Affective Responses to Increasing Levels of Exercise Intensity in Normal-weight, Overweight, and Obese Middle-aged Women

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At least 60 min of daily physical activity (PA) are recommended for weight control, a target achieved by only 3% of obese (OB) women. The purposes of this study were to examine (i) the affective responses of normal-weight (NW), overweight (OW), and OB middle-aged sedentary women to exercise of increasing intensity and (ii) the relationship of affective responses to self-efficacy and social physique anxiety. The women participated in a graded treadmill protocol to volitional exhaustion while providing ratings of pleasure–displeasure and perceived activation each minute. The Activation Deactivation Adjective Check List (AD ACL) was also completed before and after exercise. The affective responses of NW and OW women did not differ. However OB women gave lower pleasure ratings during the incremental protocol and reported lower Energy scores immediately after the protocol. Social physique anxiety, but not self-efficacy, was inversely related to pleasure and energy. The lower levels of pleasure and energy experienced by OB than nonobese women could account in part for their dramatically low levels of PA participation. Modifying the cognitive antecedents of social physique anxiety might be a useful intervention strategy.

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INTRODUCTION

Expert panels and government agencies recommend 45–60 min of moderate-intensity physical activity (PA) daily for the prevention of weight gain and 60–90 min for weight management in individuals who were previously OB (1–4). However, these recommendations have been criticized as "too daunting" (5, p. 769) and "too ambitious" (6, p.2264). In actuality, no more than 4.1% of overweight (OW) women, 3.0% of OB women, 6.9% of OW men, and 6.4% of OB men trying to lose weight report reaching 420 min of PA weekly (7).

At least one prospective study has shown that, in this apparently negative relationship between obesity and PA participation, the causal path from obesity to inactivity is stronger than that from inactivity to obesity (8). Thus, it appears that, once obesity develops, it becomes a barrier to PA participation, perpetuating a vicious cycle. Developing a PA prescription for OB individuals represents a considerable challenge. According to the American College of Sports Medicine (9), "the balance between intensity and duration of exercise should be manipulated to promote a high total caloric expenditure" (p. 218). This implies that the caloric expenditure per session must be raised as much as possible without the session becoming "too long" for what each participant considers acceptable and without it being "too intense" to be pleasant or at least tolerable. Attaining the right balance between these two factors is not easy. On the one hand, lack of time consistently ranks as one of the top perceived barriers to PA participation among adults (10). On the other hand, a higher intensity can exacerbate the risk of musculoskeletal injury and, just as importantly, OW and OB individuals report higher levels of pain, discomfort, displeasure, and perceived exertion during PA than their normal-weight (NW) counterparts (11–13).

The unique challenges associated with PA intensity among OB individuals are poorly understood. In particular, the element of affect, despite its importance, seems to have been neglected. Affect is a key component of the exercise experience and, as recent studies have shown, it may also be related to PA participation (14,15). Understanding how OW and OB individuals respond affectively to different levels of PA intensity, and how they differ from NW individuals, could help shed light on the dramatically low rates of PA participation among OW and OB individuals.

Affect could stem directly from bodily sensations (e.g., feeling energy and exhilaration or pain and discomfort) or it may follow from certain patterns of cognitive appraisals (e.g., perceptions of achievement and competence or failure and threat). The former varieties are perhaps less amenable to change, as they probably require improvements in fitness. The latter varieties however

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present an opportunity for interventions designed to change the underlying patterns of appraisals. In this study, we focused on two constructs that rely heavily on cognitive appraisals and could have an impact on affect, namely self-efficacy (16) and social physique anxiety (17). Self-efficacy is the belief in one's capabilities to perform a specifically delineated task. Social physique anxiety reflects a tendency to feel apprehensive about having one's body negatively evaluated by critical observers in social settings. We hypothesized that, for participants who are chronically sedentary and have to exercise in an inherently evaluative setting (while physiological and psychological parameters are being monitored), exercise would (i) challenge their sense of efficacy and (ii) induce apprehension about how their physique would be judged. In turn, a compromised sense of efficacy and increased apprehension could be associated with the affect experienced during and after exercise.

The present study focused on physically inactive middle-aged women. Women attempt weight loss at much higher rates than men but engage in adequate amounts of PA at significantly lower rates than men (7). Furthermore, membership in a higher BMI category (i.e., OW or OB) is associated with a progressively lower percentage of women meeting diet and PA recommendations, a phenomenon not observed among men (7). Higher BMI, adiposity, or body mass are associated with poorer adherence to PA activity among women (18).

