Relations of Mood and Exercise With Weight Loss in Formerly Sedentary Obese Women

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**Objective:** To assess relations of mood changes, exercise, and weight loss among formerly sedentary obese women (N=76; Mean BMI=36.6) reporting weight loss goals. **Methods:** At baseline and month 6, participants completed the Profile of Mood States scales of depression, tension, and total mood disturbance and were assessed on attendance in exercise sessions and changes in weight. **Results:** Significant positive correlations were found between weight changes and each mood factor at baseline (r=.31 to .40) and changes from baseline to month 6 (r=.41 to .47). Multiple regression analyses suggested exercise attendance and mood changes significantly contributed to explained variances in weight changes (R^2=.22 to .28). **Conclusions:** Mood factors and incorporation of exercise may have implications for health behavior theory and weight loss treatments. **Key words:** weight loss, mood, exercise, physical activity, obesity treatment

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Approximately one third of the US adult population is obese (body mass index; BMI≥30 kg/m^2) and two-thirds are either overweight or obese (BMI≥25). Obesity is associated with increases in health risks such as cardiovascular disease, type 2 diabetes, and some forms of cancer, as well as personal dissatisfaction with one's physical appearance. Obese individuals also tend to have more anxiety, depression, and unfavorable overall moods than do their normal-weight counterparts. At any given time, approximately 75% of women and 47% of men report trying to lose weight. Maintaining weight loss behaviors such as reductions in caloric and fat intake and increases in physical activity has been problematic for those attempting to lose weight.

Relations of psychological factors with weight loss and maintenance are poorly understood. Although "emotional eating" is a commonly used term by both the lay public and health professionals, research on this phenomenon is sparse. Some research, however, does support the association of depression, anxiety, and overall low mood with relapse into high-fat and high-calorie eating. For example, studies have found associations between negative mood and both eating more over the short-term and poor weight loss outcomes over time, in obese women. Some theoretical support for the relations of mood and eating comes from tenets of behavioral learning theory. The proposition is that consumption of some (high-calorie and high-fat) foods may be paired with previous comforting experiences and thus may be prompted, especially when psychological distress occurs. Propositions have also been made that the chemical
properties of certain foods may be sought when there is an occurrence of unfavorable mood states.11

Although weight management treatments sometimes focus on reductions in caloric intake to the exclusion of exercise, many programs emphasize increased amounts of physical activity.12 Although exercise may benefit weight loss directly through energy expenditure, some researchers have proposed that maintaining a physical activity program may benefit mood, self-image, and a generalized sense of increased self-efficacy toward weight management.6 This premise is consistent with propositions within self-efficacy theory.13 Exercise has also been shown to be associated with improvements in moods.14,15 Some research suggests that only minimal amounts of cardiovascular exercise are required to improve reported depression and tension symptoms,16 and greater amounts may not necessarily be associated with greater effects.15 Other research, however, suggests an exercise dose-mood response effect.17,18

Regular physical activity is strongly associated with maintained weight loss.19,20 It is possible that a reciprocal, triadic relationship exists among mood, exercise, and weight changes. These relationships may be especially strong when individuals are using exercise along with dieting to reach weight loss goals. Given that personal successes and failures typically occur during the course of weight loss treatment, it is possible that predictions of weight loss outcomes should account for changes in mood and exercise patterns within this dynamic process. Texiera et al21 have suggested that assessment of psychological factors, when taken only prior to treatment initiation, may have limitations for predicting weight change.

Because of possible triadic relations among mood, exercise, and weight loss as suggested above and the possibility of obese women being particularly at risk for problems with weight management associated with mood,10 the present field investigation was conducted. The present study incorporated supported exercise and nutrition information with obese women. The following research questions were posed:

1. What was the extent and distribution of changes on the mood factors of tension, depression, and total mood disturbance over the initial 6 months?
2. Were scores on the mood factors at baseline significantly correlated with weight changes over 6 months?
3. Were changes on the mood factors significantly correlated with changes in weight and, if so, were they maintained when mood scores at baseline were controlled?
4. Was exercise session attendance significantly correlated with changes on the mood factors?
5. What portion of the variance in weight changes was accounted for by changes on the mood factors and exercise session attendance together?

