minutes cool down) to reduce cortisol levels. This is information is important because it

provides a preliminary step toward some practical prescription guidelines to decrease cortisol levels among young women.

The findings from Study 2 have also contributed to advancing knowledge about the effects of exercise training on cortisol among women with specific body image concerns (i.e., high SPA). Study 2 was the first study that has demonstrated that exercise training is effective for reducing cortisol levels among young women with high SPA. These findings extend previous research that has shown that exercise training is effective for reducing the cortisol response and alleviating depressive symptoms among women (Foley et al., 2008; Nabkasorn et al., 2005).

From a practical perspective, the findings from Study 2 are important because exercise training can be recommended for improving cortisol levels among young women. Exercise training is a relatively affordable, easily implemented, non-invasive treatment option that has many positive psychological and physical side-effects. If health professionals begin to prescribe exercise training as a treatment to reduce cortisol levels the by-product of this treatment will not only be reduced stress and improved psychological well-being, but will also include improvements in general health. Therefore, based on the findings of Study 2 exercise training should be considered as a possible treatment option for reducing cortisol levels among young women.

4.6 Future Directions

The findings from this dissertation provide many directions for future research. One such direction would be to examine other contexts or environments that may elicit physique evaluative threat (e.g., swimming pools, fitness classes), and if they also elicit a cortisol response among women. In addition, future researchers may want to compare a social evaluative threat

situation to a physique evaluative threat situation to distinguish what situational components elicit a greater cortisol response among women. Deciphering what situation poses the greatest threat will further isolate what it is that women find most threatening about these situations. With regard to improving SPA, researchers should conduct exercise interventions that target changing the identified mechanisms (aerobic self-efficacy and perceived physical endurance) underlying the effects of exercise on SPA. This will aid in determining if these mechanisms *cause* concomitant changes in SPA. Studies that identify how to target these mechanisms will help further our understanding of how these mechanisms influence change in SPA and will contribute to the development of a theory on how exercise influences SPA. Finally, another research avenue would be to compare exercise training to psychological treatments such as Cognitive Behavioral Therapy or biofeedback in order to assess the best approach to alleviating body image concerns and reducing cortisol levels among women.

4.7 Conclusions

In summary, these studies have provided a broader understanding of the factors associated with SPA. These studies have shown, that for women, situations that elicit physique evaluative threat elicit concomitant changes in cortisol. Exercise training is an effective strategy for improving SPA, reducing cortisol responses, and possibly providing a protective effect against the state SPA response among young women. Aerobic exercise training is more effective for improving SPA than resistance training and this is due, in part, to increases in aerobic self-efficacy and perceived physical endurance associated with aerobic training. Finally, this dissertation provides momentum for extending the scope of research on SPA to utilize a psychobiological perspective. The knowledge that stems from this dissertation regarding

exercise, SPA and cortisol will certainly be of value for determining the best approach for improving SPA among women.

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Appendix A

Study 1 Materials

Appendix A.1: WEB-BASED ADVERTISEMENT

Female participants are needed for a research study about women's feelings about fitness facilities.

Participant criteria:

1) Exercise zero, one, or two times per week

2) 18 years or older

3) McMaster student

4) Currently taking oral contraceptives (birth control)

Participants will be asked to complete some questionnaires and provide four saliva samples in one 60 minute session. Participants will receive $10 upon completion of the study.

If you meet the criteria listed above and are interested in receiving more information about this study, please contact Heather Strong at strongh@mcmaster.ca or by phone at 905-525-9140, ext. 27624.

Appendix A.2: SCREENING QUESTIONNAIRE

PARTICIPANT SCREENING QUESTIONNAIRE

Date: _____
Age: _____
Email Address: _____

Godin Leisure Time Exercise Questionnaire

Over the past 6 months, how many times **a week** have you done the following kinds of exercise for 30 minutes or more during your **free time**?

Times per week

STRENUOUS EXERCISE (your heart beats rapidly): _____
(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, skating)

MODERATE EXERCISE (not exhausting): _____
(e.g., fast walking, weight-training, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing)

MILD EXERCISE (minimal effort): _____
(e.g., yoga, archery, fishing, bowling, horseshoes, golf, snow-mobiling, easy walking)

How many days per week do you consistently exercise?

_____

Are you currently taking oral contraceptives (birth control)?
☐ **YES** ☐ **NO**

Are you currently taking any anti-anxiety or anti-depressant medications?

☐ **YES** ☐ **NO**

Appendix A.3: DEMOGRAPHIC QUESTIONNAIRE

THANK YOU FOR AGREEING TO PARTICIPATE IN THIS RESEARCH STUDY!
This questionnaire contains nine pages in total. On this page you will find a set of questions that will tells us more about you and your background. Pages 2 - 5 include questions about your thoughts and feelings about your body. Pages 6 - 9 include questions about your thoughts and feelings about your mood. Your name is ***not*** required anywhere in this package. All of your responses will remain confidential. **There are no "right" or "wrong" answers.** Be as honest and as accurate as you can in answering each question. Thanks for your participation!

Instructions: For the following questions we are interested in learning more about your background. Please follow the directions carefully and fill in all of the questions.

1. What is your age (in years)? _____

2. What is your height ? _____

3. What is your weight? _____

4. What is your marital status? (please check the boxes that apply):

☐ Single ☐ Divorced ☐ Widowed
☐ Married ☐ Separated ☐ Common-law

5. What is your current level of education/employment? (please check the boxes that apply):

☐ Undergraduate Student ☐ 1st year ☐ 2nd year ☐ 3rd year ☐ 4th year
☐ A Graduate Student ☐ Masters ☐ Ph.D.
☐ Employed Full-time
☐ Employed Part-time

6. What is your cultural background? (please check the box that applies to you):

☐ Aboriginal
☐ Caucasian
☐ African-Canadian
☐ Asian
☐ Arab/West Asian
☐ South Asian
☐ Other_____

7. Are you currently taking any medications? (e.g., oral contraceptives, antidepressants, cold medications) Please list the name and purpose of any medications you are currently taking.

_____

8. What time did you wake up this morning? _____

9. Have you fasted from food or beverages in the past 60 minutes? ☐ Yes ☐ No

10. Have you had any alcohol in the past 24 hours? ☐ Yes ☐ No

Appendix A.4: OUTCOME MEASURES

State Social Physique Anxiety Scale

Instructions: Read each of the following statements carefully. For the current exercise setting, indicate by checking the box, the extent to which you would experience the feelings described by each item, according to the following scale.

In this exercise setting...	Not at all	Slightly	Moderately	A Lot	A Great Deal
1. I would feel uptight about my physique/figure.	☐	☐	☐	☐	☐
2. I would be concerned that other people in the room are evaluating my weight or muscular development negatively.	☐	☐	☐	☐	☐
3. Unattractive features of my physique/figure would make me nervous in this setting.	☐	☐	☐	☐	☐
4. In this setting, I would feel apprehensive about my physique/figure.	☐	☐	☐	☐	☐
5. I would feel comfortable with how fit my body appears to others.	☐	☐	☐	☐	☐
6. It would make me uncomfortable to know that other people in the room were evaluating my physique/figure.	☐	☐	☐	☐	☐
7. When it comes to displaying my physique/figure to others, in this setting I would feel shy.	☐	☐	☐	☐	☐
8. I would feel relaxed when it was obvious that others were looking at my physique/figure.	☐	☐	☐	☐	☐
9. Wearing my usual workout clothes, I would feel nervous about the shape of my body.	☐	☐	☐	☐	☐

Salivary Cortisol: Collection Instructions

SALIMETRICS: COLLECTING UNSTIMULATED WHOLE SALIVA SAMPLES BY PASSIVE DROOL FROM HUMAN SUBJECTS (ages 5+)

Things to avoid:
1. Brushing teeth within 1 hour prior to collection.
2. Using salivary stimulants: chewing gum, lemon drops, granulated sugar, drink crystals.
3. Consuming a major meal within 1 hour prior to collection.
4. Consuming alcohol 12 hours prior to collection.
5. Consuming acidic or high sugar foods within 20 minutes prior to collection.

Suggested protocol:
1. Rinse mouth with water 10 minutes prior to sample collection
2. Document prescription and over-the-counter medications taken.
3. Record time of day sample is collected.

Materials required:
_ Plastic drinking straws
_ Scissors
_ Cryovials: polypropylene – 2mL capacity
_ Labels

Salimetrics Item No. Description
5002.01 2 mL cryovial
Note: *Collections for multiple hormones may require larger vials (information available upon request). It is advisable to use a vial with at least twice the capacity of the necessary sample volume because some saliva foaming will occur.*

Prior to Saliva Collection:
1. Cut plastic drinking straws into 2-inch (5 cm) pieces.
2. Give each subject one (1) straw piece and one (1) cryovial.
3. Have subjects rinse their mouth with water 10 minutes prior to collection.