Thus, the first purpose of the present study was to compare the affective responses of NW, OW, and OB women to increasing levels of exercise intensity. The second purpose was to examine the correlations of affect with self-efficacy and social-physique anxiety.

METHODS AND PROCEDURES

Participants

An initial sample of 50 women expressed interest in participating in the study after having received an e-mail message sent to the faculty and staff of a large university or having seen announcements on public bulletin boards in the local community. The inclusion criteria were that the women (i) participated in <30 min of moderate PA daily on most days of the week; (ii) had not changed their PA habits for the previous 12 months; (iii) had a physical examination in the previous 12 months that revealed no contraindications to vigorous PA; (iv) gave negative responses to all questions on a Physical Activity Readiness Questionnaire and were, thus, apparently healthy; (v) were not suffering from any injuries or other ailments. In total, 27 women satisfied the inclusion criteria and were scheduled for testing.

Nine women were classified as NW (BMI <25 kg/m^2), 10 as OW (BMI ≥25 kg/m^2), and 8 as OB (BMI ≥30 kg/m^2). Of these, however, three women terminated the treadmill test prematurely due to skeletal or muscular complaints. Two of these women were OW (BMI of 27 and 28 kg/m^2) and one was OB (BMI of 34 kg/m^2). Thus, the final sample consisted of 24 women (9 in NW, 8 in OW, 7 in OB). Five of the participants in the OB group were classified as Class I (BMI between 30 and 34 kg/m^2) and two were classified as Class III (BMI between 40 and 45 kg/m^2). The participant characteristics are summarized in Table 1. All participants read and signed an informed consent form approved by the University's institutional review board.

Measures

Heart rate was assessed with a heart rate monitor (Polar Electro Oy, Kempele, Finland). Oxygen uptake (VO_2), carbon dioxide production (VCO_2), and minute ventilation (V_E) were assessed with a metabolic analysis system (TrueOne 2400, ParvoMedics, Sandy, UT). The rating of perceived exertion (RPE; 19) was used as a measure of perceived exertion. The RPE is a 15-point scale ranging from 6 to 20, with anchors ranging from "No exertion at all" to "Maximal exertion."

Affect was assessed from the perspective of the circumplex model (20). According to this model, the domain of affect can be defined by the orthogonal and bipolar dimensions of affective valence (pleasure–displeasure) and perceived activation (low-high). Both multi-item and single-item measures of affect were used, the latter being more practical for repeated assessments during exercise.

The Feeling Scale (FS; 21) is an 11-point, single-item, measure of affective valence. The scale ranges from −5 to +5. Anchors are provided at zero ("Neutral") and at all odd integers, ranging from "Very Bad" (−5) to "Very Good" (+5).

The Felt Arousal Scale of the Telic State Measure (22) is a 6-point, single-item measure of perceived activation. The scale ranges from 1 to 6, with anchors at 1 ("Low Arousal") and 6 ("High Arousal").

The Activation Deactivation Adjective Check List (AD ACL; 23) was used as a multi-item measure of the four quadrants of the circumplex model. Specifically, the AD ACL provides scores for the following four scales, each consisting of five items: (i) Energy (high-activation pleasure), (ii) Tension (high-activation displeasure), (iii) Tiredness (low-activation displeasure), and (iv) Calmness (low-activation pleasure).

Self-efficacy was assessed as the participants' beliefs in their ability to continue exercising for incremental 1-min periods "beyond the point at which exercise starts to become challenging". A scale consisting of eight items was used, ranging from "I believe I am able to continue for 1 minute" to "I believe I am able to continue for 8 minutes". For each item, participants were asked to indicate their confidence on a 100-point scale comprised of 10-point increments (from 0: "Not at all confident" to 100%: "Very confident").

Social physique anxiety was assessed with the 7-item version (24) of the Social Physique Anxiety Scale (SPAS; 18). Respondents were asked to indicate the extent to which each item (e.g., "It would make me uncomfortable to know others were evaluating my physique/figure") was characteristic of them, using a scale ranging from 1 ("Not at all") to 5 ("Extremely"). The 7-item version of the SPAS was chosen for this study based on evidence that it has exhibited better fit than the 12-item and 9-item versions both across genders and in several female-only samples (24).

