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ASSOCIATION BETWEEN CHANGE IN DEPRESSION AND CHANGE IN WEIGHT AMONG WOMEN ENROLLED IN WEIGHT LOSS TREATMENT

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Abstract

Objective—To examine the association between improvement in depression and loss of weight among women with depressive symptoms entering a behavioral weight loss program.

Methods—Women aged 40 to 65 with Body Mass Index (BMI) of 30 or more and co-occurring symptoms of depression were identified by a population-based survey. 203 of these women were enrolled in one of two behavioral treatment programs: one focused on weight loss and another on both weight loss and depression. Both programs included up to 26 group sessions over 12 months. Assessments at baseline, 6 months, 12 months, and 24 months included measurement of weight, depressive symptoms, self-reported physical activity, and estimated caloric intake (via food frequency questionnaire).

Results—Over the first six months, women with a decrease in depression score were more likely to lose 5kg or more than women without a significant decrease in depression (38% vs. 22%, Odds ratio = 2.20, 95% CI = 1.09 to 4.44). Over the same period, improvement in depression was associated with increase in physical activity but not with change in caloric intake. Change in depression and change in weight were not significantly associated over later intervals (between six and 12 months or between 12 and 24 months).

Conclusions—Among women with co-occurring obesity and depression, short-term improvement in depression is associated with weight loss.

Epidemiologic data generally support a cross-sectional association between obesity and depression. While some studies outside the US do not find such an association [1], US community surveys have typically found that Body Mass Index (BMI) of 30 or more is associated with a 50% to 150% increase in odds of depressive symptoms or depressive disorder [2–4].

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Longitudinal community studies show a more mixed picture regarding the association between obesity and depression. Depression in childhood is associated with development of obesity in adolescence [5] or early adulthood [6]. Conversely, obesity in adolescence is associated with depression in young adulthood [7]. Among adults, some longitudinal community studies have found that obesity predicts subsequent depression [8] and that depression predicts subsequent obesity [9] while other longitudinal studies do not support either of these relationships [1,10,11].

The longitudinal studies cited above, however, may not address the questions of greatest interest to clinicians. First, longitudinal community surveys typically address questions regarding between-person differences (Is an obese person more likely than a non-obese person to develop depression?). Clinicians may be more interested in questions regarding within-person change (Is a person who loses weight more likely to experience improvement in depression than a person who does not?). Second, clinicians are more often interested in how obesity and depression change together (or do not change together) over months rather than over years or decades.

Fewer data are available regarding how changes in depression and changes in weight do or do not correlate with each other over shorter periods of time. Participants in behavioral weight loss programs typically report improvements in mood [12–14], but improvements in mood may not be specifically correlated with weight loss [13]. In addition, previous trials of behavioral weight loss interventions have often excluded people with significant depressive symptoms. Follow-up studies of bariatric surgery patients consistently find that weight loss is associated with significant improvement in symptoms of depression [15–17]. In contrast, short-term studies of antidepressant treatment observe a range of weight changes, with some indications of differential effects between drugs [18,19]. These latter studies, of course, cannot distinguish between weight changes associated with improvement in depression and those associated with medication effects.

We examine here whether short-term changes in depressive symptoms are associated with change in weight among middle-aged women. We report secondary analyses from a randomized trial comparing two alternative group interventions among women with obesity and co-occurring symptoms of depression. We examine whether change in depression and change in weight are associated during active treatment, maintenance treatment, and the year following treatment. We also examine whether change in depression is associated with changes in caloric intake and physical activity.

METHODS

Data were drawn from a population-based study of two group therapy programs for women with co-occurring obesity and depression (one program focused on weight management and one addressing both weight management and depression). Methods are described in detail in previous publications [3] and are summarized here. The larger study was designed to examine associations between obesity and depression, to evaluate the effect of depression on success in weight loss treatment, and to compare the effectiveness of the two groups programs for women with obesity and symptoms of depression.

The study was conducted within the enrolled population of Group Health Cooperative, a prepaid health plan serving approximately 600,000 members in Washington and Idaho. Group Health serves members insured by employers, individual coverage, Medicare, Medicaid, and state-subsidized insurance for low-income residents. Members are demographically similar to the area population.

