EFFECTS OF CHRONIC EXERCISE ON BODY IMAGE: A META-ANALYTIC REVIEW

By

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To all who have helped me along the way

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Because of the high prevalence of body dissatisfaction and its negative consequences a meta-analysis of the effects of exercise interventions on body image is timely. Older meta-analyses of the effects of exercise on body image pooled data from a range of studies that include correlational, quasi-experimental, and experimental exercise designs; with limited examination of moderators. The purpose of my thesis was to meta-analytically examine the impact of exercise interventions on body image; and participant, intervention, and design features that are associated with larger intervention effects. I conducted a systematic literature search and identified 57 exercise interventions (with pre and post data for both the exercise and control groups) examining the effects of chronic exercise on body image (*N* Total = 6,273, Experimental *N* = 3,639, Control *N* = 2,634). The quality of studies varied. For the analyses, I used Comprehensive Meta-analysis-2. I found a small random effect (effect size = 0.29) indicating that exercise interventions resulted in improved body image compared to control conditions; and that participant (i.e., age), design (i.e., year of publication), and intervention (i.e., exercise frequency and specificity) features moderated the size of the effect. The results of my study indicate that chronic exercise does lead to improvements in body image. Further research is

needed examining the mechanisms and the exercise dose-response needed for this change in body image.

CHAPTER 1
INTRODUCTION

For both genders, negative body image is common and it has detrimental physical, psychological, and economic consequences. More specifically, negative body image is related to emotional distress (Johnson & Wardle, 2005), smoking (Croghan et al., 2006), dramatic measures to alter appearance (e.g., steroid use; Raevuori et al., 2006), social anxiety (Cash & Fleming, 2002), impaired sexual functioning (Wiederman, 2002), depression (Stice & Bearman, 2001), and eating disorders (Stice, Presnell, & Spangler, 2002). Widespread body-image disturbance is associated with U.S. consumers spending billions of dollars annually for products aimed at changing their body size and shape such as diet pills, unnecessary cosmetic surgery, beauty products, and fitness products. Society will benefit from a better understanding of the efficacy of interventions aimed at improving body image.

Body-image change interventions typically consist of psychoeducational, cognitive-behavioral, or drug therapies (e.g., weight loss pills; Gollings & Paxton, 2006). Given that many of these interventions are expensive, in short supply, and often not suitable for young populations other more practical strategies should be examined and promoted. Furthermore, although effective treatments have been developed, only a small proportion of those with body image problems access treatment, and thus, evaluated treatments are underutilized. There are numerous explanations for this. Some of these relate to the practicalities of treatment delivery such as geographic distance, cost, and lack of availability. Others related to the particular nature of body-image problems, such as patient shame and ambivalence about change (Banasiak, Paxton, & Hay, 1998). One promising alternative mode of intervention for negative body image is chronic exercise. Chronic exercise, also known as exercise training, refers to cumulative, acute bouts of physical activity that are planned, structured, and repeated and result in improving or maintaining of one or more physical fitness components of cardiorespiratory capacity, muscle strength, body composition, and flexibility (Caspersen, Powell, & Christenson, 1985). Physical activity refers to skeletal muscle activation resulting in energy expenditure beyond that of a resting level.

Although evaluations of body image exercise interventions have been conducted, their results have not been comprehensively reviewed. Meta-analysis is a statistical technique that can be effectively applied to the literature examining the influence of chronic exercise on body image. Meta-analysis can quantify the extent to which key features of a research design, such as the specificity of exercise interventions and the type of control conditions, moderate changes in body image associated with chronic exercise. Because of the high prevalence of negative body image and its negative consequences a comprehensive meta-analytic review of the chronic exercise and body image literature is timely. The few available reviews are narrow in scope with selection bias (Bane & McAuley, 1998; Fox, 2000; Hausenblas & Fallon, 2006; Martin & Lichtenberger, 2002). One meta-analytic review has been published (Hausenblas & Fallon, 2006), but it pooled data from a range of study types that included correlational, quasi-experimental, and experimental exercise intervention studies that rendered it impossible to examine moderators of the exercise intervention effects in detail. As the authors' predicted, a small effect size revealed that exercise intervention participants had a more positive body image post intervention compared to the nonexercising control participants. It would be informative, however, to control for preintervention scores, and examine the impact of moderator variables using more advanced meta-analytic techniques. It is also important to eliminate the possibility that these differences are simply the result of publication bias, which was not directly assessed by Hausenblas and Fallon. Thus, the overarching goal of my thesis is to address this important gap in the literature. The first aim of this review is to provide a statistical summary of these exercise intervention programs and their effects on body image (see Chapter 4). The second aim is to examine participant, intervention, delivery, and design features that are associated with larger intervention effects (see Chapter 4). Given the heterogeneity in the effects from these interventions, it is important to systematically consider the moderators associated with interventions that produced the largest effects. The third aim is to discuss theoretical, methodological, and statistical limitations of the literature; and explore promising directions for future research in light of the findings (Chapter 5).

In this Chapter, I will provide a brief rationale for the putative moderator variables to be examined, and I will advance hypotheses for these moderators. The information presented in Chapter 1 is similar to the Introduction section for a scientific manuscript. In Chapter 2, I will: (a) describe the scope and significance of body image; (b) briefly review the literature examining exercise intervention for body image; and (c) describe the importance of meta-analysis for research synthesis. In Chapter 3, I will describe the methods used for this meta-analysis. In Chapter 4, I will report the meta-analytic results. Finally, in Chapter 5, I will discuss the meta-analytic results and provide suggestions for future research in this area.

Putative Moderators of Intervention Effects

Although researchers have found positive effects of exercise for body image, discrepancies in the literature exist. Clearly, some of the ambiguity in the results obtained is the result of methodological factors. For example, studies have employed widely varying age groups. Studies have also differed with respect to the nature, intensity, and length of the exercise manipulation; the type of fitness measure employed; the general health and fitness level of the participants at the beginning of the study; subjects’ gender; the body image measure; and the nature of the control groups.

A unique feature of meta-analyses is that they permit empirical examination of factors associated with variation in effect sizes. Elucidating factors that moderate intervention program effects is informative because it highlights aspects of the participant, intervention, program delivery, and research design that are associated with stronger intervention effects. This information should increase future intervention effects by identifying the conditions under which optimal prevention effects occur. As well, this information might identify subgroups of individuals for whom alternative intervention programs need to be developed. Analyses of moderators should also advance general theories regarding effective routes to alter maladaptive health behaviors and attitudes. Accordingly, I investigated several potential moderators of intervention effects that were selected on the basis of theory, prior findings, and previous literature reviews. The moderators I examined are discussed in detail below.

Participant Features

Participant gender. Across the lifespan, female populations are at higher risk for negative body image than male populations (Altabe & Thompson, 1993; Elgin & Pritchard, 2006; Feingold & Mazzella, 1998). For example, Wang et al. (2005) found that 43% of females versus 12% of males aged 10 – 18 years were body dissatisfied. This finding may have emerged because sociocultural pressures for thinness are greater for females (Thompson, Heinberg, Altable, & Tantleff-Dunn, 1999), which may amplify the effects of negative body image for women. In support, more females than males are dissatisfied with their bodies, and most females with body image concerns are dissatisfied because they feel overweight (Thompson et al., 1999). In contrast, the reasons males give for body image concerns are more heterogeneous, with nearly half who indicate they are dissatisfied with their weight want to gain weight (McCabe & Ricciardelli, 2004). I hypothesized that interventions effects would be stronger for female samples versus male or mixed-sex samples.

Participant age. Studies routinely find that about 40% of elementary girls and 25% of elementary boys are dissatisfied with their body, with children as young as 6 years of age expressing body dissatisfaction (McCabe & Ricciardelli, 2004; Smolak, 2002). Body dissatisfaction appears to continually increase across adolescents for female and male populations, with girls continuing to report higher negative body image than boys (Eisenberg, Neumark-Sztainer, & Paxton, 2006; Muth & Cash, 1997; Wang et al., 2005). Body dissatisfaction, however, levels off and remains stable across the adult life span for men and women, with women continuing to report higher body dissatisfaction than men (Altabe & Thompson, 1993; Cash & Henry, 1995; Mangweth-Matzek et al., 2006; McLaren & Kuh, 2004; Tiggemann, 2004). For example, over 60% of female adults and older adults (aged 60 – 70 years) report body dissatisfaction (Garner, 1997; Mangweth-Matzek et al., 2006). I hypothesized that the intervention effects would increase with age until adulthood, and then remain consistent into middle and late adulthood; with larger effects evidenced for female than male populations.

Participant ethnicity. There is also reason to believe that ethnicity might moderate the exercise intervention effects. Meta-analyses reveal that nonCaucasian populations (in particular African Americans) have more favorable body image compared to Caucasians (Grabe & Hyde, 2006; Roberts, Cash, Feingold, & Johnson, 2006); suggesting that programs targeting Caucasians might be more effective because there is greater opportunity for intervention effects. Thus, I hypothesized that ethnicity would moderate the size of the effect whereby intervention targeting Caucasians (or having a larger % Caucasians) would have a larger effect.

Psychological risk status of participants. I hypothesized that interventions are more effective when offered to high-risk participants (i.e., selected programs) versus all individuals in a population (i.e., universal programs). Theoretically, these high-risk people are more motivated to engage in the intervention, and thus are more likely to benefit. It is also likely that low-risk individuals have less room for change on the outcomes (floor effect; Stice, Shaw, & Marti, 2006). Intervention program for other psychological pathologies (e.g., eating disorders, body-image disturbance, anxiety, depression, substance abuse) usually produce stronger effects for high-risk subsamples than for the full sample of individuals enrolled in these universal programs (Clark et al., 1995; Jarry & Ip, 2005; Lowry-Webster, Barrett, & Dadds, 2001; Murphy et al., 2001). Thus, I hypothesized that intervention effects would be larger for selected programs (e.g., eating disordered, high body dissatisfied) versus universal programs. However, the distinction between universal and selected program is often blurred. For example, most universal programs focus solely on female populations—a subpopulation at high-risk for negative body image. I considered interventions delivered to all participants in intact classrooms and trials that did not mention the intervention objective during recruitment (e.g., shape improvement) to be universal program. I considered interventions that screened participants for a risk factor or that used recruitment strategies that implicated screened participants, such as advertisements for body image intervention, to be selected programs.

Participant body composition. Negative body image arises primarily from sociocultural pressures to be thin and physical deviation for the current thin-ideal espoused for women and the lean and muscular-ideal espoused for men in Western culture (Thompson et al., 1999). Elevated adiposity is theorized to promote body dissatisfaction because the current ideal physique for men and women is lean. Thus, the greater the degree of deviation from the current ideal physique, the greater the ensuing body dissatisfaction. In short, elevated body mass increases the risk for body dissatisfaction (Stice & Shaw, 2002). Of significance, overweight/obese populations are more likely to have higher body-image disturbance and benefit from weight reduction during an exercise intervention compared to normal weight populations (Franklin, Denyer, Steinbeck, Caterson, & Hill, 2006; Hrabosky et al., 2006). Thus, I hypothesized that larger intervention effects would be evidenced for overweight/obese populations than normal weight populations.

Exercise Intervention Features

Exercise dose. Exercise dose consists of the following components: duration, intensity, mode, frequency, and length. Although the dose-response is well-established for the physical health benefits of physical activity (ACSM, 2000); the dose-response of exercise needed to obtain the psychological benefits of exercise is controversial. Thus, in an attempt to determine the dose-response needed to obtain the effects of exercise on body image, I will examine the moderating effects of exercise intensity, duration, mode, frequency, and length. The duration of an exercise session interacts with the intensity to result in the expenditure of a sufficient number of calories to achieve health, fitness, and weight management goals. The duration of exercise recommended by the ACSM reflects that interaction (20 to 60 minutes of continuous or intermittent (minimum of 10-minute bouts) aerobic activity throughout the day. Consequently, exercising at 70 to 85% HR_{max} or 60 to 80% HRR for 20 to 30 minutes, excluding time spent warming up and cooling down, enables most people to achieve health, fitness, and weight management goals (ACSM, 2000). Although deconditioned persons may improve cardiorespiratory fitness with only twice-weekly exercise, optimal training frequency is achieved with 3 to 5 workouts per week. The additional benefits of more frequent training appear to be minimal, whereas the incidence of lower extremity injuries increases abruptly. Consequently, the ACSM recommends an exercise frequency of 3 to 5 days week. I hypothesized that exercise interventions that meet the ACSM physical activity guidelines would result in larger effects than interventions that did not meet the guidelines; because the former interventions are more likely to produce physical changes in body composition (e.g., weight loss, toning, muscle development) that are directly related to improved body image.

Theoretically, interventions with a longer length afford a greater opportunity for presentation of information and behavioral change skills. That is, they allow participants to reflect on the intervention material between sessions, and also give participants a chance to try new skills and then return to the group for troubleshooting advice. Meta-analysis of substance abuse and eating disorder preventions reveal that interventions of longer length produced the largest effects (Rooney & Murray, 1996; Stice & Shaw, 2004). As well, exercise intervention examining mental health outcomes appear to produce larger effects with interventions of longer length (i.e., 12 weeks or greater; Craft & Landers, 1998). I hypothesized that intervention effect would be stronger for prevention programs with a longer versus short length (in weeks).

Finally, with regard to exercise type, most of the exercise interventions used aerobic exercise (e.g., walking) or a combination of aerobic exercise plus resistance training. Resistance training may be superior to aerobic exercise because improvements in strength emerge more quickly and tend to be larger than improvements in aerobic capacity (especially for the novice exerciser). Strength can improve 10 – 30% within the first 6 – 8 weeks of a resistance training program simply as a result of neuromuscular adaptation and learning the technique of weightlifting. In contrast, improvements in aerobic capacity are dependent upon physiological adaptations that occur at a slower rate (especially in a walking program) and may be less noticeable in terms of changes in body composition (Martin & Lichtenberger, 2002). Thus, I hypothesized that larger effects would be evidenced for resistance training-based interventions than aerobic-based interventions.

Physical fitness. Researchers have attempted to validate the notion that improvements in physical fitness are associated with improvements in body image (Martin & Lichtenberger, 2002). Unfortunately, most of this research consists of correlational and cross-sectional studies that have compared body image between exercisers and nonexercisers. Not only have these studies produced equivocal results, but the nature of their designs is inappropriate for drawing conclusions about the effects of exercise-induced fitness change on body image change (Fox, 2000; Taylor & Fox, 2005). To draw conclusions, the effects of systematic exercise interventions on both fitness and body image need to be examined. Furthermore, general findings across the exercise and psychological well-being literature indicate that improvements in physical status—such as cardiovascular fitness, strength, and weight or fat loss—are not consistently related to changes in psychological well-being. For example, some elements of change, such as anxiety reduction (Taylor, 2000) and mood enhancement (Biddle, 2000), appear to occur independent of fitness change. There is evidence from several studies that fitness change (as measured by standard laboratory or field tests of fitness) is not necessary for enhanced body image (Fox, 2000).This parallels the obesity treatment literature where amount of weight lost is not consistently reflected in the psychological benefits. Perceptions of health, physical competences, fitness and body image may arise simple because there is a feeling that the body is improving through exercise. There is some indication that muscular fitness reflected in improved tone or strength can have a more rapid and powerful sensory effect than cardiovascular or flexibility change. Thus, because of the equivocal research results, I will examine if programs that increase physical fitness have larger intervention effects than those that do not increase activity.

Intervention specificity. The effects of chronic exercise on body image have been unclear in interventions that used a nonspecific intervention. Exercise interventions are specific when exercise is the sole intervention and are nonspecific when another therapy (e.g., drug therapy, cognitive-behavioral therapy) is added to the exercise training. Therefore, the independent effect of chronic exercise on body image is unknown when another therapy is added. When chronic exercise was completed in conjunction with a second therapy, only a few investigators included an exercise-only comparison condition. Consequently, it is unclear whether there is an additive effect on body image when a second therapy is added to a chronic exercise intervention. Puetz et al. (2006) in their meta-analyses of the effects of chronic exercise on feelings of energy and fatigue found that the effect varied according to either the presence or absence of a placebo control or whether chronic exercise was completed alone or in combination with another therapy. Unfortunately, they did not report the effects independently for intervention specificity. Thus, it is not known if specificity was an independent moderator of the size of the effect. Thus, I will examine the moderating effect of intervention specificity on the size of the effect.

Theory. Theoretical issues can pertain to both the exercise intervention and the body image measure. For example, the exercise intervention can be based on a theoretical framework (e.g., self-efficacy theory, transtheoretical model, theory of planned behavior) in an attempt to increase exercise adherence and maintenance. Exercise interventions that are developed using a theoretical framework tend to produce larger effects than interventions that are not based on a theoretical framework (Sallis, 2001). Theoretical testing is needed to advance intervention efforts to persuade and enable people to make healthy behavior changes (Rothman, 2004; Sallis, 2001). One salient lesson and a future priority is to incorporate theory to reveal the intervention content and mechanisms to modify physical activity behaviors so that future interventions are more efficacious and efficient (Blue & Black, 2005). Thus, I hypothesized that exercise interventions that are developed based on a theoretical model will produce larger effects than nontheoretical exercise interventions.

As well, the body image measure selected should be based on a theoretical framework that maps how exercise may affect body image. Unfortunately, many researchers have taken atheoretical approaches to selecting the body image assessments. Common theoretical frameworks include the Exercise and Self-esteem Model (Sonstroem & Morgan, 1989; Sonstroem, Harlow, & Josephs, 1994). This model assumes that exercise first influences physical self-concept such that people develop a higher degree of physical competence and physical acceptance. This subsequently should lead to heightened feelings of global self-esteem. Physical Self-perception Profile, which is based on a multidimensional theoretical model of self-esteem, is consistent with the hierarchical modeling of the elements of self-esteem because several measurable levels of self-perceptions exist within the physical self. In Physical Self-perception Profile, self-perceptions can be categorized as superordinated (i.e., global self-esteem), domain (i.e., physical self-worth), subdomain (i.e., body attractiveness) and self-perception; which are general and enduring at the top of the hierarchy and increasingly specific and unstable at the lower end (Fox & Corbin, 1989). Thus, I hypothesized that body image assessments that were selected based on a theoretical model with produce larger effects than nontheoretical assessments.

Design Features

Control group. Variations in control conditions used in chronic exercise studies have made it difficult to interpret the literature on chronic exercise and body image. Controls used in the literature on chronic exercise and body image have ranged from no-treatment controls (e.g., waitlist controls, assessment only controls) to placebo control conditions that involved participants in substantial physical or cognitive activities. Placebo controls (e.g., health education classes) usually are structurally matched to the intervention in terms of contact hours, and they often contain features included in chronic exercise programs that may be therapeutic, such as opportunities for social interaction. Theoretically, the no-treatment controls will produce larger effect sizes than the placebo controls when they are compared with the intervention because the placebo control groups more effectively control for demand characteristics, participant expectancies, and other nonspecific factors that contribute to intervention effect (Stice & Shaw, 2004). Because there is no consensus as to the most appropriate control conditions for interpreting data from chronic exercise interventions, there is a need to determine whether body image is influenced by the type of control conditions selected (Puetz et al., 2006). For example, in a meta-analysis of the effects of chronic exercise on feelings of energy and fatigue, Peutz et al. (2006) found that placebo controls resulted in increased feelings of energy and lessening of fatigue compared to no-treatment controls in certain populations. I hypothesized that larger effects would be evidenced for no-treatment controls compared to placebo controls.