It was expected that both initial mood and mood changes would be associated with weight changes, and exercise attendance would significantly add to the explained variance in weight changes. Because dose-response relations between exercise and mood have been unclear, no predictions were made of the association of exercise attendance with changes in mood. It was a goal to clarify associations of mood change, exercise, and weight loss so that behavioral models of weight management may be improved, and ultimately, weight loss interventions may benefit.

METHODS

Participants

Women volunteered to be a part of this investigation by responding to advertisements in local newspapers. Inclusion criteria consisted of (1) being between 21 and 65 years old, inclusive, (2) being obese (BMI≥30), (3) having no regular (more than one session per week of 20 min or more) exercise within the previous year, and (4) reporting a goal of weight loss. A written statement of adequate physical health to participate was required from a medical professional. Fulfillment of inclusion criteria was assessed through self-report, and weight and height were directly measured at an orientation meeting. Out of 83 respondents, 4 were excluded because of failure to return a written statement of adequate health to participate. Kaiser Permanente's institutional review board approved the project, and informed consent was obtained from all participants.

Participants agreed to complete required surveys, have their weight measured, and record exercise electronically.
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during the 6-month duration of the study,
and participate in a group-based nutri-
tional treatment for weight management.
Women with complete data sets at
baseline were retained. This excluded 3
women because of problems reading sur-
vey responses. In 6 cases, participants
who dropped out during the initial 12
weeks of the study could not be reached
for assessments at week 24. To minimize
biasing of results by excluding them, and
consistent with recent suggestions,22 cor-
responding scores at baseline were im-
polated for subsequent analyses. Thus, a
modified intention-to-treat design was
incorporated. The sample size was 76
with an age range of 23 to 59 years (M=45.4
yr, SD=10.1). BMI was 30.0 to 47.7 (M=36.6,
SD=4.3). Based on participants' self-re-
port, the group makeup was 58% white,
37% African American, and 5% of other
races. Based on available census data
derived from participants' self-reported
addresses, 84% were in the lower-middle
to middle classes. There was no control
group employed.

Measures
The depression and tension scales of
the Profile of Mood States - Short Form23
required responses to 5 one- to 3-word
items (eg, sad, discouraged and anxious,
easy, respectively) anchored by 0 (Not
at all) and 4 (Extremely). The possible
score range for each was 0 to 20. The total
mood disturbance scale (30 items) is an
aggregate measure of negative mood de-
derived by summing the Profile of Mood
States scales of depression, tension, fa-
tigue (eg, weary, exhausted), confusion
(eg, bewildered, confused), and anger (eg,
annoys, grouchy), and subtracting vigor
(eg, energetic, active). The possible score
range was -20 to 100. The factor structure
of the Profile of Mood States has been
consistent across well and psychiatric
patients. Concurrent validity was demon-
strated through contrasts with other valid
measures such as the Manifest Anxiety
Scale, the Beck Depression Inventory,
and the Minnesota Multiphasic Personal-
ity Inventory-2.23,24 Alpha coefficients
for the above scales were .87 to .95 and
test-retest reliabilities over 20 days were
.65 to .74.23 Alpha coefficients for the
present sample were .79 to .89.

Weight was measured (in m) using a
recently calibrated (Tanita® digital) scale.
Changes (mean difference scores) in mood
and weight were calculated by subtract-
ing the baseline score from the corre-
sponding score at week 24 for each par-
ticipant.

