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# Changes in body image and body weight and shape goals associated with weight loss and maintenance in overweight/obese adults diagnosed with type 2 diabetes mellitus

Amy Rzeznikiewicz Bachand

*Louisiana State University and Agricultural and Mechanical College*

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CHANGES IN BODY IMAGE AND BODY WEIGHT AND SHAPE GOALS  
ASSOCIATED WITH WEIGHT LOSS AND MAINTENANCE IN OVERWEIGHT/OBESE  
ADULTS DIAGNOSED WITH TYPE 2 DIABETES MELLITUS

A Dissertation

Submitted to the Graduate Faculty of the  
Louisiana State University and  
Agricultural and Mechanical College  
in partial fulfillment of the  
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Doctor of Philosophy

in

The Department of Psychology

by  
Amy Rzeznikiewicz Bachand  
B.A., Colby College, 1997  
M.A., Louisiana State University, 2004  
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## Abstract

The primary aim of this study was to test for changes in body image in males and females in a randomized controlled trial of weight loss for older overweight/obese adults who have been diagnosed with type 2 diabetes (Look AHEAD: Action for Health in Diabetes). A computerized morphing assessment program (The Body Morph Assessment; BMA 2.0) was used to assess estimates of perceived current body size (CBS), ideal body size (IBS), acceptable body size (ABS), body dissatisfaction based on the discrepancy between participants' perceived CBS and IBS (CBS-IBS) and ABS (CBS-ABS), as well as participants' weight loss goals in terms of both body weight (in pounds) and visual body size/shape. Participants randomly assigned to the Intensive Lifestyle Intervention (ILI) arm of the study (compared to the Diabetes Support and Education [DSE] arm) were hypothesized to report greater changes in estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS, and to lose more body weight from baseline to end of year one. The primary hypothesis tested in this study was that changes in weight would mediate treatment effects on body image variables. This hypothesis was partially supported for both genders. Change in weight mediated treatment effects on estimates of CBS for males and ABS for both genders, but did not mediate change in body image dissatisfaction (CBS-IBS) for either gender. Estimates of body image dissatisfaction decreased (improved) for participants in the ILI, but greater body image dissatisfaction at baseline was not related to greater weight losses at year one. Also, moderate weight loss goals were not associated with greater weight losses at year one. Both males and females erred in their estimates of what body size/shape the opposite gender finds most attractive. These findings indicate that participation in an intensive behavioral weight loss program can lead to changes in body image and decreased body image dissatisfaction in an

older overweight/obese population diagnosed with type 2 diabetes. Changes in body image constructs could not be attributed solely to weight changes.

## **Introduction**

The prevalence of overweight/obesity and type 2 diabetes mellitus has reached epidemic proportions and is predicted to continue rising in the near future (Bray, 2004). Rates of obesity (defined as Body Mass Index [BMI]  $\geq 30$ ) and overweight (BMI of 25.0 to 29.99) in the United States as well as worldwide have been steadily increasing since World War II (Bray, 2003), with a dramatic increase in recent decades (Ogden et al., 2006; World Health Organization [WHO], 1998). The most recent data from the National Health and Nutrition Examination Survey (NHANES 1999-2004) suggests that approximately 66.3% of U.S. adults (ages twenty years or older) are overweight or obese (Ogden et al., 2006). There are serious health risks associated with overweight status including an increased risk for developing chronic illnesses such as type 2 diabetes mellitus, hypertension, coronary heart disease, gallbladder disease, as well as some cancers (Bray, 2004). Data from the 2001 Behavioral Risk Factor Surveillance System (BRFSS; Mokdad et al., 2003) also indicate an increase in prevalence rates for type 2 diabetes mellitus with increasing degree of overweight. The prevalence rates for type 2 diabetes mellitus were five-times and more than eight-times higher in obese men and women respectively compared to normal-weight individuals (Albu & Pi-Sunyer, 2004). There has been a recent upsurge of research related to obesity and type 2 diabetes mellitus, and public health officials have recommended weight loss as a standard treatment strategy for overweight and obese individuals with comorbid conditions, such as type 2 diabetes (National Institutes of Health, 1998). Several studies have suggested that intentional weight loss can reduce the medical risks associated with overweight and obesity (Bray, 2004), including the risk for developing type 2 diabetes (Diabetes Prevention Program Research Group, 2002). In conclusion, obesity and type 2 diabetes mellitus

are significant health problems that are a focus of research efforts in the U.S. and across the world.

Body image research has progressed over the past several decades. Much of this research has focused on adolescents, particularly with females who have been diagnosed with an eating disorder (Cash & Pruzinsky, 2002). Recently there has been a call to expand the research on body image with more diverse populations, e.g., overweight/obese (Cash & Pruzinsky, 2002), and older adults (Whitbourne & Skultety, 2002). In recent years, cross-sectional studies have been published in the area of obesity, body image, and quality of life (Cash, 1994; Foster, Wadden, & Vogt, 1997; Rosen, Orosan, & Reiter, 1995). Overall, these studies have found that obese individuals tend to have a more negative body image and lower quality of life than normal-weight controls (Brodie & Slade, 1998; Cash & Hicks, 1990; Mathus-Vliegen, de Weerd, & de Wit, 2004). All obese individuals do not have a negative body image, however (Schwartz & Brownell, 2002).

A few studies have investigated changes in body image in response to weight loss. Overall, improvements on various body image measures have been reported for obese individuals who have lost dramatic amounts of weight through both Very-Low-Calorie Diet (VLCD) programs (Cash, 1994; Foster, Wadden, & Vogt, 1997) and surgical interventions (Adami et al., 1998; Dixon, Dixon, & O'Brien, 2002; Stunkard & Wadden, 1992). Although strong associations between body image and obesity have consistently been found (Neumark-Sztainer & Haines, 2004), the exact relationship between body image and obesity remains unclear, and there are limited data regarding the effect of more modest weight losses on measures of body image. The current study is an ancillary study of a large randomized controlled trial (RCT; Look AHEAD trial), which provides the unique opportunity to investigate the impact

of modest weight loss (weight loss goal is 10% of the participants' initial body weight) on body image in overweight/obese adults diagnosed with type 2 diabetes mellitus, as part of a lifestyle behavior modification program (The Look AHEAD Research Group, 2003).

Behavioral weight loss interventions (like the intensive lifestyle intervention program used in the current study) have been found to be effective in producing modest weight losses and improving the medical status of overweight/obese individuals (Beutel, Dippel, Szczepanski, Thiede, & Wiltink, 2006; Holt, Warren, & Wallace, 2006). However, as is true for all non-surgical weight loss treatments currently available, weight loss maintenance remains a challenge (Sarwer, Foster, & Wadden, 2004). Therefore it is essential that researchers work toward identifying potential motivators for successful long-term weight loss. While various weight loss treatments have been shown to improve body image (Beutel et al., 2006; ), there is also evidence to suggest that appearance-related concerns such as body image dissatisfaction may function as a motivator for weight loss efforts (Bowles, Picano, Epperly, & Myer, 2006; O'Brien et al, 2007). Thus, in addition to investigating the impact of weight loss on body image, the present study also examined the impact of baseline body image dissatisfaction on weight loss achieved following one year in an intensive weight loss intervention.

The sections that follow will review the existing literature on overweight/obesity and the literature on body image dissatisfaction, specifically as it relates to overweight/obesity and intentional weight loss. The primary aims of this study will then be described, and specific hypotheses outlined.

## **Review of the Literature on Overweight/Obesity and Type 2 Diabetes**

### **Overweight/Obesity**

Definition. During the 1990's body mass index (BMI) became the universally accepted measure of obesity (Seidell & Rissanen, 2004), and is commonly used in obesity research (Field, Barnoya, & Colditz, 2002). BMI is calculated using height (meters, m) and weight (kilograms, kg) measurements, and is expressed using the following formula:  $\text{kg/m}^2$  (Bray, 2003). The most recent BMI classification system for adults developed by the WHO (2000) has led to widespread acceptance of the following categories: underweight (BMI < 18.5), normal weight range (BMI = 18.5 – 24.99), overweight (BMI = 25.0 – 29.99), and obese (BMI  $\geq$  30.0 or higher).

Prevalence. Almost one in three U.S. adults is classified as obese (Ogden et al., 2006; Sturm, Ringel, & Andreyeva, 2004). According to previous NHANES data, rates of obesity among adults increased by approximately 50% from 1980 to 1994, with 22.5% of the U.S. population classified as clinically obese and approximately 55% classified as overweight (Flegal, Carroll, Ogden, & Johnson, 2002). The most recent NHANES data indicate that the prevalence of obesity continued to increase significantly for adult men between 1999 and 2004, whereas the rates of obesity in adult women did not change significantly during that time period, suggesting that rates of obesity may be leveling off in women (Ogden et al., 2006). However, there is no evidence that the prevalence of obesity is declining in any portion of the population, and the most recent estimate is that now approximately 32.2% of the U.S. population can be classified as obese (Ogden et al., 2006).

There are notable ethnic differences in the prevalence rates of obesity, especially among women (Seidell & Rissanen, 2004). Black women in the U.S. are more likely to be obese than white women, even when socioeconomic status (SES) is statistically controlled (Dawson, 1988),

with approximately 65.8% of non-Hispanic black women classified as overweight/obese compared to 49.2% of non-Hispanic white women. The women-to-men ratio of obesity is highest among non-Hispanic blacks (~1.8) and lowest among non-Hispanic whites (~1.1; Seidell & Rissanen, 2004). The most recent NHANES (1999-2004) data suggests that significantly more Mexican American and non-Hispanic black women are classified as obese compared to non-Hispanic white women (Ogden et al., 2006).

Treatment for Overweight/Obesity in Adults. As the prevalence of overweight/obesity has continued to rise, various weight loss treatments have been developed. Some of the weight loss treatment options available include self-directed or physician assisted diet and exercise, commercial weight loss programs, and behavior modification programs. For extreme obesity, weight loss surgery may be an option. Weight loss treatment is often initiated following a comprehensive evaluation. Appropriate treatment recommendations are typically based on the client's BMI and weight-related health problems (Sarwer et al., 2004). Furthermore, algorithms have been developed to help guide treatment selection (NHLBI, 1998; Wadden, Brownell, & Foster, 2002). Surgical interventions (e.g., bariatric surgery) are typically recommended only for those who are severely obese (BMI  $\geq$  40) or have a BMI  $\geq$  35 plus comorbid health problems, such as type 2 diabetes (Henderson & Brownell, 2004).

Behaviorally based weight loss interventions (like the intensive lifestyle intervention program used in the current study) are among the most widely researched weight loss treatments. These behavioral programs typically include the following components: problem solving, stimulus control, self-monitoring of food intake and physical exercise, and some cognitive intervention components, aimed at modifying maladaptive thinking that interferes with weight loss (Sarwer et al., 2004). There is growing evidence that behavioral weight loss interventions



are effective in producing modest weight losses, improving the medical status of overweight/obese individuals, as well as producing improvements in well-being, body image, and overall quality of life for overweight/obese adults (Beutel et al., 2006; Bowles et al., 2006; Warren, & Wallace, 2006).

Overweight/Obesity and Type 2 Diabetes. Type 2 diabetes mellitus is highly associated with overweight/obesity across both genders and all ethnic groups (Colditz, Willett, Rotnitzky, & Manson, 1995; Chan, Rimm, Colditz, Stampfer, & Willett, 1994). In addition, the risk of developing type 2 diabetes mellitus increases with the increasing degree and duration of overweight, as well as with a more central adiposity distribution. Weight gain typically precedes the onset of type 2 diabetes (Bray, 2004). Experts have concluded that accumulation of excess body fat is associated with increasing insulin resistance, and that insulin resistance is a predisposing factor for developing diabetes (Albu & Pi-Sunyer, 2004).

As with overweight/obesity, the prevalence of type 2 diabetes mellitus has also reached epidemic proportions (Harris et al., 1998; Mokdad et al., 2001), and is anticipated to increase by as much as 165% from the year 2000 to 2050 (Boyle et al., 2001). Serious medical complications are associated with type 2 diabetes mellitus including increased risk of heart disease and stroke, blindness, nerve damage, kidney damage, and foot problems that can lead to amputations (American Diabetes Association, ADA, 2006). The annual cost of diabetes-related medical expenditures along with lost productivity is estimated to have increased from approximately \$98 billion dollars in 1997 to approximately \$132 billion dollars in 2002 (ADA, 2003).

Medical Consequences of Overweight/Obesity. In addition to being linked to increased risks for developing chronic illnesses such as type 2 diabetes mellitus, obesity/overweight is also associated with increased risks for other medical conditions including hypertension, coronary

heart disease, gallbladder disease, several cancers, and osteoarthritis (Bray, 2004; Must, Spadano, Coakley, Field, Colditz, & Dietz, 1999). These risk factors associated with overweight/obesity have been estimated to cause approximately 280,000 deaths annually, second only to tobacco use (Allison, Fontaine, Manson, Stevens, & VanItallie, 1999), and aggregate overweight/obesity-attributable medical costs have been estimated as high as \$78.5 billion dollars, approximately 9.1 percent of total annual U.S. medical expenditures (Finkelstein, Fiebelkorn, & Wang, 2003). According to the data from the 2001-2003 Medical Expenditure Panel Survey, obesity also increases the per person medical costs for persons diagnosed with type 2 diabetes mellitus, and these costs become greater with increasing age (Finkelstein, Brown, Trogon, Segal, & Ben-Joseph, 2007).

Psychological Consequences of Overweight/Obesity. In addition to the medical consequences of overweight/obesity, overweight/obesity has also been found to be associated with various psychological and emotional issues including discrimination, prejudice, decreased health-related quality of life (HRQOL) and depression. While research with non-clinical samples of overweight/obese adults suggests that as a group, overweight/obese adults do not differ from non-obese adults in psychological functioning, overweight/obese individuals who seek weight loss treatment have been found to have elevated rates of psychopathology (Telch & Agras, 1994; O'Neil & Jarrell, 1992).

Several studies have documented that overweight/obese persons endure significant prejudice and discrimination in today's society (Register & Williams, 1997; Rothblum, Brand, Miller, & Oetjen, 1990; Puhl & Brownell, 2001). Several studies also suggest that many overweight/obese persons may avoid seeking necessary medical care due to their overweight/obese status (Adams, Smith, Wilbur, & Grady, 1993; Fontaine, Faith, Allison, &

Cheskin, 1998; Olson, Schumaker, & Yawn, 1994). These studies indicate that the stigma and discrimination obese persons face everyday may negatively affect the acquisition of necessary healthcare. This conclusion is especially alarming since the overweight/obese patient population, particularly those with type 2 diabetes, require regular medical follow-up.

In addition to enduring discrimination and prejudice, research suggests that overweight/obese persons tend to have poor HRQOL compared to non-overweight persons (Mathus-Vliegen et al., 2004). HRQOL refers to the suffering and limitations in activity/mobility, personal hygiene, emotions, social interactions, sexual activity, and eating behavior associated with illness (Duval et al., 2006; Wadden et al., 2001). Patients' HRQOL has been reported to improve following weight loss due to bariatric surgery (Sanchez-Santos et al., 2006). While morbid obesity has been found to be associated with poor HRQOL (Mathus-Vliegen et al., 2004), the relationship between obesity and HRQOL may be moderated by other variables such as age, gender, comorbid conditions, or the presence of depression.

Depression has also been found to be associated with overweight/obesity. In a nationally representative sample of over 40,000 volunteers, Carpenter, Hasin, Allison, and Faith (2000) found that obese women were more likely to experience major depression in the past year, reported more suicidal ideation or made more suicide attempts than non-obese women. In men obesity was associated with reduced risks of major depression and suicide attempts, suggesting that there may be different consequences as a function of gender. In another study investigating the relationship between depression and severe obesity in men and women admitted into a surgical weight loss program, Dixon and colleagues (2002) found that younger women with poor body image were at increased risk for depression. Further, weight loss following bariatric surgery was associated with significant and sustained improvement of depressive symptoms. A

recent meta-analysis of the literature on weight loss and psychological well-being, revealed that although participation in weight loss treatment was associated with decreased depressive symptoms, improvements in depression were independent of weight loss (Blaine, Rodman, & Newman, 2007). These results suggest participation in weight loss programs can produce improvement in depressive symptoms, regardless of weight loss achieved. Conversely, Sarwer and colleagues (1998) found no significant differences between groups of obese and non-obese women on measures of depression. These findings suggest that the relationship between obesity and depression remains unclear at this time, and may differ as a function of gender.

Weight Loss Goals. Once a weight loss intervention has been selected, treatment goals should be established prior to beginning treatment. The NHLBI (1998) recommends two specific treatment goals 1) to lose 10% of the person's initial body weight, and 2) prevention of weight regain. Modest weight losses of approximately 10% of one's initial body weight have been shown to improve obesity-related health problems (e.g., hypertension, glucose control; Institute of Medicine, 1995; NHLBI, 1998; WHO, 1998). There is now a consensus that modest weight losses (5%-10% of initial body weight) are considered successful and that weight losses of 5% to 10% are a realistic goal for behavioral weight loss treatments. As such, participants in the intensive lifestyle intervention (behavioral intervention) of the current study were instructed to establish a 10% weight loss goal.

Although modest weight losses are viewed as successful within the field of obesity, several studies have demonstrated that the majority of individuals who enter weight loss treatment consider this goal to be disappointing (Foster, Wadden, Vogt, & Brewer, 1997), and often have a personal weight loss goal of 20% to 35% of their current weight (Foster, Wadden, Phenlan, Sarwer, & Swain-Sanderson, 2001; Foster, Wadden, Vogt, & Brewer, 1997; O'Neil,

Smith, Foster, & Anderson, 2000; Wadden et al., 2003). Since weight loss expectations of this caliber are unrealistic for most treatment approaches aside from weight loss surgery, patients often experience disappointment with 10% weight loss. Further, some researchers have postulated that if patients fail to accept a realistic weight loss goal and then do not achieve their desired weight, this could ultimately lead to higher attrition rates and/or weight regain (Sarwer et al., 2004). However, the current weight loss literature has revealed mixed findings related to the impact of unrealistic weight loss goals on weight loss, weight loss maintenance, and attrition.

A study by Jeffery, Wing and Mayer (1998) showed that men and women with more modest weight loss goals were more likely to achieve their goals, and of those who achieved their goals they also had better weight loss maintenance. However, in this same study desired weight did not predict actual weight loss. Several smaller retrospective studies have also suggested that unrealistic weight loss goals may contribute to poor weight loss maintenance (Klem, Wing, McGuire, Seagle, & Hill, 1997; Marston & Criss, 1984). Thus, several authors have suggested that clinicians encourage more realistic weight loss expectations and help their clients to accept that those goals might improve both weight loss and weight loss maintenance (Cooper, Fairburn, & Hawker, 2003; Foster, Wadden, Vogt, & Brewer, 1997). However, a recent study aimed at modifying unrealistic weight loss expectations found that although the treatment was successful in modifying weight loss expectations, this change did not produce better weight loss maintenance at 6-month follow-up (Ames et al., 2005).

White and colleagues (2007) investigated the impact of unrealistic weight loss goals on weight loss outcomes for bariatric surgery candidates. Similar to previous research findings, the surgery candidates in this study had weight loss goals that exceeded weight loss that could be expected following weight loss surgery. However, these authors also reported that weight loss

expectations prior to bariatric surgery did not predict weight loss or maintenance (White, Masheb, Rothschild, Burke-Martindale, & Grilo, 2007). Similarly, Gorin and colleagues (2007) found that in a group of very successful weight loss participants (who had lost > 10% of their body weight), neither dissatisfaction with weight loss nor a desire to lose more weight were related to weight loss maintenance outcomes.