Participants were identified by a population-based screening program. Health plan records were used to identify women aged 40 to 65, over-sampling those for whom computerized medical records indicated a body mass index (BMI) of 30 kg/m² or more. Potential participants were contacted by telephone and asked to complete a telephone survey regarding weight, depression symptoms, diet, and physical activity. Depression was assessed using the PHQ-9, a well-validated depression screening scale suitable for use in general population and medical clinic samples [20–22]. Response rate for the telephone survey was 59%. Detailed data regarding survey methods and results have been published [3].

Women reporting a BMI of 30 and a PHQ depression score of 10 or greater were invited to an in-person baseline assessment to confirm eligibility for the treatment study described below. Of 285 invited, 68 declined. Of the 217 women attending the baseline interview, 11 were found ineligible (because BMI of 30 or more was not confirmed by measurement) and 3 declined to participate in the treatment study. The remaining 203 women were enrolled. Recruitment, intervention, and follow-up data collection are illustrated in Figure 1.

The baseline assessment included the following (along with other measures not described here):

- Direct measurement of weight (while wearing light street clothing, using a calibrated balance beam) and height (without shoes, using a wall-mounted stadiometer)
- A 20-item depression scale extracted from the Hopkins Symptom Checklist or SCL [23,24]. In previous research, this measure has shown good convergent validity with clinician-administered scales [25] and good sensitivity to change [26,27].
- A 13-item measure of physical activity developed by Jacobs assessing frequency (number of times each week) that respondents typically engaged in specific moderate physical activities (e.g. walking, bowling, household work) or vigorous physical activities (e.g. jogging, lap swimming, aerobic exercise classes) over the last year [28]
- A 65-item food frequency questionnaire based on the questionnaire originally developed by Block for the National Cancer Institute [29,30]. This measure may under-estimate overall intake, but should yield unbiased assessments of changes within individuals across time (as it is used here).

Women consenting to participate in the treatment study were randomly assigned to one of two group interventions, one focused on weight loss and the other addressing both weight loss and depression. In both programs, group sessions were scheduled weekly for 12 sessions, bi-weekly for 10 sessions, and monthly for 4 sessions (total of 26 sessions over 12 months). The groups were similar in structure but differed in content. Each session included collection of self-monitoring logs, review of homework assignments, didactic instruction, small-group discussion, and specific skills training and practice. Participants received written summaries of material covered in each treatment session.

The weight loss intervention was based on previous programs developed and tested by Jeffery and colleagues [31–34]. Participants were given daily caloric intake goals of 1200 kcal or 1500 kcal (depending on initial body weight) to produce weight loss of one to two pounds per week. Dietary goals limited fat intake to 20% of daily caloric intake. Physical activity goals were increased in bi-weekly increments of 500 kcal/wk until the goal of 2500 kcal/wk was reached. Participants were provided with structured meal plans and received specific skills training in environmental stimulus control (e.g., not having high calorie snacks in the home) and problem solving related to weight loss. The program included

cognitive and behavioral strategies to address dietary change and barriers to physical activity but it did not explicitly address depression.

The combined weight loss and depression intervention integrated the behavioral weight loss program described above with essential elements of cognitive-behavioral treatment (CBT) for depression, as drawn from the *Coping with Depression* manual [35]. Approximately 55% of didactic content in the combined program addressed treatment for depression, with the remaining 45% of the content addressing behavioral weight loss treatment. In addition to completing behavioral goal setting and self-monitoring tasks for weight loss as described above, participants in the combined groups set additional behavioral and cognitive change goals to improve depressive symptoms and completed regular mood self-monitoring assignments as part of their weekly diaries.

A previous publication [36] compares weight loss and depression outcomes for the two group treatments. Women in the two group programs did not differ in weight loss. Those assigned to the combined treatment experienced slightly, but no significantly greater improvement in depression.

