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Body Image Changes Associated with Participation in an Intensive Lifestyle Weight Loss Intervention

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Abstract

The primary aim of this study was to test for changes in body image in men and women enrolled in the Look AHEAD trial. Look AHEAD (Action for Health in Diabetes) is a multi-center, randomized controlled trial designed to test whether intentional weight loss reduces cardiovascular morbidity and mortality in overweight individuals with type 2 diabetes. Participants included 157 adults at one site (Pennington Biomedical Research Center) of the Look AHEAD study. At baseline, the mean body mass index (BMI) of the female participants was 36.4, and the mean BMI for males was 33.5. Following baseline assessment, participants were randomly assigned to the Intensive Lifestyle intervention (ILI, $n = 81$) or Diabetes Support and Education (DSE, $n = 76$). The Body Morph Assessment version 2.0 (BMA 2.0) was used to assess estimates of perceived current body size, ideal body size, acceptable body size, and body image dissatisfaction at baseline and one year. Over the 1 year, participants in the ILI group had significantly greater reductions in weight (10.1% for men and 8.9% for women) than those in the DSE group (+ 0.8% for men and -0.2%, for women). Perceived current body size was reduced significantly more in both men and women in the ILI group, relative to DSE. There were also significantly greater reductions in body image dissatisfaction in the ILI group, relative to the DSE group for men and women. The results of this study indicate that body image dissatisfaction improved following participation in an intensive behavioral weight loss program.

Keywords

Body Image; Obesity; Diabetes; Weight loss; Lifestyle Intervention

The prevalence of overweight/obesity has increased over the last few decades and continues to be a significant problem.¹ Most persons with type 2 diabetes (approximately 90%) are overweight or obese.² In comparison to normal-weight adults, obese individuals report greater dissatisfaction with body size.³ Recent studies have investigated changes in body image in response to weight loss. Weight losses greater than 19 kg have been found to be associated with improved body image,^{4–7} but there is a paucity of research investigating the effects of modest weight losses on body image. However, at least one recent study found

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*The BMA has been successfully validated on individuals ranging from an 18–48 BMI. Thus, individuals with a BMI below or above this range were excluded.

Disclosure

The authors have no conflict of interest to declare.

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that even with moderate weight loss, greater weight losses were associated with greater improvements in body image.⁸

The Look AHEAD (Action for Health in Diabetes) study, a multi-center, randomized controlled trial was designed to test the effects of intentional weight loss on cardiovascular morbidity and mortality in overweight individuals with type 2 diabetes. We conducted an ancillary study at one site, the Pennington Biomedical Research Center (PBRC), to investigate the relationship between weight loss and body image changes after one year of participation in the Look AHEAD study.

This ancillary study tested the following hypotheses: 1) ILI, compared to DSE, would have a greater effect on participants' BMA 2.0 estimates of current body size and body image dissatisfaction (current body size-ideal body size) following one year, and 2) Weight loss (a decrease in BMI) would mediate the effects of the treatment group on changes in the BMA 2.0 estimates (body image).

It is of note that there were no clear hypotheses set forth regarding the effects of treatment on ideal body size or acceptable body size. We hypothesized that as body size changes (BMI increases or decreases), individuals' perception of their current body size would fluctuate with that change (e.g. as BMI increases, perceived current body size increases). However, individuals' body size goals, e.g. ideal body size and acceptable body size, may be independent of their current body size (BMI). Thus, the present study presented a chance to test for changes in ideal and acceptable body size estimates as a function of weight loss in individuals in a lifestyle intervention compared to a control condition.

