Physical Activity Predicts Changes in Body Image during Obesity Treatment in Women

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ABSTRACT

CARRAÇA, E. V., D. MARKLAND, M. N. SILVA, S. R. COUTINHO, P. N. VIEIRA, C. S. MINDERICO, L. B. SARDINHA, and P. J. TEIXEIRA. Physical Activity Predicts Changes in Body Image during Obesity Treatment in Women. *Med. Sci. Sports Exerc.*, Vol. 44, No. 8, pp. 1604–1612, 2012. **Purpose**: This study examined effects of a behavioral weight management intervention on body image (evaluative and investment dimensions) and explored the potential mediating role of structured and lifestyle physical activity (PA). **Methods**: The study was a longitudinal randomized controlled trial, including a 1-yr behavior change intervention and a 2-yr follow-up (225 women, 37.6 ± 7 yr, body mass index = 31.5 ± 4.1 $kg \cdot m^{-2}$). Statistical analyses comprised mixed-design ANOVAs with repeated measures, bivariate/partial correlations, and mediation analyses. **Results**: Body image improved considerably in both groups, favoring the intervention group (small to moderate effect sizes: 0.03–0.05), but began to deteriorate from 12 to 24 months, especially in the intervention group. Consequently, at 24 months, between-group differences were small and did not reach significance. Yet, levels of body dissatisfaction and dysfunctional investment remained below initial values (for both groups). Results were similar for both body image dimensions. Structured PA (at 12 and 24 months) and lifestyle PA (at 24 months) were positively associated with ($r > -0.25$, $P < 0.05$) and partially mediated body image improvements, especially in the investment component (95% confidence interval of −1.88 to −0.27 for structured PA at 12 months, 95% confidence interval of −1.94 to −0.21 for lifestyle PA at 24 months). In general, change in evaluative body image was not mediated by exercise participation, seeming more dependent on weight change. **Conclusions**: These findings highlight the importance of PA as a contributing factor in the improvement of body image in overweight/obese women, mainly by reducing excessive salience of appearance to one's life and self. Lifestyle PA may also be a valid option, particularly in the long term. Exercise might provide a buffer against body image deterioration overtime, favoring lasting weight loss maintenance. **Key Words:** RANDOMIZED CONTROLLED TRIAL, MEDIATION, OBESITY TREATMENT, STRUCTURED PHYSICAL ACTIVITY, LIFESTYLE PHYSICAL ACTIVITY, BODY IMAGE IMPROVEMENT

Appearance-related concerns and dissatisfaction are highly pervasive in overweight and obese individuals (32), especially among women and those seeking weight loss treatment (19). Extensive previous research supports the negative clinical effect of body image problems on the psychosocial functioning, well-being, and quality of life of obese individuals. Several adverse psychosocial consequences have been reported in the literature, including poor psychological adjustment, poor self-esteem, increased depression and anxiety, and inadequate eating and exercise behaviors (7,27).

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Improving appearance and body image is a common motive for weight loss in obese individuals (32). However, body image problems may be an obstacle to successful weight management, predicting poorer outcomes and increasing chances of relapse (16,33,40). Treatment of body image concerns within weight loss interventions is still in the developmental stages. Although some studies have shown that weight loss interventions result in significant improvements in body image (32), several questions remain unanswered. For instance, does treatment produce long-lasting positive changes in multiple body image dimensions? Which mechanisms underpin body image changes (e.g., weight changes, exercise-related factors)? Are different body image dimensions affected by the same mechanisms? This study addresses some of these questions.

Body image is a multidimensional construct that refers to subjective perceptual and attitudinal experiences about one's body (13). Prior research has confirmed that body image attitudes encompass an evaluative component (self-ideal discrepancies, (dis)satisfaction with appearance) and a dysfunctional investment component (excessive cognitive-behavioral importance of appearance to one's life and sense of self) (9,10). Currently, much of the literature on body

image focuses on the former component, partially neglecting the dimension of body image investment (13). Even so, studies have confirmed that dysfunctional body image investment contributes substantially beyond evaluative body image to the prediction of various aspects of psychosocial and behavioral functioning (e.g., eating behavior) (8,12). Given these results, one important step in extending current knowledge on body image change during obesity treatment is to determine whether both dimensions are targeted and improved during treatment.