Intervention format. Theoretically, participants in interactive programs show greater intervention effects because this presentation format helps them become engaged in the program content, which facilitates skill acquisition and attitudinal and behavioral change. Interactive programs are also more likely to involve the exercises that allow participants to apply the skills taught in the intervention, which should facilitate skill acquisition. Meta-analysis of substance abuse and eating disorder prevention programs found that interactive programs were more effective than didactic programs (Stice & Shaw, 2004; Tobler et al., 2000). I predicted that interactive programs would be more effect than didactic programs. Interactive programs would include a physical activity program whereas didactic programs would be solely educational (i.e., providing the physical activity guidelines).

Recruitment method. Intervention effects are often larger when prevention programs are delivered solely to participants who have actively self-selected into trials in response to recruitment efforts, such as media advertisements, relative to when prevention programs are offered to all people in a defined population (e.g., a particular school; Stice et al., 2006). Presumably this is because the former strategy recruits people who are more motivated to achieve the exercise prevention effects, and therefore engage more effectively in the prevention program. Thus, I hypothesized that intervention effects would be larger for self-selecting volunteers than for participants recruited through population-based recruitment efforts.

Random assignment. I theorized that trials that randomly assigned participants to conditions might produce larger intervention effects than trials that used alternative approaches to allocating participants to treatment conditions, such as matching. I reasoned that because random assignment is the best approach to generating groups that are equivalent on any potential confounding variables at baseline (with sufficiently large sample sizes), it should therefore minimize the chances that any of these confounding variables are correlated with treatment condition, which should thus maximize the ability to detect intervention effects if they really occur (i.e., randomization maximizes the signal-to-noise ratio reflected in inferential tests of the intervention effects). Accordingly, I hypothesized that intervention effects may be greater for interventions that used random assignment relative to other approaches to assigning participants to condition. However, because the proper analysis of intervention effects involves tests of differential change across conditions, that adjust for any initial differences at baseline on the outcome, I suspect that this effect might not reach statistical significance. Random assignment did not emerge as a significant moderator of effect sizes in other health interventions (Stice & Shaw, 2004).

Publication status. I investigated whether publication status (i.e., unpublished versus published) was related to the intervention effect size. Including unpublished studies allowed us to include a richer variety of exercise studies (Conn et al., 2003). Meta-analyses that only include published studies are more likely to overestimate the magnitude of the true population effect, because the single biggest difference between published and unpublished research is the statistical significance of the results (Cook et al., 1993). Finally, this is a rapidly developing area of science where unpublished reports provide valuable information that may be published later. I hypothesized that published studies would produce larger effects than unpublished studies.

Validated body image measure. Body image is a multidimensional construct encompassing perceptual, attitudes (emotional, feelings), cognitive (thinking, evaluation), sociocultural, and behavioral components. The term body-image disturbance represents some type of maladaptive response to the body image construct (Stewart & Williamson, 2004). Interventions that use psychometrically sound measures should be better positioned to detect intervention effects that do occur because these measures are more sensitive. In support of this, larger effects were found for validated than unvalidated measures in eating disorder prevention trials (Stice & Shaw, 2004). Thus, I hypothesized that interventions that used validated outcome measures would observe larger intervention effects than interventions that used measures for which reliability and validity have not been established.

CHAPTER 2
LITERATURE REVIEW

The purposes of this chapter are to: (a) highlight the scope and significance of body image; (b) review the body image intervention literature with a focus on exercise interventions; and (c) discuss the importance of meta-analyses for synthesizing research.

Scope and Significance of Body Image

Body image is a person's internal view of their outer appearance (Thompson et al., 1999); and it is characterized by cognitive, behavioral, affective, and perceptual elements. The cognitive component consists of thought processing related to body satisfaction/appearance evaluation, social situations, and general information (Bane & McAuley, 1998; Thompson et al., 1999). The behavioral component is comprised of behaviors that are appearance related (e.g., dieting, exercising, avoiding social situations). The affective element deals with emotions, negative feelings, and anxiety related to one's appearance. The perceptual aspect represents the accuracy to which an individual perceives his or her body.

Body image is often assessed using a continuum ranging from none to extreme body-image concerns. Higher levels of body-image disturbance are more likely to lead to negative psychosocial outcomes such as depression, sexual problems, and eating disorders (Cash & Henry, 1995; Cash & Strachan, 1999; Thompson et al., 1999). With regard to eating disorders, the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM – IV) includes body-image disturbance as a criteria for anorexia nervosa and bulimia nervosa stating that there must be a "disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight" (APA, 1994).

Cash and Strachan (1999) identified at least three psychosocial problems related to negative body image including depression, anxiety, and sexual dysfunction. Studies have shown that depressed individuals experience increased levels of body dissatisfaction (Marsella, Shizuru, Brennan, & Kameoka, 1981; Rierdan, Koff, Stubbs, 1988). Correspondingly, individuals with greater levels of body dissatisfaction are more at risk for developing depression. Likewise, individuals with body dissatisfaction are more likely to feel "socially unacceptable" leading to increased social-evaluative anxiety (Cash & Strachan, 1999) and social physique anxiety. Along with body-image disturbance, these problems can lead to sexual dissatisfaction or dysfunction through an avoidance of sexual contact and sexual situations.

The quest for Western society's conception of the ideal body type is a major concern for young women and men (Fallon & Hausenblas, 2004), and a main factor in determining body dissatisfaction. Internalization of these thin ideals are a risk factor for negative body image and eating disorders (Thompson & Stice, 2001). For example, Cash and Strachan (1999) found that the more these cultural ideals are internalized by an individual the higher the risk for body dissatisfaction.

As the number of individuals with body-image problems increases, so does the risk for eating disorders within the population. A 1997 survey in *Psychology Today* reported that 43% of men and 53% of women negatively evaluated their overall appearance (Garner, 1997). However, this survey lacks scientific stringency, and the population surveyed may not be an accurate depiction of the general population; thus, limiting its external validity. More scientifically stringent research using valid body image surveys report similar rates of dissatisfaction as that found in the Garner (1997) study. For example, in Cash and Henry's (1995) national survey of women's body image, over half of the 803 women reported negative appearance evaluations and concerns with being or becoming overweight; with Caucasian women reporting the most body dissatisfaction. Furthermore, a meta-analysis by Feingold and Mazzella (1998) found that the rate of American women with body dissatisfaction has become increasingly more negative over the past 50 years. The prevalence of body dissatisfaction is higher in women and girls than men and boys; with adolescent/teenage females reporting the highest levels of body dissatisfaction (Feingold & Mazzella, 1998).

In summary, body-image disturbance is prevalent; and it is associated with negative physical, social, psychological, and financial outcomes. Therefore, it is necessary to find efficacious prevention and treatment programs that are cost-effective and have the potential to reach large audiences. The next section will briefly review common interventions for body dissatisfaction with an emphasis on interventions that have used exercise as the means to either prevent or treat body-image concerns.

Body Image Interventions

Cognitive Behavioral Therapy

There are several types of interventions that have been developed to prevent and treat body-image concerns. These include cognitive behavioral therapy, exercise interventions, and various alternative treatments including psychoeducational, ecological, and experiential interventions. Cognitive Behavioral Therapy (CBT) is the most widely used and empirically studied treatment for psychological and mood disorders, including negative body image (Cash & Lavallee, 1997; Jarry & Ip, 2005; Rosen, Reiter, & Orosan, 1995). In general, CBT is effective in a wide variety of populations including clinical and nonclinical populations with body-image disturbance (Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999).

For example, Cash and colleagues (1996) developed a CBT for negative body image which is used in varying modes such as audiotapes and self-help workbooks. Cash's program consists of eight steps (see Table 2-1; Cash & Strachan, 1999). A study by Strachan and Cash (2002) investigated the efficacy of Cash's self-help CBT program. The 6 week intervention participants were 86 women and 3 men ranging in age from 18 to 63 with a mean age of 38 years. Participants were randomly assigned to one of two conditions, both included psychoeducation and self-monitoring. Group one received steps one and two and group two received steps one, two, four, and five. At the completion of the study both groups improved significantly in body satisfaction (*ES* = .33) and appearance evaluation (*ES* = .23). The authors believe the absence of group differences may be a result of low compliance (attrition rate = 53%). Overall the effectiveness of Cash's self help program is promising for the prevention and treatment of body-image disturbances.

A study by Lavallee and Cash (1997) studied the efficacy of Cash's self-help CBT program as compared to a self-esteem CBT intervention developed by McKay and Fanning (1987). The 9 week intervention consisted of 37 body dissatisfied individuals. Although both groups improved in body image investment, evaluation, and affect only the self-help CBT group had higher rates of "functional recovery". Some positive aspects to Cash's program include the relatively low cost and anonymity. However there are some limitations as well. As seen in the Strachan and Cash study (2002) there is a high level of attrition (53%) associated with self-help programs. Another limitation to this program is the high level noncompliance and the possibility of individual difficulty carrying out self-help programs.

A narrative review of stand-alone body image treatments by Jarry and Berardi (2004) found that of the 18 studies reviewed, 17 studies used at least one CBT component, and 15 studies used Cash's CBT approach. Nine studies examined and found improvements in eating attitudes and behavior. These include restraint, overeating, and eating concerns with meals per a day and binges per a week improving at follow-up. Several studies also found improvements in psychological variables including general distress, self-esteem, and anxiety which previous research has linked with body image disturbance.

Despite the positive findings of the stand-alone treatments, Jarry and Berardi (2004) noted several study limitations. First, the variability of body image measures across studies rendered it difficult to directly compare study outcomes. Furthermore, many studies ($N = 11$) failed to include a placebo condition which would allow for comparison between groups and the effectiveness of the intervention. Additionally, because most of the studies examined college populations, the generalizability of the studies to other populations is limited. Jarry and Berardi suggested that future research focus on exploring alternative approaches for body-image treatments and implementing specific components of treatment with multi-center studies to increase the intervention generalizability.

Additionally, CBT is effective when offered in a variety of settings including group therapy, individual therapy, and self-directed therapy (Cash & Lavallee, 1997; Cash & Strachan, 1999). However, Jarry and Berardi stated that while CBT is an effective treatment, it is the only stand alone empirically supported body image treatment. Thus, more research is needed focusing on alternative treatments that are more cost-effective and have the potential to reach large audiences. As well, while CBT is effective, more empirical support is needed and the measures used to assess outcomes must be streamlined to better understand the efficacy of CBT. The next section will discuss alternative treatments for improving body image.

Alternative Treatments

Other methods that have been researched as promising treatments for body image including psychodynamic, experiential, psychoeducational, ecological, and weight loss. The next section will briefly review these alternative treatments and corresponding studies. The pros and cons of each treatment will also be discussed.

Psychodynamic interventions. Psychodynamic treatments focus on the integration of the "body self" and the "psychological self" through psychotherapy (Cash & Pruzinsky, 2002). This method allows the patient to recognize and articulate on basic sensations and feelings to find an internal frame of reference. The therapist helps facilitate the individual's integration of the therapeutic process and achieves "self-regulation from the newly developed internal center of initiative, affects and esteem" (p. 467) to establish a positive body image.

A recent study by Wiltink et al., (2007) examined the effects of a psychodynamic psychotherapy treatment for severely obese individuals. Patients (*N* = 267) at an inpatient rehabilitation clinic were randomly assigned to a psychodynamic or behavioral treatment group. Eighty-five percent of the patients were female with a mean age of 41.3 years and a mean BMI of 44.3. Patients in the psychodynamic group received both individual and group therapy for an average of 7 weeks.

Results of the study found a positive effect (*ES* = .56) from post study to 3-year follow-up for improvements in body image regardless of treatment group or weight regain, while the results for weight loss were small (*ES* = 0.26). The authors assume that there are long term benefits to both psychodynamic and behavioral psychotherapy. They also note the absence of a control group as a limitation to their study. While these results are promising, more research is needed in order to improve the effectiveness of psychodynamic treatments as well as determine more cost-effective modes of delivery.

Experiential interventions. The experiential approach to body image treatment involves a multidimensional approach which includes mental, sensory, and somatic components (Cash &

Pruzinsky, 2002). Varying experiential techniques include but are not limited to mental imagery, hypnosis, music therapy, art therapy, breathing/relaxation exercises, body talk, and feminism.

A study by Dibbell-Hope (2000) investigated the effects of a dance/movement therapy in women with breast cancer. Thirty three women, with a mean age of 54.7, participated in the 6 week program. Women in the Authentic Movement group attended weekly 3 hour sessions while the women randomly assigned to the control group were given the opportunity to join the Authentic Movement group at the end of the 6 weeks. The goal of Authentic Movement is to help the individual to become aware of the body and the self through exploration of feelings and external movement. Subjective data from this study show improvements in both body image and self-esteem for women in the Authentic Movement group.

Most of the research in this area has been done using individuals with eating disorders (Cash & Pruzinsky, 2002). Therefore, more research is needed with varying populations including clinical and nonclinical to determine the efficacy of experiential treatments. Furthermore, future studies require well-designed research, implementation of randomized control groups, and stand alone interventions.

Psychoeducational interventions. Psychoeducational treatments involve programs delivered through various modes such as audiotapes, videotapes, print, or internet; without the use of a therapist (Cash & Pruzinsky, 2002). Most psychoeducational programs are theory based and vary from cognitive behavioral theory to psychodynamic, sociocultural, or feminist theory. Winzelberg and colleagues (2000) investigated the effectiveness of a nontheory-based psychodynamic internet-based intervention on body satisfaction and weight/shape concerns (Winzelberg et al., 2000). They randomly assigned 60 women (*M* age = 20.0 years) to either a computer-assisted health education group (CAHE) or control group. The CAHE program consists of an eight week internet based intervention focusing on improving body image. Components of the program included audio and video software, self-monitoring journals, behavior change exercises, and weekly assignments and discussion groups.

They found no significant outcome group differences at post intervention. At the three month follow-up however the intervention group had significant improvement in both body image and drive for thinness compared to the control group. Although positive effects were evidenced, the authors cited several study limitations including compliance, with most participants completing less than two thirds of the program.

More recently a study by Gollings and Paxton (2006) compared internet and face-to-face group body-image interventions. They found that both groups had significant improvements in body image and eating behavior from pre to post intervention. Limitations of this mode of treatment include the decrease in level of individual adherence over time and lack self-direction and motivation to adhere to the program material. Thus, internet-based interventions show promise as a useful program for improving body image, and may be better geared towards individuals who are not inclined to participate in a group setting.

Ecological interventions. Ecological based interventions are guided by the idea that social and cultural factors play a role in causing body image disturbances (Cash & Pruzinsky, 2002). This is done through the use of primary prevention programs aimed at adolescents and children and guided by cognitive-behavioral and social learning theories. McVey and Davis (2002) investigated the effects of a prevention program using a life skills promotion approach. The study involved 282 girls in Grades 6 to 8, with a mean age of 10.88 years. Girls in the prevention group participated in a six week program focused on promoting positive self-esteem/body image, uncovering unrealistic body ideals set by the media, and education on healthy eating and exercising.

Results indicate that body image improved for both the intervention and control group at posttest, 6-month, and 12-month follow-ups. As demonstrated by the McVey and Davis (2002) study, results with ecological treatments are inconsistent and mostly short-lived. Future areas of research should examine male body image disturbances and the potential role of parents in promoting body image (Cash & Pruzinsky, 2002; McVey & Davis, 2002).

Weight loss interventions. Another type of body image intervention is aimed at integrating weight loss and body image treatments. Often standard weight loss programs do not address the issue of body image in the goal to lose weight (Cash & Pruzinsky, 2002). Although weight loss alone is often enough to improve body image, these results can be fleeting with even minimal weight regain. Very few studies have been done examining the effects of a combined weight loss and body image intervention and none of them have been long term (Cash & Pruzinsky, 2002).

One of the few studies investigating the effects of a weight loss program in conjunction with a body image intervention was by Ramirez and Rosen (2001). This study consisted of 14 men and 51 women (*M* age = 44.0) randomly assigned to a weight control or weight control plus body image therapy group. The weight control intervention consisted of 16 weekly 1-hour sessions focused on nutrition and eating/exercise change. The weight control plus body image therapy consisted of the same weekly weight control sessions followed by an hour of CBT body image therapy.

They found improvements in body image for both groups at posttest, 3-month follow-up, and 1-year follow-up. Moreover, there was no difference between groups in weight loss at posttest or follow-ups with an average weight loss retention of 53%. Ramirez and Rosen (2001) postulated that body image therapy did not have a greater effect than weight control because weight loss on its own has a strong, positive effect on body image. They conclude that while weight control may be enough to improve body image, some individuals may need the added assistance of body image therapy to achieve these same effects.

These are just a few examples of alternative interventions focused on improving body image and reducing disordered eating. While each area has its shortcomings it is evident that more research is needed in all areas to determine the effectiveness and generalizability of each. Furthermore, not all interventions are appropriate for all individuals. In order to help a broader range of individuals with varying needs, interventions should be tailored to insure that all target populations are reached.

Exercise

Researchers have also focused on exercise as a useful intervention for preventing and treating body-image disturbance. There are various reasons why people engage in physical exercise. Physical, psychological, and social benefits are all factors in determining exercise behavior (Bryan & Rocheleau, 2002). Exercise reduces depression and anxiety, enhances cognitive functioning, and can aid in treating psychiatric disorders (Callaghan, 2004). Exercise has also been used as an effective intervention in individuals with negative body image, bulimia nervosa, and binge eating disorders (Fisher & Thompson, 1994; Hausenblas, Cook, & Chittester, 2008). When compared to CBT as an effective treatment for body image disturbance, Fisher and Thompson (1994) found that the positive benefits of exercise were equivalent to that of CBT. While CBT may not readily available or cost-effective for all individuals, exercise can be done with minimal cost in a variety of settings.

Bearing in mind that body-image disturbance is a criterion for eating disorders perhaps it is also important to consider exercise interventions for the prevention and/or treatment of eating disorders. Understandably, exercise is not considered a standard intervention for preventing/treating eating disorders given that excessive exercise is attributed as a behavioral feature of both anorexia nervosa and bulimia nervosa (Thurstin, 1999). Hausenblas, Cook, and Chittester (2008) argue that exercise may be beneficial for some individuals suffering from eating disorders, once given medical clearance by a physician. They propose a conceptual framework for the effects of exercise on eating disorders which takes malleable physiological, psychological, and social risk factors into account. This framework relies on a reciprocal relationship between exercise and improvements in physiological, psychological, and social factors as well as the reciprocal relationship between improvements in these factors and a decrease in eating disorder risk factors and prevalence.

Likewise, this framework can be applied to the relationship between body image and exercise (see Figure 2-1). Physical exercise has been researched extensively and has been shown empirically to reduce anxiety, stress, and depression (Carron, Hausenblas, & Estabrooks, 2003). A narrative review of 79 studies by Fox (2000) found that exercise had a positive impact on self-esteem and body image, and even more so for individuals suffering from low self-esteem. Additionally, exercise is known to reduce cardiovascular disease, improve cardiac functioning, prevent osteoporosis, aid in sleep, and alleviate pain (Carron, Hausenblas, & Estabrooks, 2003). It is evident that there is ample empirical evidence to support the positive effects of exercise. Just as exercise may be a beneficial treatment for eating disorders, it should similarly be considered an effective treatment for improving body image, as it is a precursor to eating disorders.