Measurement of attendance of exer-
cise sessions was consistent with previ-
ous research.24,25 Because participants
were assigned 3 cardiovascular exercise
sessions per week, attendance percent-
age was the ratio of sessions attended
divided by the "ideal" number of sessions
or 72 (24 weeks x 3 sessions per week). To
protect against high numbers of exercise
sessions completed in a single week (typi-
cally soon after program initiation) dis-
torting the measurement of attendance
over the full 24 weeks of the study, more
than 3 sessions completed in a week was
coded "3." This method was judged useful
for yielding a fair assessment of attend-
ance over the full length of the investi-
gation.24,25 Thus, the possible score range
was 0 to 100%. Sessions completed were
based on data collected from participants' 
logging of exercise completed into a com-
puter kiosk at an experimental facility or
through the Internet. The FitLinxx® com-
puter system was used to record and pro-
cess exercise-related data. Acceptability
of this method was indicated through
significant correlations (r-values=.42 to
.55) between exercise session attendance
and changes in cardiorespiratory func-
tion (eg, VO\textsubscript{2} max, blood pressure, resting
heart rate) in obese females.26

Procedure
Participants were given access to YMCA
wellness centers in the Atlanta, Georgia,
area. A series of 6 one-hour meetings
with a trained wellness professional,
spaced across 6 months, were provided to
each participant. These one-on-one ses-
sions included an orientation to available
exercise apparatus (eg, treadmills, sta-
tionary bicycles, rowing machines) and
administration of a cognitive-behavioral
treatment designed to support mainte-
nance of exercise. Goal setting and
progress feedback and other cognitive-
behavioral methods such as contracting,
stimulus control, cognitive restructur-
ing, and dissociation from exercise-in-
duced discomfort were presented.25 Three
exercise sessions per week were as-
signed. Cardiovascular exercise (eg, use
of treadmills and stationary bicycles, walk-
ing) progressed so that 30 minutes per
session at a moderate intensity (ie, 50 to
70% VO2 max) would be attained by the third month. Exercise sessions could be completed both inside and outside of the exercise facilities provided. Although attendants were present at the exercise facilities, sessions were not individually monitored. Computer kiosks were provided within wellness centers to record exercise completed. The Internet, to which all participants reported having easy access, was also available as a method for recording exercise. Participants were directed to enter data soon after completing exercise.

Participants were also provided 6 one-hour nutrition information sessions over the initial 12 weeks. These were taught by registered dietitians in a group format of approximately 15 participants and were based on a standardized protocol supported by a manual and workbook. Examples of curriculum components were (1) understanding calories, carbohydrates, protein, and fats; (2) calculating caloric needs for weight management; (3) developing a plan for low-fat, low-sugar snacking; and (5) planning menus. Mean number of nutrition information sessions attended was 4.1 (SD=1.1).

The Profile of Mood States was completed, and weight was assessed, in a private area at baseline and week 24.

**Data Analyses**

Initially, within-subject changes in depression, tension, total mood disturbance, and weight were assessed by dependent t-tests; and linear, bivariate correlations of baseline scores of mood and weight changes were derived. Statistical significance of score changes in depression, tension, and total mood disturbance, and changes in weight, were next determined both controlling for baseline scores and not controlling. Correlations between changes in each mood factor and exercise session attendance were then calculated. Change scores in depression, tension, and total mood disturbance, and exercise session attendance were then simultaneously entered into separate linear multiple regression equations (one equation for each of the 3 mood factors assessed) to estimate variances in weight change accounted for. Standardized beta weights of the predictor variables of weight change were calculated.

The alpha level was set at .05 (2-tailed) with the Bonferroni correction applied to adjust for multiple tests within analyses of each mood factor. This method reduced the alpha level to .01. Based on the sample size, a statistical power of .85 to detect a moderate effect for the multiple regression analyses was present. No adjustment was required for floor or ceiling effects on any variable. Because more than the 3 assigned sessions of exercise were completed less than .3 of 1% of the time, the present method of assessing exercise session attendance adequately accounted for physical activity dose—mood change response relationships. To clarify, "positive" associations occurred when changes in paired scores were in the same direction (e.g., as depression scores lowered, weight was reduced). A "negative" association was, therefore, the opposite of this (e.g., a reduction in tension scores related to a higher score in exercise session attendance).