A recent study by Grave and colleagues (2005) investigating the relationship between weight loss expectations and attrition with over thirteen hundred treatment-seeking overweight/obese women found that higher attrition rates were significantly related to higher expectation for year one weight loss (BMI), a lower dream weight, and lower age (Grave et al., 2005). Conversely, another study investigating weight loss goals and expectations in 180 treatment-seeking, obese men and women found that while weight loss expectations exceeded that which could be expected from behavioral or pharmacological weight loss treatments (> 15% of their body weight), failure to meet weight loss expectations was not related to weight regain or attrition at 26 weeks post-treatment follow-up (Fabricatore et al., 2005). These conflicting findings suggest that the relationship between weight loss goals and rates of attrition remains uncertain at this time.

## **Review of the Literature on Body Image and Overweight/Obesity**

Recently there has been a call to expand body image research with older adults, across genders, across disciplines, and with different medical populations (Cash & Pruzinsky, 2002; Pruzinsky & Cash, 2002a; Whitbourne & Skultety, 2002). As a result there has been a growing body of research investigating body image in terms of ethnic differences (Baptiste-Roberts, Gary, Bone, Hill, & Brancati, 2006; Liburd, Anderson, Edgar, & Jack, 1999; Williamson et al., 2000), gender differences (Pope, Phillips, & Olivardia, 2000; Rosenblum & Lewis, 1999; Wertheim, Paxton, & Blaney, 2004), and the relationship between body image and obesity (Foster, Wadden, & Vogt, 1997; Sarwer, Thompson, & Cash, 2005).

### **Definition of Body Image Dissatisfaction**

There are numerous body image terms and/or constructs (e.g., body image disturbance, body image dissatisfaction, body image concerns, body dysphoria) and they are often mistakenly used interchangeably (Pruzinsky & Cash, 2002b). Body image has been conceptualized as a complex, multidimensional construct with perceptual, attitudinal/subjective, and behavioral dimensions (Pruzinsky & Cash, 2002b), and much of the existing literature has focused primarily on the perceptual and attitudinal dimensions of body image. The present study tested for changes in the perceptual/attitudinal components of body image.

As discussed earlier, body image dissatisfaction is very relevant to overweight/obese individuals (Sarwer et al., 2005). Body image dissatisfaction has been defined by and validated as the discrepancy between one's perceived current body size and one's perceived ideal body size (CBS-IBS; Williamson, Gleaves, Watkins, & Schlundt, 1993; Williamson et al., 2000). In the current study, the BMA 2.0 was used assess perceptual body image dissatisfaction (CBS-IBS discrepancy score) using a computer morphing program; as well as measures of perceptual body

size distortion (estimates of perceived CBS); preferences for a thin ideal (estimates of perceived IBS); and estimates of an acceptable body size (ABS; a weight/body size that participants would not be particularly happy with but could accept or live with).

### **Gender Differences in Body Image Dissatisfaction**

It is also important to note that body image dissatisfaction may differ as a function of gender. Earlier research on body image was conducted primarily on females (Striegel-Morre & Franko, 2002). Research on male body image has increased over the past twenty years, however (McCabe & Ricciardelli, 2004). Typically women who are dissatisfied with their body desire a thinner body ideal, whereas men with high body image dissatisfaction tend to want to gain or to lose weight (Anderson, Huston, Schmitt, Linbarger, & Wright 2001; Drewnowski, Kurth, & Krahn, 1995; McCabe & Ricciardelli, 2004). The relationship between body image dissatisfaction and BMI appears to be more complex for men than it is for women. For example, women with a low or average BMI typically desire a thinner ideal weight, whereas men with a BMI in the normal range often perceive themselves as underweight and desire a larger/more muscular ideal (Betz, Mintz, & Speakmon, 1994). While the relationship between body image dissatisfaction and BMI appears to be linear in women (higher BMI associated with greater body image dissatisfaction), men tend to demonstrate a curvilinear relationship (with very high or very low BMI's associated with greater body image dissatisfaction; Muth & Cash, 1997).

A majority of studies to date have found that adult women are more dissatisfied with their bodies than adult men across all weight groups (Grilo & Masheb, 2005; Schwartz & Brownell, 2002). However, much of the literature comparing adult men and women is limited by the use of college-aged men to represent "adults," and thus there is a need to expand research in this area with older adult populations (Rosenblum & Lewis, 1999).



## **Gender Differences in Perceived Attractive Body Size and Shapes**

Gender differences have also been identified in what body size/shape men and women find to be most attractive. An initial study by Fallon and Rozin (1985) found that both males and females erred in their estimates of what the opposite gender found most attractive. In this study men believed women would prefer a heavier stature than females reported they liked, and conversely women thought men would find a thinner female stature more attractive than the men reported liking. In a similar study, Demarest and Allen (2000) replicated the findings of Fallon and Rozin (1985) and found that both genders misjudged which body size/shape the opposite gender would find most attractive (regardless of ethnicity). The implications of these findings are that women's misperceptions of what body size/shape men find attractive may serve to reinforce women's drive for the thin ideal, and may motivate women to try to lose weight more often. On the other hand, men's misperception that women prefer a bulkier male body size/shape may serve to keep men satisfied with heavier body sizes and men may therefore have less motivation to try to lose weight. In addition, these findings may help explain why women have greater body image dissatisfaction than men.

## **Ethnic Differences in Body Image Dissatisfaction**

Similar to the gender differences highlighted previously, ethnicity may also moderate the nature and degree individuals experience body image dissatisfaction. For example, while African American women are more likely to be overweight/obese than Caucasian women (when adjusted for SES), African American women are also less likely to perceive themselves as being overweight (Dawson, 1988). In a study investigating body image dissatisfaction (using three different figure rating scales, CBS-IBS discrepancy) in fifty African American women over the age of forty, only a small percentage (22%) of the sample identified themselves as overweight,

although 56% were classified as obese based on the national guidelines (Patt, Lane, Finney, Yanek, & Becker, 2002). The results were similar across all three figure-rating scales. The overall underestimation of overweight/obesity (CBS estimates) among African American women in this sample helps explain why African American women are typically more satisfied with their body than Caucasian women, as underestimating CBS decreases the discrepancy between the CBS and IBS, resulting in a decreased CBS-IBS discrepancy.

Although African American women are less likely to perceive themselves as overweight/obese, as these women typically perceive their CBS as closer to their IBS compared to Caucasian women, it is important to realize that body image dissatisfaction is still a problem for African American women (Celio, Zabinski, & Wilfley, 2002). Similarly, while African American women are typically more satisfied with their current body size (regardless of BMI), body image dissatisfaction in African American women increases with increasing BMI. As is true for most of the body image literature, less is known about body image dissatisfaction in African American men, but there has been a recent shift toward broadening the scope of body image research across genders and ethnicities.

In a study investigating both gender and ethnic differences in body image dissatisfaction (using the BIA-O, CBS-IBS discrepancy), Williamson and colleagues (2000) found that African American men and women selected significantly larger IBS figures than Caucasian men and women, African American men and women also selected significantly smaller CBS figures than Caucasian men and women, thus yielding less body image dissatisfaction than their Caucasian peers, however the differences were less pronounced in men.

### **Age Differences in Body Image Dissatisfaction**

In addition to both gender and ethnic differences, other research findings have suggested that body image dissatisfaction may differ as a function of age. There is a paucity of longitudinal research in this area. Cross-sectional studies have suggested that age could be a moderator variable for body image dissatisfaction. One cross-sectional study examining body image dissatisfaction (using the BIA-O, CBS-IBS discrepancy) in African American women aged 16-96 years, found that age was associated with different patterns of body image dissatisfaction (Williamson, White, Newton, Alfonso, & Stewart, 2005).

### **The Impact of Overweight/Obesity on Body Image**

Regardless of gender, ethnicity, or age, a common assumption is that overweight/obese adults must have a negative body image. While negative body image has been associated with overweight/obesity, it is important to note that not all overweight/obese persons have a negative body image (Schwartz & Brownell, 2002). As noted earlier, the relationship between body image and obesity is not completely clear. Overall, research to date suggests that overweight/obese individuals typically report greater body image dissatisfaction than their normal-weight counterparts, particularly for women (Schwartz & Brownell, 2004), and this dissatisfaction may have a negative impact on the individual and their behaviors. For example, a significantly higher percentage of obese women camouflage their bodies with clothing, alter their posture or body movements, avoid looking at themselves, and endure moderate to extreme embarrassment in social situations due to their weight (Sarwer et al., 1998).

### **The Effects of Weight Loss on Body Image**

While overweight/obesity has been found to be associated with body image dissatisfaction, does weight loss impact an individual's body image? As noted earlier, several

studies have reported improvements in body image in overweight/obese persons who have lost significant weight through both surgical and behavioral weight loss interventions (Beutel et al., 2006; Cash, 1994; Foster Wadden, & Vogt, 1997; Adami et al., 1998; Dixon et al., 2002). However, larger weight losses have not always been associated with greater improvements in body image.

Several weight loss surgery studies have reported that extremely obese persons who undergo bariatric surgery and subsequently lose significant weight, also experience improvements in body image. For example, Halmi, Long, Stunkard and Mason (1980) reported that 70% of bariatric weight loss patients had severe body image dissatisfaction prior to surgery, whereas only 4% had significant body image dissatisfaction following weight loss. Another study by Adami and colleagues (1998) found that patients who lost weight after surgery also had significantly improved body image. A similar study investigating body image following weight loss surgery in over three hundred men and women found significant improvement in body image satisfaction (measured by the Multidimensional Body-Self Relations Questionnaire; MBSRQ) after weight loss surgery and at four-year follow-up (Dixon et al., 2002).

Cash (1994) assessed change in body image dissatisfaction in obese men and women enrolled in a very low calorie diet (VLCD) program. The average weight loss for his study was 24% of the participants' initial body weight. The weight loss brought participants' estimates of CBS closer to their IBS, and therefore body image dissatisfaction was improved for participants in this study. However, improvements in body image dissatisfaction diminished following modest weight regain. Two limitations of this study were its high attrition rate (59%) and absence of long-term follow-up. In addition, the average weight loss (24% initial body weight)

far exceeded the average weight loss experienced with traditional behavioral weight loss treatment (approximately 10% initial body weight loss can be expected).

In another non-surgical study, Foster, Wadden, and Vogt (1997) measured overall body image dissatisfaction in 59 obese women before, during, and after a forty-eight week weight loss treatment program. Similar to the findings of Cash (1994), the average weight loss was high, 19.4 kg (~43 pounds). Weight loss was associated with significant improvements in body satisfaction, but the amount of weight loss did not relate to degree of satisfaction (e.g., participants who lost 26 lbs had similar levels of improvement in body image measures as participants who lost 60 lbs.). These findings support the idea of a “threshold effect” on body image following weight loss. Even small amounts of weight regain can apparently negatively affect body image satisfaction

In summary, several studies have found that body image typically improves following dramatic weight losses (Adami et al., 1994; Cash, 1994; Foster et al., 1997; Halmi et al., 1980), however less is known about the effects of more moderate weight losses. Since most adults cannot realistically expect to lose such large amounts of weight through traditional behavioral weight loss interventions, it is important to determine whether these improvements in body image can be replicated in studies producing more modest weight losses. The threshold effect commonly found in the above mentioned studies suggests that moderate amounts of weight loss could result in some improvement in body image, though this hypothesis remains to be tested. The current study had the advantage of utilizing an adult sample from a large, RCT investigating the effects of a behavioral weight loss intervention on body image, which was expected to produce moderate weight loss (10% initial body weight). In addition to investigating the effect of

weight loss on body image dissatisfaction, the present study also explored the role of body image dissatisfaction as a motivator for successful weight loss efforts.

### **Summary of the Existing Literature on Overweight/Obesity and Body Image**

The prevalence of overweight/obesity and type 2 diabetes mellitus is rising at alarming rates and is predicted to continue rising in the near future (Bray, 2004). Overweight/obesity has been shown to be associated with increased rates of morbidity and mortality, comorbid chronic illnesses such as type 2 diabetes mellitus, and various psychological issues (e.g., poor HRQOL and depression). Overweight/obese persons have also been found to suffer from greater body image dissatisfaction than non-overweight/obese persons (Schwartz & Brownell, 2004). While dramatic weight loss has been found to be associated with improved body image, there is a paucity of research investigating the effects of more modest weight losses (typical of non-surgical, behavioral weight loss programs) on body image. The exact nature of the relationship of weight loss on body image dissatisfaction, specifically following more moderate weight losses remains unclear and is in need of further study.

While there have been a few studies that have investigated body image as a function of weight loss, all of the published studies have used paper-and-pencil questionnaires to measure body image dissatisfaction. This study utilized a computerized morphing program (BMA 2.0) that was developed specifically for use with adult, Caucasian and African American men and women. Furthermore, most of these previous studies examined relatively young, healthy overweight/obese women. The current study allowed for the unique opportunity to examine changes in various body image constructs (estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS) and body weight and shape goals as a function of weight loss in an older (ages 40-75 years), chronically ill population (diagnosed with type 2 diabetes mellitus).

Research has found that modest weight loss goals (5%-15% of initial body weight) are associated with improvements in obesity-related health problems and lower attrition rates; however, most adults in weight loss studies have unrealistic weight loss goals (Jeffery et al., 1998; Foster, Wadden, Vogt, & Brewer, 1997). This study is the first to investigate the relationship of weight loss goals in terms of both body weight (in pounds) and in terms of body size/shape (visual morph figures) with weight loss at one year follow-up.

Although research investigating the role of body image dissatisfaction as a motivator for weight loss behaviors in an overweight/obese adult population is limited, there is research with adolescents as well as preliminary research with overweight/obese adults that suggest that body image dissatisfaction may motivate dietary restriction (Anderson, Eyler, Galuska, Brown, & Brownson, 2002; Boschi et al., 2003; van den Berg et al., 2002; Crow, Eisenberg, Story, & Neumark-Stainer, 2006). Given the difficulty in achieving weight loss and weight loss maintenance, there has been a call for researchers to investigate the role of body image dissatisfaction as a potential motivator for weight loss efforts (Cash & Pruzinsky, 2002; Teixeira, Going, Sardinha, & Lohman, 2005; Wadden & Steen, 1996). The current study will evaluate the relationship between baseline body image dissatisfaction and weight loss after one year of participation in the Look AHEAD trial.

Lastly, several studies have indicated that both men and women err in their judgments of what body size/shape the opposite gender finds attractive (Fallon & Rozin, 1985; Demarest & Allen, 2000). This study is the first investigation of what body size/shape men and women find most attractive in the opposite gender following weight loss.

## **Primary Aims and Hypotheses**

The primary aim of this study was to test for changes in body image in males and females in a randomized controlled trial of weight loss for older overweight/obese adults who have been diagnosed with type 2 diabetes mellitus (Look AHEAD: Action for Health in Diabetes).

Specifically, this study addressed the following questions: 1) Will participants in an intensive weight loss treatment program (Intensive Lifestyle Intervention; ILI) lose more weight than participants randomized into the control arm of the study (Diabetes Support & Education; DSE)? 2) Will participants' BMA 2.0 estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS change following one year in an intensive weight loss treatment program? 3) Will weight loss mediate the effects of the treatment group on changes in the BMA 2.0 estimates? 4) Does initial body image dissatisfaction (using the body image dissatisfaction discrepancy index, CBS-IBS) impact weight loss at one-year follow-up? 5) Does having more moderate weight loss goals (5%-15% initial body weight) impact weight loss at one-year follow-up? 6) Does weight loss impact BMA 2.0 estimates of what is the most attractive body size/shape in members of the same and opposite gender? 7) Do older (40-75 years), overweight/obese men and women diagnosed with type 2 diabetes differ in what they believe is the most attractive body size/shape in members of the same and/or opposite gender? 8) Will participation in an ILI impact mood (measured by change scores on the Beck Depression Inventory – Second Edition, BDI-II) at one year follow-up?

### **Primary Hypotheses**

- 1) The primary hypothesis of this study was that the effect of the treatment group (ILI versus DSE) on body image variables (BMA 2.0 estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS) would be mediated by changes in weight and adiposity (this study primarily looked at changes in BMI. Exploratory analyses were also computed to



investigate changes in percent body fat and waist circumference) from baseline to year one, such that any changes in these BMA 2.0 estimates would be due to changes in weight rather than treatment group effects. A statistical mediator is a third variable that represents the mechanism through which the independent variable (e.g., treatment group) is able to affect the dependent variable (Baron & Kenny, 1986).

- In order to support complete mediation of changes in body image, the following three primary hypotheses/conditions are required: 1) participants randomly assigned to the ILI arm of the study (compared to the DSE arm) have greater changes in estimates of CBS, IBS, ABC, CBS-IBS, and CBS-ABS (controlling for baseline values) from baseline to year one, 2) participants randomized to the ILI arm of the study lose more weight (decrease in BMI) than participants randomized to the DSE (control arm of the study) from baseline to year one, and 3) co-varying the postulated mediator variable (BMI changes from baseline to year one) removes or attenuates significant treatment effects found in the DV's (BMA 2.0 estimates of CBS, IBS, ABC, CBS-IBS, and CBS-ABS). Support for partial mediation of body image changes would occur if significant group differences for body image measures (CBS, IBS, ABS, CBS-IBS, and CBS-ABS) were attenuated by changes in BMI, but the group differences remained statistically different.
- 2) It was hypothesized that participants with greater initial body image dissatisfaction (CBS-IBS discrepancy scores) at baseline would be associated with greater weight losses (decrease in BMI and WC), and a larger decrease in percentage of body fat at year one.
  - 3) It was hypothesized that participants with moderate weight loss goals (versus extremely small or extremely large weight loss goals; in pounds & BMA 2.0 morph figures) at

baseline would be associated with better weight loss and weight loss maintenance at year one.

- 4) It was hypothesized that estimates of the “most attractive figure to members of the same and opposite gender” would become smaller (thinner) as a function of weight loss (decrease in BMI) for both genders.
- 5) It was hypothesized that women would select smaller (thinner) “most attractive figures for same gender,” than men would select for “most attractive figures to members of the opposite gender,” while men were anticipated to select larger “most attractive figures for same gender,” than women would select for “most attractive figures to members of the opposite gender.”

### **Secondary Hypotheses**

- 6) It was hypothesized that participants in the ILI arm of the study would have greater improvements in mood (decreased BDI-II scores) from baseline to year one (compared to participants randomized into the DSE arm).
- 7) It was hypothesized that changes in BDI-II scores would be a significant covariate (mediator) for treatment group effects (BMA 2.0 estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS).

## **Methods**

### **Participants**

Participants for this study were recruited from the participants enrolled in the Pennington Biomedical Research Center (PBRC) site of the Look AHEAD: Action for Health in Diabetes trial. Inclusion criteria were: 1) diagnosis of type 2 diabetes, 2) Caucasian and African American men and women; 3) BMI within the range of 25 and 55 at randomization; and 4) age within the range of 40 to 75 years. Participation was voluntary, and participants were provided a \$10.00 gift card incentive for completing the BMA, version 2.0 at baseline and another \$10.00 gift card at the end of twelve months of the intervention period. A total of 162 participants were enrolled into the study at baseline. However, two participants' data were excluded from all analyses due to race, as they did not meet the inclusion criteria listed above (one was Asian and the other was Hispanic). Additionally, two participants' data were excluded due to having a BMI > 55. Finally, one participant's baseline data was lost due to a computer malfunction, and thus was excluded from all analyses. Therefore, a total of 157 participants comprised the baseline sample.