A recent meta-analysis by Hausenblas and Fallon (2006) reviewed the impact of exercise on body image. One hundred and twenty one studies were included in the analysis and the overall mean effect size was 0.28. Specifically, a larger effect size was found for woman (*ES* = 0.45) than for men (*ES* = 0.26). Comparing age groups, the largest effect was found in adolescents (*ES* = 0.98) followed by adults (*ES* = 0.40) and elderly adults (*ES* = 0.26) while university students had the smallest effect (*ES* = 0.17). When comparing type of exercise performed the combination of aerobic and anaerobic had the most significant effect size (*ES* = 0.39) and anaerobic or aerobic exercise alone had comparable effects sizes, *ES* = 0.36 and *ES* = 0.34 respectively.

Hausenblas and Fallon (2006) also reviewed correlational interventions (68 studies) and found an overall mean effect size of 0.41 indicating that exercisers had more positive body image than non-exercisers. Analysis of single-group interventions (44 studies) revealed an overall mean effect of 0.24 demonstrating that exercisers had better body image post-intervention as compared to pre-intervention. As well, analysis of experimental versus control group interventions (35 studies) had an overall mean effect size of 0.28 revealing that participants in the exercise group had more positive body image post-intervention as compared to the non-exercising group.

A study by Asci (2003), examined the association between physical self concept, trait anxiety, and physical fitness in college females. Forty sedentary college females participated in an aerobic or step dance classes three times a week for fifty minutes, for ten weeks. They found that exercise was effective in strengthening physical self-perceptions and reducing trait anxiety compared to the control group. Although, Asci cautions that while exercise may be a useful means to improving physical self-concept, more research is needed using varying intensities, duration, and types of exercise to overcome methodological weaknesses.

Using a different population, Lindwall and Lindgren (2005) examined the effects of a six month exercise intervention on physical self-perceptions and social physique anxiety in sedentary adolescent girls. The intervention group met twice a week for forty five minutes. The girls participated in a variety of aerobic activities such as kick-boxing, spinning, dancing, and water aerobics. Results indicate overall that physical self-perceptions and social physique anxiety improve with exercise in comparison to control group.

In 2001 Williams and Cash did a study investigating the effects of a circuit weight training program on body image in undergraduate males and females (Williams & Cash, 2001). Participants engaged in strength training exercises for a total of three hours a week over a period of six weeks. In comparison to the control group, the strength training participants significantly improved on appearance evaluation, body dissatisfaction, social physique anxiety, and physical self-concept. Williams and Cash conclude that even an exercise program of short duration is successful in improving body image.

Yoga has also started to gain recognition as a useful method of exercise intervention to treat body image concerns. A study done by Daubenmier (2005) examined the effect of yoga practice on body satisfaction, self-objectification, and eating disordered attitudes. Aside from yoga's many health benefits, the main goal of yoga is to focus on greater body awareness and responsiveness to bodily sensations. Daubenmier hypothesized that increases in bodily awareness and responsiveness through yoga practice can lead to a reduction in the value placed on physical appearance and self-objectification. Participants included adult (Study 1, *M* age = 37.16) and undergraduate (Study 2, *M* age = 20.46) women participating in yoga or aerobic exercise classes as well as a base-line group. Participants were recruited out of classes practicing Iyengar or Astanga yoga which were each an hour and a half long. Daubenmier found that women who practiced yoga had greater satisfaction with physical appearance, and less self-objectification as opposed to non-yoga groups.

However, there are some shortcomings to this study. Because the study only consisted of a onetime survey given as individuals were leaving a yoga class, it is hard to say how long or often yoga must be practiced to achieve these benefits. Furthermore, most college and adult women sampled were either European American or Asian American making it difficult to generalize the findings to other ethnicities and age groups. Daubenmier's study is one of the first studies to examine yoga as an intervention for body image and eating disturbances but more research is needed to determine its effectiveness as a treatment/prevention program.

On the other hand, some researchers have found that exercise does not improve aspects of body image. For instance, McCabe, Ricciardelli, & Salmon (2006) examined the effects of a prevention program to improve body image and negative affect in adolescent boys and girls. The program consisted of eight weekly, forty minute sessions with varying types of psychical activity and sports. The intervention showed no significant change in body dissatisfaction for boys or girls. In fact, only the boys' levels of negative affect were positively affected.

Additionaly, several studies (Loland, 2000; Katz, 1986; Silberstein et al., 1988; Tiggeman & Williamson, 2000) suggest that exercise has a negative impact on body satisfaction. Tiggemann and Williamson (2000) found that as exercise increased, body satisfaction and self-esteem decreased. Zabinski et al. (2001), in a study of three hundred and thirty-eight undergrad males and females determined that women's drive for thinness actually increased while body image did not change over the course of a fifteen week aerobic and anaerobic intervention.

Caution must be taken when implementing exercise interventions in populations that may be at risk for developing eating disorders or exercise dependence. Much the same as internalization of the thin ideal, exercise dependence can also be seen as a risk factor for the development of eating disorders (Hechler et al., 2005). Silberstein et al. (1988) and Katz (1986) both found that exercising for reasons related to appearance could perpetuate the risk for eating disorders. Additionally, Loland (2000) argued that the positive effects of physical activity on body image are linear with age. Physical activity in younger women (under 25 years of age) is not related to body satisfaction, but is in older women.

It is evident that the studies exploring body image and exercise interventions vary widely in age, gender, ethnicity of target population, length of intervention, measures assessed, as well as type and intensity of exercises performed. It is important to look at these moderators in order to understand the effect that exercise has on body image, as described in detail in chapter one. The solution to improving body image can not be boiled down to one specific treatment and some approaches are easier to self-determine than others. Additionally, in order to gain a better understanding of the impact of exercise on body image more empirical evidence is needed to determine if exercise can be considered as effective or more effective than CBT as a treatment in improving or decreasing negative body image. The next section will cover the importance of meta-analysis as a tool in exploring exercise interventions as well as its advantages and disadvantages.

Meta-Analysis

Meta-analysis is a “statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings” (Glass, 1976, p.3). Meta-analytic techniques enable examination of moderator, design, and methodological variables that may explain the effect size heterogeneity (Biddle, 2006; Hagger, 2006). Effect sizes are the strength of the association between variables, within a study (Rosenthal, et al., 2006). With such an abundance of research, using a meta-analytic approach allows for a more concise and credible conclusion then would be possible by any one study alone (Rosenthal & DiMatteo, 2001).

Narrative reviews provide a good understanding of a body of literature. However, with studies ranging so vastly with regard to methods, measures, and operationalizations it is impossible to gain a clear picture through qualitative analysis alone. Through the use of quantitative review it is possible to both account for these inconsistencies as well as identify moderators and mediators within a body of research (Rosenthal & DiMatteo, 2001).

Meta-analysis offers many advantages over stand alone studies or narrative reviews. Foremost, meta-analysis requires a thorough search of the relevant research including published and unpublished data to allow for both significant and non-significant findings (Rosenthal & DiMatteo, 2001). Furthermore, to obtain data from individual studies meta-analyst must be comprehensive in their reading of an article. To effectively calculate effect sizes, the meta-analyst must evaluate all aspects of an article's methods, measures, and operationalizations for inclusion/exclusion criteria. This allows for a more thorough understanding of the literature. Third, as Rosenthal and DiMatteo (2001) stated, "emphasizing exploration instead of confirmation" of important patterns of correlation between moderators and effect sizes allows for "examination and reconciliation of differences among studies" and "adds to theory development and increases the richness of empirical work" (p. 66).

On the other hand, while there are numerous advantages to meta-analysis there are also disadvantages. Due to the method of review and inclusion/exclusion chosen for a meta-analysis some bias sampling is likely to occur (Rosenthal & DiMatteo, 2001). Not only is it possible to have bias in sampling but also bias due to lack of sufficient data provided by researchers to compute effect sizes. Another criticism is the issue of the quality of studies included in a meta-analysis. With countless variations between studies it is also likely there is variation in the quality of the studies (e.g., published vs. unpublished data). This issue can be resolved with the use of a weighting technique which accounts for the methodological strengths and weakness of individual studies (e.g., journal impact factor, published vs. unpublished, experimental vs. quasi-experimental designs; Rosenthal, 1991).

Regardless of its disadvantages, meta-analysis is a valuable method that can be used to examine the effects of exercise interventions on body image. A review of the exercise and body image literature is certainly warranted as there is only one meta-analytic review available (Hausenblas & Fallon, 2006). However, the Hausenblas and Fallon study consisted of mostly correlational studies ($N = 68$). There is also a need to focus on interventions using both random and fixed effect sizes and controlling for pre intervention scores. With the abundant amount of research literature available in the field of body image research synthesis of selected areas are necessary for research to gain an understanding of the impact of body image and future research directions. A meta-analysis of the exercise and body image literature can be useful in examining how the key features of the research design, exercise intervention types, and group condition types, all moderate the effect of exercise on body image. This synthesis of the literature will help to gain a better understanding of the body image literature, the effects of exercise on body image, moderators of these effects, and generalizability of the findings.

Table 2-1. Cash's eight step cognitive behavioral therapy

	Goals
Step 1	Body image self assessment questionnaires and goal setting
Step 2	Education and self-discovery of participant's body image
Step 3	Desensitization through mental imagery and relaxation skills
Step 4	Identifying appearance assumptions or core beliefs about appearance, and working to challenge these beliefs
Step 5	Identifying cognitive distortions and using cognitive restructuring to modify these behaviors
Step 6	Recognizing and altering avoidant behaviors and obsessive-compulsive patterns
Step 7	"Body-image affirmation" activities to enhance and reinforce positive body image
Step 8	Maintenance and relapse prevention

Reference: Cash, T.F., & Strachan, M.D. (1999). Body images, eating disorders, and beyond. In R. Lemberg & L. Cohn (Eds.), *Eating disorders: A reference sourcebook* (pp. 27-37). New York: Greenwood.

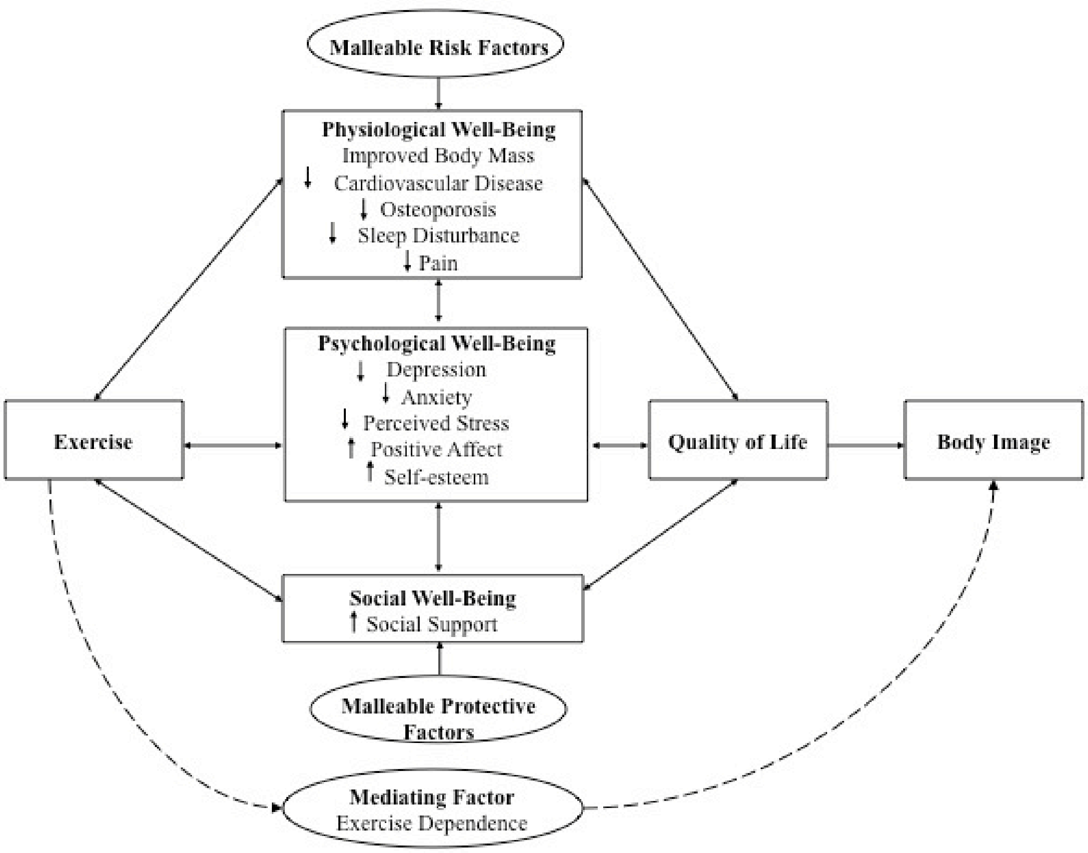

Figure 2-1. Conceptual framework for the effects of exercise on body image. Modified from Hausenblas, Cook, & Chittester (2008). Can exercise treat eating disorders? *Exercise and Sport Sciences Reviews, 36(1)*, 43-47.

CHAPTER 3
METHODS

Sample of Studies

Research related to body image and exercise was retrieved by February 2008 using the following four procedures to avoid bias retrieval of searching only major journals and to obtain fugitive studies (Barber & Milrod, 2004; Rosenthal, 1991). First, Dr. Hausenblas and myself conducted computer-based searches in PubMed, Cochrane Controlled Trials Register, Cochrane Database of Systematic Reviews (Clinical Trials), Online Journals Search Engine, Dissertation Abstracts International, and PsycINFO using the following key words: body image, exercise, physical activity, eating disorder, eating pathology, and body satisfaction/dissatisfaction. Second, ancestry searches, sometimes called treeing backward, were conducted using the references lists of all intervention research. We also manually searched all available issues of the pertinent journals in the field (e.g., *Body Image: An International Journal; International Journal of Eating Disorders;* see Appendix A for complete list). Third, we contacted active researchers in the field to retrieve either current or unpublished research (e.g., in press, in review). Active researchers in the field were defined as all authors with published articles within the last year (Hopewell, Clarke, Mallett, 2005). Researchers of studies already included in the meta-analysis as well as authors of excluded studies due to insufficient data were contacted through email for relevant data (see Appendix B & C). Of the 29 active researchers in the field contacted to retrieve either current or unpublished research 9 responded resulting in the retention of 7 studies and exclusion of 2. Fourth, computerized searches were conducted on all authors of retrieved studies meeting the inclusion criteria. Finally, often because of the magnitude of controlled trials, multiple publications will occur. In an attempt to effectively code the studies, we also retrieved other publications related to the trial in an attempt to comprehensive record the moderator variables (e.g., Sallis et al., 1999).

Selection Criteria

Criteria for inclusion were that: (a) the independent variable involved a chronic exercise program of at least 3 weeks (Puetz et al., 2006); (b) the dependent variable was a measure of body image that was assessed before and after an intervention involving chronic exercise; and (c) the design was experimental. We excluded studies that were cross-sectional, correlational, or did not have a control group because it is impossible to differentiate between spontaneous changes in body image over time as opposed to the effects of exercise. Studies of behavioral interventions which offered either education and/or advice on increasing physical activity, or structured supervised/unsupervised physical activity exercise programs were considered for inclusion. If a study had pre, mid, and post data (e.g., Asci, 2003), we used the pre and post data only to compute effect sizes. Thus, we focused exclusively on studies that tested whether the change in the outcomes over time was significantly greater in the intervention group versus the control group. It is necessary to control for initial levels of the outcome variable because otherwise the analyses are not providing a test of differential change over time across conditions (Stice et al., 2006). A total of 77 studies were excluded from the analysis because they did not meet the inclusion criteria, with the majority of studies excluded due to lack of control group (n = 24), as well as no true control (n =16), not enough information to compute an effect size (n = 15), no measure of body image (n = 12), limited exercise component (n = 7), and post data only (n = 3).

Coding the Studies

Coding was performed by Dr. Hausenblas and myself independently (see Appendix D for coding sheet). Disagreements were resolved by discussion and by further examining the studies (Orwin, 1994). All the coded characteristics were used as descriptions of the studies retrieved and as potential moderator variables (Rosenthal, 1991), in addition to the main moderators examined. Appendix E lists the numeric values used to code each moderator, the operationalization of each moderator, and relevant descriptive statistics describing the distribution of the moderators. We coded certain moderators two ways in an effort to ensure that we were not missing the effects of a moderator, because we did not operationalize it optimally. A priori lists of outcome measures to select when multiple measures were present in a study were developed to minimize the impact of coder bias on the selection process.

Participant features. We coded the following participant features: age, gender, ethnicity, risk status, body composition, and preintervention fitness level. In addition to coding the average age of participants at baseline, we also coded for age category of elementary school, middle school, high school, university, adults, or older adults. With regard to participant ethnicity, we coded both the percentage of participants who were Caucasian (a continuous variable), because this group is at high risk for negative body image compared to nonCaucasian, and the dominant ethnic group represented in the sample (nominal variable).

Exercise intervention features. We coded the exercise type (i.e., aerobic, resistance training, both), duration (i.e., minutes per session), length (i.e., length of intervention in weeks), frequency (i.e., number of sessions per week), and intensity (i.e., strenuous, moderate, mild). The intensity of aerobic exercise was coded using the classification system of the American College of Sports Medicine (2000, p. 150). In this system, intensity can be classified as a percentage of oxygen uptake reserve (%VO_2R), a relative measure of intensity, which permits consistent coding of intensity whether expressed as percent oxygen uptake (%VO_2max), heart rate, or perceived exertion (Howley, 2001). The database allowed for the formulation of light (20 – 39% VO_2R), moderate (40 – 59% VO_2R), and strenuous (60 – 84% VO_2R) categories based on these guidelines. In cases where only a verbal description regarding the intensity of exercise rather than specific information such as maximum oxygen consumption, maximal heart rate, or hear rate reserve was provided, two experts in exercise physiology made a subjective assessment of the exercise intensity referring to the ASCM definitions. Intensity of resistance training was assessed in terms of repetitions and workload using standard tables (Bompa, 1999). Two experts in resistive training made a subjective assessment in cases where only verbal information was provided. Following the procedures of Colcombe and Kramer (2003) the duration was also coded categorically as short (15 – 30 min), moderate (31 – 45 min), and long (> 45 min). The length was also coded as short (1 – 3 months), medium (4 – 6 months), and long (6 + months). The intervention specificity variable was coded into two categories: exercise only and exercise in addition to another treatment. Finally, we coded if the experimental and control participants showed improvements on physical fitness.

Design and study features. We coded for the type of control group, recruitment method, publication year (as a measure of recency), random assignment, type of exercise intervention (i.e., exercise-based or lecture-based), and publication status. Studies which did not report randomization or group assignment methodology were assumed to have used nonrandomized protocol. Although body image is generally conceptualized as a broad, multifaceted construct, most research in this area has focused on the narrower construct of weight/body dissatisfaction (Grogan, 2006). Each of the body image measures was coded independently. If we did not know what the measure assessed in particular for body image, we retrieved the article that contained the scale and examined the individual items to determine what type of body image the scale assessed.