All participants were invited to return for in-person follow-up assessments 6, 12, and 24 months after enrollment. Each follow-up assessment included weight measurement (while wearing light street clothing, using a calibrated balance beam) and repeat administration of each of the measures described above (SCL depression scale, food frequency questionnaire, and physical activity questionnaire). The rate of participation in research assessments was 83% at six months, 71% at 12 months, and 67% at 24 months. Those participating and not participating in the 6-month follow-up assessment did not differ significantly in mean age or baseline measures of depression severity, caloric intake, or physical activity.

All study procedures were reviewed and approved by the Group Health Cooperative Human Subjects Review Committee. Participants assigned to either treatment were free to pursue other treatments for obesity or depression (including psychotherapy or antidepressant medication). If study staff detected suicidal ideation or severe depression during group sessions and research assessments, participants were referred to specialty mental health services for assessment and treatment.

Data analyses examined the association between change in depression and change in other variables (weight, estimated caloric intake, and physical activity score) for each of the three follow-up intervals (baseline to 6 months, 6 months to 12 months, and 12 months to 24 months). Analyses included all women with available data for each interval, regardless of treatment group assignment or degree of treatment group participation. For statistical models, change in SCL depression score was categorized as increased (i.e. increased by more than 0.5 points), unchanged (i.e. change of 0.5 points or less in either direction), or decreased (i.e. decreased by more than 0.5 points). In this sample, a change in SCL score of 0.5 is equivalent to a change of approximately 0.8 standard deviations. For each dependent variable (change in weight, change in estimated caloric intake, or change in physical activity score), a linear model was used to compare change in the dependent variable across the three levels of SCL depression score change. Change in depression severity was modeled as a 3-level indicator (increase of 0.5 or more vs. no change vs. decrease of 0.5 or more). The p-value for each model is based on an F statistic examining heterogeneity in change scores for the dependent variable across the three levels of depression change (e.g. Is variation in weight change across the three levels of depression change greater than expected by chance). Each linear model included adjustment for baseline SCL depression score, treatment group assignment, and number of treatment group sessions attended. Additional analyses considered weight loss as a categorical outcome (did or did not lose at least 5% of

baseline body weight) and compared odds of significant weight loss between those who did or did not experience a decrease in depression score of 5% or greater.

RESULTS

The 203 women included in these analyses had a mean age of 50.1 yrs (st. dev. 6.1) and a mean BMI of 38.3 (st. dev. 7.1). At the baseline assessment, 13 (6%) had SCL depression scores less than 1.0, 104 (51%) had SCL depression scores between 1.0 and 2.0, and 86 (43%) had SCL depression scores of 2.0 or higher.

Table 1 illustrates change in each of the study measures over 24 months of follow-up. Mean depression score declined significantly over six months, but remained relatively stable for the remainder of the follow-up period. Average weight decreased between the baseline and 6-month assessments and did not change significantly thereafter. By 6 months (the point of greatest average weight loss), 31% of participants lost more than 5 percent of body weight (including 12% who lost more than 10 percent). Mean reported caloric intake declined significantly over six months and remained stable thereafter. Mean physical activity score increased over six months and then declined – but not back to baseline levels. Approximately 78% used antidepressant medication at any time during the follow-up period, and approximately 58% used antidepressant medication for at least 90 days.

Figure 2 displays the relationship between change in SCL depression score and change in weight based on the linear model described above. Change in depression score during each interval (Baseline to 6 months, 6 to 12 months, 12 to 24 months) was classified as increased by more than 0.5 points, unchanged (i.e. did not change by more than 0.5 points), or decreased by more than 0.5 points. The figure displays adjusted mean values with 95% confidence limits. At each time point, the relationship between change in depression score and change in weight is in the predicted direction; those with a greater decrease in depression show either more weight loss or less weight regain. But this association is only statistically significant for the period from baseline to 6 months. The decreasing sample size over time ($n=169$ for the baseline to six-month interval decreasing to $n=136$ for the twelve-month to 24-month interval) reflects the smaller number of participants participating in blinded outcome assessments over time. In addition, the proportion of participants with a change in depression score (either increase or decrease) was lower at later assessments.