### **Treatment Program – Look AHEAD: Action for Health in Diabetes**

This study is an ancillary study of the multi-site Look AHEAD trial, and has been approved by the Look AHEAD ancillary study committee. The Look AHEAD trial is sponsored by the National Institute of Diabetes and Digestive and Kidney diseases (NIDDK) of NIH, and is a RCT examining the impact of an intensive lifestyle intervention program aimed at producing and maintaining weight loss by decreasing caloric intake and increasing physical activity in overweight and obese individuals diagnosed with type 2 diabetes mellitus. Upon enrollment in the Look AHEAD study and after collection of baseline data, participants were randomly assigned to the intensive lifestyle intervention (ILI) or to the control arm (a diabetes support and

education group; DSE). Participants randomly assigned to the DSE group received usual medical care (provided by their own primary care provider; PCP) and three educational/support groups (topics: diet/nutrition, exercise, and social support) each year, for the first four years of the study. Attendance to these groups was strongly encouraged, but not required. In addition, participants attended regularly scheduled clinic visits for assessment of outcomes and participated in phone calls for data collection throughout the one-year period.

Participants who were randomly assigned to the ILI arm of the study received usual medical care (provided by their own PCP) and individual and group interventions aimed at inducing 10% weight loss from baseline and 175 minutes of physical exercise per week (Look AHEAD Research Group, 2006). The lifestyle intervention combined diet modification, physical activity, behavioral techniques, social support, and ongoing regular contact throughout the one-year period. The most intensive phase of the study occurred over the first year. Participants received weekly contact for the first six months (consisting of three groups and one individual session per month). During the second six months, one individual session and two group sessions were scheduled each month.

Individuals with type 2 diabetes who are also overweight/obese are at increased risk for cardiovascular disease (CVD) morbidity and mortality. The primary outcome variable for the main Look AHEAD study is time to incidence of a major CVD event (The Look AHEAD Research Group, 2003). The Look AHEAD trial is based largely upon the results of the Diabetes Prevention Program (The Diabetes Prevention Program Research Group, 2002), which found that a lifestyle modification program significantly reduced the risk of developing type 2 diabetes in overweight persons with impaired glucose tolerance. Participants in the ILI arm were encouraged to lose 10% of their initial body weight. The physical activity goal (175 minutes per

week) was based on findings that this level of physical activity significantly improves weight loss maintenance (Jakicic, Wing, Winters, & Lang, 1999; Jeffery, Wing, Sherwood, & Tate, 2003) and cross-sectional studies have suggested that increased physical fitness reduces the risk of CVD (Lee, Blair, & Jackson, 1999; Hu et al., 2004).

## **Procedure**

After participants had been enrolled in the Look AHEAD trial, they were invited to participate in this ancillary study (during the baseline phase of the study). Participants then signed a separate consent form. The only assessment instrument added to the Look AHEAD trial at PBRC site was the BMA version 2.0. The computerized BMA program was administered during the collection of baseline data, and at each annual visit for outcome measurement, for four years. The current study examined the baseline and year one data only. Data collection for the Look AHEAD study continues and will be complete in 2012. Data collection for BMA 2.0 data during Look AHEAD was completed in January, 2008. A trained research staff member was present to answer questions about the procedure, but the assessment itself was self-administered. Participants were expected to complete the BMA in less than 20 minutes time. Data from the BMA was collected automatically via the computer's operating system.

## **Primary Outcome Measures**

BMA Version 2.0. The BMA version 2.0 is a self-administered, computerized assessment program comprised of three phases. In the first phase, measures of the participants' current, ideal, and acceptable body size are gathered using the BMA morphing program (with human figures that vary in body size by 100 equal increments, ranging from very thin to very obese; see Appendices A and B for examples of the morph figures). Consent was obtained from the author of the BMA, version 2.0 to reproduce copyrighted images (see Appendix C for the signed

consent form). In the second phase, body weight and shape goals are measured using weight estimates (in pounds) and body size/shape estimates (using the BMA morphing program). Finally, the third phase of the program measures estimates of the most attractive body shapes for the same and opposite gender of the participant (using the BMA morphing program). In all phases of the assessment, the human figures that appear in the morphing program match the ethnic background of the participant, with Caucasian participants viewing white figures, and African American participants viewing black figures.

Phase 1: Assessment of Body Size Estimates. Participants were instructed to modify the size of the body stimulus (human morphing figure) using directional arrows at the bottom of their computer screen. One practice trial was administered and participants were then asked if they understood the instructions. Participants completed four trials of body size estimates for each of three sets of instructions (asking the participant to select the body size that represented their current, ideal, and acceptable body size; CBS, IBS, and ABS respectively), two trials in which the morph figure changed from very thin to obese, and two trials in which the morphing figure changed from obese to very thin (in order to control for anchoring effects). Mean values for estimates of CBS, IBS, and ABS were then calculated from the four trials and used in the statistical analyses. The order of instructions and the direction of the morphing figure were presented in random order, to control for order effects. When participants are viewing the morph figures, they are instructed to look at the blurred face on the figure and try to imagine their own face on the figure.

Phase 2: Measurement of Body Weight and Size/Shape Goals. The participant was instructed to answer the following questions prompted by the computer: “In pounds, what is your current weight” (the participant will enter a weight in numbers); “Select the figure on the BMA

you see as your current weight” (the participant will use the BMA morphing program). These instructions are repeated for “dream weight” (“the weight you would chose if you could choose any weight you wanted”); “happy weight” (the weight you would be happy to achieve”); “acceptable weight” (the weight that you would not be particularly happy with but one that you could accept or live with”); and “ideal weight” (“what weight is ideal for you”). The BMA morph figures are presented twice for each set of questions (once with the morph figure starting in the very thin position, and once with the morph figure starting in the obese position). The five sets of questions and the order the morph figures appear are both randomly selected by the computer program. The current study investigated hypotheses related to the “ideal” weight as a representation of the participants’ personal weight loss goal.

#### Phase 3: Measurement of Attractive Body Shapes for the Same and Opposite Gender.

The participant was instructed to select the body shapes that they believe are the most attractive for members of the same and opposite genders. The BMA morph figures are presented twice for each question (once with the morph figure starting in the very thin position, and once with the morph figure starting in the obese position). The two questions are presented in random order per participant, and the order the morph figures appears is randomly selected by the computer program.

BMI. BMI is a valid measure of overweight/obesity (Bray, 1998). BMI was selected as the primary measure of weight change for this study, as it has the advantage of accounting for height, which is an important component of weight measurement (Field et al., 2002). The participants’ height (centimeters, cm) was measured using a wall-mounted stadiometer, their weight (kilograms, kg) was measured using a Tanita BWB 800 digital scale, and their BMI was calculated using the following formula:  $\text{kg/m}^2$ .

## Secondary Measures

Change in Body Fat. Proportion body fat was measured using the dual-energy x-ray absorptiometry (DXA) procedure. DXA measurements provide a more valid measure of body composition than body weight alone (Harsha & Bray, 1996), allowing for the quantification and measurement of fat and lean soft tissue. Therefore, in addition to BMI, exploratory analyses were computed to evaluate changes in percent body fat as a mediator of treatment effects on body image.

Change in Abdominal Adiposity. Body fat distribution and changes in body fat distribution were assessed using waist circumference (WC) measurements. The Gulick II Tape Measure (model 67020) was used to accurately and repeatedly measure WC. The design of the tape measure eliminates the guesswork by applying a known amount of tension (four ounces) to the measuring tape. When used properly, the tape tension is always four ounces, allowing for accurate measurements. WC was recorded to the nearest 0.1 centimeter. (Phelan & Wadden, 2004): WC can be used to assess body fat distribution (van der Kooy & Seidell, 1993). Reduction in WC has been found to be associated with significant improvements in health (Wirth & Steinmentz, 1998). Exploratory analyses were also performed to evaluate the changes in WC as a mediator of treatment effects on body image.

Beck Depression Inventory - Second Edition (BDI-II; Beck, Steer, & Garbin, 1988). The BDI-II is a 21 item self-report questionnaire used to assess the severity of depression symptoms in adults and adolescents 13 years and older. Scores range from 0 to 63, with scores of 0-13 for minimal symptoms, 14-19 for mild symptoms, 20-28 for moderate symptoms, and 29-63 for severe depressive symptoms. Beck et al. (1988) found acceptable internal consistency ( $\alpha =$



.73 to .95), test-retest reliability (.60 to .90), and convergent validity with clinician ratings of depressive symptoms ( $r = .75$ ).

Demographic Questionnaire. Demographic information (including age/date of birth, ethnicity, education level, marital status, and employment status) was gathered from the participants using self-report questionnaires.

### **Statistical Methods**

An alpha level of .05 was selected for testing the study hypotheses. The statistical analyses were conducted using the Statistical Analysis Software (SAS version 9.1) and the Statistical Package for Social Sciences (SPSS for Windows version 12.0). Descriptive statistics were calculated (means, standard deviations, and frequency distributions) for BMA 2.0 data, select Look AHEAD demographic data (age, ethnicity, education level, marital status, employment status), and anthropometric information (height, weight, BMI, percent body fat, and waist circumference) for the ancillary study sample (stratified by gender and treatment group). Due to the different figures presented to males and females using the BMA 2.0, separate analyses were conducted for men and women for all statistical calculations.

On the BMA 2.0, the figures begin at frame 1 (thinnest figure; Appendix A) and end at frame 100 (largest figure; Appendix B). In the trials, there is both forward and backward presentation (thin to obese, and obese to thin). The average of the forward and backward estimates is taken to form the official estimate for the trial. This procedure was established to control for anchoring effects, in which the participant may make choices that were influenced by the default figure (beginning figure of the trial). For example, a participant may make a slightly heavier estimate of their current body size when the trial starts out with the heavier figure. Given this, some participants accepted the default figure as their own estimate across some trials. The

data for the BMA 2.0 were subjected to quality control procedures; 3.5% of the data met the criteria for the use of quality control procedures.

The following procedures were used to ensure quality control. First, cut-off values were derived in order to eliminate outliers in the data. These cut-off values were derived from a larger study that established the reliability and validity of the BMA (Stewart et al., 2005). Cut-off values were derived for each estimate by first calculating the difference score for each participant (e.g., for entries of 42, 48, 50, 48, the difference score would be  $50-42 = 8$ ). Then the distribution of difference scores was evaluated and the 99<sup>th</sup> percentile of this distribution was used as the cut-off value. The resulting cut-off values obtained were 30, 30, and 45 for estimates for CBS, IBS, and ABS respectively. Second, for the current study's sample, the difference score was obtained and compared to the cut-off values described above. Any data with a difference score greater than or equal to the cut-off values listed above were removed and the average was obtained from the remaining values.

In the first phase of the BMA 2.0, there were four trials for each BMA estimate (CBS, IBS, and ABS) for each participant (two trials in which the morph figure changed from very thin to obese, and two trials in which the morphing figure changed from obese to very thin). To control for anchoring effects, the average of these trials was used for statistical analyses. Anchoring effects were evaluated, and on average, participants selected BMA estimates four increments smaller in the forward (thin to obese) trials compared to the reverse (obese to thin) trials. For cases in which there were no valid forward or no valid reverse values, the derived average was increased by two (when there were no reverse trial values) and decreased by two (when there were no forward trial values). For the rare cases for which there were less than two

valid values for a given BMA estimate, the last observation was carried forward and used to impute the average estimate score.

The same approach was used to ensure quality control in the data from the second (Current, Ideal, Happy, Dream and Disappointed) and third phases (attractiveness ratings) of the BMA 2.0. In the second and third phases, there was only one forward and one reverse trial for each estimate. In the second phase, the cut-off values used for CBS, IBS, Happy, Dream and ABS were 41, 40, 22, 46, and 58 respectively. For the third phase, attractive for same gender, and attractive for opposite gender, the cut-off scores were 44 and 23 respectively. These values are different from the values in phase one due to the differences in the estimates measured in each phase (Phase 1 = CBS, IBS, ABS; Phase 2= Current, Ideal, Happy, Dream, and Acceptable; Phase 3= attractive for same gender, attractive for opposite gender).

To test for treatment effects, a series of analyses of covariance (ANCOVA) were conducted for the following dependent variables: (change scores in: BMI, WC, percent body fat, CBS, IBS, ABS, CBS-IBS, and CBS-ABS) with baseline values entered as covariates.

In order to evaluate if weight loss was a mediator of treatment effects on changes in CBS, IBS, ABC, CBS-IBS, and CBS-ABS from baseline to year one (hypothesis #1), mediator analyses were performed in three regression steps according to the approach outlined by Baron and Kenny in 1986. They are as follows: (1) significant relationships exist between the independent variable, treatment group, and the dependent variables; 2) the treatment is related to the potential mediators and the mediators are related to the dependent variables; and 3), the addition of the mediators to the regression models removes or reduces the significance in the relationship between treatment and the dependent variables. The Sobel test was used to assess the statistical significance of mediating effects. BMI is the primary variable of interest in this

study, since BMI is the universally accepted measure of adiposity (Seidell & Rissanen, 2004); exploratory mediation analyses were also run using change in WC, percent change in body weight, and change in percent body fat.

Correlation analyses by gender and by treatment group were conducted to test the hypothesis that greater body image dissatisfaction (CBS-IBS discrepancy scores) at baseline would be associated with greater weight losses at year one (hypothesis #2). Partial correlations were also performed by gender, while controlling treatment effects. Gender differences in weight loss goals at baseline were also evaluated.

To test the hypothesis that participants with more moderate weight loss goals at baseline would be associated with greater weight losses at year one (hypothesis #3), plots between percent weight loss and the weight loss goal variables (weight loss goal in pounds and weight loss goal with the BMA 2.0 figure) were studied first and no apparent linear or quadratic relationship was detected. Furthermore, a significant association was not found using correlations. Since there were only a few females in this study with moderate weight loss goals (ILI,  $n = 3$ ; DSE,  $n = 2$ ), no statistical comparisons were done between the moderate weight loss goal group and the extreme weight loss goal group.

To test the hypothesis that participants' estimates of the most attractive body size/shape for same and opposite gender would become thinner as participants lose weight (from baseline to year one; hypothesis #4), first a series of ANCOVA were computed to evaluate change in the "most attractive to members of the opposite gender" morph figures by weight loss (decrease in BMI) for each gender separately. Partial correlations were also performed by gender, while controlling treatment effects.

Independent t-tests were computed to test the hypotheses that females would select smaller “most attractive figures for same gender,” than males would select for “most attractive figures for opposite gender,” and males would select larger “most attractive figures for same gender,” than females would select for “most attractive figures for opposite gender” (hypothesis #5).

To test the secondary hypothesis that participants in the ILI arm of the study would have greater improvements in mood (decreased BDI-II scores) from baseline to year one compared to participants randomized to the DSE arm (hypothesis #6) a series of ANCOVA were computed for change in BDI-II scores (with baseline scores used as covariates). BDI-II change scores were not found to differ as a function of treatment, therefore no further tests of mediation were necessary to test the hypothesis (#7) that change in BDI-II scores was a significant covariate (mediator) for treatment group effects (BMA 2.0 estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS).

Exploratory analysis regarding ethnicity as a potential moderator variable were not conducted due to the small sample of African American subjects for both men ( $n = 7$ , 10% of male sample) and women ( $n = 24$ , 27% of female sample).

## Results

Of the original 157 participants enrolled in the study at baseline, 141 participants were available for study after one year of participation in the Look AHEAD trial. The study sample at baseline consisted of 76 participants in the DSE arm, and 81 participants in the ILI arm. A total of 88 females and 69 males participated in the study. Descriptive data for the total sample at baseline appears in Table 1.

**Table 1. Participant Characteristics – Baseline (N = 157)**

	<b><u>Total Sample</u></b> (n = 88)	<b><u>DSE</u></b> (n = 43)	<b><u>ILI</u></b> (n = 45 )
<b>Females</b>	<i>Mean (sd)</i>	<i>Mean (sd)</i>	<i>Mean (sd)</i>
Age	59.18 (6.52)	58.95 (6.13)	59.40 (6.94)
BMI	36.40 (5.45)	36.43 (5.34)	36.38 (5.61)
WC	109.40 (11.79)	109.89 (12.15)	108.93 (11.55)
% Fat	43.31 (4.25)	43.79 (4.36)	42.85 (4.13)
<b>Males</b>	<b><u>Total Sample</u></b> (n = 69)	<b><u>DSE</u></b> (n = 33)	<b><u>ILI</u></b> (n = 36 )
Age	61.65 (5.45)	61.88 (5.16)	61.44 (5.76)
BMI	33.51 (4.78)	33.12 (4.43)	33.87 (5.11)
WC	116.06 (12.00)	114.53 (11.13)	117.47 (12.75)
% Fat	30.62 (5.73)	30.44 (5.18)	30.78 (6.24)

Note. DSE = Diabetes Support and Education; ILI = Intensive Lifestyle Intervention; BMI = Body Mass Index; WC = Waist Circumference; % Fat = percent body fat.

A total of 16 participants did not participate in year one data collection. Of those remaining at year one (N = 141), 70 were in the ILI arm, and 71 were in the DSE arm of the study. The sample of female participants was primarily Caucasian (73%); had obtained some higher education (74% had 13+ years of education); were employed full or part-time (60%); and

58% were married, 23% divorced, and 18% widowed. The sample of male participants was primarily Caucasian (90%); were employed full or part-time (63%); had obtained some higher education (93%); and were married (90%). Descriptive information of those participants for whom year one data was collected appears in Table 2.

Table 2. Participant Characteristics - Baseline (N = 141)

	<b><u>Total Sample</u></b> (n = 78)	<b><u>DSE</u></b> (n = 40)	<b><u>ILI</u></b> (n = 38)
<b>Females</b>	<i>Mean (sd)</i>	<i>Mean (sd)</i>	<i>Mean (sd)</i>
Age	58.95 (6.33)	58.50 (5.95)	59.42 (6.76)
BMI	36.68 (5.45)	36.40 (5.48)	36.98 (5.48)
WC	110.03 (11.73)	110.27 (12.50)	109.78 (11.02)
% Fat	43.43 (4.14)	43.64 (4.31)	43.22 (4.00)
	<b><u>Total Sample</u></b> (n = 63)	<b><u>DSE</u></b> (n = 31)	<b><u>ILI</u></b> (n = 32)
<b>Males</b>			
Age	61.52 (5.24)	61.94 (5.10)	61.13 (5.42)
BMI	33.30 (4.88)	32.71 (4.24)	33.86 (5.43)
WC	115.70 (12.20)	113.48 (10.62)	117.85 (13.37)
% Fat	30.46 (5.79)	29.88 (4.86)	31.01 (6.57)

Note. DSE = Diabetes Support and Education; ILI = Intensive Lifestyle Intervention; BMI = Body Mass Index; WC = Waist Circumference; % Fat = percent body fat.

### **Primary Analyses by Hypothesis**

The first hypothesis of the study was that the effect of treatment group on changes in body image variables (BMA 2.0 estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS) would be mediated by changes in weight (BMI) from baseline to year one. The methods of Baron and Kenny (1986) were used to test for possible mediation effects. This mediation model is shown in Figure 1. To establish that a variable acts as a mediator the following conditions were required to

be met: 1) the treatment intervention must significantly affect change in BMA 2.0 estimates of CBS, IBS, ABC, CBS-IBS, and CBS-ABS (controlling for baseline values) from baseline to year one (path  $c$ , refer to Figure 2), 2) the treatment group is required to significantly affect the potential mediator variable (BMI change, path  $a$ ), 3) variations in the mediator variable are required to significantly affect the dependent variables (change in estimates of CBS, IBS, ABC, CBS-IBS, and CBS-ABS; path  $b$ ), and 4) when the effect of the mediator variable was controlled, the treatment group effects should be diminished or are no longer statistically significant (path  $c'$ ).