Methods

Description of Look AHEAD: Action for Health in Diabetes

The Look AHEAD trial^{9–12} enrolled overweight individuals with type 2 diabetes and randomly assigned them to the ILI group or to the control arm (DSE). The ILI group received a lifestyle intervention which consisted of a behavioral program developed for weight loss. Components of the ILI and DSE conditions are described in detail elsewhere.¹⁰

Participants

Participants for this ancillary study were recruited from the participants enrolled in the PBRC site of the Look AHEAD trial. Inclusion criteria for the body image study were: 1) enrollment in the Look AHEAD study at the PBRC site, 2) White and African American men and women (other race groups were excluded); 3) BMI within the range of 25 to 55 at randomization; and 4) age within the range of 40 to 75 years. Participation was voluntary. This ancillary study began recruiting participants after the parent study had already begun. Thus, all of the PBRC Look AHEAD participants were not eligible to participate in the study. Given this, the total number of participants eligible at PBRC for this study was 230 (cohorts 5–13). Out of the 230 participants, 162 agreed to participate and 69 declined participation. Reasons for declining were not recorded, but the most frequently expressed reason for refusal was the time burden for participation.

Participants for this ancillary study were provided a \$10.00 gift card incentive for completing the BMA 2.0 at baseline and another \$10.00 gift card at the end of twelve months (Year 1) of the intervention period. 162 participants enrolled in the study at baseline, however, two participants' data were excluded from all analyses, because they did not meet the inclusion criteria listed above for race. Additionally, two participants' data were excluded due to having a BMI > 55. Finally, for one participant, baseline data were lost due

to a computer malfunction, and thus were excluded from all analyses. Therefore, a total of 157 participants comprised the study sample.

Assessment Measures

Body Morph Assessment Version 2.0.¹³—The BMA 2.0 is a valid and reliable self-administered, computerized body image assessment program. Support for the content validity, convergent validity, internal consistency, and test-retest reliability of the BMA 2.0 has been reported for men and women aged 18–75 with BMIs ranging from 17.8–48.¹³ Measures of the participants' current body size, ideal body size, and acceptable body size were gathered using the BMA 2.0.

Participants are instructed to modify the size of the body stimulus using directional arrows at the bottom of their computer screen based on the instructions presented to them by the computer program. There are three instructions including; a) “Select the figure you see as being your current body size.”, b) “Select the figure you see as being your ideal body size (i.e. the body size that you would most prefer).”, and c) “Select the figure you see as being your acceptable body size (i.e. the body size that you believe is realistic for you to maintain over a long period of time). Participants complete two trials of body size estimates for each of three sets of instructions.

In order to control for anchor effects, for one trial, the stimulus figure changes from very thin to obese, and for the other trial, the stimulus figure changes from obese to very thin. Mean values for estimates of current body size, ideal body size, and acceptable body size are calculated from the two trials and used in the statistical analyses. The order of instructions and the direction of the stimulus figure are presented in random order, to control for order effects. For the purposes of the present study, body dissatisfaction is defined as the discrepancy between a participant's perceived current body size and their chosen ideal body size (as selected on the BMA).

Height, Weight, and BMI—Participants were measured in a gown without shoes at baseline and one year visits. The participants' height (centimeters, cm) was measured using a wall-mounted stadiometer, their weight (kilograms, kg) was measured using a calibrated Tanita BWB 800 digital scale, and their BMI was calculated using the following formula: kg/m^2 .

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

Procedure

After participants were enrolled in the Look AHEAD trial, they were invited to participate in this ancillary study, and if they accepted, they signed a separate consent form for the project. The computerized BMA 2.0 program was administered during the collection of baseline data, and at the end of one year of participation in the study.

Statistical Methods

An alpha level of 0.05 was selected for testing the study hypotheses. The statistical analyses were conducted using the Statistical Analysis Software (SAS version 9.1). 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.

First, to test for treatment effects (hypothesis 1), a series of analyses of covariance (ANCOVA) were conducted for the following dependent variables: (change scores in: BMI, current body size, ideal body size, acceptable body size, current body size-ideal body size). In the ANCOVAs, treatment arm was the independent variable and baseline values were entered as covariates.