Collecting saliva:
1. Instruct subject to imagine eating their favorite food and allow saliva to pool in the mouth. (Moving the jaw in a chewing motion is acceptable.)
2. With head tilted forward, subject should drool down the straw and collect saliva in the cryovial. (It is normal for saliva to foam.)
3. Repeat as often as necessary until sufficient sample is collected.
(1 mL - excluding foam - is adequate for most tests).
4. If subject's mouth is dry, instruct them to gently chew on the end of the straw. This will stimulate saliva production.
5. Keep samples cold after collection (4°C) and freeze (-20° to -80°C) as soon as possible.

CORTISOL SAMPLE TIME RECORD SHEET

Participant ID#_____

Cortisol Sample #	Time	Actual Time
Sample 1	Baseline	
Sample 2	0 minutes post	
Sample 3	15 minutes post	
Sample 4	30 minutes post	

Salimetrics High Sensitivity Salivary Cortisol EIA Kit Procedure

Step 1: Determine your plate layout. Here is a suggested layout.

1	2	3	4	5	6	7	8	9	10	11	12
A			3.000 Std		3.000 Std		Ctrl-H			Ctrl-H	
B			1.000 Std		1.000 Std		Ctrl-L			Ctrl-L	
C			0.333 Std		0.333 Std		Unk-1			Unk-1	
D			0.111 Std		0.111 Std		Unk-2			Unk-2	
E			0.037 Std		0.037 Std		Unk-3			Unk-3	
F			0.012 Std		0.012 Std		Unk-4			Unk-4	
G			Zero		Zero		Unk-5			Unk-5	
H			NSB		NSB		Unk-6			Unk-6	

Step 2: Keep the desired number of strips in the strip holder and place the remaining strips back in the foil pouch. If you choose to place non-specific binding wells in H-1, 2, remove strips 1 and 2 from the strip holder and break off the bottom wells. Place the strips back into the strip holder leaving H-1, 2 blank. Break off 2 NSB wells from the strip of NSBs included in the foil pouch. Place in H-1, 2. Alternatively, NSBs may be placed wherever you choose on the plate. Reseal the zip-lock foil pouch containing unused wells and desiccant. Store at 2-8°C.
Caution: Extra NSB wells should not be used for determination of standards, con-trols or unknowns.

Step 3: Pipette 24 mL of assay diluent into a disposable tube. Set aside for Step 5.

Step 4:

- Pipette 25 μL of standards, controls, and unknowns into appropriate wells. Stan-dards, controls, and unknowns should be assayed in duplicate.
- Pipette 25 μL of assay diluent into 2 wells to serve as the zero value.
- Pipette 25 μL of assay diluent into each NSB well.

Note: To ensure highest quality assay results, pipetting of samples and reagents must be done as quickly as possible (without interruption) across the plate. Ideally, the process should be completed within 20 minutes or less.

Step 5: Make a 1:1600 dilution of the conjugate by adding 15 μL of the conjugate to the 24 mL of assay diluent prepared in Step 3. (Scale down proportionally if not using the entire plate.) Immediately mix the diluted conjugate solution and pipette 200 μL into each well using a multichannel pipette.

Step 6: Mix plate on rotator for 5 minutes at 500 rpm (or tap to mix) and incubate at room temperature for an additional 55 minutes.

Step 7: Wash the plate 4 times with 1X wash buffer. A plate washer is recommended. However, washing may be done by gently squirting wash buffer into each well with a squirt bottle, or by pipetting 300 μL of wash buffer into each well, and then discarding the liquid by inverting the plate over a sink. After each wash, the plate should be thor-oughly blotted on paper towels before

being turned upright. ***If using a plate washer, blotting is still recommended after the last wash, just before the addition of the TMB.***

Step 8: Add 200 µL of TMB solution to each well with a multichannel pipette.

Step 9: Mix on a plate rotator for 5 minutes at 500 rpm (or tap to mix) and incubate the plate in the dark at room temperature for an additional 25 minutes.

Step 10: Add 50 µL of stop solution with a multichannel pipette.

Step 11: Mix on a plate rotator for 3 minutes at 500 rpm (or tap to mix). ***Caution: Spillage may occur if mixing speed exceeds 600 rpm.*** Wipe off bottom of plate with a water-moistened, lint-free cloth and wipe dry. Read in a plate reader at 450 nm. Read plate within 10 minutes of adding stop solution. (Correction at 490 to 630 is desirable.)

Assay Calculations

1. Compute the average optical density (OD) for all duplicate wells.
2. Subtract the average OD for the NSB wells from the average OD of the zero, standards, controls, and unknowns.
3. Calculate the percent bound (B/Bo) for each standard, control, and unknown by dividing the average OD (B) by the average OD for the zero (Bo).
4. Determine the concentrations of the controls and unknowns by interpolation using software capable of logistics. We recommend using a 4-parameter sigmoid minus curve fit.

Samples with cortisol values greater than 3.0 µg/dL (82.77 nmol/L) should be diluted with assay diluent and rerun for accurate results. To obtain the final cortisol concen-tration, multiply the concentration of the diluted sample by the dilution factor.

When running multiple plates, or multiple sets of strips, a standard curve should be run with each individual plate and/or set of strips.

Salivary Cortisol Expected Ranges

The following values have been reported for salivary cortisol.

Group	Number	AM Range(µg/dL)	PM Range (µg/dL)
Children, ages 2.5-5.5	112	0.034 - 0.645	0.053 - 0.607
Children, ages 8-11	285	0.084 - 0.839	ND - 0.215
Adolescents, ages 12-18	403	0.021 - 0.883	ND - 0.259
Adult males, ages 21-30	26	0.112 - 0.743	ND - 0.308
Adult females, ages 21-30	20	0.272 - 1.348	ND - 0.359
Adult males, ages 31-50	67	0.122 - 1.551	ND - 0.359
Adult females, ages 31-50	31	0.094 - 1.515	ND - 0.181
Adult males, ages 51-70	28	0.112 - 0.812	ND - 0.228
Adult females, ages 51-70	23	0.149 - 0.739	0.022 - 0.254
All adults	192	0.094 - 1.551	ND - 0.359

Note. ND = None detected.

Appendix A.5: COVARIATE MEASURES

State-Trait Anxiety Inventory

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then put the appropriate number to the right of the statement to indicate how you feel RIGHT NOW, that is, *at this moment.* There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1	2	3	4
Not At All	**Somewhat So**	**Moderately So**	**Very Much**

1. I feel calm_____
2. I feel secure_____
3. I am tense_____
4. I feel strained_____
5. I feel at ease_____
6. I feel upset_____
7. I am presently worrying over possible misfortunes. _____
8. I feel satisfied_____
9. I feel frightened_____
10. I feel comfortable_____
11. I feel self-confident_____
12. I feel nervous_____
13. I am jittery_____
14. I feel indecisive_____
15. I am relaxed_____
16. I feel content_____
17. I am worried_____
18. I feel confused_____
19. I feel steady_____
20. I feel pleasant_____

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then put the appropriate number to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1	2	3	4
Not at All	**Somewhat So**	**Moderately So**	**Very Much**

1. I feel pleasant_____
2. I feel nervous and restless_____
3. I feel satisfied with myself_____
4. I wish I could be as happy as others seem to be_____
5. I feel like a failure_____
6. I feel rested_____
7. I am "calm, cool, and collected" _____
8. I feel that difficulties are piling up so that I cannot overcome them_____
9. I worry too much over something that really doesn't matter_____
10. I am happy_____
11. I have disturbing thoughts_____
12. I lack self-confidence_____
13. I feel secure_____
14. I make decisions easily_____
15. I feel inadequate_____
16. I am content_____
17. Some unimportant thoughts run through my mind and bother me_____
18. I take disappointments so keenly that I can't put them out of my mind_____
19. I am a steady person_____
20. I get in a state of tension as I think over my recent concerns and interests_____

Perceived Stress Scale

Instructions: The questions in this scale ask you about your feelings and thoughts during the last month. In each case, please indicate with a check (on the left) how often you felt or thought a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?
   - ☐ Never
   - ☐ Almost never
   - ☐ Sometimes
   - ☐ Fairly often
   - ☐ Very often

2. In the last month, how often have you felt that you were unable to control the important things in your life?
   - ☐ Never
   - ☐ Almost never
   - ☐ Sometimes
   - ☐ Fairly often
   - ☐ Very often

3. In the last month, how often have you felt nervous and "stressed"?
   - ☐ Never
   - ☐ Almost never
   - ☐ Sometimes
   - ☐ Fairly often
   - ☐ Very often

4. In the last month, how often have you felt confident about your ability to handle your personal problems?
   - ☐ Never
   - ☐ Almost never
   - ☐ Sometimes
   - ☐ Fairly often
   - ☐ Very often

5. In the last month, how often have you felt that things were going your way?
   - ☐ Never
   - ☐ Almost never
   - ☐ Sometimes
   - ☐ Fairly often
   - ☐ Very often

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Fairly often
- ☐ Very often

7. In the last month, how often have you been able to control irritations in your life?
- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Fairly often
- ☐ Very often

8. In the last month, how often have you felt that you were on top of things?
- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Fairly often
- ☐ Very often

9. In the last month, how often have you been angered because of things that were outside of your control?
- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Fairly often
- ☐ Very often

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Fairly often
- ☐ Very often

Beck Depression Inventory-2

Instructions: For the next set of items choose one statement from among the group of four statements in each question that best describes how you have been feeling during the past few days. Circle the number (0,1,2,3) beside your choice.