Effect Size Calculation and Analytic Strategy

Effect size calculations. Using random and fixed effects modeling procedures, I calculated effect sizes by subtracting the mean change for a control group or condition from the mean change for an experimental group or condition and dividing this difference by the pooled standard deviation of pretest score. I adjusted all effect sizes using Hedge's and Olkin's (1985) small size bias correction before entering them into the analysis. When the *N* at the pretest differed from the *N* at the posttest, the smaller *N* was used. If the results were available for more specific subgroups (e.g., men and women; high school and middle school), effects were computed for the most specific group for which data were available. This procedure enabled a more comprehensive examination of the moderator variables of interest.

When precise mean and standard deviation data were not reported, effect sizes were estimated (Rosenthal, 1991) from *F* tests, *t* tests, *p* values, or figures. For studies in which precise standard deviations were not reported, the standard deviation was drawn from published norms (e.g., Garner, 1991). I also estimated effect sizes when a report contained inexactly described *p* values—such as when the authors indicated that a given finding was not significant at 0.05. Thus, a reported nonsignificant finding was estimated to have a probability of 0.99, whereas a significant finding was estimated to have a probability at the level of the cutoff value used in the study (e.g., 0.05 or 0.01). However, because the use of such reports may lead to incorrect estimations, I conducted separate analyses on the set of exactly reported effect sizes and all the effect sizes (including the ones estimated on the basis of inexactly reported *p* values). Because these sets of analyses yielded similar results, I reported only the results that included all the effect sizes. The effect size computation methods were coded to examine if the use of different effect size estimation methods moderated the effect size (Ray & Shadish, 1996).

Along with the weighted average effect sizes, I computed the 95% confidence intervals. If the confidence interval does not include zero, then the mean effect size is statistically significant at the $p < .05$ level. I also graphed a forest plot, which is a graph of each study as a point estimate bounded by its confidence intervals. The forest plot shows at a glance the following: (a) if the overall effect reported in the analysis is based on many studies or a few; (b) if the overall effect is based on studies that are either precise or imprecise; (c) whether the treatment effects for all studies tend to line up in a row, or whether they vary substantially from one study to the next; and (d) if outliers exist (Borenstein, 2005).

To determine heterogeneity of the effect sizes, I reviewed the actual dispersion on the forest plot and calculated both the *Q*-statistic and *I*-squared. *Q* tests the hypothesis that the observed variance in effect sizes is no greater than that expected by sampling error alone. Under the null hypothesis that all studies derive from the same population, *Q* will follow a chi-square distribution for $df = k$, where *k* is the number of outcomes minus one. The *p*-value for *Q*, like all *p*-values, should not be interpreted by rote (Borenstein & Rothstein, 1999). That is, the absence of a significant *p*-value cannot be taken by itself as evidence of homogeneity as it could reflect a low power rather than actual consistency. Because of the technical and conceptual problems with the *Q*-Statistic, I also calculated the *I*-Squared, defined as variance (between-studies)/variance (total), to quantify the variance (i.e., heterogeneity; Higgins & Thompson, 2002; Higgins, Thompson, Deeks, & Altman, 2003). That is, the *Q*-statistic indicates whether or not there is evidence of dispersion, the *I*-squared quantifies the dispersion. For interpretation, the *I*-squared values of 25, 50, and 75 are considered low, moderate, and high, respectively. Thus, an *I*-squared in the low range suggests that the effect sizes are homogeneous relative to the precision of the individual studies (Higgins et al., 2003). For moderator analyses, I used Q_B, using mixed effects analysis, to explore the impact of categorical variables on the effect size; and I used meta-regression to explore the impact of continuous variables on the effect size. Mixed-effect models provide a more stringent test of moderators and help diminish the possibility of Type I errors, which can become inflated in the fixed-effects with moderators approach to meta-analysis (Overton, 1998). Both the random and fixed effect size information is reported in the appendix (see appendix F) but for brevity in the text only the random effect size information will be reported. Furthermore, moderator analysis will only be undertaken when there are a minimum of 3 effect sizes (Wolf, 1986). Data were analyzed using SPSS-15 and Comprehensive Meta-analysis-2 (BioStat, Englewood, New Jersey).

Dependence. A fundamental assumption of most standard analyses used in meta-analysis is the independence of effects. When multiple outcomes have been measured for the same individuals, or when the same outcome is measured at several time points for the same individuals, effect sizes computed for those multiple outcomes or time points will not be independent. A number of ways exist to deal with dependence (Becker, 2000). The primary approach used in our synthesis was to separate effects into groups that included primarily independent effect. For example, some studies had two control groups (i.e., waitlist control and placebo control). In these instances we would code for both of the control groups. It was common for studies to include multiple assessments of body image. In these instances, each independent group was limited to one body image effect size. The removal order was first unstandardized questionnaires. In studies with two or more effect sizes still remaining, the rule was to give priority to body dissatisfaction measures (Groesz, Levine, & Murnen, 2002; Stice, 2000). Body dissatisfaction is one of the most consistent and robust risk and maintenance factors for eating pathology; thus, it was selected over other body image measures. If, at this point, there was still two or more remaining body standardized dissatisfaction measures, random removal was conducted until one effect remained per independent group. If studies reported on mid-experiment data or follow-up data; we recorded the immediately pre and post intervention scores only.

Publication/Dissemination Bias

Publication bias is the term for what occurs whenever the research that appears in the published literature is systematically unrepresentative of the population of completed results (Rothstein, Sutton, & Borenstein, 2005). To assess publication bias, I undertook the following graphical and statistical methods: forest plots, funnel plots, Fail Safe *N* or file drawer analysis using both Rosenthal's (1979) and Orwin's (1983) procedures (N_{fs}), Egger's test of intercept, and Duval and Tweedie's trim and fill. These procedures are described in more detail below (see Effect Size Calculation section for information regarding the forest plot).

Funnel plot. The funnel plot is a plot of a measure of study size (i.e., standard error) on the vertical axis as a function of effect size on the horizontal axis (Borenstein, et al., 2007). Large studies appear toward the top of the graph, and tend to cluster near the mean effect size. Smaller studies appear toward the bottom of the graph and tend to disperse across a range of values due to the sampling variation in effect size estimates. In the absence of publication bias the distribution of studies would be symmetrical about the combined effect size. On the other hand, in the presence of bias the bottom of the plot would show a higher concentration of studies on one side of the mean than the other. This would reflect the fact that smaller studies are more likely to be published if they have larger than average effects, which makes them more likely to meet the criterion for statistical significance. This will result in an overestimation of the treatment effect in a meta-analysis (Sutton et al., 2000). The funnel plot offers a visual sense of the relationship between effect size and precision, but the interpretation of the plot is largely subjective.

Fail safe N. Fail Safe *N* addresses the possibility that studies are missing from the analysis and that these studies, if included in the analysis, would shift the effect size toward the null. The classic Rosenthal's N_{fs} indicates the number of missing studies (with *M* effect of 0) that would need to be added to the analysis before the combined effect would no longer be statistically significant (Rosenthal, 1991, 1979). The N_{fs} analyses were calculated for each statistically significant relation reported. According to Rosenthal's (1979) conservative guidelines, N_{fs} should exceed 5k (k = number of studies) + 10 to effectively overcome the file drawer problem. Rosenthal's N_{fs} is limited in two ways (Borenstein, et al., 2007). First, it assumes that the effect in the hidden studies is nil, rather than considering the possibility that some of the studies could have shown an effect in the reverse direction. Therefore, the number of studies required to nullify the effect may be smaller than the $N_{fs.}$ Second, this approach focuses on statistical significance rather than clinical or substantive significance. So while it allows for the assumption that the treatment is not nil, it does not address the question of whether or not it remains clinically important after the missing studies have been included.

Because of the limitations of Rosenthal's N_{fs} I also computed Orwin's N_{fs}, which addresses the limitations of Rosenthal (Borenstein, et al., 2007). First, it is possible to specify the mean effect in the hidden studies as being a value other than nil. Second, the criterion value is an effect size rather than a p-value. Orwin's N_{fs} is the number of missing studies that when added to the analysis, will bring the combined effect size below a specified threshold. The minimal effect size chosen was 0.1 (VanderWerf, 1992)

Egger's test of the intercept. Egger's test of intercept is a linear regression method used to quantify the bias captured by the funnel plot (Borenstein, 2005). The standard normal deviate is regressed on precision, defined as the inverse of the standard error. The intercept in this regression corresponds to the slope in a weighted regression of the effect size on the standard error. In the absence of asymmetry, the points on a funnel plot will scatter about a line that runs through the origin at standard normal deviate zero, intercept $\beta_0 = 0$, with slope β_1 indicating the size and direction of the effect (Sterne & Egger, 2005). If there is funnel plot asymmetry, the regression line will not run through the origin, so that the intercept β_0 provides a measure of asymmetry. A test of the null hypothesis (i.e., $\beta_0 = 0$) can be derived from the usual regression output from CMA, reporting the two-tailed *p*-value. The larger the deviation from zero the more pronounced the asymmetry. The power for this test is usually low unless there is severe bias or a substantial number of studies.

Duval and Tweedie's trim and fill. The trim and fill procedure is a nonparametric technique that examines the symmetry and distribution of effect sizes plotted against the inverse of the standard error (Borenstein, et al. 2007; Duval & Tweedie, 2000). The method initially trims the asymmetric studies off the asymmetric outlying part of the funnel plot to locate the unbiased effect and then fills the plot by re-inserting the trimmed studies on the right as well as their imputed counterparts to the left the mean effect. First, the technique estimates the number of studies that may be missing as a result of publication bias, with publication bias meaning studies with effect sizes that are low or near zero relative to the average effect. Then, the trim and fill calculates hypothetical effects for potentially omitted studies and then re-estimates the average effect size and confidence intervals on the basis of the influence of studies that would have been included in the analyses if they had been published.

Missing data. Missing information to calculate an effect size will occur when studies provide no statistics or an inadequate amount of information about the outcome scores to calculate an effect size. Some researchers fill in a conservative estimate, such as zero or the mean effect, for missing effect sizes. Imputing a single value for missing effect sizes may lead to biased results, which may be compounded when those imputed values are used to estimate the variance of the missing effect size (Pigott, 1994). Some researchers use the variance of the effect size as weights in the estimated mean effect size and in weighted least squares estimation of the linear model of effect sizes. Both of these methods, however, result in biases in the mean effect size, and therefore, are not recommended (Pigott, 1994). Thus, I will undertake the following two procedures to control for this type of missing data. First, I will contact the authors of studies that fail to provide adequate information to calculate an effect size in an attempt to obtain this information. Second, I will use the procedures described by Bushman and Wang (1995, 1996) that combine sample effect sizes and vote-counts to examine missing data biases between: the included studies with the excluded studies that provide insufficient information to compute an effect size but do provide the direction of the effect (Bushman, 1994). Hence, these methods combine sample effect sizes and vote counts to estimate the population effect size. These methods allow all the data available from each study to be used in the final analysis, and hence are superior to simpler approaches such as omitting studies where no effect size is given, or imputing values such as zero, or the mean effect for the outcome in studies where no outcome is reported.

Outliers. Potential outliers were identified by examining the effects sizes graphically and then omitting one case at a time and checking for large externally standardized residuals or substantially reduced measures of heterogeneity (Hedges & Olkin, 1985). These analyses were conducted for each outcome variable (see Appendix G). The identified outliers were examined to determine if characteristics unique to the study may have produced the extreme scores. The effect of outliers is often a notable increase in observed variance and a distortion of the mean. When sample sizes are small to moderate (the usual case), extreme values can occur because of large sampling errors. Such values are not true outliers and should not be eliminated from the data, because the formula for sampling error variances assumes and allows for such occasional large sampling errors. Eliminating such nonoutlier extreme values can result in overcorrection for sampling error and underestimation of standard deviation. Because of this, I did not remove any outliers in the analyses (Hunter & Schmidt, 2004).

CHAPTER 4
RESULTS

Description of Studies

A total of 57 publications (*M* study year = 1997, range = 1972 – 2007) with 98 separate comparisons were included in the meta-analysis (see appendix H for individual study information). Reasons for multiple effect sizes per study were that studies reported results separate by age (*n* = 2) and/or gender (*n* = 6), and studies with either multiple control groups (*n* = 7) or exercise groups (*n* = 15; two studies reported results by both gender and age). The studies had a total 6,273 participants (Experimental *N* = 3,639, Control *N* = 2,634). Most studies were conducted in the United States (*n* = 38), followed by United Kingdom (*n* = 4), Canada (*n* = 3), Turkey (*n* = 3), Germany (*n* = 3), Australia (*n* = 2), Norway (*n* = 2), Sweden (*n* = 1), and Switzerland (*n* = 1). Most studies were disseminated as journal articles (*n* = 49); the remainder were dissertations/theses (*n* = 8).

All but one study included risk status, with most of the populations being universal (*n* = 42), followed by selected (*n* = 12), breast cancer participants (*n* = 2), and participants with psychological disorders (*n* = 2). The average participant age was 30.04 (*SD* = 15.35, range = 10.02 to 63.40), with 9 studies not reporting the participant age. For age group category, most participants were university students (35.7%), followed by adults (26.5%), older adults (12.2%), elementary (7.1%), middle (8.2%), and high school (2.0%); with 3 studies not reporting age group information. Most studies included female populations (*n* = 31), followed by both genders (*n* = 22), and male populations (*n* = 4; 1 study did not report gender information). Only 18 studies reported ethnicity, with Caucasian participants being the dominant ethnic group in 15 studies, followed by African American (*n* = 2) and Hispanic (*n* = 1). Within these studies, the percentage of Caucasian participants ranged from 19 to 100% with an average of 64.8% (*SD* =

25.67). Participant's body composition was described in 32 studies; with 18 studies consisting of normal weight participants and 14 studies consisting of overweight/obese participants. Finally, 28 studies described preintervention fitness level, with 27 studies reporting sedentary/low activity participants, followed by active participants (*n* = 1).

Fifty-four studies described the exercise mode. Most of the interventions used aerobic exercise (*n* = 32), followed by interventions with a combination of resistance training and aerobic exercise (*n* = 14), resistance training only (*n* = 7), and one study which had participants engage in either aerobic exercise or tai chi. The average exercise duration was 49.09 minutes (*SD* = 14.29, range = 20 to 75 minutes), with 12 studies not reporting exercise duration. A total of 54 studies described the length of intervention in weeks, with an average length of 12.69 (*SD* = 8.14, range = 4 to 52 weeks). The average exercise frequency per week was 2.81 (*SD* = 1.04, range = 1 to 5 times per week), with 10 studies not reporting exercise frequency. Intensity of exercise was described in 31 studies, with most participants performing at a moderate intensity (*n* = 20), followed by hard or very hard (*n* = 9), light (*n* = 1), and one study that had participants exercise at both moderate and hard intensity. Only 10 interventions met the ACSM (2000) physical activity guidelines (20 to 60 minutes of continuous or intermittent exercise 3 to 5 days week). All but one study reported exercise specificity, resulting in 40 exercise-only interventions and 16 exercise-in-addition-to-another-treatment interventions. A total of 12 studies based the exercise intervention on a theory. The most frequently used theories were the Transtheoretical Model (*n* = 4) and the Exercise and Self-Esteem Model (*n* = 4; two studies used both the Transtheoretical Model and the Exercise and Self-Esteem Model), followed by Social Cognitive Theory (*n* = 2), Pender's Health Promotion Lifestyle Profile (*n* = 1), Roy Adaptation Model (*n* = 1), Conservation of Resources Theory (*n* = 1), and Self-Concept Theory (*n* = 1). Additionally, 24 studies included an objective measure of exercise or fitness, 8 studies used a self-report measure, and 4 studies used both objective and self-report measures. The most common type of measures used were exercise logs/questionnaires/7-day recalls (*n* = 11), followed by run/walk/treadmill tests (*n* = 10), and VO_2 max/heart rate tests (*n* = 8).

Most of the studies used an interactive exercise intervention format (*n* = 42), followed by 11 studies that used both an interactive and didactic format, and only 4 studies used didactic intervention alone. Twenty-eight studies had no-treatment control groups, 19 studies had placebo control groups, 6 studies had multiple control groups, and only 4 studies had an activity control group. A total of 35 studies described the randomization process. Attrition was described in 31 studies, with a mean attrition of 22.69% (*SD* = 16.84, range = 0 to 67%). Almost all studies (*n* = 55) used a standardized measure of body image. Finally, the most common measure of body image was the Body Dissatisfaction subscale of the Eating Disorder Inventory (*n* = 10 studies), followed by Body Cathexis Scale (*n* = 9 studies), Physical Self-Perception Profile (*n* = 6), Weight Concern subscale of the Body Esteem Scale (*n* = 5), and the Physical Self subscale of the Tennessee Self-Concept Scale (*n* = 5).

Publication Bias

The overall mean random effect size (*ES)* was 0.29 (*SE* = .04, *CI* = $\pm$.07; *Q*(97) = 206.18, p < .001, I^2 = 52.95; and the overall mean fixed *ES* was 0.23 (*SE* = .03, *CI* = ± .05; see figure 4-1 for forest plot). Rosenthal's N_{fs} was 2,871, indicating that 2,871 null studies (or 29 missing studies for every observed study) would need to be located for the combined *p* value to exceed .05. In comparison, Orwin N_{fs} was 128, revealing that 128 studies would need to be located with a mean standard difference in means of 0 to bring the combined standard difference in means under 0.1.

Examination of the funnel plot (with the *ES* on the X axis and the standard error on the Y axis) revealed that the distribution of the *ES* showed a pattern suggestive of publication bias (see figure 4-2 for funnel plot). A statistical test of symmetry in the plot indicated significant asymmetry (intercept = 1.55, $\pm$ = 0.71, $t(96) = 4.36$, $p < .001$; Egger et al., 1997). The Duval and Tweedie's trim and fill procedure pointed at the possibility of some publication bias. More specifically, this method suggested 28 studies were missing and that the point estimate and 95% confidence interval using the Trim and Fill imputed point estimate was 0.12 ($\pm$ .08; see figure 4-3 for funnel plot with imputed values).

Moderator Analyses

Participant features. Although a larger effect size (*ES*) was evidenced for female populations (*M ES* = 0.32) compared to male populations (*M ES* = 0.19) the *ES* difference was not statistically significant, $Q_B(1) = 1.11$, $p = .29$ (see Appendix I for random effects moderator analyses). Mean age moderated the size of the effect, with larger *ESs* evidenced for older compared to younger participants ($z = 2.07$, $p = .038$). A significant difference was found for age category, $Q_B(3) = 8.87$, $p = .031$. Examination of the *M ES* scores indicated that the largest effects were evidenced for adults (*M ES* = 0.44) compared to older adults (*M ES* = 0.33) followed by university students (*M ES* = 0.23). Additionally, because of the small number of studies examining elementary ($n = 3$ studies representing 7 *ES*), middle ($n = 5$ studies representing 8 *ES*), and high school ($n = 2$ studies representing 2 *ES*), these groups were combined for the age category comparison resulting in a combined high school/middle/elementary school students group (*M ES* = 0.16).