Second, statistical mediation analyses were conducted to determine if weight loss (decrease in BMI) mediated the relationship between treatment and body image. Statistical mediation analysis tests whether a third variable (the mediator variable) influences the relationship between the two primary variables of interest. It was hypothesized that weight loss (decrease in BMI) would be a significant mediator variable. The treatment intervention arm (ILI or DSE) was hypothesized to influence both the BMI change (path a) and change in body image (path b) as illustrated in Figure 1. A finding of mediation would occur if, after controlling for the influence of weight loss (decrease in BMI), the statistically significant effect of the treatment arm on body image (path b) was reduced to non-significance.

In order to evaluate if weight loss was a mediator of treatment effects on changes in current body size, ideal body size, acceptable body size, current body size-ideal body size (*body dissatisfaction*), and from baseline to year one (hypothesis 2), mediator analyses were performed in three regression steps using the approach outlined by Baron and Kenny.¹⁴ A Sobel test was utilized to determine if the significance of the relationship between the treatment and dependent variables was reduced to a statistically significant level. BMI was the primary variable of interest in this study, since change in BMI is widely accepted as the measure of changes in total body size.¹⁵

Results

There were 157 participants enrolled in the study at baseline and descriptive information is summarized in Table 1. The sample of female participants (n=88) was primarily White (74%) with a mean age of 59 years (SD =6.3) and a mean BMI of 36.4 (SD =5.4). The sample of male participants (n=69) was primarily White (90%) with a mean age of 62 years (SD =5.2) and a mean BMI of 33.5 (SD =4.8). Of the original 157 participants enrolled in the study at baseline, a total of 16 participants did not participate in year one data collection (10.2% attrition rate); of the 16, 11 were in the ILI arm, and 6 were in the DSE arm of the study. There was no difference between drop-outs and participants who provided year 1 data with respect to baseline characteristics. Intent-to-treat analyses were computed including all randomized participants. Missing year 1 data were imputed using baseline scores. Given that the African American participants comprised a small percentage of the sample (10% males, 26% females), there was inadequate power to test for differential effects due to race. There were no significant baseline differences on body image selections (current body size, ideal body size, acceptable body size, or current body size-ideal body size/body dissatisfaction), between the DSE and ILI groups.

Weight Loss

BMI decreased after one year for both women and men (women: -3.3 ± 0.32 , $p < 0.001$; men: -3.2 ± 0.31 , $p < 0.001$) in the ILI condition, with non-significant changes in BMI for the DSE (females: -0.05 ± 0.31 , $p = 0.90$; males: 0.31 ± 0.32 , $p = 0.33$). On average, women in the ILI treatment arm lost -8.9% (SD = 5.2%) and men lost -10.1% (SD = 7.4%) of their initial body weight.

Primary Analyses Effects of Treatment on Body Image Estimates (Hypothesis 1))

Table 2 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 treatment arm effects).

Current Body Size—For men and women, change in estimates of perceived current body size differed as a function of treatment arm (Female: $F(1, 75) = 17.7, p < .001$; Male: $F(1, 60) = 12.7, p < .001$). Current body size estimate scores decreased from baseline for men and women in the ILI arm ($p < .05$); whereas there was no significant change in current body size estimate scores for men and women in the DSE arm. Baseline current body size scores were associated with change scores such that greater reductions in current body size estimates were associated with larger baseline estimates of current body size for both women ($r = -0.39, p < 0.001$) and men ($r = -0.26, p < 0.05$).

Ideal Body Size—The average change scores for estimates of ideal body size from baseline to year one did not differ as a function of treatment arm for women or for men ($p > .05$). Correlation analyses indicated that larger estimates of ideal body size at baseline were associated with greater reductions in those estimates at year one both for women ($r = -0.22, p < 0.05$) and for men ($r = -0.46, p < 0.001$).