1.
- **0** I do not feel sad.
- **1** I feel sad.
- **2** I am sad all the time and I can't snap out of it.
- **3** I am so sad or unhappy that I can't stand it.

2.
- **0** I am not particularly discouraged about the future.
- **1** I feel discouraged about the future.
- **2** I feel I have nothing to look forward to.
- **3** I feel that the future is hopeless and that things cannot improve.

3.
- **0** I do not feel like a failure.
- **1** I feel I have failed more than the average person.
- **2** As I look back on my life, all I can see is a lot of failure.
- **3** I feel I am a complete failure as a person.

4.
- **0** I get as much satisfaction out of things as I used to.
- **1** I don't enjoy things the way I used to.
- **2** I don't get any real satisfaction out of anything anymore.
- **3** I am dissatisfied or bored with everything.

5.
- **0** I don't feel particularly guilty.
- **1** I feel guilty a good part of the time.
- **2** I feel quite guilty most of the time.
- **3** I feel guilty all of the time.

6.
- **0** I don't feel I am being punished.
- **1** I feel I may be punished.
- **2** I expect to be punished.
- **3** I feel I am being punished.

7.
- **0** I don't feel disappointed in myself.
- **1** I am disappointed in myself.
- **2** I am disgusted with myself.
- **3** I hate myself.

8.
- **0** I don't feel I am any worse than anybody else.
- **1** I am critical of myself for my weaknesses or mistakes.
- **2** I blame myself all the time for my faults.
- **3** I blame myself for everything bad that happens.

9.
0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10.
0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11.
0 I am no more irritated by things than I ever am.
1 I am slightly more irritated now than usual.
2 I am quite annoyed or irritated a good deal of the time.
3 I feel irritated all the time now.

12.
0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13.
0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions than before.
3 I can't make decisions at all anymore.

14.
0 I don't feel that I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel that there are permanent changes in my appearance that make me look
3 unattractive.
I believe that I look ugly.

15.
0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16.
0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17.
0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18. **0** My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19. **0** I haven't lost much weight, if any, lately.
1 I have lost more than five pounds.
2 I have lost more than ten pounds.
3 I have lost more than fifteen pounds.
(**Score 0 if you have been purposely trying to lose weight.)

20. **0** I am no more worried about my health than usual.
1 I am worried about physical problems such as aches and pains, or upset stomach.
2 I am very worried about physical problems, and it's hard to think of much else.
3 I am so worried about my physical problems that I cannot think about anything else.

21. **0** I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
2 I am much less interested in sex now.
3 I have lost interested in sex completely.

Body Mass Index Calculation and Ranges

Weight (kgs)/ Height (cms)^2

BMI Categories:

- Underweight = <18.5
- Normal weight = 18.5-24.9
- Overweight = 25-29.9
- Obesity = BMI of 30 or greater

Trait Social Physique Anxiety Scale

Instructions: Read each of the following statements carefully and indicate the degree to which the statement is characteristic or true of you, according to the following scale.

	Not at all Characteristic	Slightly Characteristic	Moderately Characteristic	Quite Characteristic	Extremely Characteristic
1. I wish I wasn't so uptight about my physique/figure.	☐	☐	☐	☐	☐
2. There are times when I am bothered by thoughts that other people are evaluating my weight or muscular development negatively.	☐	☐	☐	☐	☐
3. Unattractive features of my physique/figure make me nervous in certain social settings.	☐	☐	☐	☐	☐
4. In the presence of others, I feel apprehensive about my physique/figure.	☐	☐	☐	☐	☐
5. I am comfortable with how fit my body appears to others.	☐	☐	☐	☐	☐
6. It would make me uncomfortable to know others were evaluating my physique/figure.	☐	☐	☐	☐	☐
7. When it comes to displaying my physique/figure to others, I am a shy person.	☐	☐	☐	☐	☐
8. I usually feel relaxed when it is obvious that others are looking at my physique/figure.	☐	☐	☐	☐	☐
9. When in a bathing suit, I often feel nervous about the shape of my body.	☐	☐	☐	☐	☐

Appendix A.6: PARTICIPANT DEBRIEFING FORM

Thank you for participating in the present study. The purpose of the present study was to examine the role of cortisol in the exercise-body image relationship. Initially, when you were screened for participation in the study you were told that you may have to exercise, however, after completing the study you did not actually have to participate in a bout of exercise. You were told that you may have to exercise so that we could get a true evaluation/reaction from you on how you would think and feel about your body in the exercise environment (fitness facility) that you were exposed to.

We are aware that some of the questions on the questionnaire may have caused you to experience feelings of anxiety about your body. If you feel like these concerns are overwhelming you now or if after you leave this experiment you still feel concerned about your anxiety about your body and you feel like you need to talk to someone about it you may contact members of the research team (Dr. Kathleen Martin Ginis or Heather Strong) or the Centre for Student Development for support. Our contact information is provided below.
Please acknowledge by signing below that you received the financial compensation for your study participation. If you would like to receive the results from the study in the form of an executive summary please provide your email address below. Thank you again for your time.

1. Did you receive the 10$ compensation?	Signature of participant:
2. Would you like to receive a summary of the results from the present study?	□ YES □ NO If YES, please provide your email address: _____

CONTACTS:
Centre for Student Development Counselling Services
Phone: 905-525-9140 ext. 24711
Email: csd@mcmaster.ca
Location: Basement of the student centre MUSC Rm. B107

Dr. Kathleen Martin Ginis
Phone: 905-525-9140 ext. 23574
Email: martink@mcmaster.ca
Location: Ivor Wynne Centre Rm. A201

Heather Strong
Phone: 905-525-9140 ext. 27624
Email: strongh@mcmaster.ca
Location: Ivor Wynne Centre Rm. A101

Appendix B

Study 2 Materials

Appendix B.1: RECRUITMENT POSTER

Feeling dissatisfied with your body?
Interested in following through with your New Years resolution to get to the gym?

We are looking for **FEMALE VOLUNTEERS** to participate in an 8-week exercise study in the Department of Kinesiology

Volunteer criteria:

- ✓ Exercise 0,1,or 2 times per week
- ✓ 18 years or older
- ✓ McMaster Student
- ✓ Currently taking oral contraceptives

Volunteers will:

- Complete some questionnaires regarding your thoughts and feelings about your mood and your body.
- Provide saliva samples.
- Complete some physical fitness and body composition tests
- **Participate in an 8-week exercise program**

Upon completion of the study participants will receive $50!
For more information, please contact Heather:
(905) 525-9140 ext. 21403
strongh@mcmaster.ca

Web-based Advertisement

Feeling dissatisfied with your body? Interested in getting started with that New Years Resolution to get into the gym? We are looking for female volunteers to participate in a research study in the Department of Kinesiology.

Volunteer criteria:

- ☐ Exercise 0,1,or 2 times per week
- ☐ 18 years or older
- ☐ Currently taking oral contraceptives
- ☐ McMaster student

Volunteers will:

- ☐ Complete some questionnaires regarding your thoughts and feelings about your mood and your body
- ☐ Provide saliva samples
- ☐ Complete some physical fitness and body composition tests
- ☐ Participate in an 8-week exercise program
- ☐ Upon completion of the study participants will also receive $125!

For more information, please contact Heather:
(905) 525-9140 ext. 21403
strongh@mcmaster.ca

Appendix B.2: SCREENING QUESTIONNAIRE

PARTICIPANT SCREENING QUESTIONNAIRE

"Thank you for your interest in participating in the research study. At this time I would like to ask you a few questions to make sure you are eligible to participate."

)ate: Click here to enter a date.
\ge: Click here to enter text.
:mail Address: Click here to enter text.

Godin Leisure Time Exercise Questionnaire

Over the past 12 months, how many times **a week** have you done the following kinds of exercise for 30 minutes or more during your **free time**?
****This does not include walking to and from class or school****

Times per week

. **STRENUOUS EXERCISE (your heart beats rapidly):** _____

e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling, skating)

. **MODERATE EXERCISE (not exhausting):** _____
e.g., fast walking, weight-training, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, lpine skiing, dancing)

. **MILD EXERCISE (minimal effort):** _____
e.g., yoga, archery, fishing, bowling, horseshoes, golf, snow-mobiling, easy walking)

. **How many days per week do you consistently exercise?** _____

. **Are you currently taking oral contraceptives (birth control)?** ☐ **YES** ☐ **NO**

. **Are you currently taking any anti-anxiety or anti-depressant medications?** ☐ **YES** ☐ **NO**

. **Now I am going to ask you a series of questions regarding how you think and feel about your body:**

Trait Social Physique Anxiety Scale

Instructions: Read each of the following statements carefully and indicate the degree to which the statement is characteristic or true of you, according to the following scale.