**RESULTS**

Within-subject changes (mean difference scores from baseline to week 24) in weight were significant and approximated a normal distribution (Table 1). Exercise session attendance ranged from 21 to 100% (M=68.3%, SD=21.1).

Scores of depression, tension, and total mood disturbance at baseline were significantly, positively associated with changes in weight over 24 weeks (r=.40, .31, and .38, respectively; Ps<0.01). Within-subject decreases in scores of depression, tension, and total mood disturbance were significantly different from zero and, with the exception of score changes in tension for kurtosis, each approximated a normal distribution (Table 1). These changes were also significantly, positively associated with changes in weight (r=.42, .41, and .47, respectively; Ps<0.01). Controlling for corresponding scores of depression, tension, and total mood disturbance at baseline did not increase the strength of the positive correlations with changes in weight (r123=.21, .30, and .31, respectively).

Exercise session attendance was significantly, negatively correlated with changes in scores of tension (r=-.36, P=.001), but did not reach statistical significance for changes in depression (r=-.23) or total mood disturbance (r=-.27). When changes in scores on each mood...
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Table 1
Changes (Mean Difference Scores) and Distributions of Changes in Mood Scores and Weight (N=76)

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>M</th>
<th>SD</th>
<th>Skewness*</th>
<th>Kurtosisb</th>
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<tbody>
<tr>
<td>Depression</td>
<td>3.2</td>
<td>3.1</td>
<td>2.1</td>
<td>2.4</td>
<td>2.66*</td>
<td>-1.1</td>
<td>3.5</td>
<td>-.30</td>
<td>.44</td>
</tr>
<tr>
<td>Tension</td>
<td>4.6</td>
<td>3.0</td>
<td>3.1</td>
<td>2.4</td>
<td>3.79**</td>
<td>-1.6</td>
<td>3.6</td>
<td>.46</td>
<td>1.65</td>
</tr>
<tr>
<td>Total Mood Disturbance</td>
<td>12.5</td>
<td>11.1</td>
<td>3.2</td>
<td>3.1</td>
<td>4.70**</td>
<td>-9.3</td>
<td>17.3</td>
<td>-2.2</td>
<td>.13</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>98.3</td>
<td>14.3</td>
<td>92.6</td>
<td>14.2</td>
<td>7.43**</td>
<td>-5.7</td>
<td>6.7</td>
<td>-.20</td>
<td>-.50</td>
</tr>
</tbody>
</table>

Note.
a For skewness, SE=.28
b For kurtosis, SE=.55
* P<0.01 **P<0.001

factor and exercise session attendance were simultaneously entered into 3 separate multiple regression equations (one equation for each of the 3 mood factors assessed), significant (P-values<0.001) portions of the variance in weight change were accounted for (R²-values=.22, .25, and .28, respectively; Table 2). Analyses of standardized beta weights suggested that for each of the 3 regression equations both mood change and exercise session attendance uniquely contributed to the explained variance in weight change.

To initiate preliminary exploration based on participants' psychological makeup at baseline, post hoc analyses of participants who reached the criteria presently set for "negative mood" at baseline (defined as a score corresponding to ≥0.5 SD above the mean normative value for women on the Profile of Mood States scales of depression, tension, or total mood disturbance) were conducted. When results from the previous regression models (that incorporated all participants) were contrasted with findings from the same models incorporating only the participants with negative mood, the explained variance in weight change was similar with the inclusion of the predictor variables of exercise session attendance and depression change (N=28; R²=.15), tension change (N=24; R²=.26), and total mood disturbance change (N=23; R²=.18). Inconsistent with findings from the entire sample, where beta weights for changes in the 3 mood factors and exercise session attendance had significant unique contributions to the variance in weight changes, only beta weights for changes in scores of depression (β=.38, P=0.05), tension (β=.51, P=0.01), and total mood disturbance (β=.43, P=0.05) reached statistical significance —indicating their unique contribution to the overall variance in weight changes —indicating their unique contribution to the overall variance in weight changes —indicating their unique contribution to the overall variance in weight changes.