An area that also requires additional research is the identification of causal factors (i.e., mediating mechanisms) in effectively improving body image that should thus be addressed within weight loss interventions. Physical activity (PA) is considered a critical component in weight management (18), in part because of its effects on psychological predictors of sustained weight loss maintenance (e.g., Teixeira et al. [41]). Following this line of research, Baker and Brownell (3) proposed that psychological factors such as body image and physical self-concept (among others) could be improved through regular PA, in turn increasing persistence in weight control–related behaviors, including dietary habits. Recently, Annesi and Unruh (2) tested part of Baker and Brownell's proposition, finding that exercise participation was associated with significant improvements in body image, mood, and exercise self-efficacy, which, in turn, contributed to exercise persistence and resultant weight loss. On the basis of these findings, the authors suggested that early incorporation of moderate PA into weight management treatments could have considerable value beyond energy expenditure (2). Thus, exercise is a potential mechanism of interest through which body image might be enhanced during weight loss interventions.

Prior research also supports the positive association between exercise and body image. Recent meta-analyses indicated that participants in exercise interventions reported greater improvements in body image and physical self-perceptions compared with controls (e.g., Campbell and Hausenblas [6]). Although related empirical research in the obesity field is sparse, improvements in body satisfaction were found in formerly sedentary obese women, even with minimal physical changes (1). Similarly, previously inactive obese women experienced positive changes in body image, via improvements in self-appraisal, at the end of either a traditional or cognitive-behavioral exercise intervention (1). Other findings suggest that different types of PA (structured vs unstructured) might influence physical self-perceptions and global self-esteem in distinct ways (e.g., Baldwin and Courneya [4], Levy and Ebbeck [24]). For example, Baldwin and Courneya (4) reported significant positive associations between strenuous PA and physical self-perceptions but not for mild to moderate PA. On the basis of these findings, Levy and Ebbeck (24) stressed the need to investigate whether the effects of PA on physical self-perceptions (including body image) were applicable to unstructured and lifestyle PA. Given the need to promote different forms of PA (e.g., formal and informal or unplanned) among the overweight population, further understanding of this issue is particularly relevant.

Finally, evidence on the durability of changes in body image after weight loss or exercise interventions is clearly lacking (13). For instance, whether the effects of exercise are transitory or long-term remains virtually unexplored (6). Thus, the purpose of the present study was to analyze body image change during obesity treatment. Specifically, we examined the medium (12 months) and longer term (24 months) effects of a 1-yr behavioral weight management intervention on different dimensions of body image attitudes (evaluative and investment) and explored the role of PA (structured and lifestyle) as a potential mediating mechanism of body image changes across time (Fig. 1).

METHODS

Study Design and Intervention

This study was part of a longitudinal randomized controlled trial, consisting of a 1-yr behavior change intervention and a 2-yr follow-up period with no intervention. Participants (n = 258) were randomly assigned to intervention and control groups. The comparison group received a 29-session general health education curriculum based on several educational courses on various topics (e.g., preventive nutrition, stress management, self-care, and effective

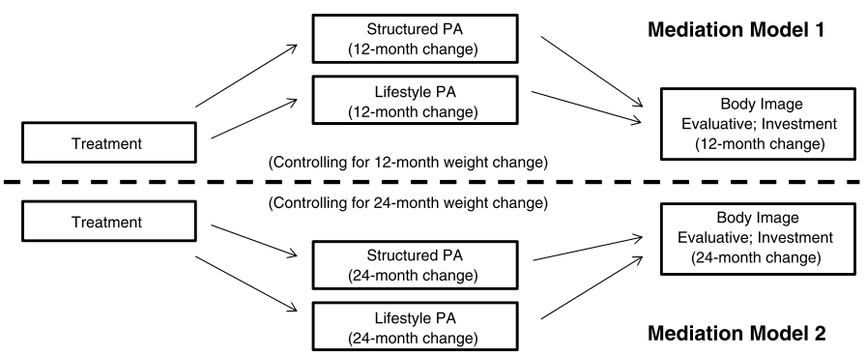

FIGURE 1—Proposed mediation models.

communication skills). The intervention included 30 group sessions aimed at increasing PA and energy expenditure, adopting a moderately restricted diet, and ultimately establishing exercise and eating patterns consistent with sustainable weight loss maintenance. The program's principles and style of intervention were based on the self-determination theory (17), with a special focus on increasing competence and internal regulation toward exercise and weight control, while supporting participants' autonomous decisions as to which changes they wanted to implement and how. A detailed description of the study's theoretical rationale, protocol, and intervention strategies can be found elsewhere (35). The Ethics Committee of the Faculty of Human Kinetics, Technical University of Lisbon, reviewed and approved the study.