	Not at all Characteristic	Slightly Characteristic	Moderately Characteristic	Very Characteristic	Extremely Characteristic
1. I wish I wasn't so uptight about my physique/figure.	☐	☐	☐	☐	☐
2. There are times when I am bothered by thoughts that other people are evaluating my weight or muscular development negatively.	☐	☐	☐	☐	☐
3. Unattractive features of my physique/figure make me nervous in certain social settings.	☐	☐	☐	☐	☐
4. In the presence of others, I feel apprehensive about my physique/figure.	☐	☐	☐	☐	☐
5. I am comfortable with how fit my body appears to others.	☐	☐	☐	☐	☐
6. It would make me uncomfortable to know others were evaluating my physique/figure.	☐	☐	☐	☐	☐
7. When it comes to displaying my physique/figure to others, I am a shy person.	☐	☐	☐	☐	☐
8. I usually feel relaxed when it is obvious that others are looking at my physique/figure.	☐	☐	☐	☐	☐
9. When in a bathing suit, I often feel nervous about the shape of my body.	☐	☐	☐	☐	☐

Physical Activity Readiness Questionnaire (PAR-Q)

ow I am going to ask you seven questions in order to determine if you should check with your doctor before you start an xercise program.

ommon sense is your best guide when you answer these questions. Please read the questions carefully and answer each ne honestly with a YES or NO.

. Has your doctor ever said that you have a heart condition and that you should only do physical activity ecommended by a doctor?_____

. Do you feel pain in your chest when you do physical activity?_____

. In the past month, have you had chest pain when you were not doing physical activity?_____

. Do you lose your balance because of dizziness or do you ever lose consciousness?_____

. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in our physical activity?_____

. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart con- ition?_____

. Do you know of any other reason why you should not do physical activity?_____

f you answered YES to one or more of the questions talk with your doctor by phone or in person BEFORE you start ecoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and hich questions you answered YES.

You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to estrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to articipate in and follow his/her advice.

f you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to o.

take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way or you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 44/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or

if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or ealth professional. Ask whether you should change your physical activity plan.

Appendix B.3: DEMOGRAPHIC QUESTIONNAIRE

THANK YOU FOR AGREEING TO PARTICIPATE IN THIS RESEARCH STUDY!
This questionnaire contains 13 pages in total. On this page you will find a set of questions that will tells us more about you and your background. Pages 2 - 9 include questions about your thoughts and feelings about your body. Pages 9- 13 include questions about your thoughts and feelings about your mood and your goals. Your name is ***not*** required anywhere in this package. All of your responses will remain confidential. **There are no "right" or "wrong" answers.** You may skip any questions you wish, but we hope you feel comfortable answering them so that we have complete information from everyone participating. Be as honest and as accurate as you can in answering the questions. Thanks for your participation!

Instructions: We are interested in learning more about your background. Please follow the directions carefully and fill in all of the questions.

1. What is your age (in years)? _____

2. What is your marital status? (please check the boxes that apply):

☐ Single ☐ Divorced ☐ Widowed
☐ Married ☐ Separated ☐ Common-law

3. What is your current level of education/employment? (please check the boxes that apply):

☐ An Undergraduate Student in: ☐ 1st year ☐ 2nd year ☐ 3rd year ☐ 4th year
☐ A Graduate Student ☐ Masters ☐ Ph.D.
☐ Employed Full-time
☐ Employed Part-time

4. What is your ethnicity/racial background? (please check the box that applies to you):

☐ Aboriginal ☐ Caucasian ☐ African-Canadian ☐ Asian
☐ Arab/West Asian ☐ South Asian ☐ Other:_____

5. Are you currently taking any medications? (e.g., oral contraceptives, antidepressants) Please list the name and purpose of any medications you are currently taking.

_____
_____
_____
_____

6. What time did you wake up this morning? _____

7. Have you fasted from food or beverages in the past 60 minutes? ☐ Yes ☐ No

8. Have you had any alcohol in the past 24 hours? ☐ Yes ☐ No

Appendix B.4: TRAIT MEASURES

Trait Social Physique Anxiety Scale

Instructions: Read each of the following statements carefully and indicate the degree to which the statement is characteristic or true of you, according to the following scale.

	Not at all Characteristic	Slightly Characteristic	Moderately Characteristic	Very Characteristic	Extremely Characteristic
1. I wish I wasn't so uptight about my physique/figure.	☐	☐	☐	☐	☐
2. There are times when I am bothered by thoughts that other people are evaluating my weight or muscular development negatively.	☐	☐	☐	☐	☐
3. Unattractive features of my physique/figure make me nervous in certain social settings.	☐	☐	☐	☐	☐
4. In the presence of others, I feel apprehensive about my physique/figure.	☐	☐	☐	☐	☐
5. I am comfortable with how fit my body appears to others.	☐	☐	☐	☐	☐
6. It would make me uncomfortable to know others were evaluating my physique/figure.	☐	☐	☐	☐	☐
7. When it comes to displaying my physique/figure to others, I am a shy person.	☐	☐	☐	☐	☐
8. I usually feel relaxed when it is obvious that others are looking at my physique/figure.	☐	☐	☐	☐	☐
9. When in a bathing suit, I often feel nervous about the shape of my body.	☐	☐	☐	☐	☐

24-hr Salivary Cortisol Collection Instructions

Saliva Collection Instructions

Collection Supplies Provided:

- Informational insert
- Collection tubes and an identification labels to adhere to tube
- Time record form
- Zip lock bag

Note: Please read all of this section before beginning saliva collection.

Saliva collection is simple and can be performed in your home at your convenience. Hormones in saliva are stable at room temperature, but please put the samples in the fridge in the zip lock bag provided as soon as possible after you are done collecting them.

1.When to Collect Your Saliva

Instructions: At the end of the first visit you were given 5 saliva tubes with labels and a zip lock bag to take home with you. The next day (between visit 1 and 2) you are asked to take a sample of your saliva immediately upon waking (0 hrs) in the morning, 1, 3, 6, and 9 hours after waking. The samples will take approximately 5 minutes each to do.

2. How to Collect Your Saliva

Instructions: Saliva is collected first in the early morning (AM) before brushing/flossing your teeth, eating, drinking or applying makeup and then at multiple time points throughout the day. We are asking you collect samples at 0, 1, 3, 6, and 9 hours after waking so that means you are going to need to refrain from brushing or flossing your teeth or eating within one hour of each saliva collection time point. Also, please refrain from drinking alcohol 24hrs prior to sample collection. **Important:** Hormones left on hands from creams can potentially contaminate the saliva during collection. Therefore, if using a cream, wash your hands thoroughly with soap and water before beginning.

a) Before you are about to give a sample rinse your mouth at least twice with cool water. Then wait a few minutes and let the saliva collect in your mouth to begin collection.

b) Next, remove the cap of the saliva collection tube and spit directly into the tube. Avoid touching the mouth of the tube with your hands.

c) Fill the tube at least 1/2 full (approximately 2ml) and put the cap on, making sure the cap is on evenly and securely. It may take you a few minutes to generate sufficient saliva.

d) Neatly print your name, date and time of collection on the peel off label(s) and affix to the saliva tube(s).

e) Completely fill out the time record form each time you give a sample. It is especially important to include the time and date of saliva collection and to list any hormonal products you are using. List each product separately and include preparation name, amount taken and time of ingestion or application.

3. How to store your saliva samples

Instructions: Please store your saliva samples in the fridge in the zip lock bag provided, after each time point. Ensure that the lid on the tube is closed tightly and that each tube is labelled properly. Please bring the saliva samples back to the lab for your second visit. Thank you! If you have any questions at all please do not hesitate to call me 905-525-1572 or email me strong@mcmaster.ca

SALIVA SAMPLE TIME RECORD SHEET

Participant ID#_____

SAMPLE	TIME	COMMENTS
What time did you wake up this morning?		
SAMPLE 1 (0 hr – when you wake up)		
SAMPLE 2 (1 hr – after waking)		
SAMPLE 3 (3 hrs - after waking)		
SAMPLE 4 (6 hrs - after waking)		
SAMPLE 5 (9 hrs - after waking)		

Salimetrics High Sensitivity Salivary Cortisol EIA Kit Procedure

Step 1: Determine your plate layout. Here is a suggested layout.