A significant effect was found for ethnicity, $Q_B(1) = 10.55$, $p = .001$, with largest *ES* evidenced for nonCaucasians (Hispanic & African American; *M ES* = 0.69) followed by Caucasians (*M ES* = 0.20). The percentage of Caucasian participants did not moderate the size of the effect, $z = 0.07$, $p = .94$. A nonsignificant effect was found for risk status, $Q_B(1) = 0.26$, $p = .61$, with larger *ESs* evidenced for universal (*M ES* = 0.29) compared to selected participants (*M ES* = 0.23). I examined the moderating effect of psychological risk using only universal and selected categories because of the low *n* in the breast cancer and psychological disorders categories. The psychological disorder category included schizophrenia, bipolar disorder, and depression but the study specifically excluded patients with previous eating disorders (Evans, Newton, & Higgins, 2005). For body composition, a nonsignificant larger effect was found for overweight/obese participants (*M ES* = 0.34) compared to normal weight participants (*M ES* = 0.18), $Q_B(1) = 3.25$, $p = .07$. Finally, for fitness level at preintervention, a moderator analysis was not feasible since most of the ES were for sedentary/low activity. However, a comparable effect was found for sedentary/low activity (*M ES* = 0.42) and sedentary and active (*M ES* = 0.41).

Design features. A negative relationship was found between publication year and the size of the effect ($z = -1.49$, $p = .14$; i.e., recency effect). No significant *ES* difference was found for published (*M ES* = 0.29) versus unpublished studies (*M ES* = .32), $Q_B(1) = 0.10$, $p = .75$. I did not examine the moderating effects of country of origin because most of the effect sizes were from interventions conducting in the United States (68%; see table 1 in Appendix F for the individual countries mean *ES*). The type of control group (i.e., no treatment, placebo, or active control) did not moderate the size of the effect, $Q_B(2) = 4.24$, $p = .12$. A nonsignificant larger effect was found for no treatment controls (*M ES* = 0.37), followed by placebo control (*M ES* = 0.23), and active control (*M ES* = 0.14). A significantly larger effect was found for exercise-based interventions (*M ES* = 0.38) compared to lecture-based (*M ES* = 0.13) or combined lecture- and exercise-based interventions (*M ES* = 0.12), $Q_B(2) = 11.88$, $p = .003$. Type of recruitment method moderated the size of the effect, $Q_B(1) = 3.91$, $p = .05$, with a larger effect found for self-selected recruitment methods (*M ES* = 0.38) compared to nonself-selected (*M ES* = 0.22). A nonsignificant effect was evidenced for studies with randomly assigned participants (*M ES* = 0.26) compared to nonrandomly (*M ES* = 0.34), $Q_B(1) = 0.93$, $p = .34$. Although validation of the body image measure did not moderate the size of the effect $Q_B(1) = 0.23$, $p = .64$, I found a larger effect size for standardized measures (*M ES* = 0.30) compared to unstandardized measures (*M ES* = 0.20). Finally, no significant difference in effect size, $Q_B(2) = 4.02$, $p = .13$, was found for self-report measures of fitness (*M ES* = 0.23), objective measures of fitness (*M ES* = 0.39), or the use of both self-report and objective measures (*M ES* = 0.17).

Exercise intervention features. No significant difference in the size of the effect was found for exercise interventions that met exercise guidelines (*M ES* = 0.30) versus interventions that did not meet the guidelines (*M ES* = 0.32), $Q_B(1) = 0.23$, $p = .63$. Exercise specificity was significant, with larger effects for exercise-only interventions (*M* ES = 0.37) compared to exercise-in-addition-to-another-treatment (*M* ES = 0.14), $Q_B(1) = 9.23$, $p = .002$. A nonsignificant effect was evidenced for experimental intervention type, $Q_B(2) = .55$, $p = .76$ (individual- based *M ES* = 0.34, group-based *M ES* = 0.26, combination of individual and group-based *M ES* = 0.32). A nonsignificant effect was found for exercise intensity, $Q_B(2) = 0.637$, $p = 0.73$, with larger effects evidenced for light intensity (*M ES* = 0.38), followed by moderate intensity (*M ES* = 0.36), and strenuous (*M ES* = 0.29).

With regard to the dose-response for exercise, exercise duration (*M* duration = 49.09 min, range = 20 to 75 min; $z = .25$, $p = .80$), length of intervention in weeks (*M* length = 12.69, range = 4 to 52; $z = -0.11$, $p = .92$), and follow-up in weeks (*M* length = 21.85, range = 2 to 72; $z = -0.24$, $p = .81$) did not moderate the size of the effect. Mode of exercise (aerobic *M* ES = 0.29, resistance *M ES* = 0.38, or both aerobic and resistance *M ES* = 0.27) did not moderate the size of the effect, $Q_B(2) = 1.37$, $p = .50$. Frequency per week of exercise (*M* frequency = 2.81, range = 1 to 5), however, did moderate the size of the effect, with larger effects evidenced for interventions of higher frequency per week ($z = 2.42$, $p = .016$).

No difference in the size of the effect was evidenced for experimental group participants who improved on either fitness or body composition from pre to post intervention compared to those who did not improve on either fitness ($Q_B(1) = 0.004$, $p = .95$) or body composition ($Q_B(1) = 0.12$, $p = .73$) from pre to post intervention. I was not able to analyze the moderating effects of control group fitness or body composition due to a lack of studies reporting this information. However, a larger effect was evidenced for control group participants who did not improve on fitness from pre to post intervention (*M ES* = 0.40) versus participants who did improve (*M ES* = 0.15). Furthermore, control group participants had larger effects for no improvement on body composition (*M ES* = 0.42) versus improvement (*M ES* = 0.10) from pre to post intervention. Finally, no difference in the size of the effect was found for use of a theory in either measure selection ($Q_B(1) = 0.95$, $p = .33$) or exercise intervention ($Q_B(1) = 3.30$, $p = .07$).

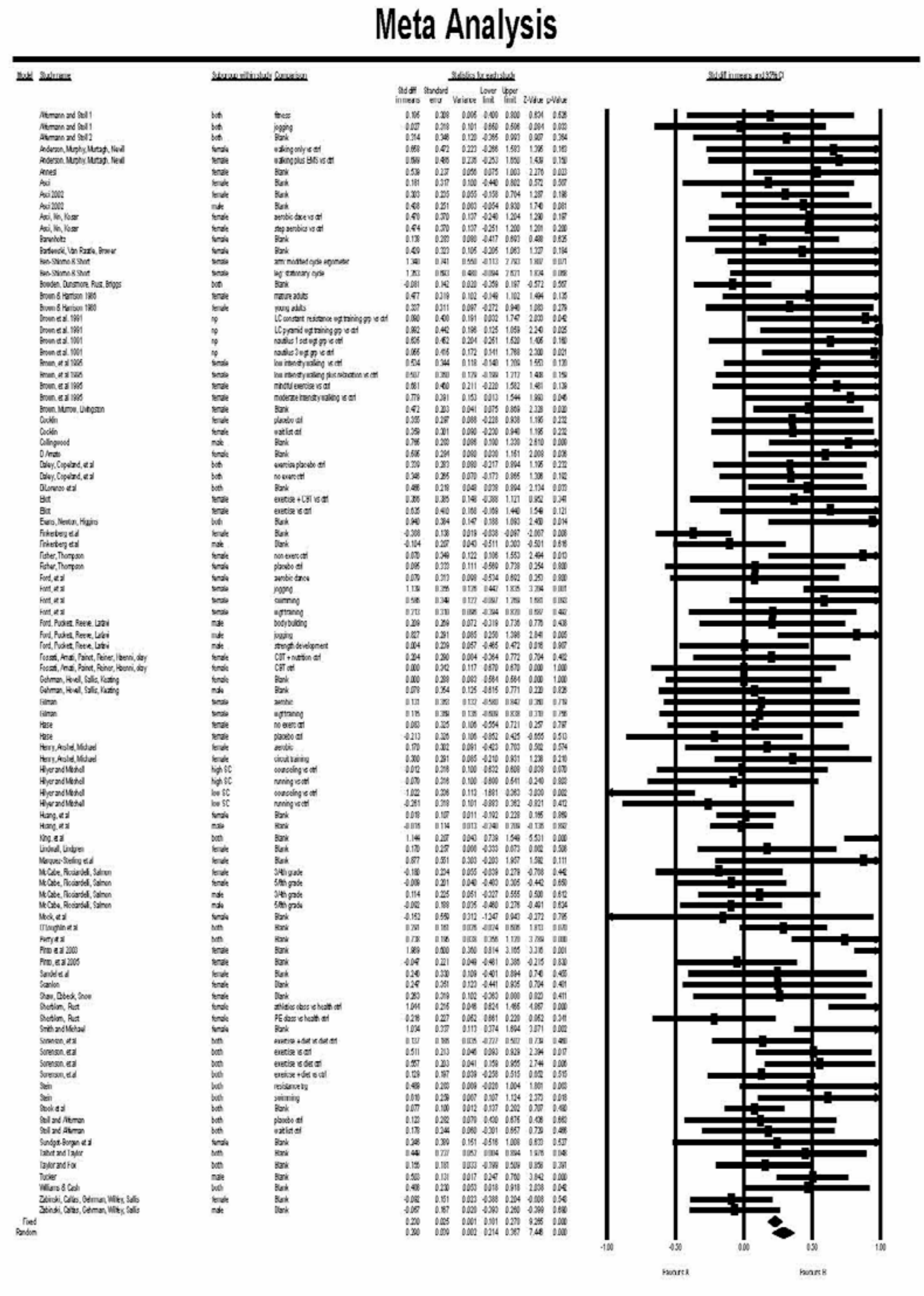

Figure 4-1. Forest plot

Figure 4-2. Funnel plot

Figure 4-3. Funnel plot with imputed values

CHAPTER 5
DISCUSSION

The main purpose of my review was to provide a statistical summary of exercise intervention programs and their effects on body image. A small overall mean effect size was found indicating that exercise interventions resulted in improvements in body image compared to a control group. Thus, my results revealed that exercise interventions are effective in reducing body image concerns, and may be considered as an alternative efficacious treatment for body image concerns along with the typical therapies (e.g., psychoeducational, cognitive-behavioral). Given the heterogeneity in the effects from these interventions, I examined participant, design, and exercise intervention features that may account for the heterogeneity. Below I discuss the findings with regard to the publication bias, moderators, the health implications, study limitations, and directions for future research.

Publication Bias

Because not all studies, especially those with nonsignificant findings or small treatment effects, are published this can lead to a bias in the studies included in the meta-analysis. To avoid overestimating the true size of the treatment effect and subsequent inferences, it is necessary to assess the likelihood of publication bias (Borenstein, Hedges, Higgins, & Rothstein, 2007). Thus, I examined the following methods to examine publication bias: funnel plot, classic fail-safe *N*, Orwin fail-safe *N*, Egger's test of intercept, as well as Duval and Tweedie's trim and fill. Below I discuss each of these publication bias findings and the implications of these finding on result interpretation.

Examination of the funnel plot distribution was suggestive of publication bias. More specifically, the bottom of the funnel plot showed a higher concentration of studies to the right of the mean indicating that smaller studies were more likely to be published if they had larger than average effects (Borenstein et al., 2007). For this reason, both the Rosenthal's classic and Orwin's fail-safe *N* were calculated to further determine if the treatment effect was an artifact of bias. The large number of unpublished null trials (Rosenthal's (N_{fs} = 2,871) and Orwin's (N_{fs} = 128) lead to the conclusion that the findings were unlikely to be biased by the file-drawer problem. The reason for the disparity in Rosenthal's and Orwin's fail-safe *N* is that Rosenthal's *N* assumes that the effect size of the studies that would be added is zero while Orwin's *N* allows specification of a value for the effects of the studies added.

Because the interpretation of a funnel plot is largely subjective, I also calculated Egger's linear regression method to quantify or test the relationship between sample size and effect size (Egger et al., 1997). Egger's test of intercept indicated significant asymmetry ($p < .001$) confirming the funnel plot interpretation of the presence of bias. Thus, the body of evidence suggests that smaller studies reported a larger association than did the larger studies. While Egger's test of intercept provides a more powerful test of asymmetry than the funnel plot the statistical power of the test is also limited by the number of studies included in the meta-analysis.

The Duval and Tweedie's trim and fill procedure also indicated the possibility of some publication bias. Since there are more small studies on the right side of the funnel plot this leads to the assumption that there are studies missing on the left side of the funnel plot (Borenstein et al., 2007). Trim and fill suggested that a total of 28 studies are missing that would need to be imputed in order to yield an unbiased estimate of the *ES* (0.12). It should be noted, however, that CMA-2 states that the present release of trim and fill can occasionally produce an incorrect result which is a potential confound when interpreting its results (BioStat, Englewood, New Jersey). In summary, although these tests provide some evidence of potential publication bias in the data, there are other sources of asymmetry in funnels plots. Table 5-1 shows the potential sources of asymmetry in funnel plots (Khoshdel et al., 2006). Among those is true heterogeneity in the effects (e.g., gender, age). Thus, further analyses investigating the sources of heterogeneity via moderator analyses was warranted.

Moderator Analyses

Participant features

Participant gender. First, in contrast to my hypothesis I did not find that gender moderated the size of the effect. Although I did not find significant gender differences, it is important to note that larger effects were evidenced for female (*M ES* = 0.32) compared to male (*M ES* = 0.19) populations. The nonsignificant findings may be due to the large confidence intervals and the small number of studies exclusively examining male populations. It is not surprising, however, that most studies included in my review focused on female populations because women are more likely than men to report body image concerns, and thus most in need of intervention (Altabe & Thompson, 1993; Elgin & Pritchard, 2006; Feingold & Mazzella, 1998). With the rise in male body-image concerns, and the pressure for men to achieve a “fit” physique, further research is needed examining the gender effects of exercise interventions on body image; in particular with a focus on resistance exercise because men tend to want to increase muscle mass to achieve their ideal physique (McCabe & Ricciardelli, 2004).

Participant age. Consistent with my hypothesis, age moderated the size of the effect (using both a categorical and continuous moderator analysis). For the categorical analysis, I found that intervention effects increased with age until adulthood, and then remained consistent into middle and late adulthood. Comparing the combined youth (elementary, middle, and high school), with university, adult, and older adults provides evidence of larger effects for older compared to younger populations. Second, to corroborate this evidence, mean age moderated the size of the effect (M = 30.04, SD = 15.35; $p < .001$), indicating that the interventions had a greater impact on older compared to younger participants. This age effect may be due to adults reporting higher body image concerns than younger populations (Striegel-Moore & Franko, 2002). Thus, it is not surprising that most of the studies focused on college and adult-aged participants. However, with the increased interest and rise in body image concerns at young ages, further research is needed focusing on preadolescent populations (McCabe & Ricciardelli, 2004; Smolak, 2002). For example, further research is needed examining the effects of exercise on body image in youth considering the high percent that report body image concerns coupled with the increase in obesity.

Participant ethnicity. Evidence was found for the hypothesis that ethnicity would moderate the size of the effect, however, not in the direction predicted. While there were only a few studies that looked at nonCaucasian populations (African American or Hispanic; $N = 3$; 10%), this group had a significantly larger effect than interventions targeting Caucasian populations. I found no support for the hypothesis that Caucasians or having a larger percent Caucasians would have a larger effect. Ethnicity (based on the percentage of Caucasians in a study) did not moderate the size of the effect. Further research is needed examining and reporting ethnic differences to further examine its moderating effect. The low number of studies examining ethnic minorities calls for further research with ethnic minorities. More specifically, only two studies exclusively examined African Americans and one study examined Hispanics. Interestingly, a previous meta-analyses of body image and ethnicity, based on 17,000 participants, found that Asian women reported significantly more eating disturbances/body dissatisfaction than Caucasian women (Wildes, Emery, & Simons, 2001). Furthermore, it was concluded that ethnicity played a role in the influence and development of eating disturbances however the lack of studies examining nonCaucasian populations (i.e., African American, Asian, Hispanic, Arab, Native American) made it impossible to determine how and why these differences exist. Clearly, more research is needed examining minorities as well as research directly comparing Caucasians to ethnic minorities. Future studies should include this descriptive information for better examination of its moderating effect.

Psychological risk status of participants. In contrast to my hypothesis, I found larger intervention effects for universal programs (*M ES* = 0.29) versus selected programs (e.g., eating disordered, high body dissatisfied; *M ES* = 0.23). In contrast to this, research has shown greater intervention effects for selected program participants due to the floor effects for low risk participants and increased likelihood for selected participants to engage more fully in the intervention (Stice & Shaw, 2004). It is possible that while selected participants may be more likely to benefit from interventions they may also be more at risk of harm from the interventions than universal participants (Trikalinos & Ioannidis, 2005). Further research exploring universal versus selected programs should be done to better identify programs that are better suited to provide maximal benefits for these populations.

Although there were not enough ES to run a moderator analysis for psychologically disordered participants or breast cancer patients a preliminary evaluation of the effect of exercise on body image of these populations may prove useful. Of importance, exercise training is associated with increased body satisfaction among women recovering from breast cancer, men and women with paraplegia and quadriplegia, adolescents with postural deformities, and women classified as obese. These findings speak to the robustness of exercise for improving body image within a variety of populations (Martin & Lichtenberger, 2002).

Participant body composition. I did not find support for my hypothesis that larger intervention effects would be evidenced for overweight/obese populations than normal weight populations, however it was approaching significance (p = .07). For body composition, nonsignificant larger effects were found for participants who were overweight/obese (*M ES* = 0.34) at the beginning of the intervention compared to normal weight participants (*M ES* = 0.18). This may be because overweight/obese individuals are at a higher risk for body image disturbances compared to normal weight individuals, and therefore more likely to gain benefits from an exercise intervention. Further research is still needed examining the moderating effect of weight status, as well as changes in body composition, in exercise interventions.

Preintervention fitness level. There was no support for the hypothesis that low activity groups would evidence greater effects than high activity groups. Only 28 of the studies reported preintervention fitness level, and 27 of these studies had participants of low PA levels. Because no studies reported moderate activity or highly active participants exclusively it is difficult to ascertain whether sedentary participants would have produced larger effects. Although moderator analysis was not possible it is commendable that most studies had low activity groups because this group is most in need of and most likely to benefit from interventions compared to high activity groups. Future studies should continue to report the preintervention fitness level and further investigate the influence of sedentary versus active participants on the size of the effect.

Design Features

Control group. In contrast to my hypothesis, the type of control group did not moderate the size of the effect. Although the hypothesis was not supported the effect was in the predicted direction, no-treatment controls had a larger nonsignificant effect size than placebo controls. Similar to these findings, Puetz et al. (2006) found that placebo controls were associated with smaller effect sizes compared to other study designs. Furthermore, they suggest that future studies more clearly report control group procedures to allow for better replication and interpretation of the results. With so much variation in control conditions from study to study and a need to identify how control conditions effect body image, further research is needed examining the “ideal” type of control group for comparison purposes.