Acceptable Body Size—Change scores for acceptable body size estimate scores differed as a function of treatment arm $F(1, 75) = 6.9, p < .01$ for females. There was no change in acceptable body size estimate scores for females in the ILI arm; whereas acceptable body size scores increased from baseline for females in the DSE ($p < .05$) arm. As observed for current body size, females' baseline acceptable body size estimate scores were associated with change scores such that greater reductions in acceptable body size estimate scores were associated with larger baseline estimates of acceptable body size ($r = -.45, p < .001$). For males, changes in acceptable body size estimate scores also differed as a function of treatment arm $F(1, 60) = 11.1, p < .01$. Assignment to the ILI was associated with a decrease in estimate scores of acceptable body size ($p < .01$) for males; whereas there was no significant change in acceptable body size estimate scores for males in the DSE arm of the study.

Discrepancy score (current body size - ideal body size = body dissatisfaction)

—For women, change in current body size – ideal body size (body dissatisfaction) scores differed as a function of treatment arm ($F(1, 75) = 8.4, p < .01$). Current body size – ideal body size scores decreased for women in both the ILI and DSE treatment arms, but scores for women in the ILI arm decreased more than the DSE group. Similar effects were observed for men, change in current body size – ideal body size scores differed as a function of treatment ($F(1, 60) = 4.2, p < .05$). Body dissatisfaction scores decreased from baseline for men in the ILI arm. Baseline estimates of current body size – ideal body size were associated with change scores such that larger baseline estimates of that measure of body dissatisfaction were associated with greater reductions in estimates of that measure of body dissatisfaction at year one for both women ($r = -0.46, p < 0.001$) and men ($r = -0.53, p < 0.001$). In sum, body dissatisfaction scores decreased from baseline for both men and women, but the interaction was significant for both genders.

Secondary Analyses: Tests of Mediator Effects (Hypothesis 2)

Effects of Treatment Assignment on BMI and Body Weight—ANCOVAs were computed for men and women to confirm the influence of the treatment group on the

mediator variable (weight loss/decrease in BMI). There was a significant effect of treatment group on change in BMI for both women and men ($p < .001$).

Mediating Effects of Change in BMI

We first hypothesized that treatment had a significant effect on body image estimates. Further, we hypothesized that weight loss would mediate this effect. The method of Baron and Kenny¹⁴ was utilized to test possible mediation effects of weight loss (decrease in BMI).

Four steps are required to establish the mediation effects of weight loss. The first step is to establish that treatment is correlated with the change in body image estimates. The results from the primary analyses illustrated the significant treatment effect on body image estimates (current body size, acceptable body size, and body dissatisfaction) in both men and women. Treatment effects for both men and women's ideal body size were not detected, thus mediation effects were not tested for this variable. The second step is to establish that assignment to ILI was correlated with the weight loss. As described in the results section, this relationship was statistically significant ($p < .001$).

Finally, a series of regression analyses was conducted to determine whether weight loss affected the body image estimates (third step) and significantly attenuated the effect of treatment (last step). The same regression model were used for these two steps (Change in body image estimates = treatment arm + baseline score + weight loss). For change in current body size, the effect of treatment was significant (female: $b = .39$, $p < .0001$; male: $b = .39$, $p < .001$). After controlling for weight loss, the significant effect from treatment was diminished (female: $b = .21$, $p = .08$; male: $b = -.03$, $p = .83$). The same effect was observed for acceptable body size. The treatment effect (female: $b = .26$, $p < .01$; male: $b = .39$, $p < .001$) was no longer significant after entering weight loss (decrease in BMI) in the equation (female: $b = .04$, $p = .75$; male: $b = -.04$, $p = .75$). Regression results indicated that weight loss was significantly related to current body size and acceptable body size ($p < .001$) but not significantly related to body dissatisfaction ($p = .10$). Thus, weight loss was not interpreted as a putative mediator for body dissatisfaction.