As an alternative presentation of the association between change in weight and change in depression, we examined the proportion of women losing at least 5% of weight over six months, a customary threshold for significant weight loss [37]. Among women with a decrease in depression score of at least 0.5 points, 38% had a significant weight loss by this measure. This compares to 21% with significant weight loss among women with no change or increase in SCL depression score (Odds ratio = 2.20, 95% confidence interval 1.09 to 4.44).

Given that the association between change in weight and change in depression score was only significant for the interval between the baseline and six-month assessment, our analyses of potential intervening or explanatory factors (caloric intake and physical activity) were limited to this period. Figure 3 displays the relationship between change in SCL depression score and change in reported caloric intake. No consistent pattern is apparent, and the mean caloric intake does not vary significantly among the three groups. Figure 4 displays the relationship between change in depression score and change in physical activity score. This relationship is in the expected direction (decreased depression associated with increased physical activity) and is statistically significant.

DISCUSSION

In this sample of middle-aged women entering a weight loss program, we observed that weight loss during the first six months of treatment was strongly associated with decrease in symptoms of depression. Over the first six months of treatment, decrease in depression was also associated with increase in physical activity, but not with change in reported caloric intake. After six months, associations between change in depression and change in weight were not significant.

While the associations between change in weight and change depression during the later follow-up periods were in the expected direction (Figure 1), these associations were well within the range expected by chance. Two explanations for this observation seem plausible, one methodologic and one substantive. First, change in depression was greatest during this first interval, and smaller changes in subsequent intervals may not have shown enough variability to observe associations. In other words, statistical power to detect associations was less in later intervals when change in depression was smaller. Second, change in depression may have a stronger association with success in weight loss than with subsequent weight re-gain.

We should acknowledge some limitations of these data. Our sample was limited to middle-aged women, all of whom entered treatment with a BMI of 30 or more. All participants had significant symptoms of depression, and most had moderate to severe depression. Our findings may not apply to men, to older or younger women, to non-obese women, or to those without significant depression.

Observing an association between change in depression and change in weight does not imply that any causal relationship flows in one direction or the other. Our findings are consistent with a conclusion that improvement in depression leads to greater weight loss or that greater weight loss leads to improvement in depression or that the two are mutually reinforcing. The observed early association between decreased depression and increased physical activity also does not imply a causal direction. It is equally plausible that decreasing depression contributes to increased physical activity leading to weight loss or that increasing physical activity contributes to both weight loss and improvement in depression.

Our findings do add to a large literature documenting cross-sectional and longitudinal associations between obesity and depression. In cross-sectional community studies obesity is associated with an approximate doubling of the risk of depressive symptoms or depressive disorder [2–4]. In longitudinal community studies, obesity is associated with subsequent development of depression [8], and depression is associated with subsequent development of obesity [9]. And in shorter-term studies of patients entering undergoing surgical treatment of obesity, weight loss is associated with reduction of depressive symptoms [15–17]. Here we observe a similar association between weight loss and improvement in depression among women entering behavioral treatment for obesity.

CONCLUSIONS

Among women with co-occurring obesity and depression, short-term improvement in depression is associated with weight loss. This association is clearest early in weight loss treatment.

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Figure 1.
Study recruitment flow diagram.

Figure 2.
Change in weight according to change in SCL depression score for women enrolled in group treatment

Figure 2. Change in estimated caloric intake according to change in depression score for interval between baseline and 6-month assessments.

Figure 3. Change in physical activity score according to change in depression score for interval between baseline and 6-month assessments.

Table 1

Mean (st. dev.) for each time point

	Baseline Pre- Treatment (n=203)	6 months Mid- Treatment (n=169)	12 months End of Treatment (n=144)	24 months After Treatment (n=136)
SCL Depression Score	1.86 (0.60)	1.34 (0.67)	1.21 (0.67)	1.15 (0.66)
Weight in kg	105 (20)	105 (20)	102 (21)	102 (20)
Est. Caloric Intake	2242 (923)	1669 (789)	1654 (731)	1756 (711)
Physical Activity Score	627 (778)	967 (1423)	799 (916)	813 (1017)