Exercise session attendance did not significantly contribute to the overall explained variance in any of the regression models (β=.12, .01, and -.01, respectively) for participants with negative mood, as it did in analyses of the entire sample (Table 2). These results should be interpreted with caution, however, because of the reduced statistical power of analyses of the subsample of women defined as having negative mood at baseline.

DISCUSSION

Within this field investigation, obese, formerly sedentary women enrolled in a supported program of moderate physical activity and nutrition education were tested on measures of mood, exercise...
Changes over 6 months in depression, tension, and total mood disturbance scores were also significantly correlated with weight changes, and explained 17 to 22% of the variance in weight changes. Controlling for initial scores on the mood factors did not strengthen the associations. The findings supported propositions that both individuals' initial mood profiles, and changes in moods, predict weight changes, particularly for obese women who may frequently be attempting to lose weight through modifying their diet and physical activity behaviors. Consistent with tenets of self-efficacy theory, findings supported the premise that improved mood and success with weight loss benefit one another.

Inclusion of exercise session attendance along with changes in depression, tension, and total mood disturbance into multiple regression equations increased the explained variances in weight loss to a substantial 22 to 28%. Although exercise attendance and changes in each mood factor both significantly contributed to the overall variances in weight change accounted for in the entire sample, when only women defined as having negative mood were assessed (approximately one third of the overall sample), exercise attendance did not significantly contribute to the strength of predictions of changes in weight. It is understandable that the properties of exercise involvement associated with mood improvement and energy expenditure could have an important role in accounting for weight changes in obese women. Possibly, however, for those with an unfavorable psychological

### Table 2

#### Simultaneous Multiple Regression Analyses for Weight Change (N=76)

<table>
<thead>
<tr>
<th>Model Variables</th>
<th>β</th>
<th>R</th>
<th>R²</th>
<th>F_{1,73}</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Depression* Attendance</td>
<td>.36</td>
<td>.50</td>
<td>.25</td>
<td>11.85</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>-.27</td>
<td>-.27</td>
<td>-.24</td>
<td>10.19</td>
<td>0.004</td>
</tr>
<tr>
<td>Δ Tension Attendance</td>
<td>.33</td>
<td>.47</td>
<td>.22</td>
<td>10.19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>-.24</td>
<td>-.24</td>
<td>-.24</td>
<td>13.87</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Δ Total Mood Disturbance Attendance</td>
<td>.40</td>
<td>.53</td>
<td>.28</td>
<td>13.87</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>-.24</td>
<td>-.24</td>
<td>-.24</td>
<td></td>
<td>0.02</td>
</tr>
</tbody>
</table>

Note.

* The delta symbol (Δ) indicates change in score from baseline to week 24.
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profile, exercise is a less salient variable. Future research will be needed to investigate this possible difference directly.

Although this study incorporated a single-group field design and did not follow up on maintenance of weight loss beyond 6 months, the preliminary findings on relations of mood, exercise, and weight loss were instructive. A more comprehensive evaluation of the proposed triadic relationship of mood, exercise, and weight loss is warranted, as are analyses of directionality of associations. Future research should better account for relationships between mood, exercise, and weight loss over both shorter (eg, monthly) and longer (eg, follow-ups every 6 months) periods. Recent research also suggests that differences in participants’ ethnic group should be better accounted for. Future research should better account for possible expectation and experimenter effects within treatments—possibly by incorporating a control group.

It is suggested that evidence-based behavioral methods be incorporated to support adherence to exercise regimens. These methods may also be important components of weight loss treatments. Because little is currently known about psychological factors’ relationship with weight loss, extension of the present research is needed. As better predictive models of weight loss are developed and validated, it is hoped that treatments may be revised to increase probabilities of long-term success with weight management for the many individuals in considerable need.

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REFERENCES
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