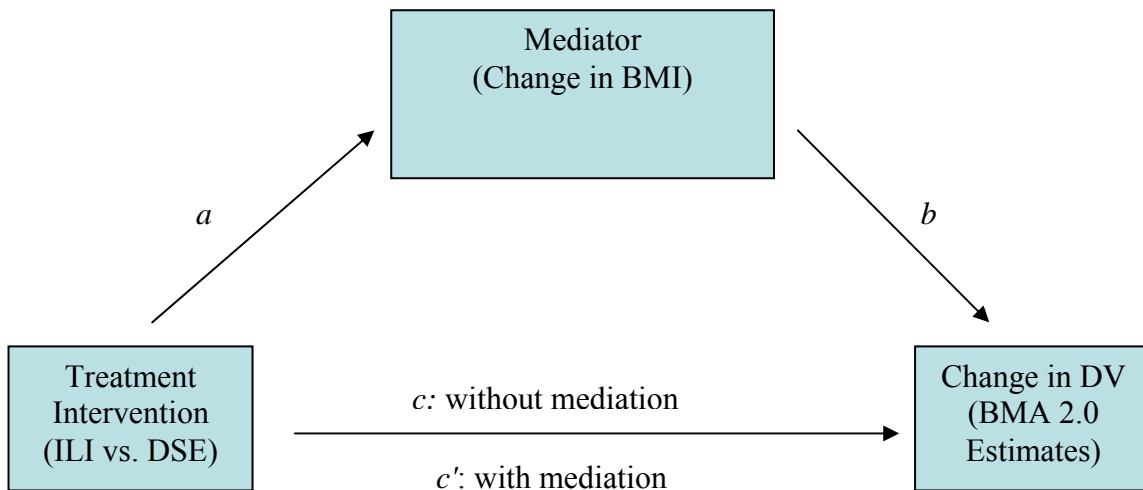


Figure 1. Graphical Depiction of the Hypothesized Mediation Effect. Path  $a$  represents treatment effects on the mediator variable; path  $b$  represents the effect of the mediator on the dependent variable; path  $c$  represents treatment effects on the dependent variable; and path  $c'$  represents treatment effects on the dependent variable including the mediator variable in the regression model.

Effects of Treatment Assignment on BMA 2.0 Estimates. It was hypothesized that participants randomly assigned to the ILI arm of the study (compared to the DSE arm) would have greater changes in estimates of CBS, IBS, ABC, CBS-IBS, and CBS-ABS (controlling for baseline values) from baseline to year one. To evaluate the change in each of the body image



variables (changes in BMA 2.0 estimates of CBS, IBS, ABC, CBS-IBS, and CBS-ABS) from baseline to year one, separate analysis of covariance (ANCOVA) statistics were calculated for each variable's change score by treatment group, co-varying baseline values. This hypothesis was partially supported for both genders. Table 3 summarizes the ANCOVA results for each variable's change score by gender (note: baseline and year one means are provided for descriptive purposes only; adjusted mean and standard error for change scores were used to determine within group differences; and the  $F$  value describes between group effects).

For females, change in estimates of CBS differed as a function of treatment arm  $F(1, 75) = 20.97, p < .001$ . This treatment effect is depicted in Figure 2a. CBS estimate scores decreased from baseline for females in the ILI arm ( $p < .001$ ); whereas there was no change in CBS estimate scores for females in the DSE arm. Similarly for males, change in estimates of CBS differed as a function of treatment arm  $F(1, 60) = 14.87, p < .001$ . As depicted in Figure 2b, assignment to the ILI was associated with a decrease in estimates of CBS ( $p < .001$ ) for males; whereas there was no change in CBS estimate scores from baseline for males in the DSE arm of the study. Baseline CBS scores were associated with change scores such that greater reductions in CBS estimates were associated with larger baseline estimates of CBS for both females ( $r = -.38, p < .001$ ) and males ( $r = -.29, p < .05$ ).

The average change scores for estimates of IBS from baseline to year one did not differ as a function of treatment group for females ( $F(1, 75) = 2.77, p = .10$ ) or for males ( $F(1, 60) = 3.56, p = .06$ ) respectively. These non-significant findings are depicted in Figure Figures 3a and 3b respectively. This pattern of findings can probably attributed to the finding that the mean estimates for IBS did not change from baseline to year one for either gender, in either treatment condition. Correlation analyses indicated that larger estimates of IBS at baseline were associated

Table 3. Descriptive Statistics and Tests of Treatment Effects on Change Scores for BMA 2.0 Estimates

<u>Dependent Variable</u>	<u>Intensive Lifestyle Intervention</u>			<u>Diabetes Support &amp; Education</u>			<u>F<sup>b</sup></u>
	<u>Baseline M</u>	<u>Year1 M</u>	<u>Δ M (±se)</u>	<u>Baseline M</u>	<u>Year1 M</u>	<u>Δ M (±se)</u>	
<b><u>Females</u></b>							
CBS	75.52	66.72	-8.51 ±1.05 <sup>a</sup>	73.39	71.88	-1.78 ±1.02	20.97***
IBS	53.67	52.66	-1.06 ±0.75	54.06	54.70	0.68 ±0.73	2.77
ABS	56.82	55.93	-1.42 ±0.75	59.46	60.45	1.49 ±0.73 <sup>a</sup>	7.57**
CBS-IBS	21.85	14.07	-7.35 ±1.04 <sup>a</sup>	19.32	17.18	-2.55 ±1.01 <sup>a</sup>	10.85**
CBS-ABS	18.69	10.79	-6.78 ±1.20 <sup>a</sup>	13.93	11.43	-3.57 ±1.17 <sup>a</sup>	3.50
<b><u>Males</u></b>							
CBS	73.41	61.87	-11.45 ±1.66 <sup>a</sup>	72.78	70.55	-2.33 ±1.69	14.87***
IBS	53.94	51.37	-2.23 ±1.24	52.47	53.95	1.12 ±1.26	3.56
ABS	60.16	56.50	-3.50 ±1.09 <sup>a</sup>	57.64	59.74	1.94 ±1.11	12.05**
CBS-IBS	19.47	10.50	-9.28 ±1.71 <sup>a</sup>	20.31	16.61	-3.38 ±1.74	5.88*
CBS-ABS	13.25	5.37	-8.37 ±1.22 <sup>a</sup>	15.15	10.82	-3.83 ±1.24 <sup>a</sup>	6.76*

Note. Δ M = adjusted mean change score; CBS = Current Body Size; IBS = Ideal Body Size; ABS = Acceptable Body Size.

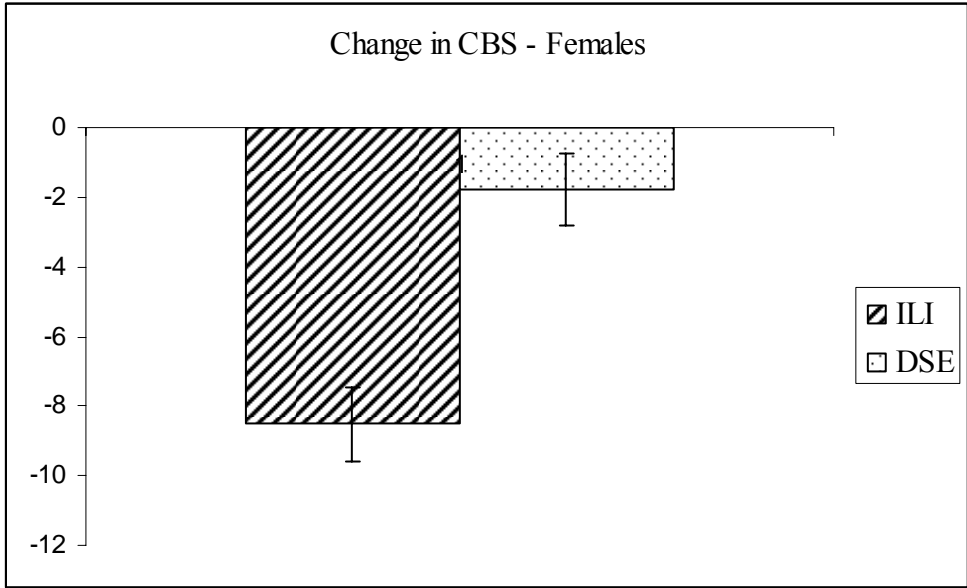
<sup>a</sup> = significant treatment effects from baseline to year one at .05 level.

F<sup>b</sup> = ANCOVA statistic for mean change scores; *df*(1, 75) – females; *df*(1, 60) – males.

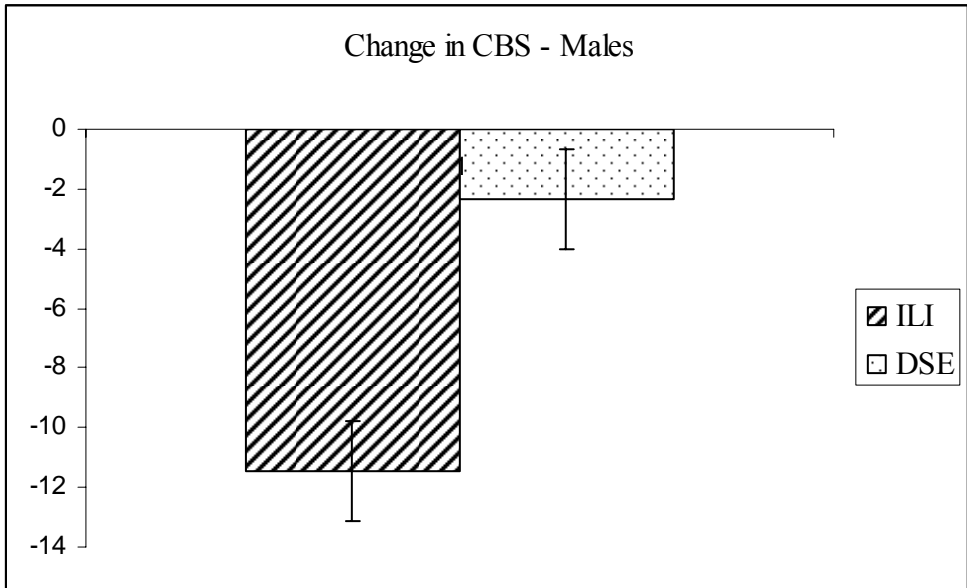
\*\*\**p* < .001

\*\**p* < .01

\**p* < .05



a



b

Figure 2. Treatment Effects from Baseline to Year 1 – BMA 2.0 estimates of CBS

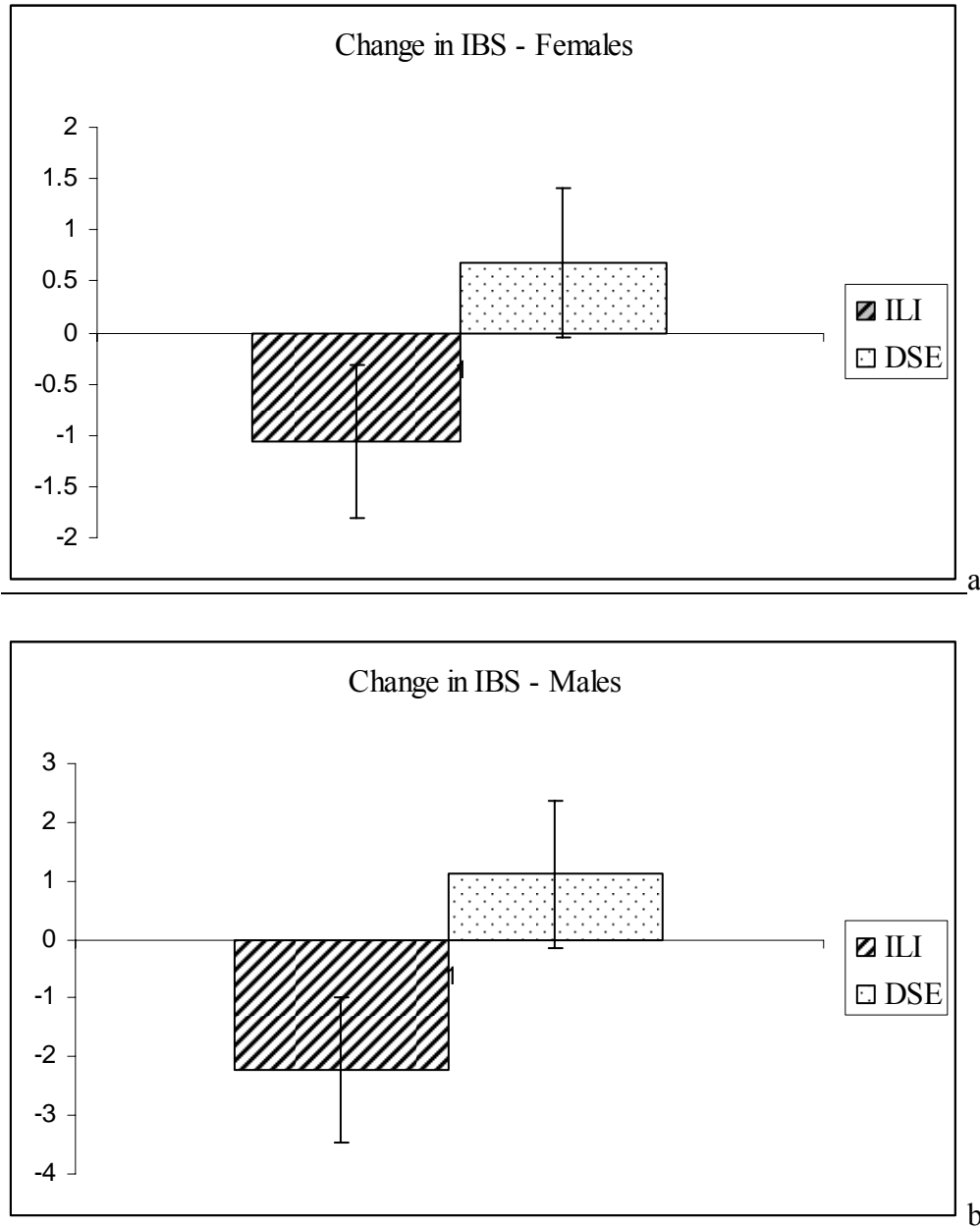


Figure 3. Treatment Effects from Baseline to Year 1 – BMA 2.0 estimates of IBS

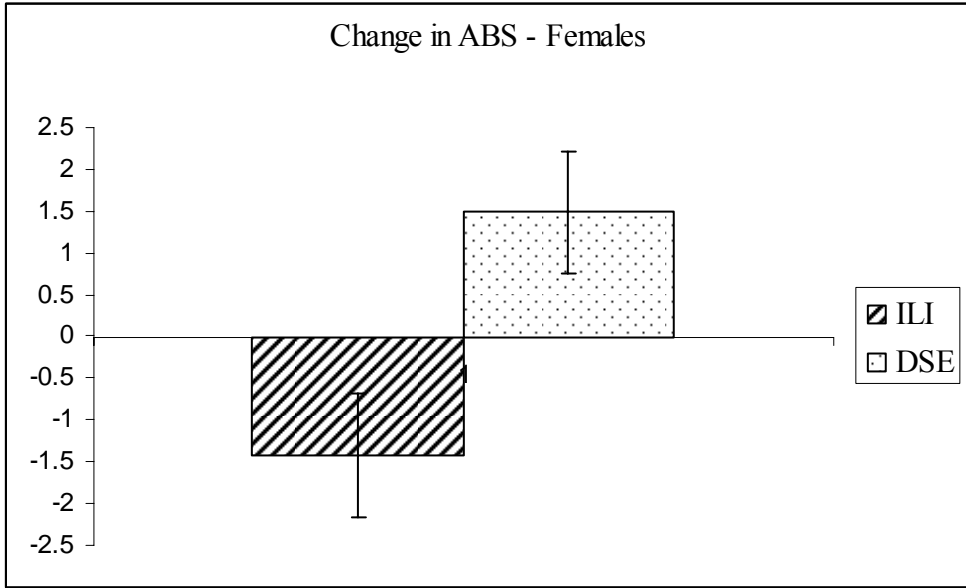
with greater reductions in IBS estimates at year one for females ( $r = -.25, p < .05$ ) and for males ( $r = -.48, p < .001$ ).

Change scores for ABS estimates differed as a function of treatment arm  $F(1, 75) = 7.57, p < .01$  for females. This treatment effect is illustrated in Figure 4a. There was no change in ABS

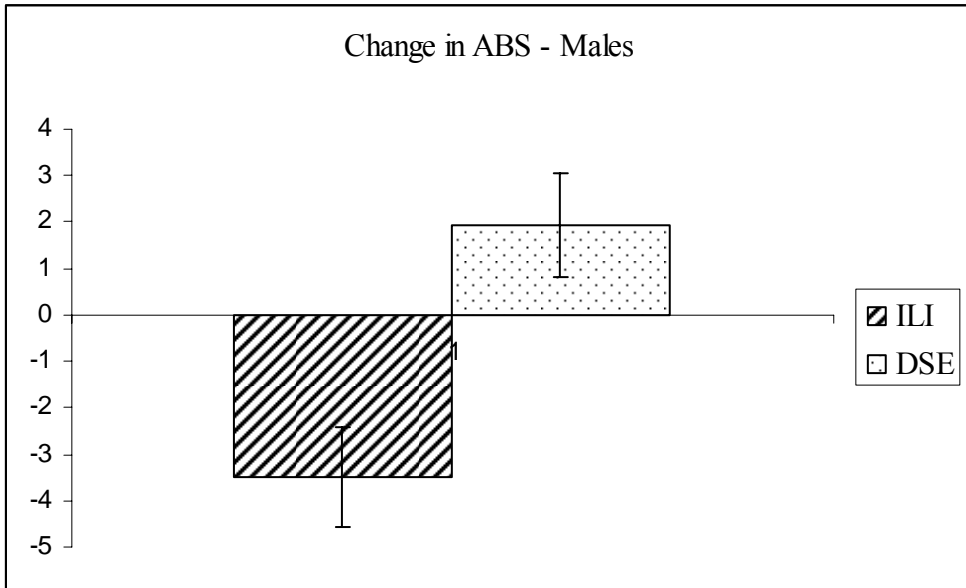
estimate scores for females in the ILI arm; whereas ABS scores increased from baseline for females in the DSE ( $p < .05$ ) arm. As observed for CBS, females' baseline ABS scores were associated with change scores such that greater reductions in ABS estimates were associated with larger baseline estimates of ABS ( $r = -.45, p < .001$ ). For males, changes in ABS estimates also differed as a function of treatment arm  $F(1, 60) = 12.05, p < .01$ . As shown in Figure 4b, assignment to the ILI was associated with a decrease in estimates of ABS ( $p < .01$ ) for males; whereas there was no significant change in ABS scores for males in the DSE arm of the study.

For females, change in CBS-IBS scores differed between the two treatment arms  $F(1, 75) = 10.85, p < .01$ . As illustrated in Figure 5a, CBS-IBS scores decreased for females in both the ILI ( $p < .001$ ) and DSE ( $p < .05$ ) treatment conditions. Similarly for males, average CBS-IBS scores differed as a function of treatment  $F(1, 60) = 5.88, p < .05$ , illustrated in Figure 5b. CBS-IBS scores decreased from baseline for males in the ILI ( $p < .001$ ) arm. Baseline estimates of CBS-IBS were associated with change scores such that larger baseline estimates of CBS-IBS were associated with greater reductions in CBS-IBS estimates at year one for both females ( $r = -.47, p < .001$ ) and males ( $r = -.54, p < .001$ ).