Table 1 Descriptive statistics for the demographic, anthropometric, physiological, and psychological characteristics of the participants

	Normal-weight (n = 9)	Overweight (n = 8)	Obese (n = 7)
Age (years)	43.67 ± 4.24	39.06 ± 8.89	44.71 ± 3.77
Height (m)	1.65 ± 0.07	1.70 ± 0.04	1.65 ± 0.04
Body mass (kg)***	60.35 ± 6.99[b,c]	81.79 ± 6.80[a,c]	95.13 ± 12.29[a,b]
BMI (kg/m^2)***	22.26 ± 1.85[b,c]	28.25 ± 1.28[a,c]	35.15 ± 5.41[a,b]
VO_{2peak} (ml/kg/min)**	25.90 ± 6.22[c]	23.96 ± 3.68[c]	17.50 ± 2.23[a,b]
Lactate (mmol/l)	5.46 ± 2.40	6.56 ± 2.42	4.09 ± 2.11
VT (% VO_{2peak})	68.42 ± 12.27	71.63 ± 8.30	75.72 ± 8.85
SPAS (7–35)*	18.50 ± 3.93[c]	20.29 ± 6.07	27.57 ± 6.40[a]
Self-efficacy (0–100%)	53.33 ± 26.59	64.06 ± 23.07	41.88 ± 14.55

[a]Different from normal-weight. [b]Different from overweight. [c]Different from obese. *P < 0.05; **P < 0.01; ***P < 0.001 for one-way ANOVA.

Procedures

The participants completed the FS, Felt Arousal Scale, and AD ACL for the first time after arriving at the laboratory, receiving an overview of the experimental procedures, and signing the informed consent form. After the assessment of height and weight, each participant was fitted with the heart rate monitor and a nasal-and-mouth-breathing face mask (model 8920/30; Hans Rudolph, Kansas City, MO).

Two minutes of resting data were collected while the participant was standing on the treadmill (model L8, Landice, Randolph, NJ), to ensure the proper functioning of the metabolic system. The incremental treadmill test began at a speed of 2.5 mph (1.11 m/s) and 0% grade for 2 min. This initial speed was selected to be substantially lower than the reported average preferred walking speed of OB women, namely ~1.40 m/s (25,26). Thereafter, the speed was increased by 0.4 mph (0.18 m/s) every second minute (while maintaining the grade at 0%) until each participant reached the point of maximal effort. At that point, all women had reached at least two of the following criteria: ±10 beats/min from age-predicted maximal heart rate, a plateau (changes of ≤2 ml/kg/min) in VO_2 despite increasing the workload, or a respiratory exchange ratio ≥1.1. The highest 1-min average of oxygen uptake was designated as peak oxygen uptake (VO_{2peak}). The designation "peak" rather than "max" was chosen out of caution, due to the possibility that, in this sample, factors other than cardiorespiratory limitations could have prompted the participants to terminate the test.

The first stage of the incremental protocol (i.e., 2.5 mph) was considered a warm-up. Thus, no assessments were made during the first minute. Assessments of RPE, FS, and Felt Arousal Scale began from the end of the first stage (hereafter designated as Stage 1) and were repeated each minute thereafter. The participants were shown a poster-size version of the scales (removed from view the rest of the time) and were asked to respond either verbally or by pointing.

After the participants stopped the treadmill, the face mask was removed. While still standing on the treadmill, the participants then completed the AD ACL. This was followed by a 5 min cooldown walk on the treadmill (2.5 mph, 0% grade) and one more completion of the AD ACL. The participants were then seated in an armchair for a 20-min recovery and observation period. The AD ACL was administered two more times, at min 10 and min 20 of this recovery period.

Data reduction and statistical analysis

Because different women terminated the test at different times, a data reduction technique was developed to yield data points during the protocol that were physiologically comparable for all participants (i.e., points at the beginning of exercise, proximal to the ventilatory threshold (VT), and at exhaustion). Specifically, the following time points were retained: (i) the first stage of the incremental protocol (Stage 1), (ii) the minute before the VT-1, (iii) the minute of the VT, (iv) the minute after the VT+1, and (v) the last minute of the incremental protocol before volitional termination (End).

The VT was determined offline as the intensity at which breakpoints were identified (both by computerized algorithms and by visual inspection) for at least two of the following three relationships: (i) CO_2 production over O_2 utilization, (ii) ventilatory equivalent for O_2 over O_2 utilization, and (iii) excess CO_2 over O_2 utilization.