Regarding body image enhancement, the intervention aimed at increasing participants' body acceptance and satisfaction and at decreasing their dysfunctional investment in appearance. On the basis of previous work from Cooper et al. (16), several strategies were implemented. Asking participants to view and gradually explore their body and its parts, in front of a mirror, in the privacy of their home; establishing more realistic goals and expectations for themselves and their weight/body by confronting their ideal physique with the real limits to meet their goals (e.g., observe their own and their parents' weight history); and providing dance and relaxation classes were the main strategies used to improve body acceptance and satisfaction and, so, the evaluative component (predominantly). To reduce dysfunctional investment in appearance, i.e., the overconcern with and the salience of body image to oneself, the following key strategies were implemented: helping participants understand the concept of body image (i.e., a subjective construct, independent of physical appearance) and recognize the social and personal roots of their own body image development; asking participants to keep a self-monitoring diary to record critical body image experiences in which they feel self-conscious, their beliefs in the situation (e.g., thoughts, self-statements, negative "body talk"), and the associated emotional and behavioral consequences; helping participants cope with stereotypes and prejudice, facilitating the abandonment of the idea that they must look different to be happier; and working on cognitive restructuring to help participants challenge their maladaptive assumptions about appearance and its salience to their life and self-worth by promoting the evaluation of evidence for and against their beliefs and the construction of alternative thoughts.

Participants

Participants were recruited from the community at large through Web and media advertisements. To join the trial, participants had to be female, between 25 and 50 yr old, premenopausal, with a body mass index (BMI) between 25 and 40 $kg \cdot m^{-2}$, willing to attend weekly meetings (during 1 yr), free from major illnesses, and not taking medication known to interfere with weight regulation. Of all the women who entered the study ($n = 258$), 33 were subsequently excluded from all analyses because they started taking medication susceptible to affecting weight ($n = 13$) or because of serious chronic disease diagnosis or severe illness/injury ($n = 4$). Others were excluded because of pregnancy ($n = 9$) or because they entered menopause ($n = 7$). These 33 women were of similar age ($P = 0.905$) and BMI ($P = 0.494$) as the 225 participants who were considered the valid initial sample for this study. The sample was between 23 and 50 yr old (37.5 ± 7 yr) and overweight or mildly obese, with an initial BMI of 31.5 ± 4.1 $kg \cdot m^{-2}$. Women in the intervention group ($n = 114$) did not differ from those in the control group ($n = 111$) in terms of demographic and main psychosocial variables at baseline ($P > 0.05$). Of the 225 participants who started the program, 184 were available for 24-month assessments: 82% overall retention, 90% in the intervention group, and 72% in the control group. This was considered the effective sample in the current statistical analyses. There were no differences between these 184 women and those who quit the program ($n = 41$) for any demographic or baseline psychosocial variables, with the exception of age; women who stayed in the trial until the 24-month assessments were on average 3 yr older ($P < 0.05$) at the program's start. All participants signed a written informed consent before participation in the study.

Measurements

Body image. The evaluative component of body image, herein represented by self-ideal body discrepancy, was measured with the Figure Rating Scale (39). This scale comprises a set of nine silhouettes of increasing body size, numbered from 1 (very thin) to 9 (very heavy), from which respondents are asked to indicate the figure they believed represented their current (i.e., perceived body size) and ideal body size. Self-ideal discrepancy was calculated by subtracting the score for ideal body size from the perceived body size score. Higher values indicate higher discrepancies. Thompson and Altabe (43) found that the Figure Rating Scale had good test–retest reliability and scores correlated with other measures of body image dissatisfaction, eating disturbance, and self-esteem.

The dysfunctional investment component of body image was represented by measures of body shape concerns and social physique anxiety. Together, these measures tapped into several facets of the investment dimension of body image including disturbed thoughts, emotions, and behaviors that reflect the attentional, cognitive, and behavioral salience of appearance in one's personal life and sense of self. Body shape concerns were assessed with the Body Shape Questionnaire (15) and social physique anxiety was assessed with the Social Physique Anxiety Scale (SPAS) (21). The Body Shape Questionnaire is a 34-item instrument scored on a six-point Likert-type scale that evaluates concern about body weight and shape, in particular the experience of "feeling fat" (e.g., "Has being naked, such as when

taking a bath, made you feel fat?") and several cognitive-behavioral consequences of those feelings (e.g., "Have you avoided wearing clothes that make you aware of your body?"). Higher values represent greater body shape concerns and greater body image salience in one's life. Rosen et al. (31) reported good test–retest reliability and good concurrent validity with other measures of body image. The SPAS measures the degree to which people become anxious and concerned when others observe or evaluate their physiques, thereby assessing affective, cognitive, and behavioral avoidant features of body image in a social environment. This scale comprises 12 items (e.g., "unattractive features of my physique make me nervous in certain social settings") rated on a five-point Likert-type scale. Higher scores represent greater social physique anxiety. Hart et al. (21) found good internal consistency and test–retest reliability for the SPAS.