1	2	3	4	5	6	7	8	9	10	11	12
A			3.000 Std		3.000 Std		Ctrl-H			Ctrl-H	
B			1.000 Std		1.000 Std		Ctrl-L			Ctrl-L	
C			0.333 Std		0.333 Std		Unk-1			Unk-1	
D			0.111 Std		0.111 Std		Unk-2			Unk-2	
E			0.037 Std		0.037 Std		Unk-3			Unk-3	
F			0.012 Std		0.012 Std		Unk-4			Unk-4	
G			Zero		Zero		Unk-5			Unk-5	
H			NSB		NSB		Unk-6			Unk-6	

Step 2: Keep the desired number of strips in the strip holder and place the remaining strips back in the foil pouch. If you choose to place non-specific binding wells in H-1, 2, remove strips 1 and 2 from the strip holder and break off the bottom wells. Place the strips back into the strip holder leaving H-1, 2 blank. Break off 2 NSB wells from the strip of NSBs included in the foil pouch. Place in H-1, 2. Alternatively, NSBs may be placed wherever you choose on the plate. Reseal the zip-lock foil pouch containing unused wells and desiccant. Store at 2-8°C.
Caution: Extra NSB wells should not be used for determination of standards, con-trols or unknowns.

Step 3: Pipette 24 mL of assay diluent into a disposable tube. Set aside for Step 5.

Step 4:

- Pipette 25 µL of standards, controls, and unknowns into appropriate wells. Stan-dards, controls, and unknowns should be assayed in duplicate.
- Pipette 25 µL of assay diluent into 2 wells to serve as the zero value.
- Pipette 25 µL of assay diluent into each NSB well.

Note: To ensure highest quality assay results, pipetting of samples and reagents must be done as quickly as possible (without interruption) across the plate. Ideally, the process should be completed within 20 minutes or less.

Step 5: Make a 1:1600 dilution of the conjugate by adding 15 µL of the conjugate to the 24 mL of assay diluent prepared in Step 3. (Scale down proportionally if not using the entire plate.) Immediately mix the diluted conjugate solution and pipette 200 µL into each well using a multichannel pipette.

Step 6: Mix plate on rotator for 5 minutes at 500 rpm (or tap to mix) and incubate at room temperature for an additional 55 minutes.

Step 7: Wash the plate 4 times with 1X wash buffer. A plate washer is recommended. However, washing may be done by gently squirting wash buffer into each well with a squirt bottle, or by pipetting 300 µL of wash buffer into each well, and then discarding the liquid by inverting the plate over a sink. After each wash, the plate should be thor-oughly blotted on paper towels before

being turned upright. ***If using a plate washer, blotting is still recommended after the last wash, just before the addition of the TMB.***

Step 8: Add 200 µL of TMB solution to each well with a multichannel pipette.

Step 9: Mix on a plate rotator for 5 minutes at 500 rpm (or tap to mix) and incubate the plate in the dark at room temperature for an additional 25 minutes.

Step 10: Add 50 µL of stop solution with a multichannel pipette.

Step 11: Mix on a plate rotator for 3 minutes at 500 rpm (or tap to mix). ***Caution: Spillage may occur if mixing speed exceeds 600 rpm.*** Wipe off bottom of plate with a water-moistened, lint-free cloth and wipe dry. Read in a plate reader at 450 nm. Read plate within 10 minutes of adding stop solution. (Correction at 490 to 630 is desirable.)

Assay Calculations

1. Compute the average optical density (OD) for all duplicate wells.
2. Subtract the average OD for the NSB wells from the average OD of the zero, standards, controls, and unknowns.
3. Calculate the percent bound (B/Bo) for each standard, control, and unknown by dividing the average OD (B) by the average OD for the zero (Bo).
4. Determine the concentrations of the controls and unknowns by interpolation using software capable of logistics. We recommend using a 4-parameter sigmoid minus curve fit.

Samples with cortisol values greater than 3.0 µg/dL (82.77 nmol/L) should be diluted with assay diluent and rerun for accurate results. To obtain the final cortisol concen-tration, multiply the concentration of the diluted sample by the dilution factor.
When running multiple plates, or multiple sets of strips, a standard curve should be run with each individual plate and/or set of strips.

Salivary Cortisol Expected Ranges
The following values have been reported for salivary cortisol.

Group	Number	AM Range(µg/dL)	PM Range (µg/dL)
Children, ages 2.5-5.5	112	0.034 - 0.645	0.053 - 0.607
Children, ages 8-11	285	0.084 - 0.839	ND - 0.215
Adolescents, ages 12-18	403	0.021 - 0.883	ND - 0.259
Adult males, ages 21-30	26	0.112 - 0.743	ND - 0.308
Adult females, ages 21-30	20	0.272 - 1.348	ND - 0.359
Adult males, ages 31-50	67	0.122 - 1.551	ND - 0.359
Adult females, ages 31-50	31	0.094 - 1.515	ND - 0.181
Adult males, ages 51-70	28	0.112 - 0.812	ND - 0.228
Adult females, ages 51-70	23	0.149 - 0.739	0.022 - 0.254
All adults	192	0.094 - 1.551	ND - 0.359

Note. ND = None detected.

Appendix B.5: PHYSICAL FITNESS MECHANISMS ASSESSMENT FORMS

Anthropometric measurements

Subject ID: _____ **Date:** _____

PRE / POST (circle one)

Administered by: _____

#1 Body Composition (7 site skinfold assessment, set by ACSM)

Subscapular (diagonal)	_____ Mm	_____ mm	_____ Mm
triceps (vertical)	_____ Mm	_____ mm	_____ Mm
midaxilary (vertical)	_____ Mm	_____ mm	_____ Mm
chest (diagonal fold)	_____ Mm	_____ mm	_____ mm
suprailiac (diagonal fold)	_____ Mm	_____ mm	_____ mm
abdomen (vertical)	_____ Mm	_____ mm	_____ mm
thigh (vertical)	_____ Mm	_____ mm	_____ mm

Notes: all measurements done on the right side of the body
*maintain pinch while reading caliber
*wait 1 to 2 seconds (not longer) before reading caliper
*Take duplicate measures at each site and retest if duplicate measurements are not within 1 to 2mm
*Rotate through measurement sites or allow time for skin to regain normal texture or Thickness

#2 Height & Weight; Circumferences (set by ACSM)

Height	_____ cm	_____ cm
Weight	_____ kgs	_____ kgs
Hip	_____ cm	_____ cm
Waist	_____ cm	_____ cm

Notes:*hip: With the subject standing, legs slight apart (~10 cm) a horizontal measure is taken at the maximal circumference of the hip/proximal thigh, just below the gluteal fold
*Waist: subject stand upright, arms at the sides, feet together, and abdomen relaxed, a horizontal measurement is taken a the narrowest part of the torso (above the umbilicus and below the xiphoid process

ASTRAND TREADMILL SUBMAXIMAL FITNESS TEST

BASELINE ASSESSMENT	POST ASSESSMENT
Name:_____	Date:_____
Participant ID#:_____	Age:_____
Date:_____	Weight:_____Height:_____
Age:_____	Resting Heart Rate:_____
Weight:_____Height:_____	Power: Start_____ Finish_____ (rpm)
Resting Heart Rate:_____	
Power: Start_____ Finish_____ (rpm)	
Exercise Heart Rate:	**Exercise Heart Rate:**
Minute	**Minute**
1:30-2:00_____	1:30-2:00_____
2:30-3:00_____	2:30-3:00_____
3:30-4:00_____	3:30-4:00_____
4:30-5:00_____	4:30-5:00_____
5:30-6:00_____	5:30-6:00_____
5th & 6th minute average = _____(b/min)	5th & 6th minute average = _____(b/min)
VO2 max _____(L/min)	VO2 max _____(L/min)
X HR max correction factor_____ =	X HR max correction factor_____ =
Adjusted Vo2 max _____(L/min)	Adjusted Vo2 max _____(L/min)
Relative Vo2 max_____(mL/kg/min)	Relative Vo2 max_____(mL/kg/min)
Fitness Category (circle): VH H G Ave F L	Fitness Category (circle): VH H G Ave F L
EXERCISE PRESCRIPTION	
Week1-2 target HR (65%):_____	Week 4-6 target HR (75%):_____
Week 2-4 target HR (70%):_____	Week 6-8 target HR (80%):_____

10RM Strength Testing

Subject ID: _____ **Trial:** Pre or Post

Date: _____

Exercise	**10 RM**
Bench Press	
attempt #1	_____
attempt #2	_____
attempt #3	_____
Shoulder Press (machine press)	
attempt #1	_____
attempt #2	_____
attempt #3	_____
Seated Row	
attempt #1	_____
attempt #2	_____
attempt #3	_____
Leg Press	
attempt #1	_____
attempt #2	_____
attempt #3	_____

NOTES:

Perform 10 RM's in the order in which the subjects will be performing during their training

Appendix B.6: PSYCHOSOCIAL MECHANISMS MEASURES

Physical Self-Description Questionnaire

INSTRUCTIONS: Please read each sentence and decide your answer. There are six possible answers for each question – "True", "False", and four answers in between. There are six boxes next to each sentence, one for each of the answers. The answers are written at the top of the boxes. Choose your answer to a sentence and **circle the number which is the most correct statement about you.**