RESULTS

Descriptive statistics for the three groups and the results of intergroup comparisons are presented in **Table 1**. The groups differed significantly in body mass, BMI, VO_{2peak}, and SPAS.

Physiological responses

In the analyses of change that follow, when the sphericity assumption was violated, the Huynh-Feldt adjustment of the degrees of freedom was used and the adjusted degrees are reported. A 3 (BMI groups) by 6 (Rest, Stage 1, VT-1, VT, VT+1, End) ANOVA on the percentage of age-predicted maximum heart rate showed only a significant main effect of time, F (2.77, 52.60) = 109.00, $P < 0.001$, $\eta^2 = 0.85$. The participants reached 91 ± 3% of age-predicted maximal heart rate during the last minute of the test (161 ± 5 beats/min). Each point-to-point increase was significant. Likewise, a 3 (BMI groups) by 5 (Stage 1, VT-1, VT, VT+1, End) ANOVA on the RPE data showed only a main effect of time, F (2.85, 59.89) = 101.36, $P < 0.001$, $\eta^2 = 0.83$. During the last minute of the test, the average RPE was 17.3 ± 0.4 (i.e., approximately corresponding to a rating of "Very Hard"). No significant differences emerged for the percentage of VO_{2peak} at which the VT occurred (see **Table 1**).

A 3 (BMI groups) by 5 (Stage 1, VT-1, VT, VT+1, End) ANOVA on the VO_2 data showed a significant main effect of BMI group, F (2, 21) = 4.42, $P < 0.05$, η^2 =0.30, a significant main effect of time, F (2.60, 54.47) = 76.00, $P < 0.01$, η^2 =0.78, as well as a significant interaction, F (5.19, 54, 47) = 3.84, $P < 0.01$, $\eta^2 = 0.27$. VO_2 increased gradually for each group but at different rates. Significant differences between groups emerged at VT+1 (with OB being lower than NW) and End (with OB being lower than both NW and OW). This was consistent with the fact that OB had shorter test durations and reached the VT earlier than both other groups.

Affective responses

A 3 (BMI group) by 6 (Rest, Stage 1, VT-1, VT, VT+1, End) ANOVA on the FS data showed a significant main effect of group, F (2, 20) = 5.44, $P < 0.05$, $\eta^2 = 0.35$, and a significant main effect of time, F (2.28, 45.68) = 5.45, $P < 0.01$, $\eta^2 = 0.21$ (see **Figure 1a**). Overall, FS ratings in OB were significantly lower than those of both NW and OW. Furthermore, across all three groups, once the incremental protocol started (Stage 1), FS ratings gradually declined. At the last minute of the test, the average rating (0.96 ± 0.43) was significantly lower than at all previous time points.

A 3 by 6 ANOVA on the Felt Arousal Scale data showed only a significant main effect of time, F (2.88, 60.56) = 25.84, $P < 0.001$, $\eta^2 = 0.55$. Once the incremental protocol started, perceived activation increased gradually regardless of group. Each point-to-point increase was significant.

A 3 (BMI group) by 5 (Rest, End, Cool-down, Post-10, Post-20) ANOVA on the Energy data showed a significant main effect of time, F (4, 72) = 9.21, $P < 0.001$, $\eta^2 = 0.34$, and a significant group by time interaction, F (8, 72) = 2.27, $P < 0.05$, $\eta^2 = 0.20$. Although energy increased significantly in both NW and OW from Rest to immediately after the exercise test (followed by a gradual return to pre-exercise levels over the course of cooldown and the first 10 min of recovery), it showed no significant changes in the OB group (see **Figure 1b**).

A similar 3 by 5 ANOVA on the Tiredness data showed only a significant main effect of time, F (2.63, 47.26) = 7.36, $P < 0.001$, $\eta^2 = 0.29$. Regardless of group, Tiredness decreased significantly from Rest to immediately after the end of the exercise test and started increasing again by the 10th min of recovery. However, at the 20th min of recovery, Tiredness was still significantly below pre-exercise levels.