The mean change scores for estimates of CBS-ABS from baseline to year one did not differ as a function of treatment group for females. This non-significant finding is depicted in Figure 6a. CBS-ABS scores decreased for females in both the ILI ( $p < .001$ ) and DSE ( $p < .01$ ) treatment conditions. Change scores for CBS-ABS differed as a function of treatment arm  $F(1, 60) = 6.76, p < .05$  for males. As shown in Figure 6b, CBS-ABS scores for males in the both the ILI ( $p < .001$ ) and DSE ( $p < .01$ ) decreased from baseline. Correlation analyses indicated that larger baseline estimates of CBS-ABS were associated with greater reductions in CBS-ABS scores at year one for both females ( $r = -.51, p < .001$ ) and males ( $r = -.43, p < .001$ ).



a



b

Figure 4. Treatment Effects from Baseline to Year 1 – BMA 2.0 estimates of ABS

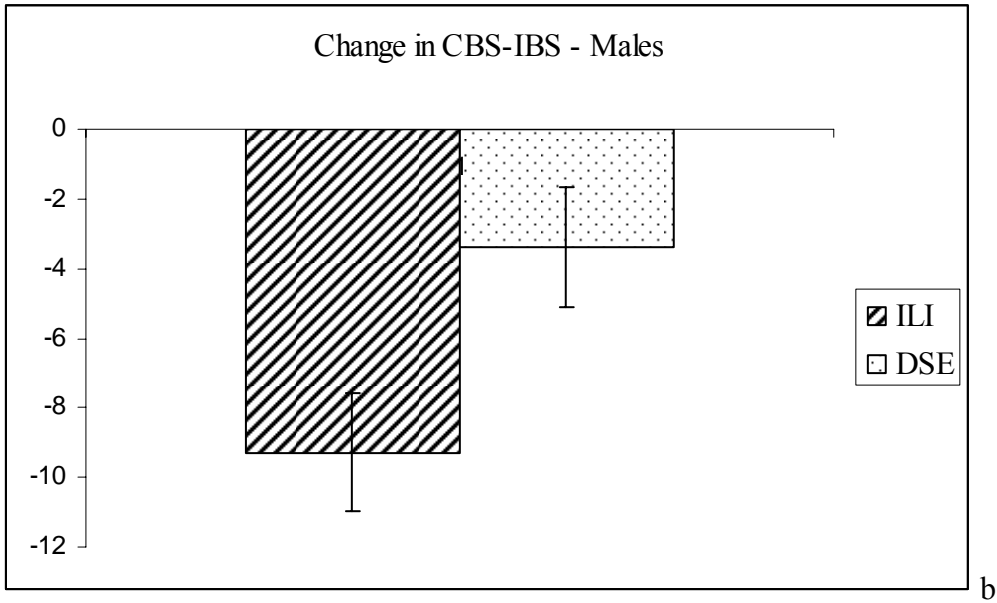
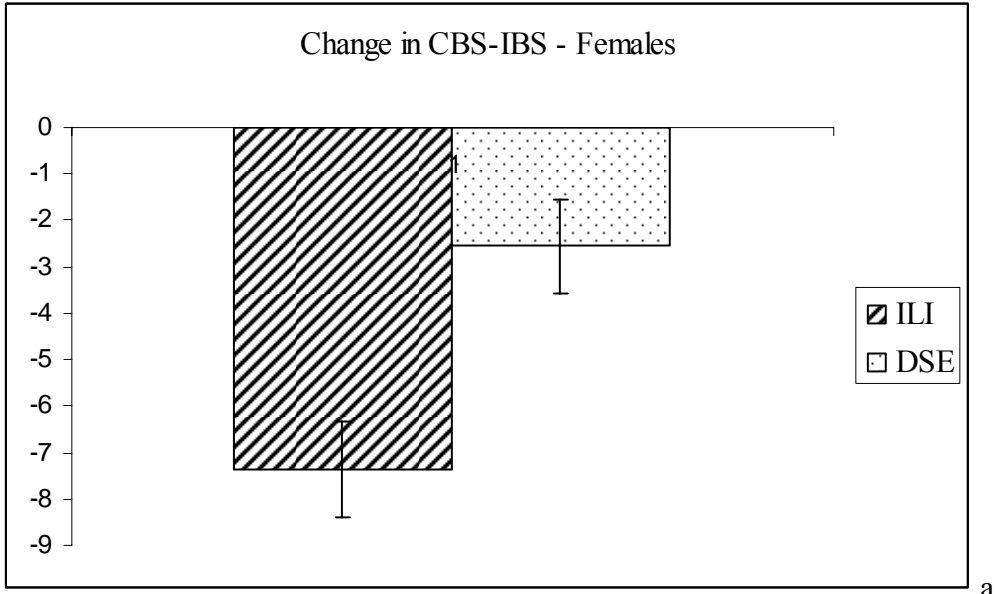


Figure 5. Treatment Effects from Baseline to Year 1 – BMA 2.0 estimates of CBS-IBS

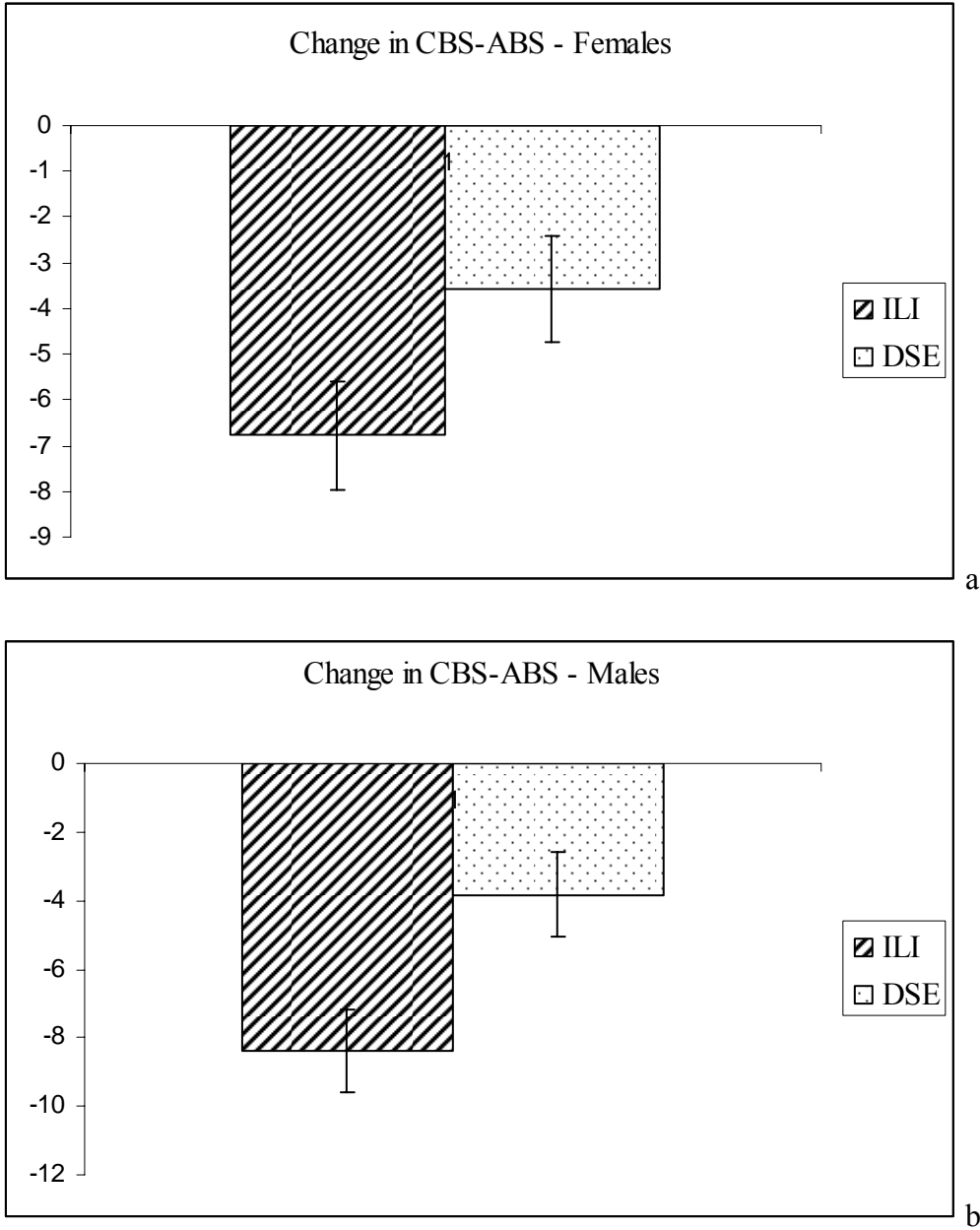


Figure 6. Treatment Effects from Baseline to Year 1 – BMA 2.0 estimates of CBS-ABS

Effects of Treatment Assignment on Weight and Adiposity Measures. The hypothesis that participants randomly assigned to the ILI arm would lose significantly more weight (BMI), more percent body fat, and greater WC than participants randomly assigned to the DSE (control arm of the study) from baseline to year one was supported by the results of this study. To



evaluate the change in each of the weight and adiposity variables (BMI, WC, and percent body fat) from baseline to year one, separate analysis of covariance (ANCOVA) statistics were calculated for each variable's change score by treatment group, co-varying baseline values. Change in BMI differed as a function of treatment for both females ( $F(1, 75) = 60.34, p < .001$ ) and males ( $F(1, 60) = 75.80, p < .001$ ). These treatment effects are depicted in figures 7a and 7b. There was no change in BMI from baseline for females or males in the DSE condition, but BMI decreased after one year for both genders (females:  $p < .001$ ; males:  $p < .001$ ) in the ILI. On average, the intensive behavioral weight loss condition produced moderate weight loss (represented as percent weight loss) for both female (mean = -9.32%,  $sd = 5.18$ ) and male (mean = -10.94%,  $sd = 7.13$ ) participants in the ILI arm of the study. For participants in the ILI arm, WC (mean = -6.38,  $sd = 5.47$ ; mean = -10.86,  $sd = 6.54$ ) and percent body fat (mean = -2.33%,  $sd = 2.55$ ; mean = -4.96%,  $sd = 2.83$ ) also decreased for females and males respectively.

Tests of Mediator Effects. It was hypothesized that co-varying the postulated mediator variable (change in BMI) would remove significant treatment effects found in the dependent variables (BMA 2.0 estimates of CBS, ABS, CBS-IBS, and CBS-ABS). The tests of mediation, as outlined by Baron and Kenny (1986) are presented in Table 4 by gender (refer to mediation model graphically depicted in Figure 2). Table 4 is organized such that the first column lists each of the dependent variables that differed as a function of treatment arm; the regression coefficient for treatment group effects on the mediator (BMI) is represented as Path *a*; the regression coefficient for effects of the mediator (BMI) on the DV (after controlling for effects of treatment and baseline values of the DV) is represented as Path *b*; the regression coefficient for treatment group effects is represented as Path *c*; all of which are required to be statistically significant to assume mediation. The treatment group effects on changes in the body image dependent

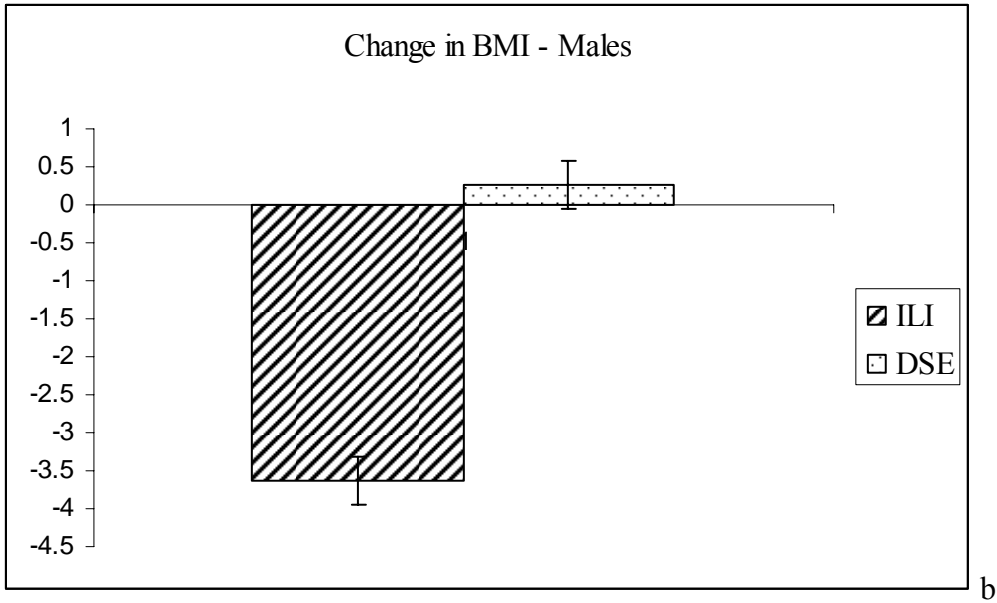
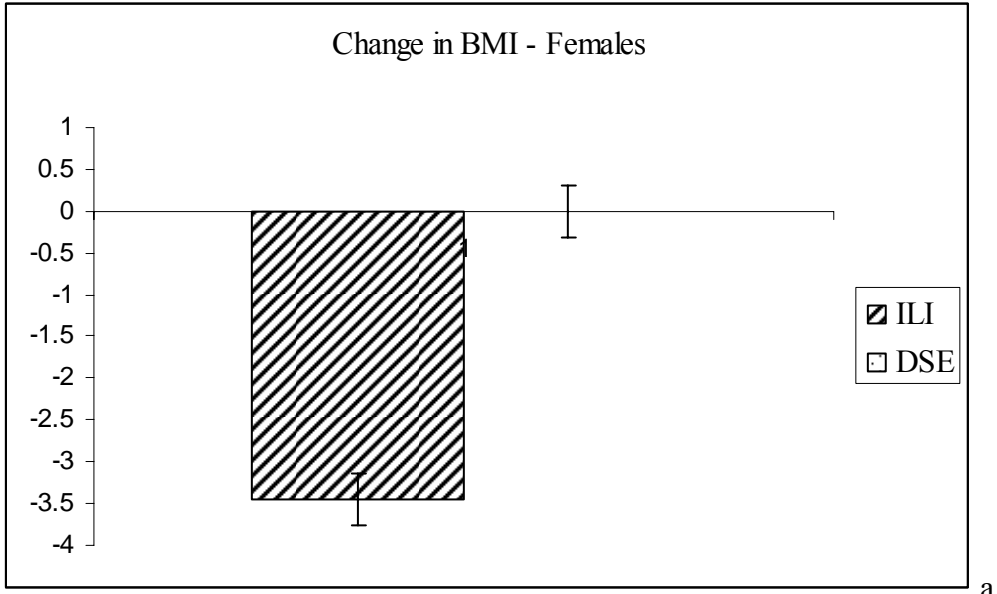


Figure 7. Treatment Effects from Baseline to Year 1 – BMI

variables with the mediator (BMI) in the regression model are presented under Path c'; and finally, Sobel's test (represented as z) was used to test whether the indirect effect of the treatment

Table 4. Summary of Mediation Analyses Related to Change in Body Mass Index.

<u>Dependent Variable</u>	<u>Path a</u>	<u>Path b</u>	<u>Path c</u>	<u>Path c'</u>	<u>ab</u>	<u>z</u>	<u>p</u>
<b>Females</b>							
Δ CBS	3.46(0.44)***	0.73(0.37)	6.72(1.47)***	4.17(1.94)*	2.53	3.21	.0013
Δ ABS <sup>l</sup>	3.46(0.44)***	0.67(0.26)*	2.91(1.06)**	0.54(1.38)	2.33	3.84	< .0001
Δ CBS - IBS	3.46(0.44)***	0.19(0.38)	4.80(1.46)**	4.15(1.97)*	0.65	.089	.3753
<b>Males</b>							
Δ CBS <sup>l</sup>	3.87(0.44)***	2.27(0.63)***	9.12(2.37)***	0.35(3.24)	8.78	6.28	< .0001
Δ ABS <sup>l</sup>	3.87(0.44)***	1.65(0.40)***	5.45(1.57)**	-0.89(2.06)	6.37	6.61	< .0001
Δ CBS - IBS	3.87(0.44)***	0.88(0.70)	5.91(2.44)*	2.51(3.64)	3.40	2.35	.0186
Δ CBS -ABS	3.87(0.44)***	0.65(0.50)	4.54(1.75)*	2.04(2.60)	2.51	2.40	.0165

Note. CBS = Current Body Size; IBS = Ideal Body Size; ABS = Acceptable Body Size; BMI = Body Mass Index; ab = the product of a and b; z = test statistic for Sobel's test.

Model 1: Change in Dependent Variable = treatment group + baseline Dependent Variable

Model 2: Mediator = treatment group

Model 3: Change in Dependent Variable = treatment group + baseline Dependent Variable + Mediator

Path a: Regression coefficient (Standard error) for 'treatment group' effect from model 2

Path b: Regression coefficient (Standard error) for 'mediator' effect from model 3

Path c: Regression coefficient (Standard error) for 'treatment group' effect from model

Path c': Regression coefficient (Standard error) for 'treatment group' effect from model 3

<sup>l</sup> = change in BMI full mediator of treatment effects

\*\*\**p* < .001

\*\**p* < .01

\**p* < .05

on the dependent variable while controlling for the mediator variable was significantly different from zero.

As noted earlier, for females, changes in CBS ( $p < .001$ ), ABS ( $p < .01$ ) and CBS-IBS ( $p < .01$ ) differed as a function of treatment arm, (thus meeting this mediation criterion of Baron and Kenny [1986], path  $c$ ). Treatment effects for IBS and CBS-ABS were not detected, thus mediation effects were not tested for these variables for females. For males changes in CBS ( $p < .001$ ), ABS ( $p < .01$ ), CBS-IBS ( $p < .05$ ), and CBS-ABS ( $p < .05$ ) differed significantly as a function of treatment arm (meeting the mediation criterion of path  $c$ ). Treatment effects for IBS were not detected, and therefore mediation effects were not tested for this variable in males. Regression analyses were performed to confirm the treatment effects on the dependent variables, and are presented in Table 4 under path  $c$ .

A second series of regression analyses was conducted to confirm the influence of the treatment group on the putative mediator variable (BMI change), the direct effects of treatment on the proposed mediator variables are presented as Path  $a$  in Table 4. As noted above, BMI change scores differed across treatment groups at the  $p < .001$  significance level for both genders, therefore meeting this criterion for tests of mediation (path  $a$ ).

Of note, out of all the adiposity measures, BMI change was most highly correlated with percent weight loss ( $r = .99, p < .001$ ;  $r = .99, p < .001$ ) for females and males respectively, thus supporting the use of BMI change as the primary mediator variable of interest in this study. BMI was also highly correlated with change in percent body fat (females:  $r = .77, p < .001$ ; males:  $r = .88, p < .001$ ) and WC (females:  $r = .69, p < .001$ ; males:  $r = .87, p < .001$ ).