PA. Structured PA was assessed with the Seven-Day Physical Activity Recall (5), a semi–interview-based instrument that estimates the time spent in PA for the past 7 d (or a typical week of the last month, if the previous week was atypical). Trained interviewers guided the participants through the recall process, day by day. Previous studies have supported the reliability and validity of the Seven-Day Physical Activity Recall as a measure of PA (44). For the current study, activity reports were collapsed into total minutes of moderate and vigorous intensity PA in a week (all activities above 3 METs were considered). Daily lifestyle PA was evaluated with a lifestyle PA index (36), which was integrated in a questionnaire specifically developed for this study to measure habitual lifestyle physical activities typical of the last month. To calculate the lifestyle PA index, we used a score based on seven items ("using stairs or escalators," "walking instead of using transportation," "parking away from destination," "using work breaks to be physically active," "choosing to stand up instead of sitting," "choosing hand work instead of mechanical/automatic," "choosing to be physically active whenever possible"). Responses ranged from never (1 point) to always (5 points) on a Likert scale ($\alpha = 0.84$).

Participants completed Portuguese versions of all the questionnaires cited above. Forward and backward translations between English and Portuguese were performed for all the questionnaires. Next, two bilingual Portuguese researchers subsequently reviewed the translated Portuguese versions, and minor adjustments were made to improve grammar and readability. Previous studies using the Portuguese versions of these scales reported acceptable internal consistencies (above 0.70) for all these instruments (7,41).

Body habitus. Weight-related measurements were performed in the morning, after fasting for 3 h. Body weight was measured twice, with an electronic scale calibrated on-site and accurate to 0.1 kg (Seca, Hamburg, Germany). Vertex height was measured with a balance-mounted stadiometer to the nearest 0.1 cm. BMI was calculated from weight (kg) / height (m) squared.

Analytical Procedure

A mixed-design ANOVA with repeated measures (time × group) was conducted to test the effect of the intervention on body image change across time (before intervention, at intervention's end [12 months], and at 1-yr follow-up [24 months]). To perform this analysis, body image absolute scores at each time point were considered. A standardized composite score based on body shape concerns and social physique anxiety scores was created to represent dysfunctional investment body image. Participants' scores on each scale were recoded into a scale ranging from 0 to 100; a composite score reflecting the mean value of the two recoded scales was then calculated for each participant. Correlations between the original scores for each scale and the composite score were examined. The coefficients were very high (above 0.90), suggesting that both measures are represented in the computed score. The 24-month body weight change was included in the ANOVA as a covariate. Eta squares (η^2) and confidence intervals (CIs) for the effect sizes were estimated to express the magnitude of effects. Values of 0.01, 0.06, and 0.14 are considered small (but not trivial), medium, and large effect sizes, respectively (14). In addition, CIs for the η^2 were estimated. Pearson and partial correlations were used to examine the associations between changes in PA and body image dimensions within each time point (12 and 24 months). The effects of participation group and body weight change, two putative confounders, were controlled for.

Two models were assessed using AMOS 18.0 (Amos Development Corporation, Copyright 2007, James L. Arbuckle), one with change in 12-month PA (model 1) and one with change in 24-month PA (model 2) mediating the relation between treatment and body image change. Considering the sample size of this study, a hybrid model, combining one latent (i.e., body image investment) and observed variables, was specified to ensure sufficient power to conduct the analysis and to stay within the limits of sample size requirements for model testing (23). Model fit was assessed using the χ^2 goodness-of-fit test, Bollen's incremental fit index (IFI > 0.95), and the standardized root mean residual (SRMR < 0.08) values as the criteria (22). Tests of multivariate normality indicated significant departures from normality for both models. Therefore, the Bollen–Stine bootstrap was used to assess the significance of the χ^2 statistic. Tests of mediation were conducted using a resampling method advocated by several authors for testing mediation (e.g., Preacher and Hayes [29]). AMOS does not give specific indirect effects for models with multiple mediators. Therefore, to test the significance of specific indirect effects of multiple mediators, a tool developed by Selig and Preacher (34), which calculates a sampling distribution and 95% CIs for indirect effects using a Monte Carlo resampling method, was used. In the present study, 5000 replications were performed. An indirect effect is significant (at $\alpha = 0.05$) if its 95% CI does not include zero.

For correlation and mediation analyses, change in body weight, body image, and exercise measures was expressed

by baseline-residualized scores, where the 12- or 24-month value was regressed onto the baseline value (14). Using residualized change scores is considered preferable to the use of subtraction scores because it provides a value that is orthogonal to the pretreatment value(s) (14).