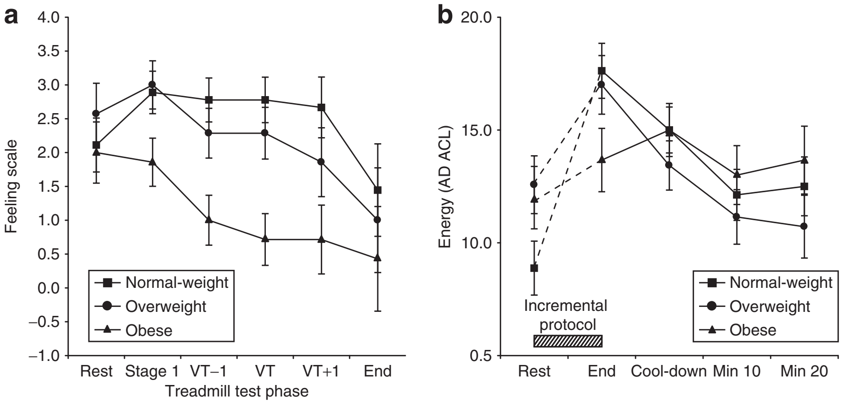

Figure 1 Responses on the (**a**) feeling scale and the (**b**) energy scale of the Activation Deactivation Adjective Check List (AD ACL) among normal-weight, overweight, and obese women.

A 3 by 5 ANOVA on the Tension data also showed only a significant main effect of time, F (3.32, 59.75) = 14.23, P < 0.001, η^2 = 0.44. Tension was slightly elevated, but not to a significant extent, from Rest to immediately after the exercise test. Thereafter, regardless of group, it dropped continuously (and significantly) over the course of the cooldown and the first 10th min of recovery. At the 20th min of recovery, Tension remained significantly below pre-exercise levels.

A 3 by 5 ANOVA on the Calmness data also showed only a significant main effect of time, F (4, 72) = 13.57, P < 0.001, η^2 = 0.44. Regardless of group, there was a significant decrease in Calmness from Rest to immediately after the end of the exercise test. This was followed by a significant rebound over the course of the cooldown and a further significant increase during the first 10 min of recovery. There was no significant difference between the levels of Calmness at Rest, the end of the cooldown, or min 10 and 20 of recovery.

Correlational analyses

A series of semipartial correlations were conducted to examine the relationships of FS ratings during the phases of the incremental treadmill protocol (at Stage 1, VT-1, VT, VT+1, and End) with (i) BMI, (ii) the scores on the SPAS, and (iii) the scores on the self-efficacy scale. The variance accounted for by FS at Rest was controlled.

BMI showed significant negative semipartial correlations with FS at VT-1 (r = −0.48, P < 0.05), VT (r = −0.54, P < 0.01), and VT+1 (r = −0.49, P < 0.05). Similarly, SPAS showed significant negative semipartial correlations with FS at VT (r = −0.48, P < 0.05) and VT+1 (r = −0.45, P < 0.05). Interestingly, neither BMI (r = −0.09) nor SPAS (r = −0.06) exhibited any relationship with FS at the beginning of the incremental protocol (Stage 1) and, although nonzero, neither relationship was strong enough to reach statistical significance at the end of the incremental protocol (for BMI: r = −0.36, P = 0.09; for SPAS: r = −0.40, P = 0.07). Self-efficacy exhibited consistently positive but weak semipartial correlations with FS from VT-1 to VT+1 (from r = 0.24 to 0.26), never reaching statistical significance.

Similar analyses were also performed for the scales of the AD ACL. Both BMI (r = −0.63, P < 0.001) and SPAS (r = −0.54, P < 0.01) showed significant negative semipartial correlations with Energy immediately upon the termination of the incremental protocol. Self-efficacy again showed no significant correlations.

DISCUSSION

The purpose of this study was twofold: (i) to compare the affective responses of NW, OW, and OB middle-aged sedentary women across the range of tolerable exercise intensity and (ii) to examine the relationships of affective responses to two constructs that rely heavily on cognitive appraisals, namely self-efficacy and social physique anxiety. The analyses of affective change indicated that, although the affective responses of OW women did not differ from those of NW women across any of the variables studied and any phase of the experimental protocol, the OB women exhibited a distinct pattern. Specifically, during the incremental protocol, NW and OW women showed a pattern of responses that was consistent with findings from younger and physically active samples, initiating a decline in pleasure ratings only once the VT had been exceeded (27). In contrast, the OB women showed a decline in pleasure ratings that started with the initiation of the incremental protocol and continued for the duration of the test. Although the BMI group by time interaction for FS ratings was not significant, the groups did not differ at rest or during the last minute of the exercise protocol (see **Figure 1a**). The significant group effect and the significantly lower overall FS ratings of the OB group compared to the NW and OW groups can be attributed to differences that emerged from Stage 1 to VT+1. This is important because this is a broad spectrum (from 47 to 78% VO_{2peak}) essentially covering the entire range of exercise intensity recommended for fitness, health, and weight management (1,9).