Finally, a series of regression analyses was conducted separately by gender to determine whether the hypothesized mediator variable (change in BMI) attenuated the treatment group

effects on changes in the body image dependent variables (Path  $c'$ ). For females, change in BMI emerged as a complete mediator of the treatment effects on change in ABS ( $R^2 = .33$ ,  $\beta = 0.54$ ,  $se = 1.38$ ,  $p = .70$ ). For males, change in BMI emerged as a complete mediator of the treatment effects on change in CBS ( $R^2 = .40$ ,  $\beta = 0.35$ ,  $se = 3.24$ ,  $p = .91$ ) and change in ABS ( $R^2 = .38$ ,  $\beta = -0.89$ ,  $se = 2.06$ ,  $p = .67$ ). Therefore, the significant changes from baseline to year one found in CBS for males and ABS for both genders were due to changes in weight (BMI) rather than direct effects of the treatment condition. Please refer to Table 4 for a summary of all tests of mediation.

Association Between Body Image Dissatisfaction and Weight Loss. Pearson's partial correlation analyses by gender (controlling for treatment effects) were performed to test the hypothesis that participants with greater initial body image dissatisfaction (baseline CBS-IBS discrepancy scores) at baseline would be associated with greater weight losses (decrease in BMI) at year one. Results from the partial correlation analyses did not support this hypothesis for either gender. Baseline estimates of CBS-IBS were not significantly related to changes in BMI (females:  $r = .06$ ,  $p = .63$ ; males:  $r = .01$ ,  $p = .97$ ), percent body fat (females:  $r = .11$ ,  $p = .33$ ; males:  $r = .08$ ,  $p = .57$ ), or WC (females:  $r = -.11$ ,  $p = .33$ ; males:  $r = -.01$ ,  $p = .96$ ) at year one for either gender. These results indicate that body image dissatisfaction (as measured by the CBS-IBS discrepancy score) at baseline was not associated with greater or lesser degrees of weight loss at year one for females or males.

As a further test of this hypothesis, Pearson's correlation tests were performed by gender and treatment group. These analyses resulted in similar findings, such that baseline estimates of CBS-IBS were not associated with change in weight for females or males in either treatment arm.

Although initial body image dissatisfaction (baseline CBS-IBS discrepancy scores) was not associated with greater weight losses (decrease in BMI) at year one, change in BMI was associated with change in CBS-IBS for females ( $r = .26, p < .05$ ) and there was a similar trend for males ( $r = .25, p = .0503$ ). In the ILI condition, body image dissatisfaction improved (decrease in CBS-IBS scores) as BMI decreased for both females ( $t(75) = -7.08, p < .001$ ) and males ( $t(60) = -5.43, p < .001$ ). This finding is due to the fact that change in BMA 2.0 estimates of CBS were also related to change in BMI for both females ( $p < .001$ ) and males ( $p < .001$ ), such that estimates of CBS decreased as BMI decreased. While estimates of CBS-IBS are influenced by both CBS and IBS change scores, as noted above IBS did not change from baseline to year one for either gender. Therefore, the improvement in body image dissatisfaction (decrease in CBS-IBS) at year one was primarily due to decreasing estimates of CBS, as this change resulted in a reduction of the discrepancy between CBS and IBS for both females and males in this study.

For females, change in BMI was associated with change in each of the BMA 2.0 estimates CBS ( $p < .001$ ), IBS ( $p < .05$ ), ABS ( $p < .01$ ), CBS-IBS ( $p < .05$ ) except CBS-ABS ( $p = .10$ ); such that BMA 2.0 estimates decreased as BMI decreased for females. On the other hand for males, change in BMI was associated with change in estimates of CBS ( $p < .001$ ), IBS ( $p < .001$ ), ABS ( $p < .001$ ), and CBS-ABS ( $p < .05$ ), but not associated with change in CBS-IBS ( $p = .0503$ ). Together these findings indicate that change in weight was associated with change in most of the body image variables for both genders.

Another related finding was that changes in estimates of CBS (for females) were associated with change in estimates of IBS ( $r = .33, p < .01$ ), such that estimates of IBS decreased as estimates of CBS decreased. On the contrary, there was no relationship between

change in CBS and change in IBS for males. This pattern of findings suggests that for females, change in IBS was related to changes in perceived CBS, whereas for males change in IBS was not related to changes in CBS.

Association Between Weight Loss Goals and Weight Loss. It was hypothesized that participants with moderate weight loss goals (5-15% initial weight, versus >15% initial weight) at baseline would be associated with better weight loss at year one. An examination of scatter plots and Pearson partial correlation analyses did not support this hypothesis (see Figures 8-11). Data for both males and females in both treatment conditions resulted in a random pattern for weight loss goals in terms of both pounds and BMA 2.0 figure. The data plot for percent weight loss goals (in pounds) by percent weight loss at year one is illustrated in Figure 8 for females and Figure 9 for males. The data plot for weight loss goals (BMA 2.0 morph figure) by percent weight loss is illustrated in Figure 10 for females and Figure 11 for males.

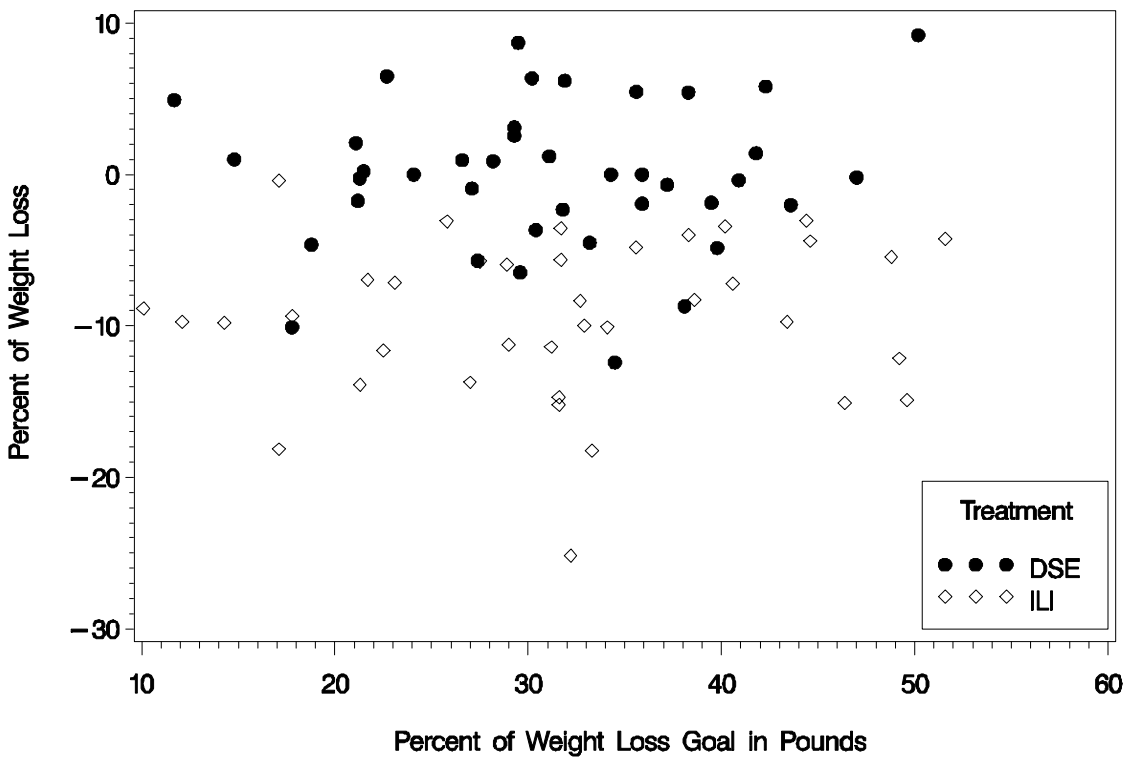


Figure 8. Percent Weight Loss at Year 1 by Weight Loss Goals in Pounds –Females

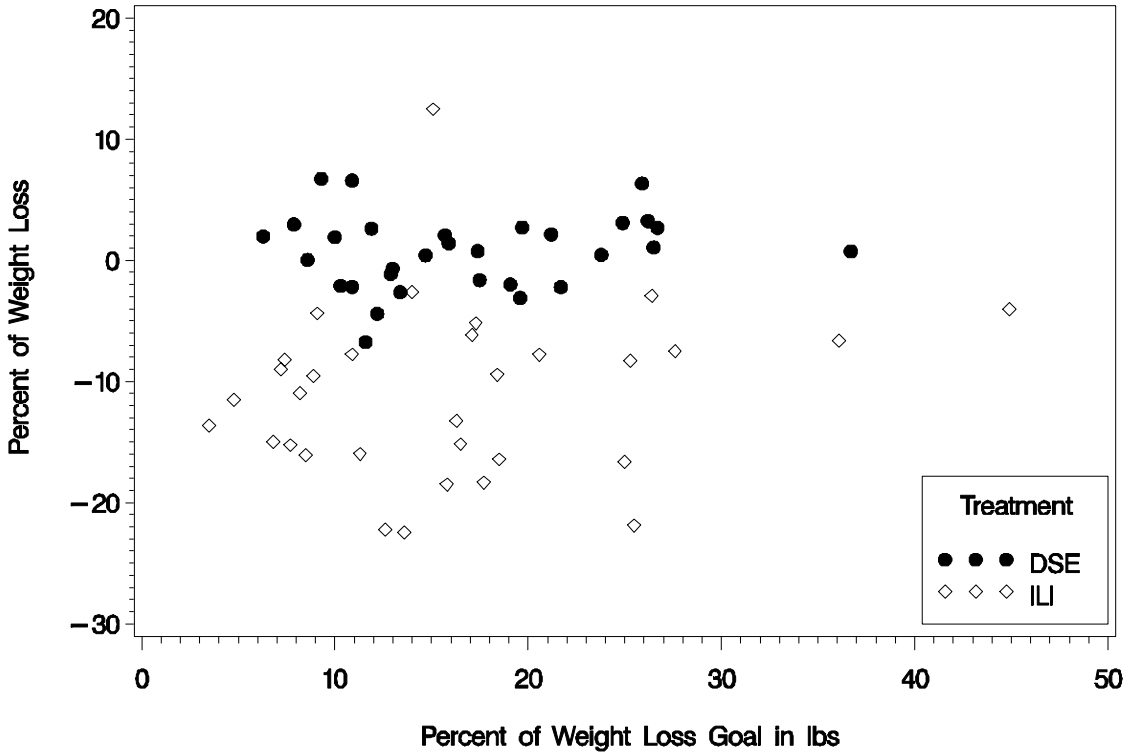


Figure 9. Percent Weight Loss at Year 1 by Weight Loss Goals in Pounds –Males

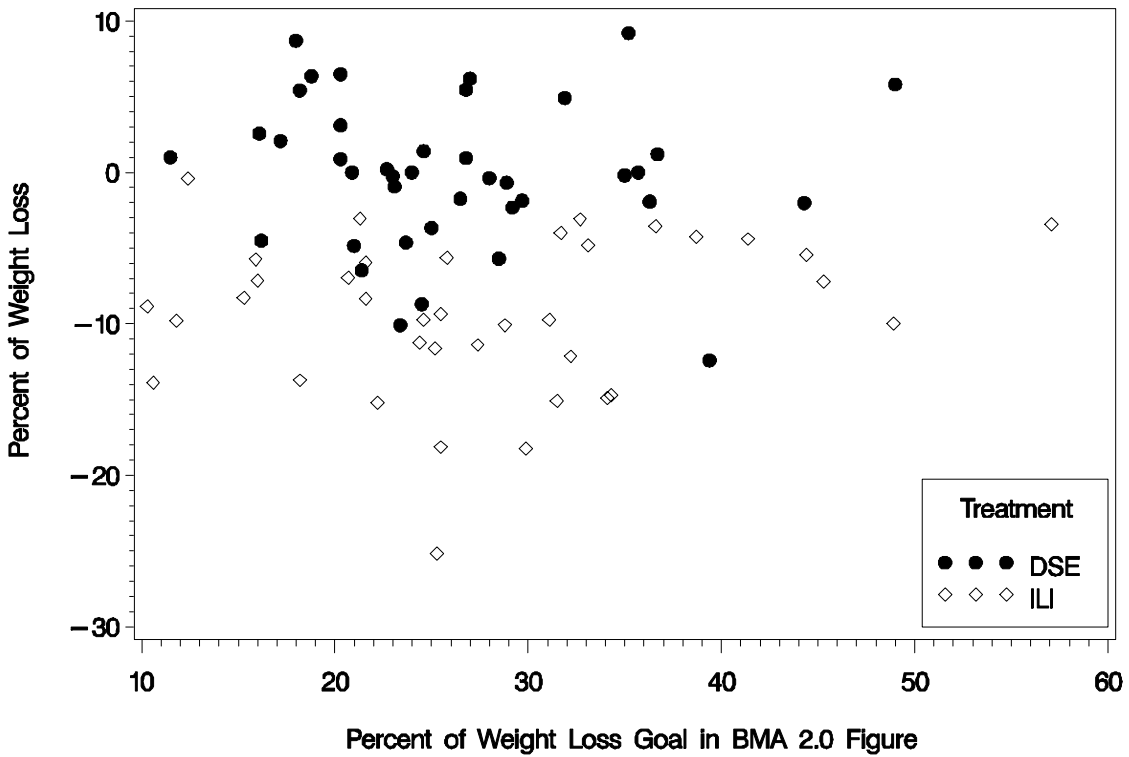


Figure 10. Percent Weight Loss at Year 1 by Weight Loss Goals with Morph Figure –Females



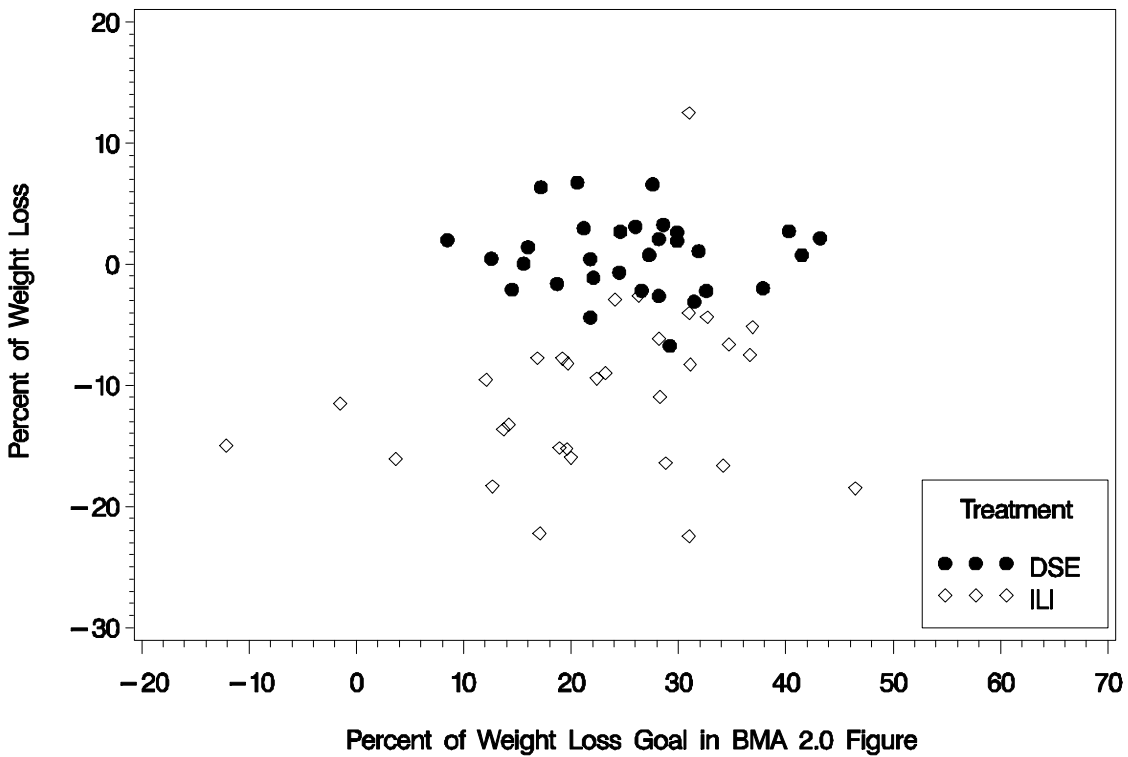


Figure 11. Percent Weight Loss at Year One by Weight Loss Goals with Morph Figure –Males

Results from Pearson partial correlation analyses indicated that percent weight change at year one was not associated with baseline weight loss goals in pounds ( $r = .08, p = .49$ ;  $r = .17, p = .20$ ) or weight loss goals in BMA 2.0 figures ( $r = .05, p = .65$ ;  $r = .03, p = .80$ ) for females or males respectively. Weight loss goals in pounds were significantly correlated to weight loss goals using the BMA 2.0 morph figure for females in each arm of the study (ILI:  $r = .62, p < .001$  ; DSE:  $r = .47, p < .01$ ), and similarly for males in both the ILI ( $r = .62, p < .001$ ) and DSE ( $r = .44, p < .05$ ) arms of the study. These correlations suggest that the BMA 2.0 is measuring related constructs in terms of weight loss goals in both pounds and morph figures.

The males in this study selected more realistic weight loss goals ( $m = 16.52\%, sd = 8.22$ ) with almost half (47.62%) of the males selecting weight loss goals within the moderate range (5-15% initial weight), compared to females weight loss goals ( $m = 31.47\%, sd = 9.89$ ),  $t(139) =$

9.61,  $p < .001$ , with only 6.41% of females selecting moderate weight loss goals at baseline. Out of the total female sample, only five females (DSE,  $n = 2$ ; ILI,  $n = 3$ ) selected weight loss goals within the moderate range (within 5-15% initial weight), which may help explain why no differences were detected between these two groups. The percentage of males (47.62%) who selected moderate weight loss goals compared to females (6.41%) was significantly different,  $\chi^2 = (1, 141) = 52.74, p < .001$ . Nevertheless, weight goals (defined in pounds or BMA 2.0 figures) were not associated with changes in BMI for either treatment arm.

Change in “Most Attractive” Figures as a Function of Weight Loss. The hypothesis that estimates of the “most attractive figure to members of the same and opposite gender” would become smaller (thinner) as a function of weight loss was not supported by the results of this study. First, a series of ANCOVA (co-varying baseline values) were computed to test this hypothesis. For females, the average change score for “most attractive figure of the same gender” (ILI: adj. mean = -1.09, ( $se$ ) = 1.43,  $p = .45$ ; DSE: adj. mean = -.50, ( $se$ ) = 1.39,  $p = .72$ ) and “most attractive figure of the opposite gender” (ILI: adj. mean = .44, ( $se$ ) = 1.01,  $p = .67$ ; DSE: adj. mean = .16, ( $se$ ) = .82,  $p = .84$ ) did not change significantly from baseline to year one in either treatment condition.

Similarly for males the average change score for “most attractive figure of the same gender” (ILI: adj. mean = 1.44, ( $se$ ) = 1.26,  $p = .26$ ; DSE: adj. mean = 1.70, ( $se$ ) = 1.29,  $p = .19$ ), and “most attractive figure of the opposite gender” (ILI: adj. mean = -1.08, ( $se$ ) = .80,  $p = .18$ ; DSE: adj. mean = .16, ( $se$ ) = .82,  $p = .84$ ) did not change significantly from baseline to year one in either treatment condition. Therefore, contrary to what had been hypothesized, estimates of the “most attractive figure to members of the same and opposite gender” did not become smaller (thinner) from baseline to year one of this study, regardless of weight loss.

Pearson's partial correlation analyses (controlling for treatment effects) were then performed to evaluate the relationship between change in estimates of the "most attractive figure to members of the same and opposite gender" and change in weight (BMI change) at year one. Results indicated that BMI change was not significantly related to change in "most attractive figure of the same gender" (females:  $r = -.13, p = .28$ ; males:  $r = -.01, p = .92$ ) or change in "most attractive figure of the opposite gender" (females:  $r = -.06, p = .61$ ; males:  $r = -.14, p = .29$ ). These results indicate that there was no significant association between change in estimates of the "most attractive figure to members of the same or opposite gender" and weight loss (decrease in BMI) for either gender in this study.