RESULTS

The effects of the intervention on weight and PA are described elsewhere (36,41). In brief, at the end of the intervention (12 months), average weight loss was higher in the intervention group (−7.3% ± 5.9%) than in the control group (−1.7% ± 5.0%, $P < 0.001$), and so were the levels of structured PA (300 ± 179 vs 162 ± 171 min·wk^{-1}, $P < 0.001$) and lifestyle PA (3.84 ± 0.69 vs 2.98 ± 0.81, $P < 0.001$) (36). At the 24-month follow-up assessment, average weight reduction remained higher in the intervention group (−5.5% ± 7.79%) compared with the control group (−2.2% ± 7.5%, $P < 0.001$). Similar results were observed for structured PA (244 ± 212 vs 185 ± 182 min·wk^{-1}, $P < 0.05$); however, no significant between-group differences were found for lifestyle PA (3.40 ± 0.87 vs 3.15 ± 0.90, $P = 0.144$).

Time course changes in body image. A mixed-design ANOVA with repeated measures was used to assess group-specific time course changes in each dimension of body image, i.e., evaluative and dysfunctional investment, throughout the 24 months (Fig. 2). Results were adjusted for body weight change. Regarding evaluative body image, there was a significant group × time interaction ($F = 5.51$, $P < 0.01$, $\eta^2 = 0.034$, 95% CI = 0.004–0.077), indicating that time course changes in evaluative body image were different between participation groups. To break down this interaction, simple effects analyses were performed comparing groups at each time point (ANCOVA) and running separate ANOVAs with repeated measures for each group. Results revealed that during the intervention phase (0–12 months), body dissatisfaction decreased significantly in both groups, favoring the intervention group (at 12 months, $F = 5.52$, $P < 0.05$, $\eta^2 = 0.032$, 95% CI = 0.001–0.099); on the other hand, during the 1-yr follow-up (12–24 months), body dissatisfaction showed a significant large increase in the intervention group ($F = 12.9$, $P < 0.01$, $\eta^2 = 0.125$, 95% CI = 0.026–0.255) but nonsubstantial changes in the control group ($F = 0.403$, $P > 0.05$, $\eta^2 = 0.006$, 95% CI = 1.18E-03–0.087). At 24 months, no significant between-group differences were observed, although evaluative body image remained slightly more improved in the intervention group ($F = 2.07$, $P > 0.05$, $\eta^2 = 0.012$, 95% CI = 4.81E-03–0.063). Regarding the dysfunctional investment component, a significant group × time interaction was found ($F = 22.7$, $P < 0.001$, $\eta^2 = 0.128$, 95% CI = 0.064–0.195). Simple effects analyses showed that groups differed considerably at 12 months, with the intervention group presenting greater improvement in dysfunctional investment ($F = 8.63$, $P < 0.01$, $\eta^2 = 0.05$, 95% CI = 0.005–0.127). In contrast, at 24 months, the between-groups effect was small and did not reach significance ($F = 2.09$, $P > 0.05$, $\eta^2 < 0.012$, 95% CI = 4.87E-03–0.064). During the follow-up phase, the improvement in the intervention group was reduced, whereas dysfunctional investment in appearance continued to decrease in the control group. Even so, dysfunctional investment in the intervention group at 24 months remained lower than among the controls and also largely below the initial levels ($F = 101.29$, $P < 0.001$, $\eta^2 = 0.532$, 95% CI = 0.388–0.632).

Associations between PA and body image. Pearson correlations considering the whole sample showed significant associations between all exercise and body image measures at each time point, i.e., 12 and 24 months (Table 1). Generally, correlations including investment body image and structured PA were of slightly higher magnitude. After adjusting for the effects of putative confounding variables, namely, participation group and body weight change, the pattern of associations changed. At 12 months, only the association between structured PA and investment body image remained significant after the first (i.e., participation group) and second adjustments (i.e., participation group and weight change). At 24 months, after adjusting for the group effect, both structured and lifestyle PA remained significantly associated with dysfunctional investment in appearance, and lifestyle PA continued to show a significant correlation