To the extent that these findings are found to be generalizable by future investigations, they seem to suggest that exercise practitioners should assume that OB, chronically sedentary, middle-aged women experience less pleasure than their NW and OW counterparts across the entire range of intensity likely to be employed in practice. Furthermore, these findings suggest that OB women might not experience the post-exercise surge in perceived energy that is known to be among the most robust effects of aerobic exercise bouts in the general population (28).

Collectively, these findings raise the possibility that affective responses might be at least one of the culprits behind the dramatically low rates of PA participation among OB adults. Although not yet a widely recognized determinant of exercise behavior, affect is viewed in psychology and behavioral economics as one of the major factors driving human decision-making. As noted in the Introduction, recent investigations have also provided preliminary support for the involvement of affect in exercise behavior and maintenance (14,15). Furthermore, these findings support the observation made earlier by others that OB individuals exhibit an increased sensitivity to elevations in the intensity of PA (11–13).

To put the challenge of exercise prescription in obesity into perspective, we should point out that the average value of VO_{2peak} attained by the OB women in our sample, most of whom (five out of seven) were classified as Class I and whose average age was <45 years, was 17.5 ml/kg/min. This is only one metabolic equivalent (1 MET, equal to 3.5 ml/kg/min) higher than the 14.0 ml/kg/min cutoff often considered the main risk stratification criterion for referring heart failure patients for cardiac transplantation (29). This level of VO_{2peak} is by no means atypical of OB middle-aged women. The average value reported by Hulens *et al.* (30) from a sample of 225 OB women (age: 40.2 ± 11.8 years; BMI: 38.1 ± 5.6 kg/m) was even lower, at 15.8 ± 3.8 ml/kg/min.

These figures underscore the difficulties faced by exercise practitioners working with chronically sedentary OB adults. An oxygen uptake reserve that does not exceed four metabolic equivalents does not allow much flexibility in selecting an exercise intensity. The OB women in the present sample, after walking at a speed of 2.5 mph (1.11 m/s) for 2 min (i.e., what was intended to be only the warm-up), had already reached 61% VO_{2peak}. Similarly, the 55 OB women tested by Mattsson *et al.* (13), who were more physically active and fit than the women in the present sample, reached 56.0% ± 15.3% VO_{2peak} after walking at a self-selected "comfortable" speed (2.65 mph, 1.18 m/s) for only 4 min. The difficulty of (i) maintaining intensity within the recommended range from 40 to 60% of oxygen uptake reserve, at least by using walking as the exercise modality, and (ii) continuing the activity for the 60–90 min recommended for weight management should be obvious.

As noted, ratings of pleasure exhibited a continuous decline among the OB participants across the entire range of the incremental protocol. Taking into account that a certain degree of physiological "drift" (i.e., gradual increase in physiological parameters over time, even if the workload remains constant) is inevitable, this could mean that reduced pleasure might be a constant part of the exercise experience for OB, chronically sedentary women. If so, it is possible that exercise will register in the memory of OB individuals as a negative stimulus to be avoided. Supporting evidence for this proposition comes from research on the concept of kinesiophobia, the fear and avoidance of PA (or movement, in general) among patients suffering from chronic pain or fatigue. The fearful expectation that exercise will induce pain or exacerbation of fatigue has been shown to relate to reduced PA participation (31,32). Pain (primarily from the back, hips, knees, and ankles) is a frequent complaint of OB individuals during exercise (13,33) and does not appear to be limited to walking (30).

The correlational analyses led to two main conclusions: (i) ratings of pleasure–displeasure during the incremental treadmill protocol were correlated with both BMI and social physique anxiety and (ii) both relationships were significant for most of the exercise intensity range but not when the intensity was low (i.e., Stage 1) or maximal (i.e., End). Social physique anxiety is a type of social anxiety and, as such, depends on a specific pattern of cognitive appraisal. Social anxiety is elicited when an individual is motivated to make a desired impression on other people but doubts that he or she will be able to successfully make such an impression. Social physique anxiety might act as a predisposition to experience worry and anxiety in exercise contexts in which an individual might perceive that his or her body is being critically evaluated. Although the impact of social physique anxiety on exercise behavior may decline with age (34), social physique anxiety remains prevalent among middle-aged women and could still influence their exercise behavior (35). The present study was the first to show that social physique anxiety is also negatively related to ratings of pleasure–displeasure during exercise.