Intervention format. In support of my hypothesis, the intervention format significantly moderated the size of the effect. Interactive programs were found to be more effective than didactic programs or a combination of both interactive and didactic, for improving body image. This is in support of previous research which found interactive programs more beneficial for eating disorder preventions (Stice & Shaw, 2004; Tobler et al., 2000). Stice and Shaw (2004) propose that interactive programs are more effective because participants more readily engage in the program facilitating skill acquisition and attitudinal and behavioral change. Future researchers should consider designing exercise-based interventions to further explore the benefits of interactive programs.

Recruitment method. In support of my hypothesis, significant larger effects were found for self-selecting volunteers than for participants recruited through population-based recruitment efforts. This lends further support to the notion that participants who are self-selected are more motivated and engaged more actively in the intervention and will therefore gain more benefits (Stice et al., 2006). It is likely that these self-selecting participants represent the preparation or action stage of change, and are thus intending and motivating to make changes (Prochaska et al, 1994). Participants in the precontemplation and contemplation stage, however, are more likely in need of intervention. Thus, future researchers are encouraged to examine which stage of change their participants are in, and target individuals in the preaction stages.

Random assignment. Contrary to my hypothesis, intervention effects were not found to be larger for interventions that used random assignment relative to other approaches. However, as hypothesized this effect did not reach statistical significance similar to previous health interventions (Stice & Shaw, 2004). Previous research has shown that nonrandomized trials are more likely to both under and over estimate the size of the effect (Conn & Rantz, 2003). Future research should continue to use randomized trials as they are useful in ruling out possible confounds, as well as allow for more precise inferences with regard to intervention effects (Stice & Shaw, 2004)

Publication status. In contrast to the hypothesis and the extant literature, I found that publication status (i.e., unpublished versus published) was not related to the intervention effect size (Hopewell et al., 2007). However, of interest unpublished studies produced nonsignificant larger effects than published studies. My finding provides support for publication status being an inadequate indication for study quality, in part because authors often do not submit studies unless they have statistically significant treatment effects (Conn & Rantz, 2003); illustrating the need to examine publication bias via multiple methods (e.g., funnel plot, fail safe *n*) to obtain a more accurate picture of publication bias in the extant literature.

Validated body image measure. The hypothesis that interventions using validated outcome measures would observe larger intervention effects than interventions that used unstandardized measures was not supported. A nonsignificant larger effect was found for standardized measures, which is consistent with the hypothesis, however this may be due to the large confidence interval and minimal number of studies that used unvalidated measures. It is commendable that most researchers employed a standardized measure (95%) and future studies should continue to do so. It was my original intent to examine body image categories. However, most of the *ES* represented the attitudinal component of body image (i.e., body dissatisfaction), which is the most common type of body image examined (Thompson &Van Den Berg, 2002). Since body image is a multidimensional construct encompassing perceptual, affective, cognitive, sociocultural, and behavioral components future researchers are encouraged to examine the effects of exercise on body image using a multidimensional body image approach to gain a more comprehensive view of body image

Exercise Intervention Features

Exercise Dose. I found no support for my hypothesis that exercise interventions that met the ACSM physical activity guidelines would result in larger effects than interventions that did not meet the guidelines. It should be noted that most studies (70%) did not meet the ACSM physical activity guidelines, and future interventions should strive to meet these guidelines to more clearly determine a standard for future exercise interventions. I also found no support for my hypothesis that the intervention effect would be stronger for prevention programs with a long versus short length (in weeks). Furthermore, although the exercise dose-response is well established for the physical health benefits of physical activity (ACSM, 2000) I did not find a moderating effect for exercise duration, intensity, or length. I did, however, find that exercise frequency moderated the size of the effect, with greater exercise frequency per week resulting in larger effect sizes. Additionally, I did not find significant support for the hypothesis that larger effects would be evidenced for resistance training-based interventions than aerobic-based interventions. It should be noted, however, that larger effects were evidenced in the predicted direction for resistance interventions (*M ES* = 0.38) versus aerobic interventions (*M ES* = 0.29). Finally, no moderating effect was found for follow-ups, most likely because only a few studies conducted follow-ups (18%), so it is uncertain whether fitness interventions produce lasting body image change. Further research into the issue of the dose-response is clearly important and much needed, and should be systematically examined in future intervention studies.

Physical fitness. Examination of the hypothesis that programs that increase physical fitness have larger intervention effects than those that do not increase activity revealed that the fitness level improvements moderated the size of the effect for the control group, but not for the experimental group. That is, for the experimental groups the size of the effect did not differ for participants whose fitness level improved from pre to post intervention versus participants whose fitness level did not improve from pre to post intervention. In the control group, the size of the effect for participants whose fitness level did not improve from pre to post was larger than for those that did improve. However, this may be due to the small number of studies that found improvements in fitness of the control groups.

Intervention specificity. An examination of the moderating effect of intervention specificity on the size of the effect found that exercise specificity moderated the size of the effect, with larger effects evidenced for specific compared to nonspecific interventions. On the other hand, Puetz et al. (2006) found that specific interventions yielded smaller effects than other interventions, but this also may have been due to type of control group used. Clearly it is not known whether specificity independently moderates the size of the effect. Because little is known about how or why exercise specificity moderates this effect future research should focus on further exploring the exercise interventions both alone and in conjunction with other therapies.

Theory. My hypothesis that body image assessments that are selected based on a theoretical model will produce larger effects than nontheoretical assessments was not supported. It should be noted that although the results were nonsignificant, studies that used theory for measure selection produced larger effects than those that did not. Similarly, my hypothesis that exercise interventions that are developed based on theoretical models will produce larger effects than nontheoretical exercise interventions was not supported, however approaching significance ($p = .07$). These nonsignificant findings may be due to a lack of studies employing theories for both measure selection and exercise intervention development. Future studies should consider the use of theoretical models in both intervention design and measure selection, as they tend to produce larger effects (Sallis, 2001).

Limitations

Limitations of the extant literature include the lack of studies examining male populations as well as nonCaucasian populations. Without further research examining these two subgroups it is not possible to generalize the findings of this study to such populations. Furthermore, many studies did not adequately prescribe, monitor, and control the frequency, duration, and intensity of the exercise to ensure fitness gains. Despite this limitation it is still possible to examine the psychological effects of participation in an exercise program independent of changes in fitness. However, it does not permit the examination of the psychological effects of increased fitness. Similarly, researchers have not adequately described the physiological measures that were used to assess change in fitness and often assumed that participation in an exercise program was synonymous with increased fitness. Finally, while many studies demonstrated the effects of exercise on body image over limited periods of time, very few studies have been designed to examine the long-term intervention phase of a study in a nonclinical population. The question as to whether the effects of exercise are transitory (i.e., only lasting as long as the intervention) or long term (i.e., continuing after cessation of the intervention) remains virtually unexplored.

Limitations specific to my meta-analysis include search limitations. That is, although an attempt was made to exhaustively identify eligible studies through the search strategies, limitations do exist. For example, the computer-based searches were limited to MEDLINE. Because none of the electronic databases include all published studies, searching multiple databases is recommended. For example, searching EMBASE can add up to 30% more references, mainly from European journals that are not indexed on MEDLINE (Khoshdel et al., 2006). Of note, omission of EMBASE electronic database references does not appear to bias the results of meta-analysis, but only reduces precision (Suarez et al., 2000).

Further limitations of this meta-analysis are similar to criticisms of meta-analyses in general (Borenstein et al., 2007). For example, the file drawer problem can occur if the collection of studies is based on a biased sample of studies that will be reflected in the overall effect size. Several methods exist to assess and determine the extent of bias and meta-analysis allows us to quantify this bias. Another criticism of meta-analyses is the possibility of combining studies with different characteristics that can overlook important differences between the studies. However, meta-analysis allows for the synthesis of varying studies through exclusion criteria to determine the similarity of included studies. Meta-analysis also allows for generalizability of the findings based on the studies included. Lastly, critics claim that meta-analyses are inevitably performed poorly because of the complexity of meta-analysis, which leads to mistakes. As Borenstein et al. (2007) states primary studies are performed poorly and have flaws but these flaws are "in the application of the method, rather than problems with the method itself." Researchers should consider these flaws and their impact on the analysis in order to prevent them in subsequent meta-analyses.

Future Directions

In addition to the future directions discussed in the individual moderator analyses above, one important next step toward science-based practice is the need to better understand which biological, psychological, and social aspects of chronic exercise contribute to improved body image. For example, exercise interventions often involve substantial social interaction. Thus, if the effect of chronic exercise on body image is to be understood, it is critical to investigate or control for variables that are independent of exercise itself, such as social interaction (Puetz et al., 2006). If the factors that derive body image change can be identified, then exercise interventions can be designed to be more effective by targeting these mechanisms. It is most likely that objective physical characteristic changes (e.g., weight loss) are just one set of variables that can influence body image. Indeed, Cash's (2002) cognitive-behavioral model of body image identifies physical characteristics as one of four developmental influences on body image (in addition to cultural socialization, interpersonal experiences, and personality variables). Of relevance to understanding the effects of exercise, Cash noted that changes in body weight, muscularity, and physical competence can all influence body image.

Another set of variables that might explain the effects of exercise on body image are changes in people's perceptions of their physical characteristics. For example, strength training can make exercisers feel stronger, thinner, and more toned. These perceived physical changes may elicit improvements in body image independent of objective physical changes (Martin & Lichtenberger, 2002). In support of this, Martin Ginis et al. (2005) found that body image improvements were related to subjective physical changes in participants of a 12-week strength-training program. In short, although there is sound evidence that exercise produces positive changes in well-being through improved physical self-perceptions, the question still remains as to the main mechanisms underpinning such change. For the fine-tuning of intervention design, it is important not only for mechanisms to be determined but also for the conditions under which they optimally function to be identified.

Conclusion

In summary, as Borenstein et al. (2007) stated, the goal of meta-analysis is to "broaden the base of studies in some way, expand the question, and study the pattern of answers." As such, this meta-analysis provides further evidence that exercise represents an innovative, practical, and widely disseminable intervention for negative body image. Although small effect sizes for the effects of exercise on body image were found, it is important to emphasize the advantages of exercise over other types of therapy, such as cognitive-behavioral therapy. For example, exercise has the ability to reach and benefit large audiences. Other practical advantages of exercise are that compared to other interventions, exercise has a relatively low cost, negligible negative side effects, and is a socially acceptable behavior; which may result in greater treatment acceptance. Finally, exercise is self-sustaining because it can be maintained once the basic skills are learnt. Further research is needed comparing exercise to other body image interventions to determine its effectiveness in randomized controlled trials.

Table 5-1. Khoshdel's potential sources of asymmetry in funnel plots

Selection bias
Publication and reporting bias
Biased inclusion criteria
True heterogeneity: size of effect differs according to study size
Intensity of intervention
Differences in underlying risk
Data irregularities
Poor methodological design of small studies
Inadequate analysis
Fraud
Artefact: due to poor choice of effect measure
Chance

Reference: Khoshdel, A., Attia, J., & Carney, S. L. (2006). Basic concepts in meta-analysis: A primer for clinicians. *International Journal of Clinical Practice*, *60*, 1287 – 1294.

APPENDIX A
LIST OF JOURNALS MANUALLY SEARCHED

List of Journals Manually Searched:
Body Image: An International Journal
Eating and Weight Disorders
Eating Disorders: A Journal of Treatment and Prevention
Health Psychology
International Journal of Eating Disorders
International Journal of Sport and Exercise Psychology
Journal of Applied Sport Psychology
Journal of Sport & Exercise Psychology
Perceptual and Motor Skills
Psychology of Sport and Exercise

APPENDIX B
LETTER TO ACTIVE RESEARCHERS

Dear Colleague,

The Exercise Psychology lab here at the University of Florida is conducting a meta-analysis on the relationship between exercise interventions and body image. We are looking for data from experimental studies which are not readily available through search engines or the UF school libraries (e.g. dissertations, master's theses, unpublished data, poster presentations, in review articles, etc.).

We would appreciate any relevant data to add to our meta-analysis. Please only include findings from experimental studies with both an exercise and control group. We will be more than happy to cite your research in the paper if it is used. Studies or relevant data can be mailed to the postal address below, sent as a reply to this email, or emailed to Dr. Heather Hausenblas at heatherh@hhp.ufl.edu

Exercise Psychology Lab
University of Florida
P.O. Box 118205
Gainesville, FL 32611-8205

We have attached a table detailing the information needed (e.g., population, type of intervention, sample size, etc.). If all the given information is available in the research you send it is not necessary to fill out the table. Any information you can provide us with would be greatly appreciated. If there are any question or concerns regarding the study please feel free to contact us. Thank you.

Sincerely,

Dr. Heather Hausenblas, Associate Professor, Director of Exercise Psychology Laboratory, University of Florida

Anna Campbell, M.S. Student, Sports and Exercise Psychology, University of Florida

APPENDIX C
TABLE TO ACTIVE RESEARCHERS

Author Name(s) and Country	
Publication Year	
Type of Study (published article, thesis, dissertation, unpublished data, etc.)	
Sample Size (include sex of population or # of males/females)	
Sample Population (university students, children, eating disordered, etc.)	
Participant Ethnicity (and % if available)	
Participant Age (mean and range)	
Participant Body Composition (normal, overweight, obese) and Activity Level Pre-intervention (sedentary, active)	
Exercise Intervention Frequency (per week), Duration (in minutes), and Length (in weeks)	
Type of Exercise Performed (aerobic, resistance, both, etc.)	
Intervention Type (individual/home based, group based, etc.)	
Theory Used for Exercise Intervention	
Type of Control (no treatment, placebo control, activity control, etc.)	
Body Image Measure(s)	
Results (e.g., M, SD for EXP and CONTROL group, F value, sign level, etc.)	

APPENDIX D
CODING SHEET

GENERAL CHARACTERISTICS
1) Study #____________

2) Author's Names: ____

3) Year of Publication: ____________

4) Country of Origin: 1 = United States 2 = Canada 3 = Australia 4 = United Kingdom

PARTICIPANT FEATURES
5) Age: Mean= ____ Group: 1 = Elementary, 2 = Middle, 3 = High, 4 = Univer, 5 = Adults, 6 = Older Adults

6) Sex: 1 = Female 2 = Male 3 = Both

7) Ethnicity: A) Caucasian ________% (if given)
B) Dominant Ethnic Group: 1 =Caucasian, 2 = African American, 3 = Hispanic, 4 = Other

8) Risk Status: 1 = Universal 2 = Selected [High Risk Population (e.g. eating disordered)]

9) Body Composition: 1 = Normal weight 2 = Overweight/Obese

10) Fitness Level at Preintervention: 1 = Sedentary/Low Active 2 = Active

EXERCISE INTERVENTION FEATURES
11) Type: 1 = Aerobic 2 = Resistance Training 3 = Resistance and Aerobic

12) Duration (in minutes): ____________

13) Length of intervention (in weeks): ____________ 14) Frequency: ____________

15) Intensity of exercise performed: 1 = Light 2 = Moderate 3 = Hard/Very Hard

16) Length of follow-up (in weeks): ____________

17) Fitness Exp: 1 = Improve 2 = No Improve

18) Body Composition Exp: 1 = Improve 2 = No Improve

19) Fitness Control: 1 = Improve 2 = No Improve

20) Body Composition Control: 1 = Improve 2 = No Improve

21) Specificity: 1 = Exercise Only 2 = Exercise in Addition to Another Treatment

22) Experimental Intervention Type: 1 = Individual-based 2 = Group-based 3 = Both

23) Meet Exercise Guidelines: 1 = Yes 2 = No

24) Theory Used for Exercise Intervention: 1 = Yes, 2 = No Describe ____________________________

Theory Used for Measure Selection: 1 = Yes, 2 = No Describe ____________________________

DESIGN AND STUDY FEATURES

25) Control Group: 1 = No treatment (usual care); 2 = Placebo control (Health Ed. class); 3 = Activity control

26) Recruitment Method: 1 = Self-selected 2 = Not self-selected

27) Publication Status: 1 = Published 2 = Unpublished

28) Attrition Rate: ________% Dropout

29) Random Assignment: 1 = Yes 2 = No

30) Exercise Intervention: 1 = Exercise-based 2 = Lecture-based 3 = Both

MEASURE FEATURES

31) Measure of exercise/fitness: 1 = Self-Report; 2 = Objective Describe_________________________

32) Body Image Outcome Measure:

____

____

33) Standardized Measure with established validity and reliability: 1 = Yes 2 = No

34) Number of Body Image Measures: ___________

35) Correction Factor Needed: 1. Yes; 2. No (If higher scores = less pathology, correction factor is needed)

EFFECT SIZE INFORMATION: ***Continuous (Ms) Unmatched Groups, Pre and Post Data (select 1)***

A. Means, SD pre and post, N, in each group, pre/post corr
Exercise Group: Pre M_____ Pre SD______ Post M ______ Post SD ______ N _____
Control Group: Pre M_____ Pre SD______ Post M ______ Post SD ______ N _____
Pre-Post correlation: _________

B. Means, SD difference, N, in each group, pre/post corr
Exercise Group: Pre M_____ Post M ______ Difference SD _____ N _____
Control Group: Pre M_____ Post M ______ Difference SD ______ N _____
Pre-Post correlation: _________

C. Means pre and post in each group, t within groups, N
Exercise Group: Pre M_____ Post M ______ Paired t for change _____ N _____
Control Group: Pre M_____ Post M ______ Paired t for change ______ N _____
Pre-Post correlation: _________

D. Means pre and post in each group, p within groups, N
Exercise Group: Pre M_____ Post M ______ Paired p for change ______ N _____
Control Group: Pre M_____ Post M ______ Paired p for change ______ N _____
Tails for p-value: _______ Pre-Post correlation: _________

E. Means pre and post in each group, F for differences between changes, N
Exercise Group: Pre M_____ Post M ______ N _____
Control Group: Pre M_____ Post M ______ N _____
F for difference: _______ Pre-Post correlation: _________

F. Mean change, SD pre and post, N, in each group, Pre/post corr

Exercise Group: M Change_____ Pre SD ______ Post SD ______ N _____
Control Group: M Change_____ Pre SD ______ Post SD ______ N _____
Pre-Post correlation: _________

G. Mean change, SD difference, N, in each group, pre/post corr
Exercise Group: M Change _____ Difference SD ______ N _____
Control Group: M Change _____ Difference SD ______ N _____
Pre-Post correlation: _________

H. Mean change in each group, t within groups, N
Exercise Group: M Change_____ Paired t for change ______ N _____
Control Group: M Change_____ Paired t for change ______ N _____
Pre-Post correlation: _________

I. Mean change in each group, p within groups, N
Exercise Group: M Change_____ Paired p for change ______ N _____
Control Group: M Change_____ Paired p for change ______ N _____
Tails for p values______ Pre-Post correlation: _________

J. Mean change in each group, F for difference between changes, N
Exercise Group: M Change_____ N _____
Control Group: M Change_____ N _____
F for difference: ________ Pre-Post correlation: _________

K. F for difference between changes, N
Exercise Group: N _____
Control Group: N _____
F for difference: ________ Pre-Post correlation: _________

NOTE:

APPENDIX E
MODERATOR TABLE

Table E-1. Moderator table

Moderator	*Value*	*Coding Description and Criteria*
Participant Features		
Age		
Mean	Continuous	Mean age of participants at baseline.
Range	Continuous	Number of values in the age range (e.g., 18 – 22 = 5). When age range was not reported.grade range was substituted (+2 because most grade levels include students from 2 age levels).
Gender	1 = Female, 2 = Male, 3 = Both = 3	Categorical variable representing whether intervention assessed females only, males only, or both genders.
Ethnicity		
% Caucasian	% Caucasian	Percentage of participants from the entire sample (at baseline) who were Caucasian because Caucasians are at highest risk for body-image disturbance.
Dominant Ethnic Group	1 = Caucasian, 2 = African American, 3 = Hispanic, 4 = Other	Ethnic group representing most of the sample.
Risk Status	1 = Universal, 2 = Selected	Categorical variable representing whether the study was universally implemented or whether study participants were selected because they are a group at increased risk for body-image disturbance (e.g., eating disordered, overweight)
Body Composition	1 = Normal Weight, 2 = Overweight/obese	Categorical variable representing whether the population was overweight/obese or normal weight using the classification of overweight and obesity by BMI. Because there were so few studies that examined underweight populations, we combined normal and underweight populations. Similarly, because of the low number of obese populations, we combined overweight and obese populations.
Fitness Level Preintervention	1 = Sedentary, 2 = Low Active; 3 = Active	Categorical variable representing the fitness level of participants. Sedentary represents no physical activity; low active represents exercising less than the ACSM guidelines; active represents meeting the ACSM guidelines.