Gender Differences in Estimates of "Most Attractive" Figures. It was hypothesized that females' average estimates of the "most attractive figure for same gender" (female figure) would be smaller (thinner) than males' average estimates of the "most attractive figure for opposite gender" (female figure). The results of  $t$ -tests supported this hypothesis, such that females selected a female figure that was significantly smaller ( $m = 47.73, sd = 5.46$ ) than the average female figure males selected ( $m = 50.10, sd = 4.96$ ),  $t(139) = -2.67, p < .01$ . It was also hypothesized that men would select a larger average estimate of the "most attractive figure for same gender" (male figure) than women's average estimates of the "most attractive figure for opposite gender" (male figure). The results of  $t$ -tests did not support this hypothesis. Rather the opposite result was found, such that females selected a male figure that was significantly larger ( $m = 53.60, sd = 7.55$ ) than the average male figure males selected ( $m = 45.77, sd = 7.35$ ),  $t(139) = 6.20, p < .001$ .

## Secondary Hypotheses

Changes in Mood by Treatment Group. A series of ANCOVA for change in BDI-II scores (co-varying baseline scores) by treatment group were computed to test the hypothesis that participants in the ILI arm would have greater improvements in mood (decreased BDI-II scores) from baseline to year one. The results of these tests did not support this hypothesis. BDI-II change scores did not differ significantly between the two treatment groups for females  $F(1, 75) = .00, p = .98$ . However, the mean BDI-II scores decreased from baseline to year one in both the ILI (adj. mean = -1.43,  $se = .71, p < .05$ ) and DSE (adj. mean = -1.45,  $se = .69, p < .05$ ) arms of the study for females. Similarly for males BDI-II change scores did not differ significantly between the two treatment groups  $F(1, 60) = .01, p = .91$ , such that the average BDI-II scores for males did not change significantly from baseline to year one, regardless of treatment arm.

The hypothesis that changes in BDI-II scores would be a significant mediator of treatment group effects on the dependent variables (BMA 2.0 estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS) was also not supported by the results of this study. Since BDI-II change scores did not differ as a function of treatment, no further tests of mediation were necessary. As such, BDI-II scores did not mediate treatment group effects on change in the BMA 2.0 estimate variables.

## Exploratory Analyses

Although this study was primarily interested in change in BMI as a potential mediator of treatment effects on change in BMA 2.0 estimates (CBS, IBS, ABS, CBS-IBS, and CBS-ABS), exploratory analyses were conducted to determine if change in other measures of adiposity (WC and percent body fat) would also mediate changes in the BMA 2.0 estimates at year one. The methods of Baron and Kenny (1986) were used to test these mediation models.

Exploratory analyses revealed that change in percent body fat and WC were not significant mediator variables for change in CBS, ABS, or CBS-IBS for females. For males, changes in percent body fat and changes in WC (secondary adiposity variables) emerged as significant mediators of the treatment effects for change in BMA 2.0 estimates of CBS and ABS. Regression analyses also found that changes in percent body fat mediated the treatment effects for change in CBS-IBS scores ( $R^2 = .43$ ,  $\beta = -0.34$ ,  $se = 3.83$ ,  $p = .93$ ). Therefore, the significant changes from baseline to year one found in CBS, ABS, and for males were due to changes in adiposity (measured by WC and percent body fat) rather than direct effects of the treatment condition, and changes in CBS-IBS were influenced by changes in body fat alone. The complete results of the mediation tests for change in WC are summarized in Table 5, and the results of tests of mediation for change in percent body fat are summarized in Table 6.

Table 5. Summary of Mediation Analyses Related to Change in Waist Circumference

Dependent Variable	Path a	Path b	Path c	Path c'	ab	z	p
<b>Females</b>							
Δ CBS	4.66(1.41)**	0.31(0.11)**	6.72 (1.47)***	5.32(1.50)***	1.43	1.74	.0814
Δ ABS	4.66(1.41)**	0.21(0.08)*	2.91(1.06)**	1.93(1.10)	0.96	1.44	.1492
Δ CBS - IBS	4.66(1.41)**	0.19(0.12)	4.80(1.46)**	3.94(1.53)*	0.88	1.33	.1834
<b>Males</b>							
Δ CBS <sup>l</sup>	11.76(1.38)***	0.60(0.21)**	9.12(2.37)***	2.04(3.32)	7.06	5.51	< .0001
Δ ABS <sup>l</sup>	11.76(1.38)***	0.48(0.13)***	5.45(1.57)**	-0.22(2.11)	5.62	5.35	< .0001
Δ CBS - IBS	11.76(1.38)***	0.30(0.23)	5.91(2.44)*	2.36(3.59)	3.55	3.29	.0010
Δ CBS -ABS	11.76(1.38)***	0.12(0.16)	4.54(1.75)*	3.10(2.58)	1.45	1.97	.0489

Note. CBS = Current Body Size; IBS = Ideal Body Size; ABS = Acceptable Body Size; WC = Waist Circumference; ab = product of a and b; z = test statistic for the Sobel's test.

Model 1: Change in Dependent Variable = treatment group + baseline Dependent Variable

Model 2: Mediator = treatment group

Model 3: Change in Dependent Variable = treatment group + baseline Dependent Variable + Mediator

Path a: Regression coefficient (Standard error) for 'treatment group' effect from model 2

Path b: Regression coefficient (Standard error) for 'mediator' effect from model 3

Path c: Regression coefficient (Standard error) for 'treatment group' effect from model

Path c': Regression coefficient (Standard error) for 'treatment group' effect from model 3

<sup>l</sup> = change in BMI full mediator of treatment effects

\*\*\*p < .001

\*\*p < .01

\*p < .05

Table 6. Summary of Mediation Analyses Related to Change in Percent Body Fat

Dependent Variable	Path a	Path b	Path c	Path c'	ab	z	p
<b>Females</b>							
Δ CBS	2.51(0.49)***	0.52(0.36)	7.02(1.52)***	5.70(1.76)**	1.31	1.95	.0511
Δ ABS	2.51(0.49)***	0.09(0.24)	2.50(1.02)*	2.28(1.20)	0.22	0.54	.5887
Δ CBS - IBS	2.51(0.49)***	0.16(0.36)	5.05(1.50)**	4.65(1.77)*	0.39	0.65	.5156
<b>Males</b>							
Δ CBS <sup>l</sup>	5.45(0.59)***	1.97(0.49)***	9.28(2.45)***	-1.47(3.43)	10.75	7.64	< .0001
Δ ABS <sup>l</sup>	5.45(0.59)***	1.28(0.32)***	5.98(1.63)***	-0.99(2.27)	6.99	6.97	< .0001
Δ CBS - IBS <sup>l</sup>	5.45(0.59)***	1.12(0.55)*	5.75(2.48)*	-0.34(3.83)	6.10	4.30	< .0001
Δ CBS - ABS	5.45(0.59)***	0.71(0.39)	4.15(1.77)*	0.27(2.72)	3.88	3.77	.0002

Note. CBS = Current Body Size; IBS = Ideal Body Size; ABS = Acceptable Body Size; % Body Fat = percent body fat; ab = product of a and b; z = test statistic for the Sobel's test.

Model 1: Change in Dependent Variable = treatment group + baseline Dependent Variable

Model 2: Mediator = treatment group

Model 3: Change in Dependent Variable = treatment group + baseline Dependent Variable + Mediator

Path a: Regression coefficient (Standard error) for 'treatment group' effect from model 2

Path b: Regression coefficient (Standard error) for 'mediator' effect from model 3

Path c: Regression coefficient (Standard error) for 'treatment group' effect from model

Path c': Regression coefficient (Standard error) for 'treatment group' effect from model 3

<sup>l</sup> = change in BMI full mediator of treatment effects

\*\*\*p < .001

\*\*p < .01

\*p < .05

## Discussion

The primary aim of this study was to test for changes in body image in males and females in a randomized controlled trial of weight loss for older overweight/obese adults who have been diagnosed with type 2 diabetes mellitus (ancillary study to the Look AHEAD: Action for Health in Diabetes trial). The main findings were that participation in a behavioral weight loss intervention resulted in moderate weight loss and improvements in several body image constructs for both genders. Weight loss appeared to have a strong influence on changes in estimates of perceived "current body size" for males and perceived "acceptable body size" for both genders, whereas change in the body image dissatisfaction variables (CBS-IBS and CBS-ABS) was influenced by additional factors. The subsequent section is organized according to the individual study hypotheses, and the discussion that follows integrates these findings.

### Study Hypotheses

Hypothesis 1. The first hypothesis of this study was that the effect of treatment group (ILI versus DSE) on the changes in the body image variables (BMA 2.0 estimates of CBS, IBS, ABS, CBS-IBS, CBS-ABS) from baseline to year one would be mediated by change in weight (BMI). The methods of Baron and Kenny (1986) were used to test this hypothesis, and three conditions (sets of findings) were required in order to support this hypothesis.

Females randomly assigned to the behavioral intervention (ILI arm of the study) were found to have greater changes in BMA 2.0 estimates of CBS, ABS, and CBS-IBS (controlling for baseline values) from baseline to year one compared to female participants in the DSE arm. However, the difference between the ILI and DSE arms of the study did not reach significance for IBS or CBS-ABS change scores for females. Similarly, males randomly assigned to the ILI were found to have greater changes in BMA 2.0 estimates of CBS, ABS, CBS-IBS, and CBS-



ABS, but no difference was found for IBS changes scores between the two treatment arms. Therefore, the results of this study partially supported the hypothesis that participants randomly assigned to the ILI would have greater changes in estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS compared to the participants randomly assigned to the DSE arm.

The fact that BMA 2.0 estimates of the "ideal body size" (IBS) did not change significantly from baseline to year one, and that there were no significant treatment effects for change scores in IBS for either males or females, suggests that IBS can be viewed as a relatively stable construct. This finding is consistent with previous research that has suggested that estimates of IBS may be "relatively inflexible," and may be indicative of strict cultural standards that define ideal body size (Williamson et al., 2000). Conversely, the results of this study indicate that CBS and ABS may be more labile body image constructs that can be influenced by outside factors (e.g., participation in an intensive behavioral weight loss program; moderate weight loss, reductions in WC and percent body fat, etc.).

Second, it was postulated that participants randomly assigned to the ILI arm of the study would lose significantly more weight (decrease in BMI) than participants randomized to the DSE (control arm of the study) from baseline to year one. This hypothesis was also supported for both females and males in this study. As hypothesized, the ILI produced moderate weight losses (-9.32% and -10.94% of initial body weight) for both females and males respectively. This finding is consistent with previous research that has found behavioral weight loss programs to be effective in achieving at least moderate weight loss in overweight/obese participants (Sorbara & Geliebter, 2002; The DPP Research Group, 2002).

Finally, it was postulated that co-varying the potential mediator variable (change in BMI) would remove significant treatment effects found in the body image variables (BMA 2.0

estimates of CBS, IBS, ABS, CBS-IBS, CBS-ABS). The results of this study partially supported this hypothesis for females. Females in the ILI had larger changes in CBS, ABS, and CBS-IBS than females in the DSE condition, and change in BMI was found to mediate the treatment effects found for estimates of ABS. These findings indicate that for females, change in estimates of an "acceptable body size" from baseline to year one can primarily be attributed to changes in body weight that occurred with assignment to the ILI arm. However, change in BMI did not mediate the treatment effects for change in estimates of CBS or CBS-IBS for females. These findings suggest that these changes in body image were primarily due to treatment effects for females. Therefore, it is likely that there are other mechanisms of change related to adult females' perceived current body size (CBS) and body image dissatisfaction (CBS-IBS) following participation in an intensive behavioral weight loss program.

Possible factors that may have influenced changes in perceived CBS and CBS-IBS (body image dissatisfaction) for females might include changes in self-esteem or attributional style. For example, Matz and colleagues (2002) investigated body image dissatisfaction in 79 overweight/obese women and found that self-esteem, internalization of socio-cultural appearance standards, and adult teasing were associated with body image dissatisfaction, whereas BMI and youth teasing were not related to body image dissatisfaction. Self-esteem, teasing, and attribution styles were not assessed in the current study and may represent an area for future investigation.

An alternative explanation for why weight loss did not mediate changes in estimates of CBS or CBS-IBS for females could be that the age of onset of overweight/obesity may have been a critical factor in determining change in body image for females. Stunkard and Mendelson (1961) postulated that body image crystallizes during childhood and adolescence, such that individuals with early onset obesity may maintain a negative body image despite a decrease in

BMI. For example, Adami and colleagues (1998) found that overall body image improved following bariatric surgery. However, age of onset impacted these findings such that body image dissatisfaction did not differ between women with adult-onset obesity and never-obese controls; whereas women with early-onset obesity had more body image dissatisfaction than normal-weight controls. Therefore, age of onset may have been a factor that influenced the changes found in the CBS and CBS-IBS variables for females in the current study. However, age of onset for overweight/obesity was not evaluated in the present study, and may represent an area for future research.

The hypothesis that the treatment effects on body image variables would be mediated by change in BMI was also partially supported for males in this study. Males in the ILI had larger changes in estimates of CBS, ABS, CBS-IBS, and CBS-ABS compared to males in the DSE condition, and the treatment effects for estimates of CBS and ABS were mediated by change in BMI. Therefore for males in this study, change in estimates of perceived "current body size" and "acceptable body size" were due to changes in BMI rather than treatment group assignment, while change in estimates of body image dissatisfaction (CBS-IBS and CBS-ABS) were not mediated by change in BMI. The results of this study indicate that other factors in addition to weight loss (decrease in BMI) may influence change in body image dissatisfaction for males following participation in an intensive behavioral weight loss program. As was suggested for females, other factors that may have influenced change in CBS-IBS and CBS-ABS for males include changes in self-esteem, internalization of socio-cultural appearance standards, adult teasing, and/or age of onset for overweight/obesity status. While much of the research that points to these possible mechanisms of change investigated primarily women (Adami et al., 1998; Matz et al., 2002), one study found that binge eating and low self-esteem predicted body image

dissatisfaction in men and women seeking bariatric surgery (Grilo, Masheb, Brody, Burke-Martindale, & Rothschild, 2005). The findings of this study highlight the need for more research investigating potential mechanisms for change in body image dissatisfaction following weight loss, particularly involving both genders.

The finding that change in BMA 2.0 estimates of ABS were mediated by changes in weight (BMI) for both genders, suggests that what older adults consider to be an “acceptable” body size may change, and become smaller as they lose weight. This is important for clinicians to consider when discussing realistic (acceptable) weight loss goals with their clients, as even realistic weight loss goals may change as a function of weight loss itself, potentially resulting in increased dissatisfaction with treatment results and potentially an increased risk of attrition (Grave et al., 2005). On the other hand, for the participants randomly assigned to the DSE arm estimates of ABS became larger after one year in the Look AHEAD study. These changes were not mediated by change in BMI, as BMI did not change from baseline to year one for participants in the DSE arm. This finding suggests that in the absence of weight loss, what older adults consider to be an "acceptable" body size may change and become larger over time.

Together, these findings indicate that various body image constructs (BMA 2.0 estimates of CBS and ABS) can change as a function of moderate weight loss (decrease in BMI); such that estimates of CBS decreased for males, and estimates of ABS decreased for both genders following moderate weight loss. These results are similar to the findings of previous research that has investigated changes in body image in overweight/obese adults following more dramatic weight losses (Cash, 1994; Dixon et al., 2002; Adami et al., 1998). The results of this study also indicate that body image dissatisfaction decreased (improved) for both genders following

participation in an intensive behavioral weight loss program; however this improvement was not due to weight loss alone.

Hypothesis 2. It was postulated that greater body image dissatisfaction (CBS-IBS discrepancy scores) at baseline would be associated with greater weight losses (decrease in BMI) at year one. Pearson product-moment correlation tests did not support this hypothesis. The results indicated that initial body image dissatisfaction (as measured by CBS-IBS discrepancy scores) was not associated with greater or lesser degrees of weight loss at year one for females or for males in either treatment condition.

These results are inconsistent with limited previous research investigating the relationship between body image dissatisfaction and weight loss. Specifically, these findings are inconsistent with the findings of Anderson and colleagues (2002), who found that in a group of older (ages 40-75 years) overweight/obese females, those who were not satisfied with CBS (defined by participant responding “not satisfied” in response to how they felt about their current body size) were almost nine times more likely to try to lose weight. The results of this study indicate that initial baseline body image dissatisfaction (defined as the discrepancy between CBS and IBS estimates) did not predict weight loss one year later. However, these findings may be confounded by the fact that all of the participants in the current study inherently had a desire to lose weight, simply by the nature of their voluntary involvement in a weight loss study (the Look AHEAD trial). It is also important to note that although previous research has found that initial body image dissatisfaction may increase efforts to lose weight, increased effort does not necessarily result in increased weight loss at one-year follow-up.

The findings from this study are also inconsistent with the study by Heinberg and colleagues (2000) which found that in a group of elderly African American men and women,

those participants with less body image dissatisfaction at baseline had less weight loss at follow-up. It was an intention for the current study to evaluate ethnic differences; however the African American sample for the current study was too small to make meaningful comparisons by ethnic group. These findings suggest a need for future studies to investigate ethnic differences related to the role of body image dissatisfaction (defined by CBS-IBS discrepancy) as a predictor of weight loss for older Caucasian and African American adults.

Hypothesis 3. This hypothesis postulated that participants with moderate weight loss goals (5-15% initial weight, versus >15% initial weight) at baseline would be associated with better weight loss at year one. The results of this study did not support this hypothesis for men or women. An analysis of plots between percent weight loss and weight loss goals revealed no apparent linear or quadratic relationship between variables. While a curvilinear fit of the data was anticipated, the data for both males and females in both conditions resulted in a random pattern for weight loss goals in terms of both pounds and BMA 2.0 morph figure, suggesting that weight loss goals at baseline were not associated with weight loss after one year. This finding is consistent with recent studies that reported weight loss goals at baseline were not related to weight loss following participation in behavioral and pharmacological weight loss interventions (Fabricatore et al., 2005) or following bariatric surgery (White et al., 2007).

As noted above, only five females (DSE,  $n = 2$ ; ILI,  $n = 3$ ) selected weight loss goals within the moderate range (within 5-15% initial weight). The lack of range in weight loss goals may help explain why no differences were detected between these two groups. However, this finding also suggests that the majority of overweight/obese females in this age group (40-75 years) did not have realistic weight loss goals. As previous studies have reported, moderate weight loss is realistic to expect from traditional behavioral weight loss approaches (Sorbara &

Geliebeter, 2002). The fact that the females in this study did not have realistic weight loss goals is consistent with previous research that has found the majority of participants entering weight loss programs find moderate weight loss goals to be disappointing (Foster, Wadden, Vogt, & Brewer, 1997), and have personal weight loss goals of 20-35% of their initial weight (Foster, Wadden, Phenlan, Sarwer, & Swain-Sanderson, 2001; Foster, Wadden, Vogt, & Brewer, 1997; O'Neil, Smith, Foster, & Anderson, 2000; Wadden et al., 2003).

Although more moderate weight loss goals were not associated with significantly better weight loss for the men in this study, it is worth noting that compared to the female sample, more males in the current study selected realistic weight loss goals; almost half of the male sample (~48%) selected moderate weight loss goals (between 5-15% initial weight) compared to only ~6% of the female sample. This finding suggests that older, overweight/obese males have more realistic weight loss expectations than older overweight/obese females. Further, this finding suggests that males may be more satisfied with their year-one weight losses than their female counterparts. However this was not directly tested in the current study, and may represent an area for future study.