The lack of a significant relationship between social physique anxiety and pleasure–displeasure at low and maximal exercise intensities is consistent with the postulates of the dual-mode theory (36). This theory predicts that cognitive appraisals may become important determinants of affective responses when the intensity presents a challenge but is not yet overwhelming. In the present study, walking at 2.5 mph (1.11 m/s, considerably less than the walking speed that OB middle-aged women find comfortable; 25,26) may have permitted the participants to maintain their composure and a relatively stable gait pattern. Overt signs of poor physical conditioning could probably be avoided. Thus, in this relatively innocuous situation, the likelihood that the participants would perceive that their physique was being negatively evaluated was probably low. However, as the intensity rose, overt signs of fatigue and discomfort might have become unavoidable and, therefore, the likelihood of the situation being perceived as posing an evaluative threat was probably increased. Finally, at the highest end of the intensity spectrum, the influence of social physique anxiety might have lost some of its salience as powerful interoceptive cues (e.g., respiratory or muscular sensations) probably became the primary determinants of affect. These possibilities are open to empirical examination in future research.

The fact that social physique anxiety was found to be significantly related to ratings of pleasure–displeasure during exercise suggests that interventions aimed at altering the cognitive antecedents of social physique anxiety or the environmental stimuli that trigger physique-related anxiety reactions might also benefit affective responses. Previous research has highlighted the influence of such factors as the placement of mirrors in exercise facilities (37) or whether the exercise leader places emphasis on health or appearance (38). Addressing these environmental factors, along with implementing cognitive interventions aimed at altering the underlying patterns of cognitive appraisal (i.e., the focus on impression management and the perception that others will make critical judgments), could narrow the gap in ratings of pleasure–displeasure between OB and nonobese women during exercise.

Self-efficacy, which was found to be unrelated to affective responses in the present investigation, has been found to be related to ratings of pleasure–displeasure during exercise in some studies (39) but not in others (40). This inconsistency may be related to whether participants have or have not been exposed to the theorized sources of self-efficacy information before self-efficacy is assessed. The women in the present sample (i) had no recent personal exercise experiences, (ii) had not observed a relevant model that could have provided vicarious experiences, (iii) had not received information relevant to their capabilities through consultation, and (iv) had not experienced relevant physiological or emotional cues. Therefore, their confidence in their ability to tolerate an exercise challenge was based on assumptions that might have been inaccurate or unrealistic. Thus, the absence of a relationship between self-efficacy and affective responses in the present study might not generalize to situations in which women have had recent experiences within the context of exercise.

In interpreting the results of the present study, researchers and practitioners should take into account its inherent limitations. First, the small size of the sample limits the generalizability of the findings. The replication of these findings with larger and more diverse samples of women and men is necessary before firm conclusions can be drawn. Second, treadmill exercise was selected for this study on the basis of the popularity of this mode in the adult population, including OW and OB individuals. However, nonweight-bearing activities that minimize impacts on the joints are also recommended for OW and OB individuals (9, p. 218). The extent to which the results reported here would also occur with other, nonweight-bearing modes of exercise is unknown and requires additional study. Third, the role of social physique anxiety and self-efficacy was explored via correlational analyses, which do not permit inferences about causation. Correlational data can perhaps suggest which variables are relevant in a given context but clear evidence of causation cannot be derived without experimental research (i.e., the manipulation of theorized causal antecedents of social physique anxiety and self-efficacy, and the examination of their impact on affective responses).

The data presented here suggest that OB individuals represent a highly challenging "special population" not only from a physiological and biomechanical perspective but also from a psychological one. Although OB individuals now make up >30% of the population in western societies, the unique challenges faced by this population in the context of exercise have not been adequately studied. Besides focusing on safety (i.e., injury avoidance) and effectiveness (i.e., maximization of energy expenditure), future investigations should also consider the subjective experience of exercise for OB individuals.

DISCLOSURE

The authors declared no conflict of interest.

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