Discussion

The findings of this study support the hypothesis that participation in an intensive lifestyle intervention for weight loss results in significant weight loss and improvements in measures of body image for men and women. As hypothesized, the ILI produced weight losses (-9.32% and -10.94% of initial body weight) for both women and men respectively. Moreover, those in the ILI group had greater reductions in their body dissatisfaction over the one year program.

This study is the first to investigate the potential mediation of weight loss (decrease in BMI) on body image estimates in an obese population. Weight loss (decrease in BMI) had a strong mediating influence on changes in estimates of current body size and acceptable body size for both genders. In women, BMI was found to mediate the treatment effects found for estimates of current body size and acceptable body size. For women and men, change in estimates of current body size and acceptable body size from baseline to year one can primarily be attributed to weight loss (decrease in BMI) that occurred with assignment to the ILI arm. However, weight loss (decrease in BMI) did not mediate the treatment effects for change in estimates of current body size - ideal body size (body dissatisfaction).

The BMA 2.0 estimates of the ideal body size did not change significantly from baseline to year one, and there were no significant treatment effects for change scores in ideal body size

for either men or women. This finding suggests that a person's concept of ideal body size is not altered by changes in body weight. This finding is consistent with previous research that has suggested that "goals" of ideal body size may be "relatively inflexible," and may be indicative of strict cultural standards that define ideal body size.¹⁶ Thus, regardless of a person's perceived current body size or what they believe to be acceptable, "ideal" continues to be a standard that remains the same over time and weight change. Conversely, the results of this study indicate that current body size and acceptable body size may be more labile (fluctuating) body image constructs that can be influenced by external factors (e.g., participation in an intensive behavioral weight loss program, moderate weight loss, or social support). For example, regardless of a person's size, most individuals select (desire) a similar "ideal" body size which may be indicative of standards of body size portrayed in the media. Conversely, as an individual loses weight, their selected current body size and acceptable body size may change with weight loss.

These results suggest that these changes in body image were primarily due to treatment effects. Therefore, it is likely that there are other mechanisms of change related to men and women's body image dissatisfaction (current body size - ideal body size) following participation in an intensive behavioral weight loss program (e.g. initial body weight, improved self-esteem, greater social support, or improved functional abilities). The findings of this study highlight the need for more research investigating potential mechanisms of change in body image dissatisfaction following weight loss, for both men and women.

The finding that change in acceptable body size was mediated by weight loss (decrease in BMI) for both genders in the ILI arm, suggests that what older adults consider to be an "acceptable" body size may change, and become smaller as they lose weight. This phenomenon may be important for discussions of realistic or acceptable weight loss goals, as even realistic weight loss goals may change as a function of weight loss itself. This phenomenon could potentially result in an increase in dissatisfaction with treatment results.¹⁷ Conversely, for the participants in the DSE arm, estimates of acceptable body size became larger after one year in the Look AHEAD study. These changes were not mediated by weight loss (decrease 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 increase over time.

These results significantly inform the scientific and medical community about the changes in body image related to moderate weight loss (decrease in BMI) in an overweight and obese adult population with type 2 diabetes mellitus. These results are similar to those of previous research that has investigated changes in body image in overweight/obese adults following more dramatic weight losses.^{4, 6, 7} One limitation of the study includes participant attrition. There were 16 participants who completed baseline assessment, but did not complete Year 1 assessment for the BMA 2.0 (10.2% attrition rate). A second limitation of the study is that all of the aforementioned variables were measured at the same time. More recent statistical models indicate that the mediator should be assessed prior to the outcome.¹⁸

Together, the results of this study indicate that for persons with type 2 diabetes mellitus, modest weight loss (10%) is likely to be associated with improvement in body image dissatisfaction. While there were no changes in ideal body size, suggesting inflexibility of this as a fixed goal, the improvement in body image dissatisfaction is the result primarily of improvement in current body size. However, this improvement in body image dissatisfaction was not due to weight loss alone, as evidenced by our mediation analysis. Future research is needed to address additional factors that may contribute to perceptions of body size and body image dissatisfaction in overweight individuals with type 2 diabetes mellitus.