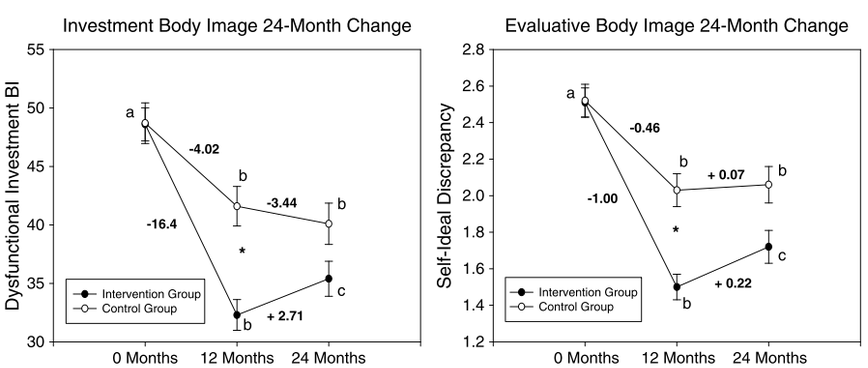

FIGURE 2—Change in body image dimensions during the 24 months for the intervention and control groups. *Errors bars* show SEM. Mixed-design ANOVAs were conducted. *Same superscript letters* indicate no differences ($P > 0.05$) within the intervention and control groups. *Differences ($P < 0.05$) between groups at each time point.

TABLE 1. Associations between change in exercise behavior and body image at the program's end (12 months) and after 1-yr follow-up (24 months).

	Body Image					
	Evaluative Body Image			Investment Body Image		
Exercise Behavior	*r*	Partial *r* (Group Adj)[a]	Partial *r* (Weight Adj)[b]	*r*	Partial *r* (Group Adj)[a]	Partial *r* (Weight Adj)[b]
12 months						
Structured PA	−0.24*	−0.13	−0.03	−0.44**	−0.33**	−0.26*
Lifestyle PA	−0.22*	−0.001	−0.01	−0.36**	−0.07	−0.08
24 months						
Structured PA	−0.26*	−0.20***	0.03	−0.29*	−0.36*	−0.27****
Lifestyle PA	−0.28*	−0.26****	−0.17	−0.31*	−0.30*	−0.25****

[a] Partial correlation (*r*) controlling for the effect of the participation group.
[b] Partial correlation (*r*) controlling also for the effect of weight change.
* $P < 0.01$.
** $P < 0.001$.
*** $P < 0.100$.
**** $P < 0.05$.
r, Pearson correlations.

with evaluative body image. After adjusting also for weight change, the latter association did not reach significance.

Mediation analysis. To further understand the role of PA in the improvement of body image due to treatment, mediation tests were performed. First, we tested whether changes in structured and lifestyle PA mediated the effects of treatment on each body image dimension, during the 12-month intervention period (model 1). Second, we tested whether 24-month changes in both types of exercise mediated the changes in body image (model 2). Analyses were performed controlling for body weight changes during each respective period. In model 1, results showed an acceptable fit (χ^2 = 6.09 (df = 6), $P > 0.05$; SRMR = 0.02; IFI = 1.00; Bollen–Stine χ^2 = 6.31, P = 0.445). Mediation tests showed that the indirect effects of treatment on investment body image, through structured PA, were significant (95% CI of −1.88 to −0.27). Changes in lifestyle PA did not mediate investment body image improvement during the 12-month intervention period (95% CI of −2.07 to 2.08). Results also revealed the absence of mediating effects through either PA type on treatment-related changes in evaluative body image (95% CI of −0.03 to 0.03 for structured PA, 95% CI of −0.12 to 0.10 for lifestyle PA). The second model (24-month changes in body image) presented a reasonable fit, showing adequate values for most of the indices (χ^2 = 21.65 (df = 6), $P < 0.05$; SRMR = 0.06; IFI = 0.96; Bollen–Stine χ^2 = 6.79, P = 0.005). The 95% CIs showed significant indirect effects through lifestyle PA on evaluative (95% CI of −0.10 to −0.01) and investment body image (95% CI of −1.94 to −0.21) change at 24 months. Mediation analyses also showed significant (marginal) indirect effects through structured exercise but only on the investment component (95% CI of −1.16 to −0.004).

DISCUSSION

Prior research suggests that an improved body image can facilitate weight loss and maintenance by increasing psychological resources as well as persistence with requisite behaviors, such as those related with caloric restriction (28,33). Corroborating this idea, a recent study by Carraça et al. (8) showed that body image enhancement during obesity treatment, especially the reduction in its dysfunctional investment component, contributed to a more flexible and self-confident regulation of eating behavior and to the adoption of less extreme and unhealthy eating patterns. All these aspects are likely to lead to a more effective weight control process, which is more sustainable in the long term. Thus, further investigation of body image improvement and its underlying mechanisms is of relevance in obesity studies. This was the general purpose of the current study.