		False	Mostly False	More False than True	More True than False	Mostly True	True
1.	I am too fat	1	2	3	4	5	6
2.	I am a physically strong person	1	2	3	4	5	6
3.	I can run a long way without stopping	1	2	3	4	5	6
4.	My waist is too large	1	2	3	4	5	6
5.	I have a lot of power in my body	1	2	3	4	5	6
6.	I would do well in a test of physical endurance and stamina	1	2	3	4	5	6
7.	I have too much fat on my body	1	2	3	4	5	6
8.	I am stronger than most people my age	1	2	3	4	5	6
9.	I could jog 5 kilometres without stopping	1	2	3	4	5	6
10.	I am overweight	1	2	3	4	5	6
11.	I am weak and have no muscles	1	2	3	4	5	6
12.	I think I could run a long way without getting tired	1	2	3	4	5	6
13.	My stomach is too big	1	2	3	4	5	6
14.	I would do well in a test of strength	1	2	3	4	5	6
15.	I can be physically active for a long period of time without getting tired	1	2	3	4	5	6
16.	Other people think that I am fat	1	2	3	4	5	6
17.	I am good at lifting heavy objects	1	2	3	4	5	6
18.	I am good at endurance activities like distance running, aerobics, bicycling, swimming, or cross-country skiing	1	2	3	4	5	6

Note. Perceived body fat subscale items = 1, 4, 7, 10, 13, 16; perceived physical endurance subscale items = 3, 6, 9, 12, 15, 18; perceived strength subscales items = 2, 5, 8, 11, 14, 17.

Self-Presentational Exercise Efficacy Scale

Instructions: Think about going to the Pulse to work out. Using any values from this scale (0 to 100%), please indicate how confident you are for each of the following in the box provided:

0%---------- 50%----------100%
Not at all confident **Completely confident**

How confident are you that….

1. Other people will think that you have good physical co-ordination_____
2. Other people will think that your body looks fit and toned._____
3. Other people will think that you have good stamina._____
4. Other people will think that you are someone who works out regularly._____
5. Other people will think that you are in good shape._____

Aerobic Self-Efficacy Scale

Instructions: Think about working out. Using any values from this scale (0 to 100%) please indicate, by circling a number that best represents how confident you are for each of the following:

0%---------- 50%----------100%
Not at all confident Completely confident

How confident are you that you could run on a treadmill, at a moderate intensity (not exhausting), without stopping...											
1. For 5 minutes	0	10	20	30	40	50	60	70	80	90	100
2. For 10 minutes	0	10	20	30	40	50	60	70	80	90	100
3. For 15 minutes	0	10	20	30	40	50	60	70	80	90	100
4. For 20 minutes	0	10	20	30	40	50	60	70	80	90	100
5. For 30 minutes	0	10	20	30	40	50	60	70	80	90	100
6. For 40 minutes	0	10	20	30	40	50	60	70	80	90	100
7. For 50 minutes	0	10	20	30	40	50	60	70	80	90	100
8. For 60 minutes	0	10	20	30	40	50	60	70	80	90	100

Bench Press Self-Efficacy Scale

Instructions: Think about working out. Using any values from the scale (0 to 100%), please indicate by circling the number that best represents how confident you are for each of the following:

1. How confident are you that you could BENCH/CHEST PRESS ...

0%---------- 50%----------100%
Not at all confident Completely confident

a) A 5 pound weight	0	10	20	30	40	50	60	70	80	90	100
b) A 10 pound weight	0	10	20	30	40	50	60	70	80	90	100
c) A 15 pound weight	0	10	20	30	40	50	60	70	80	90	100
d) A 20 pound weight	0	10	20	30	40	50	60	70	80	90	100
e) A 25 pound weight	0	10	20	30	40	50	60	70	80	90	100
f) A 30 pound weight	0	10	20	30	40	50	60	70	80	90	100
g) A 35 pound weight	0	10	20	30	40	50	60	70	80	90	100
h) A 40 pound weight	0	10	20	30	40	50	60	70	80	90	100
i) A 45 pound weight	0	10	20	30	40	50	60	70	80	90	100
j) A 50 pound weight	0	10	20	30	40	50	60	70	80	90	100

Seated Row Self-Efficacy Scale

2. How confident are you that you could perform a SEATED ROW with ...

0%---------- 50%----------100%
Not at all confident Completely confident

a) A 20 pound weight	0	10	20	30	40	50	60	70	80	90	100
b) A 25 pound weight	0	10	20	30	40	50	60	70	80	90	100
c) A 30 pound weight	0	10	20	30	40	50	60	70	80	90	100
d) A 35 pound weight	0	10	20	30	40	50	60	70	80	90	100
e) A 40 pound weight	0	10	20	30	40	50	60	70	80	90	100
f) A 45 pound weight	0	10	20	30	40	50	60	70	80	90	100
g) A 50 pound weight	0	10	20	30	40	50	60	70	80	90	100
h) A 55 pound weight	0	10	20	30	40	50	60	70	80	90	100
i) A 60 pound weight	0	10	20	30	40	50	60	70	80	90	100
j) A 65 pound weight	0	10	20	30	40	50	60	70	80	90	100

Shoulder Press Self-Efficacy Scale

3. How confident are you that you could SHOULDER PRESS....

0%---------- 50%----------100%
Not at all confident Completely confident

a) A 5 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
b) A 10 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
c) A 15 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
d) A 20 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
e) A 25 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
f) A 30 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
g) A 35 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
h) A 40 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
i) A 45 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
j) A 50 pound weight	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Leg Press Self-Efficacy Scale

4. How confident are you that you could leg press ...

0%---------- 50%----------100%
Not at all confident Completely confident

a) A 50 pound weight	0	10	20	30	40	50	60	70	80	90	100
b) A 60 pound weight	0	10	20	30	40	50	60	70	80	90	100
c) A 70 pound weight	0	10	20	30	40	50	60	70	80	90	100
d) A 80 pound weight	0	10	20	30	40	50	60	70	80	90	100
e) A 90 pound weight	0	10	20	30	40	50	60	70	80	90	100
f) A 100 pound weight	0	10	20	30	40	50	60	70	80	90	100
g) A 120 pound weight	0	10	20	30	40	50	60	70	80	90	100
h) A 130 pound weight	0	10	20	30	40	50	60	70	80	90	100
i) A 140 pound weight	0	10	20	30	40	50	60	70	80	90	100
j) A 150 pound weight	0	10	20	30	40	50	60	70	80	90	100
k) A 160 pound weight	0	10	20	30	40	50	60	70	80	90	100
l) A 170 pound weight	0	10	20	30	40	50	60	70	80	90	100
m) A 180 pound weight	0	10	20	30	40	50	60	70	80	90	100
n) A 190 pound weight	0	10	20	30	40	50	60	70	80	90	100
o) A 200 pound weight	0	10	20	30	40	50	60	70	80	90	100

Goal Satisfaction

What are your goals for participating in the 8-week exercise program? (Please list and explain)	How much do you value each of these goals? (Please circle a number next to each goal).	How satisfied are you with each of the outcomes of each of these goals? (Please circle a number next to each goal).
	1 = do not value at all 2 = value a little 3 = moderately value 4 = mostly value 5 = strongly value	1 = very dissatisfied 2 = mostly dissatisfied 3 = neither satisfied nor dissatisfied 4 = mostly satisfied 5 = very satisfied
1.	1 2 3 4 5	1 2 3 4 5
2.	1 2 3 4 5	1 2 3 4 5
3.	1 2 3 4 5	1 2 3 4 5
4.	1 2 3 4 5	1 2 3 4 5
5.	1 2 3 4 5	1 2 3 4 5
6.	1 2 3 4 5	1 2 3 4 5
7.	1 2 3 4 5	1 2 3 4 5
8.	1 2 3 4 5	1 2 3 4 5
9.	1 2 3 4 5	1 2 3 4 5
10.	1 2 3 4 5	1 2 3 4 5

Appendix B.7: EXERCISE LOG SHEETS

AEROBIC EXERCISE LOG SHEETS

Instructions: Please record the time you spent exercising on your assigned days, what type of exercise you did, and your heart rate during exercise.