Hypothesis 4. It was postulated that estimates of the “most attractive figure to members of the same and opposite gender” would both become smaller (thinner) as a function of weight loss. The results of this study did not support this hypothesis, as the average estimate for “most attractive figure of the same and opposite” genders did not change significantly from baseline to year one for males or females in either treatment condition. This result suggests that what males and females find attractive is a relatively stable construct for this population, older adults with type 2 diabetes.

Hypothesis 5. It was postulated that females' average estimates of the "most attractive figure for same gender" (female figure) would be smaller (thinner) than males' average estimates of the "most attractive figure for opposite gender" (female figure). The results of this study supported this hypothesis, such that females selected a female figure that was significantly smaller (thinner) than the average female figure males selected as the most attractive. This finding is consistent with previous studies that have also found that females typically err in their estimate of what female body size and shape males find attractive (Demarest & Allen, 2000; Fallon & Rozin, 1985; Gleaves et al., 2000; Rozin, 1985). As noted above, the implications of these findings are that women's misconceptions of what men find attractive may serve to reinforce women's drive for the thin ideal and exacerbate body image dissatisfaction in women.

Conversely, it was postulated that men would select a larger average estimate of the "most attractive figure for same gender" (male figure) than women's average estimates of the "most attractive figure for opposite gender" (male figure). The results of this study did not support this hypothesis. Rather the opposite result was found, such that females selected a male figure that was larger than the average male figure males selected. This finding is inconsistent with previous research that has found that men believed that women found a heavier male stature more attractive (Fallon & Rozin, 1985; Rozin, 1985). While in the current study males still erred in their estimate of what male body size and shape females would find attractive, the males in this study selected a smaller male body size than females selected. One possible explanation for this finding is that the BMA 2.0 does not differentiate weight gain and muscle gain, and the results of this study may reflect the men's preference for a slender build over being overweight. These results may also reflect changing cultural standards for the attractive male body



size/shape, but these findings would need to be replicated before such conclusions could be made.

Hypotheses 6 and 7. It was postulated that participants in the ILI arm of the study would have greater improvements in mood (decreased BDI-II scores) from baseline to year one. The results of this study did not support this hypothesis. While the average BDI-II scores decreased from baseline to year one for females in both arms of the study, the two groups did not differ. These results are consistent with a recent meta-analysis of the literature on weight loss and psychological well-being which found that improvements in depression were independent of weight loss (Blaine, Rodman, & Newman, 2007). These findings are inconsistent with findings from previous studies that have found significantly positive changes in mood with dramatic weight loss following bariatric surgery (Karlsson, Sjostrom, & Sullivan, 1998; Powers, Rosemurgy, Boyd & Perez, 1997). However, since the mean percent weight loss (9.32% initial body weight for females, and 10.94% initial body weight for males) for participants in the ILI arm of this study was more moderate, these findings suggest that larger weight losses may be necessary to find a significant effect on depressive symptoms (BDI-II scores). The non-significant differences for change in BDI-II scores between the two treatment groups could also be due to a lack of variance within the sample for both genders, such that participants with elevated BDI-II scores at baseline may have been excluded from the study. For example, the mean (5.43) and median (4.00) baseline BDI-II scores for the entire sample were within the non-clinical range of depressive scores. This trend may also reflect a natural regression to the mean.

Changes in BDI-II scores were hypothesized to be a significant covariate (mediator) for treatment group effects on estimates of CBS, IBS, ABS, CBS-IBS, and CBS-ABS. This study

found that there were no significant treatment group effects for BDI-II change scores; therefore there was no need to test if BDI-II was a significant covariate (mediator).

## Conclusions

The primary findings of this outcome study were that participation in a behavioral weight loss intervention resulted in moderate weight loss and improvements in various body image constructs for both males and females. While weight loss appeared to have a strong influence on these changes for some body image variables, changes in body image dissatisfaction could not be attributed to changes in body weight. The behavioral intervention (ILI) produced significant changes in all of the body image variables from baseline to year one, except for estimates of CBS-ABS for females, and estimates of IBS for both genders. The behavioral intervention (ILI) was also more successful in achieving weight loss, as evidenced by significantly greater reductions in BMI, percent body fat, and WC for both males and females. Tests of mediator effects demonstrated that changes in weight (BMI) mediated the effects of the intervention on BMA 2.0 estimates of "current body size" and "acceptable body size" for males, and BMA 2.0 estimates of "acceptable body size" for females. Conceptually, the mediator variables are neither necessary nor sufficient to observe a treatment effect, but can help explain the mechanism through which the independent variable influences the outcome variables (Baron & Kenny, 1986).

Contrary to the hypotheses of this study, the results indicated that greater body image dissatisfaction (as defined as CBS-IBS discrepancy) at baseline was not associated with greater weight loss at year one follow-up. Consistent with the existing weight loss literature, this study revealed that only a minority of females who enter a weight-loss study have moderate weight loss goals (5-15% initial body weight); whereas almost half the males participants selected moderate weight loss goals. The implications of these findings are that even in a study where the participants are informed that the intervention weight loss goal is moderate (10% initial body

weight), the participants' personal weight loss goals far exceeded what was to be expected from a behavioral weight loss program. These findings highlight the need for clinicians to work with weight-loss clients on setting more realistic weight loss goals, particularly as it may relate to attrition rates at long-term follow-up.

Finally, although estimates of what males and females find attractive in the same and opposite genders appeared to be a stable construct, there were significant differences in what males and females found attractive in the opposite gender. Consistent with previous research looking at gender differences in attractive body sizes, this study found that females selected a female figure that was significantly smaller (thinner) than the average female figure males selected as being the most attractive. Males also erred in their judgments of what females found most attractive. The females selected a male figure that was significantly larger than the average male figure males selected, which is inconsistent with previous research that has found the opposite to be true (Fallon & Rozin, 1985; Rozin, 1985).

There were several limitations to the current study that should be mentioned. First, the number of African American participants in this study was too small to allow for meaningful comparisons by ethnic group. Although it was the original intention of this author to make comparisons between Caucasian and African American participants on the various body image and weight loss measures, this was not possible due to low African American participation in the study.

Due to the difference in the BMA 2.0 stimuli presented to males and females, males and females could not be directly compared in this study. However, it was believed that the benefit of the highly sophisticated measure of perceptual body image constructs measured by the BMA 2.0 outweighed the negative consequence of not being able to compare the scores of men and

women. Additionally, some researchers have recently suggested analyzing body image dissatisfaction data separately by gender regardless of the assessment instrument used (Kostanski, Fisher, & Gullone, 2004). The BMA 2.0 has been validated with both males and females, which allowed for the assessment of both genders in this study. While this study allowed for comparison from baseline to year one, it would be useful to evaluate the participants' outcomes at later follow-up, particularly to evaluate weight loss maintenance.

Although there were limitations to the current study, this study had several significant strengths that should also be mentioned. First, the use of the BMA 2.0, a computerized morphing program that was developed as a realistic, valid and precise measure of body image, specifically for use with adult, Caucasian and African American men and women. The BMA 2.0 addresses issues that have plagued other pen and paper scales for perceptual body image measures, i.e., scale coarseness, restriction of scale range, and adequate reliability and validity across genders (Stewart & Williamson, 2004). This investigation is the first to examine changes in body image and body size goals as a function of weight loss using this computerized method of assessment.

Anthropomorphic measurements (height, weight, percent body fat, and WC) were all measured both at baseline and year one assessments. The use of multiple measures of change in body weight and fat allowed for comparison of these measures, although all three indexes (BMI, percent body fat, and WC) changed significantly from baseline to year one in the ILI arm of this study. In addition, this was one of the first studies to look at the effects of moderate weight loss (5-15% initial body weight), on changes in body image. Much of the existing literature has examined the effects of more dramatic weight loss achieved through bariatric surgery or VLCD on body image (Cash, 1994; Foster, Wadden, & Vogt, 1997; Adami et al, 1998). Since moderate weight losses are being viewed as successful and have demonstrated significant improvements in

obesity-related health problems (National Heart, Lung, and Blood Institute [NHLBI], 1998; WHO, 1998), it is important to evaluate what effects moderate weight losses will have on body image.

This study sample consisted of an important, and previously understudied population (specifically, an older, overweight/obese population diagnosed with type 2 diabetes mellitus). The lack of attrition is another major strength of this study, as previous research on weight loss has been plagued by high attrition rates (Grave et al., 2005). Finally, this study was an ancillary study in a randomized, controlled trial (RCT). Randomized, controlled trials provide an unbiased, balanced, and reliable method for determining treatment effects, and are considered the gold-standard in clinical research design (Green & Raley, 2000).

The primary contribution of this study is that it has extended previous research investigating changes in body image as a function of weight loss, to an older overweight/obese adult population, who have been diagnosed with type 2 diabetes mellitus. This study confirmed that even moderate weight loss following participation in a behavioral weight loss intervention can lead to improvements in body image for both males and females. These findings are encouraging, such that they provide evidence that behavioral weight loss interventions may be effective treatments for both overweight/obesity and body image dissatisfaction in adult men and women. The questions that remain include: What is the mechanism of change for body image dissatisfaction in men and women? and Will these improvements be maintained at long-term follow-up? The present study provides further evidence for a strong association between overweight/obesity and body image, and suggests that weight loss differentially influences change in various body image constructs by gender. While this study did not find initial estimates of body image dissatisfaction (estimates of CBS-IBS at baseline) to be associated with

degree of weight loss at one-year follow-up, there remains a need to investigate other body image variables that could potentially be related to and/or predict successful weight loss efforts. As the prevalence of overweight/obesity and type 2 diabetes mellitus continues to rise to epidemic proportions, so does the need for further longitudinal examination of potential predictors of weight loss and weight loss maintenance. Implications of the current findings are that weight loss is not necessary to achieve improvement in body image dissatisfaction, and that the mechanism of change may be gender specific. Ultimately, these findings underscore the need for more studies involving both men and women investigating the differential effects of weight loss on body image, so as to better inform body image treatment.

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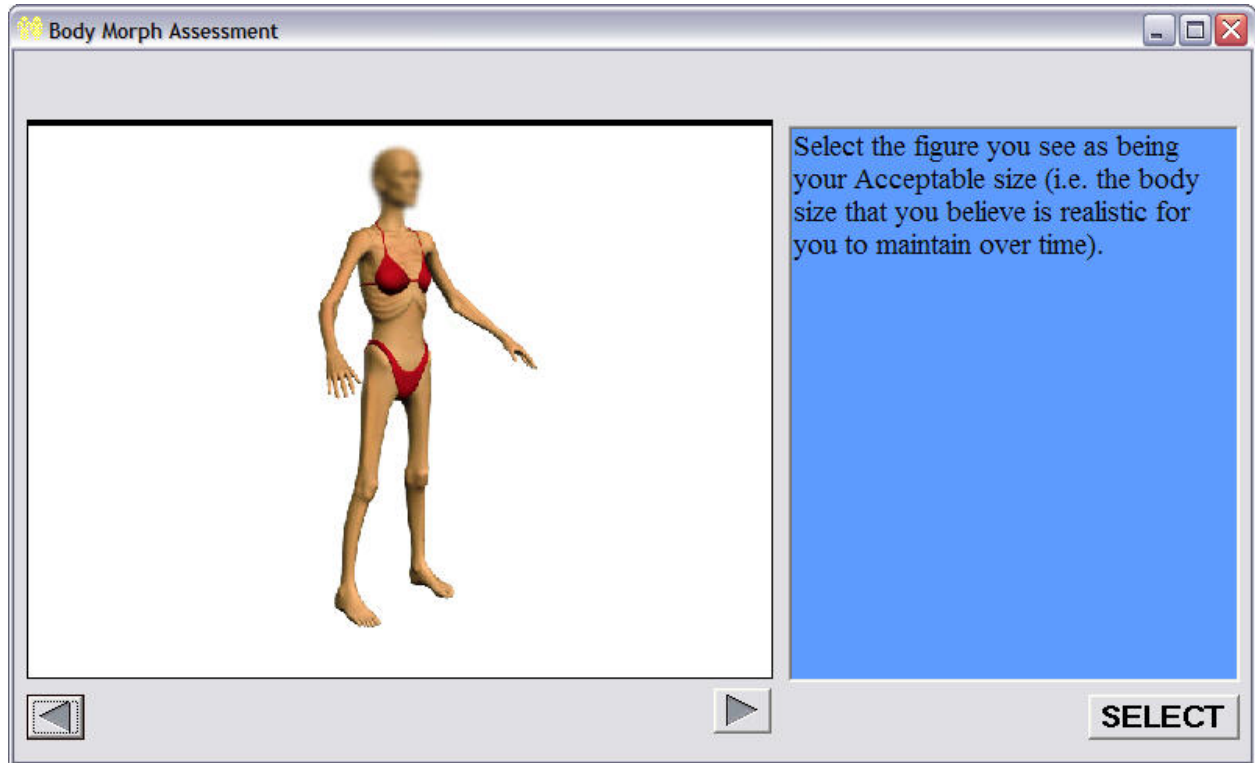
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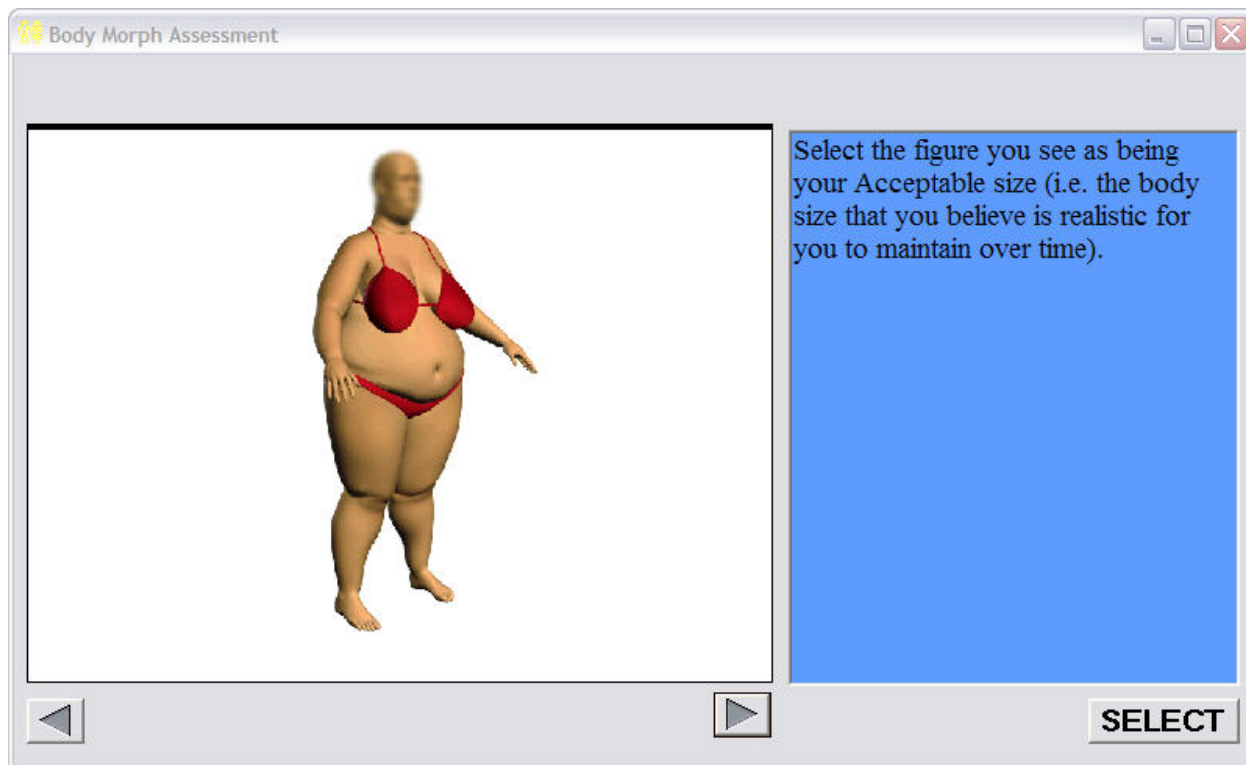
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**Appendix A: BMA 2.0 Morph Figure  
(Very Thin End of the Morph Continuum)**



<sup>1</sup> From "Body Morph Assessment: Preliminary report on the development of a computerized measure of body image," by T. M. Stewart, D. A. Williamson, M. A. M. Smeets, and F. L. Greenway, 2001, *Obesity Research*, 9, 43-50. Copyright 2001 by the American Psychological Association. Adapted with permission of the author.

**Appendix B: BMA 2.0 Morph Figure  
(Very Obese End of the Morph Continuum)**



<sup>2</sup> From "Body Morph Assessment: Preliminary report on the development of a computerized measure of body image," by T. M. Stewart, D. A. Williamson, M. A. M. Smeets, and F. L. Greenway, 2001, *Obesity Research*, 9, 43-50. Copyright 2001 by the American Psychological Association. Adapted with permission of the author.

## Appendix C: Consent for Copyright Material



VA MEDICAL CENTER  
Psychology Service (116B)  
150 South Huntington Ave.  
Boston, MA 02130

March 5, 2008

Tiffany M. Stewart, Ph.D.  
Health Psychology  
Pennington Biomedical Research Center  
6400 Perkins Road  
Baton Rouge, LA 70808

Dear Dr. Stewart:

I am currently completing a doctoral dissertation at Louisiana State University entitled "Changes in Body Image with Weight Loss and Maintenance in Overweight/Obese Adults Diagnosed with Type 2 Diabetes Mellitus." I used a measure you developed (the Body Morph Assessment, version 2.0) as part of my dissertation, and would like permission to reprint in my dissertation excerpts from the following:

Stewart, T. M., Williamson, D.A., Smeets, M. A. M., & Greenway, F. L. (2001). Body Morph Assessment: preliminary report on the development of a computerized measure of body image. *Obesity Research*, 9, 43-50.

Specifically, I would like to include two screen captures (attached) from the Body Morph Assessment, version 2.0 in the Appendix section of my dissertation to help readers visualize the measure accurately.

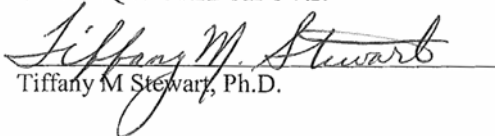
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If these arrangements meet with your approval, please sign this letter where indicated below and return it to me in the enclosed return envelope. Thank you very much.

Sincerely,

  
Amy R. Bachand, M.A.

PERMISSION GRANTED FOR THE  
USE REQUESTED ABOVE:

  
Tiffany M Stewart, Ph.D.

3-6-08  
Date

## **Vita**

Amy Elaine Rzeznikiewicz Bachand was born and raised in Brooklyn, Connecticut. She attended Colby College, graduating in 1997 with a Bachelor of Arts degree in psychology. Under the supervision of Dr. Donald A. Williamson, she earned a Master of Arts degree in psychology from Louisiana State University in 2004. She later completed an American Psychological Association accredited internship in clinical psychology in August 2007 at the Boston Consortium in Clinical Psychology. Currently she is completing a research fellowship position at the Veterans Affairs Boston Healthcare System, working with Dr. John D. Otis. After graduating from Louisiana State University in May 2008, she will begin a clinical psychology research fellowship at the Veterans Affairs Boston Healthcare System, under the direction of Dr. DeAnna L. Mori. Her primary research and clinical interests are in health psychology, with specific interests in the areas of diabetes management, eating and weight-related disorders, pain management, and body image.