As predicted, the intervention produced considerable improvements in both body image dimensions. However, at present, determining whether a given improvement in body image among the obese population is clinically meaningful remains a difficult task. There is no established minimum amount of change in body image that can be deemed clinically significant available in the literature, at least for this population, and research reporting meaningful improvements in body image with dieting or behavioral obesity treatment (that is, body image in the sense of satisfaction or social comfort with appearance) is scarce (30). Nevertheless, our findings seem to suggest that body image changes were substantial, on the basis of the large magnitude of effects. In addition, Maciejewski et al. (25) proposed that 5%–10% improvements in psychosocial measures (including body image) could be adopted as a marker of success. *Post hoc* analysis of our data in light of these criteria of success showed that the amount of change (%) far exceeded the 10% boundary for both body image dimensions. The treatment resulted in an average reduction of 33% versus 8% in dysfunctional investment and of 37% versus 16% in body dissatisfaction, for the intervention and control groups, respectively. We further observed that the intervention was successful (with regards to at least a 10% improvement) for 90% and 77% of all participants for investment and evaluative BI, respectively. Hence, these results seem to suggest that the effect of the intervention on body image improvement was of practical (and clinical) significance.

In contrast, our study showed that in the long term (24 months), these favorable outcomes may tend to fade, with

body dissatisfaction and dysfunctional investment in appearance gradually increasing (medium–large effect sizes). Nevertheless, body image remained considerably improved compared with initial levels, indicating that positive changes are not completely reversed 1 yr after the intervention. Prior research has shown that most changes in body image are maintained at least 2 or 3 months after intervention (10); however, longer follow-ups have not previously been conducted. Our study seems to suggest that positive body image changes do persist over longer periods, although they do diminish to some extent. Weight regain, which is the expected long-term outcome for many, might be one important factor in body image worsening after the intervention (9,19). In this context, some authors (e.g., Cooper et al. [16], Sarwer et al. [32]) have suggested that the treatment of body image concerns may be most useful during the maintenance phase of treatment, when weight loss may be beginning to slow down or even reverse. More research on this topic, comprising longer follow-ups, is clearly warranted not only to confirm our findings but also to explore the causes underlying body image worsening (i.e., residual body image problems that are not being effectively tackled by the intervention).

As expected, body image improvements during the intervention phase favored the treatment group over the controls; yet, against expectations, at 24 months, there were only small nonsignificant differences between groups for either dimension of body image. This was especially evident in the investment component, which continued to improve from baseline to follow-up in the control group. As previously mentioned, in the intervention group, during the follow-up phase, dysfunctional investment in appearance and body dissatisfaction began to increase (i.e., deteriorate). To better understand these results, we explored each group's specific time course changes in body weight and PA (data not shown). Results revealed slight but significant increases in body weight from 12 to 24 months in the intervention group, but no substantial changes were observed in the controls. Regarding PA variables, no 12- to 24-month changes were observed for either group in structured exercise; yet, while lifestyle PA slightly decreased in the intervention group, it showed a tendency to keep increasing in the controls. These aspects might account, at least partially, for these unexpected findings. For instance, as previously mentioned, it is well documented in the literature that even a small weight gain negatively affects body image (9,19) and especially among individuals presenting an overweight history and, thus, a vestigial body image disparagement (11). In addition, as our study and previous others show (e.g., Annesi [1]), PA is associated with positive changes in body image, which could help explain the continued body image improvement in the control group.

Correlation and mediation results revealed that structured rather than lifestyle PA was more relevant for the improvement of body image during the 12-month intervention, namely, for reducing the dysfunctional investment in appearance. Our results are in line with previous findings that reported significant associations between structured exercise such as aerobic classes and swimming (e.g., Sonstroem et al. [37]) and physical self-perceptions but that failed to find associations (24) or reported only minimal effects (42) when general PA (structured and unstructured, moderate intensity on average) was considered. In addition, Baldwin and Courneya (4) reported significant positive associations between strenuous exercise and physical self-perceptions but not for mild to moderate PA. This is an interesting point considering that these are the most typical intensities in unstructured recreational activities. On the other hand, the present results suggest that lifestyle PA might be especially important in the long term, if not to improve, at least to attenuate body image deterioration after intervention. Given the current focus on lifestyle and unstructured PA as a means of meeting the guidelines for attaining the health-related benefits of PA, especially among the overweight/obese population (18), these findings are encouraging.