WEEK OF:	TYPE OF EXERCISE & TIME SPENT DOING THE EXERCISE (e.g., 5minute warm-up on the bike, 30 mins on the treadmill, 5 mins cool down on treadmill, 5 mins stretching on the mat)	HEART RATE DURING EXERCISE
MONDAY	Warm Up: Exercise Bout: Cool Down: Stretching:	
TUESDAY	Warm Up: Exercise Bout: Cool Down: Stretching:	
WEDNESDAY	Warm Up: Exercise Bout: Cool Down: Stretching:	

THURSDAY	Warm Up: Exercise Bout: Cool Down: Stretching:	
FRIDAY	Warm Up: Exercise Bout: Cool Down: Stretching:	
SATURDAY	Warm Up: Exercise Bout: Cool Down: Stretching:	
SUNDAY	Warm Up: Exercise Bout: Cool Down: Stretching:	

Upper Body: Resistance Training Exercise Log Sheet

Exercise	Equipment	SET #	Reps.	Weight
BENCH PRESS	Machine	1		
		2		
		3		
SEATED ROW	Machine	1		
		2		
		3		
SHOULDER PRESS	Machine	1		
		2		
		3		
LAT PULL DOWN	Machine	1		
		2		
		3		
TRICEP EXTENSIONS	Free Weights	1		
		2		
		3		
BICEP CURLS	Free Weights	1		
		2		
		3		

LOWER BODY: Resistance Training Exercise Log Sheet

DATE:							
PRESCRIPTION:							
Exercise	Equipment	Weight	Reps.	Sets	Weight	Reps.	Sets
LEG PRESS	Machine						
LEG EXTENSION	Machine						
HAMSTRING CURLS	Machine						
ABDOMINALS	Mat						

EXAMPLE:

Exercise	Equipment	Weight	Reps.	Set#	Weight	Reps.	Set#
BENCH PRESS	Machine	30lbs	10	1	30lbs	10	2

Appendix B.8: STATE MEASURES

STATE SOCIAL PHYSIQUE ANXIETY SCALE

Instructions: Read each of the following statements carefully. Indicate by checking the box, the extent to which you experience the feelings described by each item at this moment in time, according to the following scale.

RIGHT NOW...	Not at all	Slightly	Moderately	A Lot	A Great Deal
1. I feel uptight about my physique/figure.	☐	☐	☐	☐	☐
2. I am concerned that other people in the room are evaluating my weight or muscular development negatively.	☐	☐	☐	☐	☐
3. Unattractive features of my physique/figure make me nervous.	☐	☐	☐	☐	☐
4. I feel apprehensive about my physique/figure.	☐	☐	☐	☐	☐
5. I feel comfortable with how fit my body appears to others.	☐	☐	☐	☐	☐
6. It makes me uncomfortable to know that other people in the room are evaluating my physique/figure.	☐	☐	☐	☐	☐
7. When it comes to displaying my physique/figure to others, I feel shy.	☐	☐	☐	☐	☐
8. I feel relaxed when it is obvious that others are looking at my physique/figure.	☐	☐	☐	☐	☐
9. Wearing these clothes, I feel nervous about the shape of my body.	☐	☐	☐	☐	☐

Acute Cortisol: Saliva Collection Instructions

SALIMETRICS: COLLECTING UNSTIMULATED WHOLE SALIVA SAMPLES BY PASSIVE DROOL FROM HUMAN SUBJECTS (ages 5+)

Things to avoid:
1. Brushing teeth within 1 hour prior to collection.
2. Using salivary stimulants: chewing gum, lemon drops, granulated sugar, drink crystals.
3. Consuming a major meal within 1 hour prior to collection.
4. Consuming alcohol 12 hours prior to collection.
5. Consuming acidic or high sugar foods within 20 minutes prior to collection.

Suggested protocol:
1. Rinse mouth with water 10 minutes prior to sample collection
2. Document prescription and over-the-counter medications taken.
3. Record time of day sample is collected.

Materials required:
_ Plastic drinking straws
_ Scissors
_ Cryovials: polypropylene – 2mL capacity
_ Labels

Salimetrics Item No. Description
5002.01 2 mL cryovial
***Note**: Collections for multiple hormones may require larger vials (information available upon request). It is advisable to use a vial with at least twice the capacity of the necessary sample volume because some saliva foaming will occur.*

Prior to Saliva Collection:
1. Cut plastic drinking straws into 2-inch (5 cm) pieces.
2. Give each subject one (1) straw piece and one (1) cryovial.
3. Have subjects rinse their mouth with water 10 minutes prior to collection.

Collecting saliva:
1. Instruct subject to imagine eating their favorite food and allow saliva to pool in the mouth. (Moving the jaw in a chewing motion is acceptable.)
2. With head tilted forward, subject should drool down the straw and collect saliva in the cryovial. (It is normal for saliva to foam.)
3. Repeat as often as necessary until sufficient sample is collected.
(1 mL - excluding foam - is adequate for most tests).
4. If subject's mouth is dry, instruct them to gently chew on the end of the straw. This will
stimulate saliva production.

5. Keep samples cold after collection (4°C) and freeze (-20° to -80°C) as soon as possible.

ACUTE CORTISOL SAMPLE TIME RECORD SHEET

Participant ID#_____

Cortisol Sample #	Time	Actual Time
Sample 1	Baseline	
Sample 2	0 minutes post	
Sample 3	15 minutes post	
Sample 4	30 minutes post	

Salimetrics High Sensitivity Salivary Cortisol EIA Kit Procedure

Step 1: Determine your plate layout. Here is a suggested layout.

1	2	3	4	5	6	7	8	9	10	11	12
A			3.000 Std		3.000 Std		Ctrl-H			Ctrl-H	
B			1.000 Std		1.000 Std		Ctrl-L			Ctrl-L	
C			0.333 Std		0.333 Std		Unk-1			Unk-1	
D			0.111 Std		0.111 Std		Unk-2			Unk-2	
E			0.037 Std		0.037 Std		Unk-3			Unk-3	
F			0.012 Std		0.012 Std		Unk-4			Unk-4	
G			Zero		Zero		Unk-5			Unk-5	
H			NSB		NSB		Unk-6			Unk-6	

Step 2: Keep the desired number of strips in the strip holder and place the remaining strips back in the foil pouch. If you choose to place non-specific binding wells in H-1, 2, remove strips 1 and 2 from the strip holder and break off the bottom wells. Place the strips back into the strip holder leaving H-1, 2 blank. Break off 2 NSB wells from the strip of NSBs included in the foil pouch. Place in H-1, 2. Alternatively, NSBs may be placed wherever you choose on the plate. Reseal the zip-lock foil pouch containing unused wells and desiccant. Store at 2-8°C.
Caution: Extra NSB wells should not be used for determination of standards, con-trols or unknowns.

Step 3: Pipette 24 mL of assay diluent into a disposable tube. Set aside for Step 5.

Step 4:

- Pipette 25 µL of standards, controls, and unknowns into appropriate wells. Stan-dards, controls, and unknowns should be assayed in duplicate.
- Pipette 25 µL of assay diluent into 2 wells to serve as the zero value.
- Pipette 25 µL of assay diluent into each NSB well.

Note: To ensure highest quality assay results, pipetting of samples and reagents must be done as quickly as possible (without interruption) across the plate. Ideally, the process should be completed within 20 minutes or less.

Step 5: Make a 1:1600 dilution of the conjugate by adding 15 µL of the conjugate to the 24 mL of assay diluent prepared in Step 3. (Scale down proportionally if not using the entire plate.) Immediately mix the diluted conjugate solution and pipette 200 µL into each well using a multichannel pipette.

Step 6: Mix plate on rotator for 5 minutes at 500 rpm (or tap to mix) and incubate at room temperature for an additional 55 minutes.

Step 7: Wash the plate 4 times with 1X wash buffer. A plate washer is recommended. However, washing may be done by gently squirting wash buffer into each well with a squirt bottle, or by

pipetting 300 µL of wash buffer into each well, and then discarding the liquid by inverting the plate over a sink. After each wash, the plate should be thor-oughly blotted on paper towels before being turned upright. ***If using a plate washer, blotting is still recommended after the last wash, just before the addition of the TMB.***

Step 8: Add 200 µL of TMB solution to each well with a multichannel pipette.

Step 9: Mix on a plate rotator for 5 minutes at 500 rpm (or tap to mix) and incubate the plate in the dark at room temperature for an additional 25 minutes.

Step 10: Add 50 µL of stop solution with a multichannel pipette.

Step 11: Mix on a plate rotator for 3 minutes at 500 rpm (or tap to mix). ***Caution: Spillage may occur if mixing speed exceeds 600 rpm.*** Wipe off bottom of plate with a water-moistened, lint-free cloth and wipe dry. Read in a plate reader at 450 nm. Read plate within 10 minutes of adding stop solution. (Correction at 490 to 630 is desirable.)

Assay Calculations

1. Compute the average optical density (OD) for all duplicate wells.
2. Subtract the average OD for the NSB wells from the average OD of the zero, standards, controls, and unknowns.
3. Calculate the percent bound (B/Bo) for each standard, control, and unknown by dividing the average OD (B) by the average OD for the zero (Bo).
4. Determine the concentrations of the controls and unknowns by interpolation using software capable of logistics. We recommend using a 4-parameter sigmoid minus curve fit.

Samples with cortisol values greater than 3.0 µg/dL (82.77 nmol/L) should be diluted with assay diluent and rerun for accurate results. To obtain the final cortisol concen-tration, multiply the concentration of the diluted sample by the dilution factor.