Table E-1. Continued

Moderator	*Value*	*Coding Description and Criteria*
Exercise Intervention Features		
Type	1= Aerobic, 2 = Resistance Training, 3 = Both	Categorical variable representing whether the exercise intervention consisted of aerobic, resistance training, or both.
Duration	Continuous	Number of minutes per session excluding warmup and cooldown.
Length	Continuous	Length of exercise intervention in weeks.
Frequency	Continuous	Number of sessions per week.
Intensity	1 = Light, 2 = Moderate, 3 = Hard/Very Hard	Categorical variable representing the intensity of exercise based on the ACSM (2000, p. 150) classification table.
Physical Fitness	1 = Improvement, 2 = No Improvement, 3 = Not Reported	Categorical variable representing whether the intervention group showed improvement from pre to post intervention on physical fitness.
Specificity	1 = Exercise Only, 2 = Exercise in Addition to Another Treatment	Categorical variable representing whether the intervention was an exercise only group, or exercise in addition to another treatment (cognitive-behavioral theory, weight management).
Meet Guidelines	1= Yes; 2 = No	Categorical variable representing whether the exercise intervention met the ACSM (2000) guidelines of exercising 3 – 5 times a week, at a moderate intensity level for 30 minutes per session.
Design and Study Features		
Control Group	1 = No treatment, 2 = Placebo control, 3 = Activity control	The literature allowed for a meaningful statistical comparison when control condition variable was coded into 2 categories: no-treatment (e.g., usual care) placebo controls (e.g., cognitively oriented or health education classes), and activity controls (e.g., yoga)
Recruitment Method	1 = Self-selected, 2 = Not self-selected	Categorical variable representing whether participants were recruited through a population-based strategy (e.g., at particular school) or self-selected in response to broader recruitment efforts (e.g., media advertisement).
Publication Status	1 = Published, 2 = Unpublished	Categorical variable representing whether report was published (peer-reviewed journal article) or unpublished (e.g., master's thesis, dissertation). If 2 separate reports were used to code a single study (e.g., dissertation and published report in scientific journal), we coded the type of the more formally published report (i.e., journal article).

APPENDIX F
EFFECT SIZE INFORMATION

Table F-1. Categorical random effect size (ES) information

	Mean ES	*Standard Error*	± 95% *CI*	*Number of ES*	*p value*
PARTICIPANT					
Gender					
Male	0.189	0.092	0.180	12	0.039
Female	0.300	0.056	0.100	55	*
Both	0.281	0.070	0.138	27	*
Age					
Elementary	0.006	0.072	0.141	7	0.929
Middle	0.239	0.168	0.330	8	0.155
High school	0.478	0.283	0.555	2	0.091
University	0.225	0.066	0.130	35	0.001
Adults	0.442	0.064	0.126	26	*
Older Adults	0.329	0.100	0.197	12	0.001
Combined (elementary, middle, and high school)	0.160	0.088	0.172	17	0.068
Ethnicity					
Caucasian	0.200	0.063	0.124	26	0.001
NonCaucasian	0.692	0.138	0.270	3	*
Psychological Risk Status					
Universal	0.289	0.044	0.085	72	*
Selected	0.231	0.105	0.206	17	0.028
Breast Cancer	0.143	0.284	0.557	2	0.614
Psychological Disorder	0.243	0.328	0.643	3	0.459
Body Composition					
Normal	0.180	0.053	0.105	30	0.001
Overweight	0.338	0.069	0.136	24	*
Preintervention Fitness Level					
Sedentary/Low Activity	0.415	0.051	0.100	42	*
Sedentary & Active	0.405	0.223	0.437	2	0.069
DESIGN					
Type of Control Group					
No treatment	0.369	0.055	0.108	49	*
Placebo	0.232	0.060	0.117	41	*
Active	0.138	0.135	0.265	8	0.305
Exercise Intervention					
Exercise-based	0.376	0.050	0.097	69	*
Lecture-based	0.129	0.095	0.186	6	0.173
Both	0.120	0.066	0.129	23	0.066

Table F-1. Continued

	Mean ES	*Standard Error*	± 95% *CI*	*Number of ES*	*p value*
Recruitment Method					
Self-selected	0.379	0.059	0.117	38	*
Nonself-selected	0.220	0.054	0.105	53	*
Random Assignment					
Yes	0.257	0.047	0.093	60	*
No	0.336	0.067	0.131	38	*
Publication Status					
Published	0.291	0.043	0.084	85	*
Unpublished	0.322	0.087	0.171	13	*
Country of Origin					
US	0.330	0.056	0.109	66	*
Canada	0.166	0.087	0.171	3	0.057
Australia	0.041	0.141	0.275	5	0.770
UK	0.334	0.108	0.212	6	0.002
Turkey	0.362	0.131	0.257	5	0.006
Sweden	0.170	0.257	0.503	1	0.508
Switzerland	0.119	0.221	0.434	2	0.591
Norway	0.314	0.098	0.192	5	0.001
Germany	0.154	0.131	0.257	5	0.241
Validated Measure					
Standardized	0.295	0.039	0.077	92	*
Unstandardized	0.201	0.195	0.382	6	0.302
Measure of Fitness					
Self-report	0.226	0.089	0.174	12	0.011
Objective	0.392	0.066	0.129	39	*
Both	0.172	0.109	0.214	5	0.113
EXERCISE					
Mode					
Aerobic	0.291	0.060	0.118	53	*
Resistance	0.375	0.067	0.131	17	*
Both	0.268	0.074	0.145	23	*
Met Exercise Guidelines					
Yes	0.301	0.113	0.222	14	0.008
No	0.316	0.043	0.085	72	*
Specificity of Exercise					
Specific	0.367	0.053	0.104	61	*
Nonspecific	0.141	0.052	0.102	33	0.007
Experimental Intervention Type					
Individual-based	0.341	0.111	0.217	12	0.002
Group-based	0.262	0.044	0.087	75	*
Both	0.320	0.132	0.260	7	0.016

Table F-1. Continued

	Mean ES	*Standard Error*	± 95% *CI*	*Number of ES*	*p value*
Intensity of Exercise					
Light	0.384	0.129	0.254	4	0.003
Moderate	0.358	0.069	0.135	31	*
Hard/Very Hard	0.286	0.079	0.155	13	*
Fitness – Experimental					
Improve	0.344	0.064	0.126	37	*
No Improve	0.351	0.094	0.184	14	*
Body Composition – Experimental					
Improve	0.458	0.153	0.301	9	0.003
No Improve	0.398	0.079	0.155	20	*
Fitness – Control					
Improve	0.152	0.102	0.200	2	0.136
No Improve	0.397	0.054	0.105	42	*
Body Composition – Control					
Improve	0.099	0.214	0.420	2	0.643
No Improve	0.423	0.071	0.138	26	*
Theory Used for Measure Selection					
Yes	0.431	0.143	0.281	4	0.003
No	0.286	0.040	0.079	94	*
Theory Used for Exercise					
Intervention	0.181	0.060	0.117	21	0.002
Yes	0.320	0.047	0.093	77	*
No					

Note: CI = confidence interval; * = $p < .001$

Table F-2. Continuous mixed ES information

	z value	*p value*	*Number of ES*
PARTICIPANT			
Age	2.074	0.038	81
% Caucasian	0.074	0.941	28
DESIGN			
Attrition Rate %	-0.515	0.607	49
Year of Publication	-1.490	0.136	98
EXERCISE			
Duration (in min.)	0.248	0.804	76
Length (in weeks)	-0.107	0.915	93
Frequency (per week)	2.416	0.016	79
Follow-up (in weeks)	-0.243	0.808	13

Table F-3. Categorical fixed ES information

	Mean ES	*Standard Error*	± 95% *CI*	*Number of ES*	*p value*
PARTICIPANT					
Gender					
Male	0.163	0.056	0.110	12	0.004
Female	0.212	0.037	0.074	55	*
Both	0.266	0.042	0.082	27	*
Age					
Elementary	0.006	0.072	0.141	7	0.929
Middle	0.281	0.097	0.189	8	0.004
High school	0.530	0.155	0.304	2	0.001
University	0.178	0.040	0.079	35	*
Adults	0.442	0.056	0.110	26	*
Older Adults	0.296	0.082	0.161	12	*
Combined (elementary, middle, and high school)	0.156	0.054	0.106	17	0.004
Ethnicity					
Caucasian	0.140	0.042	0.082	26	0.001
NonCaucasian	0.691	0.136	0.267	3	*
Psychological Risk Status					
Universal	0.222	0.027	0.054	72	*
Selected	0.221	0.069	0.135	17	0.001
Breast Cancer	0.143	0.284	0.557	2	0.614
Psychological Disorder	0.201	0.197	0.387	3	0.308
Body Composition					
Normal	0.161	0.043	0.085	30	*
Overweight	0.242	0.046	0.091	24	*
Preintervention Fitness Level					
Sedentary/Low Activity	0.408	0.043	0.085	42	*
Sedentary & Active	0.405	0.223	0.437	2	0.069
DESIGN					
Type of Control Group					
No treatment	0.269	0.035	0.069	49	*
Placebo	0.227	0.039	0.077	41	*
Active	0.023	0.082	0.161	8	0.775
Exercise Intervention					
Exercise-based	0.330	0.033	0.065	69	*
Lecture-based	0.089	0.066	0.129	6	0.177
Both	0.107	0.046	0.090	23	0.019
Recruitment Method					
Self-selected	0.338	0.045	0.089	38	*
Nonself-selected	0.192	0.033	0.064	53	*

Table F-3. Continued

	Mean ES	*Standard Error*	± 95% *CI*	*Number of ES*	*p value*
Random Assignment					
Yes	0.204	0.032	0.064	60	*
No	0.226	0.039	0.076	38	*
Publication Status					
Published	0.222	0.026	0.051	85	*
Unpublished	0.322	0.087	0.171	13	*
Country of Origin					
US	0.241	0.031	0.060	66	*
Canada	0.166	0.087	0.170	3	0.057
Australia	0.006	0.101	0.199	5	0.956
UK	0.334	0.108	0.212	6	0.002
Turkey	0.362	0.131	0.257	5	0.006
Sweden	0.170	0.257	0.503	1	0.508
Switzerland	0.119	0.221	0.434	2	0.591
Norway	0.313	0.096	0.189	5	0.001
Germany	0.154	0.131	0.257	5	0.241
Validated Measure					
Standardized	0.232	0.026	0.051	92	*
Unstandardized	0.210	0.081	0.159	6	0.009
Measure of Fitness					
Self-report	0.191	0.067	0.132	12	0.05
Objective	0.377	0.043	0.085	39	*
Both	0.172	0.109	0.214	5	0.113
EXERCISE					
Mode					
Aerobic	0.232	0.036	0.070	53	*
Resistance	0.375	0.067	0.131	17	*
Both	0.214	0.050	0.098	23	*
Met Exercise Guidelines					
Yes	0.146	0.052	0.102	14	0.005
No	0.268	0.030	0.059	72	*
Specificity of Exercise					
Specific	0.321	0.034	0.067	61	*
Nonspecific	0.111	0.037	0.073	33	0.003
Experimental Intervention Type					
Individual-based	0.214	0.054	0.106	12	*
Group-based	0.219	0.029	0.057	75	*
Both	0.320	0.132	0.20	7	0.016
Intensity of Exercise					
Light	0.384	0.129	0.254	4	0.003
Moderate	0.318	0.046	0.090	31	*
Hard/Very Hard	0.255	0.068	0.134	13	*

Table F-3. Continued

	Mean ES	*Standard Error*	± 95% *CI*	*Number of ES*	*p value*
Fitness – Experimental					
Improve	0.321	0.039	0.077	37	*
No Improve	0.315	0.083	0.163	14	*
Body Composition – Experimental					
Improve	0.515	0.102	0.201	9	*
No Improve	0.331	0.055	0.108	20	*
Fitness – Control					
Improve	0.145	0.090	0.177	2	0.109
No Improve	0.371	0.043	0.084	42	*
Body Composition – Control					
Improve	0.099	0.214	0.420	2	0.643
No Improve	0.376	0.050	0.098	26	*
Theory Used for Measure Selection					
Yes	0.431	0.143	0.281	4	0.003
No	0.224	0.025	0.05	94	*
Theory Used for Exercise					
Intervention	0.138	0.045	0.089	21	0.002
Yes	0.269	0.030	0.058	77	*
No					

Note: CI = confidence interval; * = $p < .001$

Table F-4. Continuous fixed ES information

	z value	*p value*	*Number of ES*
PARTICIPANT			
Age	3.320	*	81
% Caucasian	-0.168	0.867	28
DESIGN			
Attrition Rate %	-0.884	0.377	49
Year of Publication	-3.546	*	98
EXERCISE			
Duration (in min.)	0.655	0.513	76
Length (in weeks)	0.018	0.986	93
Frequency (per week)	3.594	*	79
Follow-up (in weeks)	-0.243	0.808	13

Note: * = $p < .001$

APPENDIX G
OUTLIER TABLE

Table G-1. Outlier table

Author	*ES (SE)*	*Z-Value*	*M Fixed ES (with removal)*	*M Random ES (with removal)*	*Potential Reason for Outlier*
Annessi (2005)	0.54 (0.24)	2.28	0.22 (0.03)	0.22 (0.05)	1. Population: Sedentary 2. Sample Size: E= 48, C = 30
Brown, Morrow, & Livingston (1982)	0.47 (0.20)	2.33	0.21 (0.03)	0.28 (0.05)	1. Population: Low in self-concept
Brown, Wang, Hinkle, Webber, Ahlquist, Puleo, et al. (1991)	0.89 (0.44)	2.03	0.22 (0.03)	0.28 (0.05)	1. Sample size: E1 = 11, E2 = 11, E3 = 9, E4 = 14, C = 12
Collingwood (1972)	0.77 (0.29)	2.61	0.21 (0.03)	0.28 (0.05)	1. Intervention: Short length = 4 weeks
D'Amato (1981)	0.60 (0.28)	2.10	0.22 (0.03)	0.28 (0.05)	1. Intervention: Inconsistent duration due to variation of 15 to 30 minutes depending on fitness level
DiLorenzo, Bargman, Stucky-Ropp, Brassington, Frensch, & LaFontaine (1999)	0.47 (0.22)	2.13	0.22 (0.03)	0.28 (0.05)	1. Population: Sedentary 2. Sample size: E = 82, C = 29
Evans, Newton, & Higgins (2005)	0.94 (0.38)	2.45	0.22 (0.03)	0.28 (0.05)	1. Population: Overweight 2. Sample Size: E = 23, C = 11
Finkenberg, DiNucci, & McCune (1993) (females only)	-0.37 (0.14)	-2.67	0.25 (0.03)	0.30 (0.05)	1. Population: Largely female (54%) 2. Sample size: E = 116, C = 99

Table G-1. Continued

Author	*ES (SE)*	*Z-Value*	*M Fixed ES (with removal)*	*M Random ES (with removal)*	*Potential Reason for Outlier*
Fisher & Thompson (1994)	0.87 (0.35)	2.49	0.22 (0.03)	0.28 (0.05)	1. Population: Low on MBSRQ scores
Hilyer & Mitchell (1979) (low self-concept only)	-1.02 (0.34)	-3.04	0.23 (0.03)	0.30 (0.05)	1. Population: Either high or low in self-concept 2. Sample size: total *N* = 120
King, Taylor, Haskell, & DeBusk (1989)	1.14 (0.21)	5.53	0.20 (0.03)	0.26 (0.05)	1. Population: Sedentary 2. Intervention: Long length = 24 weeks
Perry, Rosenblatt, Kempner, Feldman, Paolercio, & Van Bemden (2002)	0.74 (0.19)	3.79	0.21 (0.03)	0.28 (0.05)	1. Population: Mostly Hispanic (72%) 2. Sample size: E = 161, C = 33
Pinto, Clark, Maruyama, et al. (2003)	1.99 (0.60)	3.32	0.22 (0.03)	0.28 (0.05)	1. Population: Overweight, older adult, breast cancer 2. Sample size: E = 12, C = 12
Sherblom & Rust (2004)	1.04 (0.22)	4.87	0.21 (0.03)	0.27 (0.05)	1. Sample size: E1 = 35, E2 = 56, C = 44
Smith & Michel (2006)	1.03 (0.34)	3.07	0.21 (0.03)	0.28 (0.05)	1. Population: Largely African American (60%), overweight, pregnant women
Talbot & Taylor (1998)	0.45 (0.23)	1.98	0.22 (0.03)	0.28 (0.05)	1. Population: Sedentary, older adult, at risk for heart disease
Tucker (1987)	0.50 (0.13)	3.84	0.21 (0.03)	0.28 (0.05)	1. Sample size: E = 114, C = 127

Table G-1. Continued

Author	*ES (SE)*	*Z-Value*	*M Fixed ES (with removal)*	*M Random ES (with removal)*	*Potential Reason for Outlier*
Williams & Cash (2001)	0.47 (0.23)	2.04	0.22 (0.03)	0.28 (0.05)	1. Population: Sedentary, largely African American (56%)
All studies removed:			0.12 (.03)	0.12 (.03)	

Note: E = experimental group; C = control group

APPENDIX H
DESCRIPTIVE CHARACTERISTICS OF STUDIES

Table H-1. Descriptive characteristics of studies included in the meta-analysis

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Alfermann & Stoll (2000)	E = 24 (Resistance + Aerobic) C = 13 (No treatment)	E = 36.7 C = 39.3	Concerns About Physical Attractiveness (α = .54)	Group	24 Moderate
Alfermann & Stoll (2000)	1. E = 31 (Resistance + Aerobic) C = 16* (Placebo)	E & C = 43.2	Concerns About Physical Attractiveness (α = .54)	Group	24 Moderate
	2. E = 26 (Aerobic) C = 16* (Placebo)	E & C = 43.2			
Anderson, Murphy, Murtagh, & Nevill (2006)	1. E = 10 (Aerobic) C = 9* (No treatment)	E & C = 38.1	EDI – Body Dissatisfaction Scale (α = .92)	Individual	8 Moderate
	2. E = 9 (Aerobic) C = 9* (No treatment)	E & C = 38.1			
Annessi (2005)	E = 48 (Aerobic) C = 30 (No treatment)	E & C = 41.4	Body Esteem Scale – Weight Concern subscale (α = .78)	Group	12 Hard/Very Hard
Asci (2002)	Male: E = 33 (Aerobic) C = 32 (Placebo)	E & C = 22.8	Physical Self Perceptions Profile – Attractive Body	Group	10 Hard/Very Hard
	Female: E = 37 (Aerobic) C = 36 (Placebo)	E & C = 21.7			
Asçi (2003)	E = 20 (Aerobic) C = 20 (Placebo)	E = 21.35 C = 21.20	Physical Self-description Questionnaire – Body Fat subscale	Group	10 Hard/Very Hard