Results also showed that the investment component was more closely related to PA, especially after controlling for body weight change. In effect, partial correlations showed that the evaluative component was no longer associated with PA after the adjustment, suggesting that the change in this component might be more dependent on weight change than the investment component. Evaluative body image, as it was measured in this study (a self-ideal body size discrepancy index), is affected by actual change in weight and also by change in ideal body size (28). Our intervention worked on self-acceptance and on the establishment of more realistic, less stringent ideal figures, which likely affected one component of the equation (i.e., ideal body size); the other component was naturally influenced by weight change. On the other hand, the investment component is a more complex dimension (comprising cognitive, affective, and behavioral facets), which is reflected in excessive appearance management efforts (13). Hence, investment might be more susceptible to the effects of exercise participation. In the light of the present results, it can be concluded that although body image dissatisfaction and dysfunctional investment started to increase after the end of the intervention, PA might still provide a buffer against the effects of minor weight gain and other potential threats to body image (e.g., media messages, social pressure).

Several mechanisms (physiological and psychological) by which exercise might exert its influence on body image have been proposed, but the literature seems to suggest that these are more likely to be psychosocial in origin (20). One of the most plausible explanations is well illustrated by the exercise and self-esteem model (38), according to which exercise-induced changes in physical self-efficacy fuel exercise-related changes in body image. Exercise effects might be mediated by changes in subjective perceptions of one's physical fitness and competence rather than by actual changes in fitness or body weight. These perceptions may simply arise because there is a feeling that the body is improving through

exercise (e.g., muscle tone, agility, clothing fits better) (20). Thus, even when interventions fail to generate statistically significant changes in weight and fitness, exercisers may perceive real or imagined yet personally meaningful improvements in their physical functioning, which in turn might enhance self-efficacy, producing more positive feelings about the body (26). In addition, exercise may improve body image by making people more aware of their physical capabilities, while reducing focus on their physical appearance. Research on exercise motives indicates that although, among initiate exercisers, extrinsic motives such as exercising for appearance-related reasons are more prominent, intrinsic motives such as improving physical functioning, psychological well-being, or simple enjoyment are more prominent than extrinsic motives among regular exercisers (e.g., Martin and Lichtenberger [26]). Improved physical acceptance derived from exercise participation might also contribute to diverting attention from appearance-related concerns (24,42).

This study is not without limitations. Although this was a longitudinal study and we did measure change in the variables of interest, changes in body image and PA measures occurred during the same period. Thus, we cannot exclude the possibility of alternative causal relations between these variables. It is possible that the change in body image led to positive changes in exercise participation or that these variables reciprocally influence each other. The psychometric instruments used to measure investment body image were only able to capture some facets of this construct, namely, overpreoccupation with body image and appearance and its behavioral consequence, thus failing to capture another core facet of body image investment: appearance-related self-schemas. Future studies should include more comprehensive measures that are able to capture these additional facets of body image investment. Structured PA was measured using a self-report questionnaire that has been shown to provide a valid and reliable assessment of PA. However, future studies may consider incorporating objective measures of PA such as accelerometry and HR monitors. Finally, this study only included overweight and obese women, and, therefore, it is unclear whether similar results will be observed in other groups.

Summary and practical implications. Improving overweight and obesity interventions remains a critical challenge, and the present study represents one more step in this direction. Poor body image is associated with poor psychological well-being in obese individuals (e.g., Carraça et al. [7]), and its improvement during treatment, especially dysfunctional investment reduction, has been shown to result in improved eating self-regulation (e.g., Carraça et al. [8]). Hence, body image seems to play an important role in the weight control process, and examining whether weight loss interventions effectively target and improve body image (in particular, but not exclusively, the investment component) and identifying the mechanisms by which it improves are relevant goals. Given that PA plays a critical role in long-term weight maintenance (18), seems to be positively associated with better body image (e.g., Annesi [1]), and was the main outcome of this intervention (35), its mediating role was examined. Our findings highlight the relevance of encouraging PA participation as a way of improving body image in overweight women, especially by reducing the excessive salience of appearance to one's life and sense of self. Our results suggest that to see significant gains in body image in the short/medium term, moderately intense PA should be prescribed; as assessed in this study, this can include brisk walking, light sports, dancing, and other activities of similar (or higher) intensity. Moreover, if enhanced perceptions of physical competence mediate changes in body image (38), then successful, challenging, moderate to vigorous PA will result in a greater improvement in self-efficacy and body image than lighter workouts (26).

A strength of our study is the inclusion of a measure of lifestyle unstructured PA such as taking the stairs whenever possible or choosing to walk more in daily life. Because this type of exercise might be more easily integrated into people's lives, it has been the target of increased attention as a means of achieving the recommended doses of PA for weight management purposes (18), including among the overweight and obese population. Our results revealed that especially in the longer term, lifestyle PA might also be important to attenuate body image deterioration. For the sake of weight maintenance, these findings are encouraging and informative for professionals, providing further support for the inclusion and recommendation of this type of PA (as a complement to structured activities) within future weight loss interventions.

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