When running multiple plates, or multiple sets of strips, a standard curve should be run with each individual plate and/or set of strips.

Salivary Cortisol Expected Ranges

The following values have been reported for salivary cortisol.

Group	Number	AM Range(µg/dL)	PM Range (µg/dL)
Children, ages 2.5-5.5	112	0.034 - 0.645	0.053 - 0.607
Children, ages 8-11	285	0.084 - 0.839	ND - 0.215
Adolescents, ages 12-18	403	0.021 - 0.883	ND - 0.259
Adult males, ages 21-30	26	0.112 - 0.743	ND - 0.308
Adult females, ages 21-30	20	0.272 - 1.348	ND - 0.359
Adult males, ages 31-50	67	0.122 - 1.551	ND - 0.359
Adult females, ages 31-50	31	0.094 - 1.515	ND - 0.181
Adult males, ages 51-70	28	0.112 - 0.812	ND - 0.228
Adult females, ages 51-70	23	0.149 - 0.739	0.022 - 0.254
All adults	192	0.094 - 1.551	ND - 0.359

Note. ND = None detected.

Appendix B.9: EXERCISE TRAINING PROTOCOLS

Exercise Calendar: This calendar tells you where you will be exercising and when you have scheduled your exercise sessions over the next 8 weeks.

LOCATION: _____ Participant ID#:_____

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1					
Week 2					
Week 3					
Week 4					
Week 5					
Week 6					
Week 7					
Week 8					
Week 9					

Aerobic Exercise Training

Where will the exercise sessions take place?

- All aerobic training sessions will take place in the **Pulse Fitness Centre** located in the David Brawley Athletic Centre. You must use your student card to enter the Pulse at all times.
- All sessions will be supervised by a certified fitness trainer.

What will I be doing for 8-weeks?

- **FREQUENCY:** You will participate in aerobic or cardiovascular exercise ***3 days/week for the next 8 weeks***.
- **INTENSITY:** Begin exercise training at a moderate intensity and progress to a more vigorous or strenuous intensity by the end of the training program. **Tracking your intensity:** Make sure you stay within your target heart rate by taking your heart rate every 10 minutes during exercise.
- **TYPE:** Exercise will be performed using a ***treadmill or elliptical machine.*** If there are no treadmills or elliptical machines available please use a ***stationary bike***.
- **TIME:** Begin your exercise session with a 5 minute warm up on a piece of aerobic equipment (e.g., treadmill or bike). Continue with 30 minutes of aerobic exercise on the treadmill or elliptical. Finish your session with a 10 minute cool down on aerobic equipment. Remember to stretch at the end!

How do I know when I need to progress?

Let your heart rate be the guide to your exercise intensity.

- Week 1: Start your exercise program at a moderate intensity. This intensity should feel somewhat hard, but it still feels OK to continue.
- Week 2: Increase the speed of the treadmill slightly. Still feels somewhat hard, but feels OK to continue.
- Week 3: Increase the speed of the treadmill. Now your intensity should feel hard and tiring, but continuing isn't terribly difficult.
- Week 4: Maintain the speed of the treadmill so that you are still at a15. Again it should feel hard and tiring, but continuing isn't terribly difficult.
- Week 5: Increase the speed of the treadmill. Now your intensity should be between hard and very hard. It should still feel tiring, but continuing is still OK.
- Week 6: Maintain the speed of the treadmill so that you should be between hard and very hard.
- Week 7: Increase the speed of the treadmill so that now your exercise intensity feels very hard. This is strenuous work. You can still go on, but you really have to push yourself and you are very tired.
- Week 8: Maintain the speed of the treadmill. Again, this feels very hard. You can still go on, but you may have to push yourself and you feel very tired.

What if I cannot make it to an exercise session?

- You are required to complete 20 out of a total of 24 exercise sessions over 8 weeks. If you need to change your exercise session time because of a conflict (i.e., you are sick or have class) please contact Heather Strong (strongh@mcmaster.ca) (phone: 905-525-9140 ext.21403) to schedule a new time.

Resistance Training

Where will the training sessions take place?

- All resistance training sessions will take place in the **Research and Training Laboratory , Ivor Wynne Centre, Rm 230** (McMaster University).
- All sessions will be supervised by a certified fitness trainer.

What will I be doing for 8-weeks?

- **FREQUENCY:** You will be participating in full body resistance training program ***3 days/week for 8 weeks.***
- **INTENSITY:** Training will occur at a moderate intensity progressing to a more strenuous intensity by the end of the program.
- **TYPE**: Exercises will be performed using ***weight machines*** and ***free weights*** for upper body and lower body exercises.
- **Upper body and Lower body exercises** will be done on alternating days (i.e., upper body on Monday, lower body on Wednesday, etc.) and will progress from 2 sets of 10 repetitions per exercise to 3 sets with 12 repetitions per exercise with 2 minutes rest between sets. Individual exercises are described below in the order they will be performed.
- Upper body: Bench press, seated row, shoulder press, lat pull down, triceps, biceps
- Lower Body: Quadricep extension, Hamstring curls, Leg press/squats, abdominals
- **TIME:** Resistance training sessions will be approximately ***45 minutes*** in duration. Start with a 5 minute warm-up on a bike/treadmill complete your weight training sets and finish with a 5 minute cool down on a bike/treadmill.

How will I know when I need to progress?

- Begin your exercise program with 2 sets of each exercise with 10 repetitions per exercise. Make it your goal to work up to 3 sets of each exercise with 12 repetitions per exercise.
- When you can do 3 sets and 12 repetitions per exercise comfortably you should increase the weight you are using on your upper body by 5 to 10 pounds and on your lower body by 10 to 20 pounds.

What if I cannot make it to an exercise session?

- You are required to complete 20 out of a total of 24 exercise sessions over 8 weeks. If you need to change your exercise session time because of a conflict (e.g., you are sick, you have class, you have to work) please contact Heather Strong (strongh@mcmaster.ca) (phone: 905-525-9140 ext.21403) to schedule a new time.

Exercise Tips

What should I wear and where should I change?

- Please wear a loose fitting, comfortable t-shirt and shorts/pants for every exercise session. No tank tops.
- Wear comfortable shoes.
- Feel free to bring a MP3 player to listen to music during your exercise sessions.
- Change rooms, showers and bathrooms are available in the David Brawley Athletic Centre. Please change into your exercise clothes before showing up for your exercise session.

What should I eat or drink before, during and after exercise?

- Before exercise: About two to three hours before your exercise session, try to drink plenty of fluid and eat a balanced meal. This will help to boost your energy levels, prevent hunger, and increase body fluid levels.
- During exercise: You can get very tired from cramping muscles. To prevent muscle cramping, try to drink every 15 minutes during exercise.
- After exercise: Once your exercise session is finished, your body is ready to store energy again, repair muscles and fill up with fluids. Whatever your food choices for exercise recovery make sure they are balanced and the timing is critical – eat as soon as possible after physical activities!

Should I stretch before and after the exercise session?

- **YES!** You will likely feel some muscle soreness for the first few weeks after your exercise session. This is completely normal and should be happening! It means that the exercises are doing their jobs!

- **To reduces muscle soreness STRETCH before and after exercise. Here are some tips:**
  - **Target major muscle groups.** When you're stretching, focus on your calves, thighs, hips, lower back, neck and shoulders.
  - **Hold each stretch for at least 30 seconds.** It takes time to lengthen tissues safely. Hold your stretches for at least 30 seconds — and up to 60 seconds for a really tight muscle or problem area. That can seem like a long time, so keep an eye on the clock or your watch. Then repeat the stretch on the other side. For most muscle groups, a single stretch is often enough if you hold it long enough.
  - **Don't bounce.**
  - **Focus on a pain-free stretch.** Expect to feel tension while you're stretching. If it hurts, you've gone too far.

Appendix B.10: PARTICIPANT DEBRIEFING FORM

Thank you for participating in the present study. The purpose of the present study was to examine the underlying mechanisms in the exercise-body image relationship. Initially, when you were screened for participation in the study you were told that you would be participating in an 8-week exercise study which you were. However, during one of the first and last assessments you were exposed to a situation that was designed to elicit anxious feelings about your body in order so that we could get a true evaluation/reaction from you on how you would think and feel about your body in this context. This situation was your body composition testing. We had a male trainer conduct the test and you were asked to wear a tank top and shorts for the assessment. This situation may have caused you to be concerned about your body over and above what you currently experience day to day. It is possible that this situation made you feel uncomfortable and the McMaster Research Ethics Board asks researchers to inform participants about where they can obtain follow-up support if desired. For McMaster students, a good place to turn is the Centre for Student Development which can be reached by phone: 905-525-9140 ext. 24711 or email: csd@mcmaster.ca or by visiting them in person in the basement of the student centre MUSC Rm. B107.

If you have any other questions please do not hesitate to contact Dr. Martin Ginis or Heather Strong:

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