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Appendix

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Figure 1.
Graphical depiction of the mediation effect.

Table 1

Participant Characteristics at Baseline (n = 157)

Group	<i>Intensive Lifestyle Intervention</i>		<i>Diabetes Support & Education</i>	
Characteristic	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>
Number	45	36	43	33
Average age (y)	59.4 ± 6.9	61.4 ± 5.8	59.0 ± 6.1	61.9 ± 5.2
Mean Body Weight (kg)	96.4 ± 16.4	108.0 ± 16.0	96.5 ± 13.0	105.1 ± 14.6
Mean Body Mass Index (kg/m ²)	36.4 ± 5.6	33.9 ± 5.1	36.4 ± 5.3	33.1 ± 4.4
Race				
African American/Black (not Hispanic)	10 (22.2%)	5 (13.9%)	13 (30.2%)	2 (6.1%)
White	35 (77.8%)	31 (86.1%)	30 (69.8%)	31 (93.9%)
Marital Status				
Never Married	0	0	1 (2.3%)	0
Married/Marriage-like Relationship	22 (48.9%)	32 (88.9%)	29 (67.4%)	31 (93.9%)
Widowed	10 (22.2%)	0	6 (14.0%)	0
Divorced/Separated	13 (28.9%)	4 (11.1%)	7 (16.3%)	2 (6.1%)
Education				
<13 years	9 (20.0%)	1 (2.8%)	10 (23.3%)	2 (6.1%)
13–16 years	24 (53.3%)	13 (36.1%)	14 (32.6%)	12 (36.4%)
>16 years	12 (26.7%)	22 (61.1%)	15 (34.9%)	18 (54.5%)
Unknown	0	0	4 (9.3%)	1 (3.0%)

Table 2
Descriptive Statistics and Tests of Treatment Effects on Change Scores for BMA 2.0 Estimates

<i>Dependent Variable</i>	<i>Intensive Lifestyle Intervention</i>			<i>Diabetes Support & Education</i>		
	Baseline M	Year1 M	$\Delta M (\pm se)$	Baseline M	Year1 M	$\Delta M (\pm se)$
Females						
Current body size	74.3	66.8	-7.3 $\pm 0.95^a$	73.5	72.1	-1.5 ± 0.97
Ideal body size	53.4	52.5	-1.0 ± 0.65	54.5	55.1	0.7 ± 0.67
Acceptable body size	56.8	56.1	-1.2 ± 0.66	59.5	60.4	1.4 $\pm 0.68^a$
Current body size – Ideal body size	20.9	14.3	-6.3 $\pm 0.94^a$	19.0	17.0	-2.3 $\pm 0.96^a$
Males						
Current body size	73.4	63.2	-10.2 $\pm 1.57^a$	73.1	71.0	-2.2 ± 1.64
Ideal body size	53.9	51.6	-2.1 ± 1.12	53.1	54.5	1.2 ± 1.17
Acceptable body size	60.0	56.7	-3.1 $\pm 0.99^a$	58.0	59.9	1.8 ± 1.03
Current body size – Ideal body size	19.6	11.6	-8.1 $\pm 1.59^a$	20.0	16.5	-3.3 $\pm 1.66^a$
						F^b
						17.7***
						2.9
						6.9**
						8.4**
						12.7***
						3.9
						11.1**
						4.2*

Note: Baseline M and Year 1 M are raw means at baseline and year 1;

ΔM is least square means from analysis of covariance, adjusting baseline value.

^a = significant treatment effects from baseline to year one at .05 level.

^b = F value for treatment effects; $df(1, 75)$ – females; $df(1, 60)$ – males.

 $p < .001$

**
 $p < .01$

*
 $p < .05$