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Asci, Kin, & Kosar (1998)	1. E = 15 (Aerobic) C = 15* (Placebo)	Age range = 19-28	Physical Self Perceptions Profile – Physical Attractiveness	Group	8 Moderate
	2. E = 15 (Aerobic) C = 15* (Placebo)	Age range = 19-28			
Barenholtz (1995)	E = 25 (Resist. + Aerobic, TX) C = 25 (No treatment)	Middle school	EDI – Body Dissatisfaction Scale	Group	6 NP
Bartlewski, Van Raalte, & Brewer (1996)	E = 15 (Aerobic) C = 28 (Placebo)	E & C = 22.12	Body Esteem Scale – Weight Concern (α = .87)	Group	10 NP
Ben-Schlomo & Short (1986)	1. E = 5 (Aerobic) C = 5* (No treatment)	Age range = 21-45	Tennessee Self Concept Scale – Physical Self subscale	Group	6 Hard/Very Hard
	2. E = 4 (Aerobic) C = 5* (No treatment)	Age range = 21-45			
Bowden, Rust, Dunsmore, & Briggs (2005)	E = 140 (Resistance + Aerobic) C = 77 (Placebo)	University	SPAS – 12 item	Group	16 NP
Brown & Harrison (1986)	Young: E = 21 (Resistance) C = 21 (No treatment)	E & C = 21.5	Tennessee Self-concept Scale – Physical Self subscale	Group	12 Moderate & Hard
	Mature: E = 23 (Resistance) C = 18 (No treatment)	E & C = 44.4			
Brown, Morrow, & Livingston (1982)	E = 50 (Aerobic, TX) C = 50 (Placebo)	E = 24.2 C = 20.5	Tennessee Self-concept Scale – Physical Self subscale (α = .87)	Group	14 NP

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Brown, Wang, Hinkle, Webber, Ahlquist, Puleo, et al. (1991)	1. E = 11 (Resistance) C = 12* (No treatment)	NP	Body Cathexis Scale	NP	12 Light
	2. E = 11 (Resistance) C = 12* (No treatment)	NP			
	3. E = 9 (Resistance) C = 12* (No treatment)	NP			
	4. E = 14 (Resistance) C = 12* (No treatment)	NP			
Brown, Wang, Ward, Ebbeling, Fortlage, Puleo, Benson, & Rippe (1995)	1. E = 12 (Aerobic) C = 17* (No treatment)	E = 52.7 C = 52.1	Body Cathexis Scale	Group	16 Moderate
	2. E = 18 (Aerobic) C = 17* (No treatment)	E = 53.4 C = 52.1			16 Light
	3. E = 15 (Aerobic, TX) C = 17* (No treatment)	E = 53.7 C = 52.1			
	4. E = 7 (Martial arts, TX) C = 17* (No treatment)	E = 50.9 C = 52.1			
Cocklin (1989)	1. E = 22* (Aerobic) C = 24 (Activity)	E = 25.62 C = 31.21	Body Cathexis Scale	Group	8 Hard/Very Hard
	2. E = 22* (Aerobic) C = 23 (No treatment)	E = 25.62 C = 27.83			
Collingwood (1972)	E = 25 (Resistance + Aerobic) C = 25 (Placebo)	Age range = 18-26	Body Attitude Scale – Evaluative subscale	Group	4 NP
Daley, Copeland, Wright, Roalfe, & Wales (2006)	1. E = 28* (Aerobic, TX) C = 30 (No treatment)	E & C = 13.1	Children and Youth Physical Self-Perception Profile – Attractive Body Adequacy subscale	Individual	8 Moderate
	2. E = 28* (Aerobic, TX) C = 23 (Activity)	E & C = 13.1			

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
D'Amato (1981)	E = 27 (Aerobic) C = 25 (Placebo)	E & C = 26.6	Body Cathexis Scale	Group	8 NP
DiLorenzo, Bargman, Stucky-Ropp, Brassington, Frensch, & LaFontaine (1999)	E = 82 (Aerobic) C = 29 (No treatment)	E = 33.05 C = 29.45	Tennessee Self-Concept Scale – Physical Self subscale	Group	12 Hard/Very Hard
Eliot (1998)	1. E = 13 (Resistance + Aerobic) C = 12* (No treatment)	E = 47.4 C = 38.5	BASS of MBSRQ	Both	6 NP
	2. E = 16 (Resist. + Aerobic, TX) C = 12* (No treatment)	E = 38.9 C = 38.5			
Evans, Newton, & Higgins (2005)	E = 23 (Not specified, TX) C = 11 (No treatment)	E = 34.6 C = 33.6	Clinical Global Impressions – Body Image	Individual	12 NP
Finkenberg, DiNucci, & McCune (1993)	Female: E = 116 (Aerobic) C = 99 (Activity)	University	Body Esteem Scale – Weight Concern (α = .87)	Group	NP
	Male: E = 38 (Aerobic) C = 60 (Activity)	University			
Fisher & Thompson (1994)	1. E = 18* (Resist + Aerobic, TX) C = 18 (Placebo)	E & C = 23.5	EDI –Body Dissatisfaction Scale (α = .91)	Both	6 NP
	2. E = 18* (Resist + Aerobic, TX) C = 18 (No treatment)	E & C = 23.5			

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Ford, Puckett, Blessing, & Tucker (1989)	1. E = 21 (Aerobic) C = 20* (Placebo)	E & C = 19.8	Body Cathexis Scale	Group	8 NP
	2. E = 17 (Aerobic) C = 20* (Placebo)	E & C = 19.8			
	3. E = 15 (Aerobic) C = 20* (Placebo)	E & C = 19.8			
	4. E = 22 (Resistance) C = 20* (Placebo)	E & C = 19.8			
Ford, Puckett, Reeve, & Lafavi (1991)	1. E = 23 (Resistance) C = 35* (Placebo)	University	Body Cathexis Scale	Group	8 NP
	2. E = 35 (Resistance) C = 35* (Placebo)	University			
	3. E = 20 (Aerobic) C = 35* (Placebo)	University			
Fossati, Amati, Painot, Reiner, Haenni, & Golay (2004)	1. E = 25* (Aerobic, TX) C = 13 (Placebo)	E = 37.4 C = 45.6	Body Dissatisfaction of EDI-2	Both	12 NP
	2. E = 25* (Aerobic, TX) C = 23 (Placebo)	E = 37.4 C = 42.3			
Gehrman, Hovell, Sallis, & Keating (2006)	Male: E = 16 (Resist. + Aerobic, TX) C = 16 (Placebo)	E & C = 11.5	Body Dissatisfaction of EDI-2	Group	8 NP
	Female: E = 33 (Resist. + Aerobic, TX) C = 19 (Placebo)	E & C = 11.5			
Gilman (1996)	1. E = 49 (Aerobic) C = 9* (Placebo)	E & C = 20.5	BASS of MBSRQ	Group	14 NP
	2. E = 40 (Resistance) C = 9* (Placebo)	E & C = 20.5			

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Hase (1995)	1. E = 18* (Resistance) C = 20 (Placebo)	E = 14.5 C = 15.0	EDI –Body Dissatisfaction Scale	Group	8 Hard/Very Hard
	2. E = 18* (Resistance) C = 20 (No treatment)	E = 14.5 C = 13.9			
Henry, Anshel, & Michael (2006)	1. E = 23 (Aerobic) C = 21* (Activity)	E = 19.4 C = 20.1	Body Self-image Questionnaire – Fatness Evaluation subscale (α = .94)	Group	12 Moderate
	2. E = 28 (Resistance) C = 21* (Activity)	E = 19.1 C = 20.1			
Hilyer & Mitchell (1979) (High Self-concept: 1 & 2; Low Self-concept: 3 & 4)	1. E = 20 (Aerobic) C = 20* (Placebo)	E & C = 19.8	Tennessee Self-concept Scale – Physical Self subscale (α = .80)	Group	10 NP
	2. E = 20 (Aerobic, TX) C = 20* (Placebo)	E & C = 19.8			
	3. E = 20 (Aerobic) C = 20* (Placebo)	E & C = 19.8			
	4. E = 20 (Aerobic, TX) C = 20* (Placebo)	E & C = 19.8			
Huang, Norman, Zabinski, Calfas, & Patrick (2007)	Female: E = 175 (Not specified, TX) C = 174 (No treatment)	Age Range = 12-14	EDI –Body Dissatisfaction Scale (modified)	Individual	52 NP
	Male: E = 166 (Not specified, TX) C = 142 (No treatment)	Age Range = 12-14			
King, Taylor, Haskell, & DeBusk (1989)	E = 57 (Aerobic) C = 52 (No treatment)	E & C = 48	Satisfaction with Physical Shape and Appearance (unstandardized)	Individual	24 Moderate

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Lindwall & Lindgren (2005)	E = 27 (Aerobic, TX) C = 35 (No treatment)	E & C = 16.35	Physical Self-perceptions Profile – Bodily Attractiveness subscale	Group	22 NP
Marquez-Sterling, Perry, Kaplan, Halberstein, & Signorile (2000)	E = 9 (Aerobic) C = 6 (No treatment)	E = 31.3 C = 27.8	Body Cathexis Scale	Group	15 Hard/Very Hard
McCabe, Ricciardelli, & Salmon (2006)	3/4th grade Male: E = 44 (Aerobic, TX) C = 36 (No treatment)	E = 10.25 C = 10.23	Body Image and Body Change Questionnaire for Children - Weight Dissatisfaction (single item)	Group	8 NP
	5/6th grade Male: E = 64 (Aerobic, TX) C = 51 (No treatment)				
	3/4th grade Female: E = 41 (Aerobic, TX) C = 33 (No treatment)	E = 10.08 C = 9.96			
	5/6th grade Female: E = 51 (Aerobic, TX) C = 48 (No treatment)				
Mock, Burke, Sheehan, Creaton, Winningham, & Liebman (1994)	E = 9 (Aerobic, TX) C = 5 (No treatment)	E & C = 44	Body Image Visual Analogue Scale	Group	20 Moderate
O'Loughlin, Paradia, Meshefedjian, & Kishchuck (1998)	E = 82 (Not specified, TX) C = 75 (No treatment)	E = 39.2 C = 37.0	Satisfaction with Appearance (author developed; unstandardized)	Individual	8 Light

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Perry, Rosenblatt, Kempner, Feldman, Paolercio, & Van Bemden (2002)	E = 161 (Resist. + Aerobic, TX) C = 33 (No treatment)	E = 16.53 C = 15.61	Body Satisfaction – body silhouette (adapted from Stunkard & Sorensen)	Group	24 Moderate
Pinto, Clark, Maruyama, et al. (2003)	E = 12 (Resistance + Aerobic) C = 12 (No treatment)	E & C = 52.5	BES – Weight Concern	Group	12 Moderate
Pinto, Frierson, Rabin, Trunzo, & Marcus (2005)	E = 39 (Aerobic) C = 43 (No treatment)	E = 53.42 C = 52.86	BES – Weight Concern	Individual	12 Moderate
Sandel, Judge, Landry, Faria, Ouellette, & Majczak (2005)	E = 19 (Resistance + Aerobic) C = 18 (No treatment)	E = 59.7 C = 59.5	Body Image Scale	Group	12 NP
Scanlon (1991)	E = 18 (Aerobic) C = 15 (Activity)	E & C = 12.6	EDI –Body Dissatisfaction Scale	Group	5 Moderate
Shaw, Ebbeck, & Snow (2000)	E = 18 (Resistance) C = 22 (No treatment)	E = 64.2 C = 62.5	Physical Self-concept Profile – Physical Appearance subscale	Group	36 NP
Sherblom & Rust (2004)	1. E = 35 (Aerobic) C = 44* (Placebo)	E & C = 12.1	Body Image Satisfaction Questionnaire	Group	6 NP
	2. E = 56 (Aerobic) C = 44* (Placebo)	E & C = 12.1			
Smith & Michel (2006)	E = 20 (Aerobic) C = 20 (No treatment)	E = 25.1 C = 24.8	Pregnant Body Shape Questionnaire (α = .86)	Group	6 Moderate

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Sorensen, Anderssen, Hjeran, Holme, & Ursin (1997)	1. E = 48 (Resistance + Aerobic) C = 53* (Placebo)	E & C = 44.9	Harter Adult Self-perception Profile - Appearance subscale	Group	52 Moderate
	2. E = 64 (Resist. + Aerobic, TX) C = 53* (Placebo)	E & C = 44.9			
	3. E = 48 (Resistance + Aerobic) C = 43* (No treatment)	E & C = 44.9			
	4. E = 64 (Resist. + Aerobic, TX) C = 43* (No treatment)	E & C = 44.9			
Stein (1989)	1. E = 28 (Aerobic) C = 35* (Placebo)	E & C = 20.02	Body Cathexis Scale	Group	7 Moderate
	2. E = 26 (Resistance) C = 35* (Placebo)	E & C = 20.02			
Stock, Miranda, Evans, Plessis, Ridley, Yeh, & Chanoine (2007)	E = 228 (Aerobic, TX) C = 132 (No treatment)	Elementary	Figure Rating Scale (modified)	Group	21 Hard/Very Hard
Stoll & Alfermann (2002)	1. E = 42* (Resistance + Aerobic) C = 18 (Placebo)	E = 61.60 C = 59.67	Body Self-concept – Physical Attractiveness subscale (α = .54)	Group	14 Moderate
	2. E = 42* (Resistance + Aerobic) C = 28 (No treatment)	E = 61.60 C = 61.93			

Table H-1. Continued

Study	*Participants by Group (E = Experimental Number; C = Control Number)*	*Mean Age*	*Body Image Measure*	*Intervention Type*	*Intervention Length (weeks) and Intensity*
Sundgot-Borgen, Rosenvinge, Bahr, & Schneider (2002)	E = 12 (Resistance + Aerobic) C = 15 (No treatment)	E = 23 C = 22	EDI –Body Dissatisfaction Scale (α = .82)	Both	16 Moderate
Talbot & Taylor (1998)	E = 46 (Aerobic) C = 35 (No treatment)	E & C = 54.2	Physical Self-perceptions Profile – Appearance subscale (modified)	Individual	10 NP
Taylor & Fox (2005)	E = 97 (Aerobic) C = 45 (No treatment)	E = 54.1 C = 54.4	Physical Self Perceptions Profile – Body Appearance subscale	Individual	16 Moderate
Tucker (1987)	E = 114 (Resistance) C = 127 (Placebo)	University	Body Cathexis Scale	Group	16 NP
Williams & Cash (2001)	E = 39 (Resistance) C = 39 (No treatment)	E & C = 21.7	BASS of MBSRQ	Group	6 NP
Zabinski, et al (2001)	Female: E = 80 (Resist. + Aerobic, TX) C = 97 (Placebo)	E & C = 24	EDI – Female Concerns/Body Dissatisfaction (α = .90)	Group	15 Moderate
	Male: E = 79 (Resist. + Aerobic, TX) C = 66 (Placebo)	E & C = 24	EDI – Male Concerns/Body Dissatisfaction (modified; α = .75)		

Note: Body image measures were standardized, unless otherwise reported, and the alpha (if reported) appears in () after the scale; Both = Individual and group based; NP = Not provided; TX = Exercise in addition to another treatment; * = Same experimental or control group

APPENDIX I
RANDOM EFFECTS MODERATOR ANALYSES

Table I-1. Random effects moderator analyses

	Number of ES	Q_B	*df*	*p value*
PARTICIPANT				
Gender (*female, male, both*)	Female = 55 Male = 12 Both = 27	1.072	2	0.585
Age (*combined, university, adults, older adults*)	Combined = 17 University = 35 Adults = 26 Older Adults = 12	8.873	3	0.031
Ethnicity (*Caucasian, NonCaucasian*)	Caucasian = 26 NonCaucasian = 3	10.552	1	0.001
Psychological Risk Status (*universal, selected*)	Universal = 72 Selected = 17	0.263	1	0.608
Body Composition (*normal, overweight*)	Normal = 30 Overweight = 24	3.246	1	0.072
DESIGN				
Type of Control Group (*no treatment, placebo, active*)	No treatment = 49 Placebo = 41 Active = 8	4.241	2	0.120
Exercise Intervention (*exercise-based, lecture-based, both*)	Exercise-based = 69 Lecture-based = 6 Both = 23	11.875	2	0.003
Recruitment Method (*self-selected, nonself-selected*)	Self-selected = 38 Nonself-selected = 53	3.914	1	0.048
Random Assignment (*yes, no*)	Yes = 60 No = 38	0.928	1	0.336
Publication Status (*published, unpublished*)	Published = 85 Unpublished = 13	0.102	1	0.750
Validated Measure (*standardized, unstandardized*)	Standardized = 92 Unstandardized = 6	0.226	1	0.635
Measure of Fitness (*self-report, objective, both*)	Self-report = 12 Objective = 39 Both = 5	4.021	2	0.134
EXERCISE				
Mode (*aerobic, resistance, both*)	Aerobic = 53 Resistance = 17 Both = 23	1.374	2	0.503
Met Exercise Guidelines (*yes, no*)	Yes = 14 No = 72	0.015	1	0.902
Specificity of Exercise (*specific, nonspecific*)	Specific = 61 Nonspecific = 33	9.229	1	0.002

Table I-1. Continued

	Number of ES	Q_B	*df*	*p value*
Experimental Intervention Type (*individual-based, group-based, both*)	Individual-based = 12 Group-based = 75 Both = 7	0.553	2	0.758
Intensity of Exercise (*light, moderate, hard/very hard*)	Light = 4 Moderate = 31 Hard/Very Hard = 13	0.637	2	0.727
Fitness – Experimental (*improve, no improve*)	Improve = 37 No Improve = 14	0.004	1	0.951
Body Composition – Experimental (*improve, no improve*)	Improve = 9 No Improve = 20	0.121	1	0.728
Theory Used for Measure Selection (*yes, no*)	Yes = 4 No = 94	0.951	1	0.329
Theory Used for Exercise Intervention (*yes, no*)	Yes = 21 No = 77	3.298	1	0.069

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BIOGRAPHICAL SKETCH

Anna was born in Germany and raised in Satellite Beach, Florida. After attending Satellite High School she obtained her undergraduate degree in psychology from the University of Florida. Through volunteer research in the exercise psychology lab she became interested in sports and exercise psychology and decided to pursue her master's in the field. After completing her master's, she plans to attend the University of Florida pursuing a doctorate degree in physical therapy.