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Internet-delivered obesity treatment improves symptoms of and risk for depression

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Abstract

Objective—In-person lifestyle interventions for obesity treatment yield significant improvements in depression. These improvements may be attributed to the excellent weight losses produced by in-person interventions. In contrast, Internet programs yield more modest weight losses, and their effect on depression is unknown. This study is the first to examine whether Internet-delivered obesity treatment impacts depressive symptoms.

Methods—Participants (N=136) were randomized to either a community campaign PLUS Internet behavioral weight loss (IBWL) or community campaign alone (Control). IBWL did not include online social support components. A measure of depressive symptoms was administered and weight was objectively assessed.

Results—Of the total sample, 24% met the clinical cut-off for elevated depression risk at baseline. IBWL participants lost more weight during treatment (p=.005) and experienced significantly greater improvements in depressive symptoms (p=.02). Among participants who met the clinical cut-off for elevated risk for depression at baseline, those assigned to IBWL had greater improvements in depressive symptoms during treatment compared to Controls (p=.033). Consequently, at post-treatment, a smaller percentage of IBWL participants were at elevated risk for depression.

Conclusions—This study is the first to show that Internet-delivered obesity treatment improves depression risk and depressive symptoms in individuals with overweight or obesity.

Keywords

Depression; Internet; Weight Loss; Obesity Treatment

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Introduction

Depression is associated with body mass index (BMI) and with treatment outcomes in face-to-face lifestyle interventions.(1, 2) Individuals entering obesity treatment with depression are less likely to complete treatment.(2-4) However, if they complete treatment, they tend to achieve weight losses similar to those without depression.(2, 4) Moreover, lifestyle interventions have been shown to yield significant reductions in depressed mood.(2, 5)

Previous studies examining the impact of lifestyle interventions for obesity treatment on depression have focused solely on in-person intervention. In the Look AHEAD trial, in-person lifestyle obesity treatment was compared to an education control.(2) Results showed that in-person treatment yielded greater improvements in depression and greater weight loss.(2) Two other trials recruited individuals with a diagnosis of depression, randomized them to either behavioral weight loss treatment alone or behavioral weight loss treatment plus depression treatment.(6, 7) In both trials, results showed that adding depression treatment to weight loss treatment did not improve weight loss outcomes. Depression results were mixed; one trial showed significantly greater improvements in depression among participants who received weight loss PLUS depression treatment, whereas the other trial showed no effect of adding depression treatment to weight loss treatment. All of these studies have involved in-person lifestyle interventions for obesity treatment. To our knowledge, no previous study has examined whether *Internet-based* lifestyle interventions for obesity improves depression. Given that Internet interventions often yield less weight loss (8, 9) it is possible that these interventions have limited effect on depression.

This study is the first to examine whether Internet-delivered weight loss treatment impacts depressive symptoms in individuals with overweight or obesity and how those with elevated risk for depression at baseline fare during treatment. Data are from a randomized trial that tested whether adding an Internet behavioral weight loss program to a community campaign improves weight loss outcomes in individuals with overweight or obesity. Results showed that the Internet behavioral weight loss program plus community campaign significantly enhanced weight loss outcomes compared to the community campaign alone.(10) Using data from the trial, we examined the impact of the Internet behavioral weight loss treatment on symptoms of and risk for depression. In addition to examining overall symptoms of depression, we also examined specific symptom clusters including somatic symptoms (e.g., lack of energy), interpersonal symptoms (e.g., isolation), and affective symptoms (e.g., sadness). The analysis of depression subcomponents was included to provide clues for future studies as to potential mechanisms by which weight loss impacts mood. Our hypothesis was that baseline depressive symptoms would be associated with higher attrition during treatment.(3-5) We also explored whether the Internet behavioral weight loss program yields greater improvements in depressive symptoms and symptom clusters (somatic, interpersonal, affective) compared to the community campaign alone, and examined how those with elevated risk for clinical depression at baseline fared during treatment.

Methods

Design

Data reported herein were collected during a randomized trial that examined whether the addition of an Internet behavioral weight loss program to Shape Up Rhode Island, an annual statewide wellness campaign, improves weight loss outcomes in individuals with overweight or obesity.(10) Study exclusion criteria were age < 18 or >70, BMI < 25kg/m^2, current participation in another weight loss program, a health condition that would make changes to diet or exercise unsafe (e.g., pregnancy, uncontrolled heart condition), unreliable Internet access, or planned relocation during the study period. For detailed exclusion criteria, please see the primary outcome paper.(10) All participants in this secondary data analysis were randomized to either the Internet behavioral weight loss program plus the community initiative (IBWL) or the community initiative alone (Control) using a 2:1 randomization scheme. Both programs were 3 months in length. Assessments were conducted at baseline and post-treatment. As part of the community program, all participants received a pedometer, access to an online platform to report physical activity, free attendance at community workshops focused on healthy eating and physical activity, and prizes for meeting weight and activity goals. Participants in IBWL also received access to an Internet behavioral weight loss program based on the Diabetes Prevention Program.(11) The IBWL program included an online platform where participants received weight loss, calorie, and physical activity goals; 12 weekly multimedia lessons focused on behavioral weight loss strategies (strategies to reduce calories and increase physical activity including goal setting, problem solving, cognitive restructuring, and relapse prevention); and a self-monitoring platform where participants reported their weight, calorie, and activity information and received automated, tailored feedback each week. IBWL did not include any social support components; there was no platform for participant-participant or participant-staff communication. Instead, all Internet intervention aspects were completely automated. Results from the main trial have been published; IBWL yielded significantly better weight losses than Control.(10) All methods were approved by the Miriam Hospital's Institutional Review Board.

Measures

All measures were completed at baseline and post-treatment (month 3) unless noted otherwise. All assessments took place at the research center and were conducted by trained research staff.

Demographics—At baseline, participants reported basic demographic information including sex, age, race, and ethnicity.

Weight and Height—Weight was measured to the nearest 0.1kg using a digital scale. Height was measured at baseline using a stadiometer. Body mass index (BMI) was calculated using the formula: weight in kg/height in $meters^2$.

Depression—Depression was measured using the Center for Epidemiologic Studies Depression Scale (CES-D).(12) The CES-D is a 20 item measure that assesses frequency of

depression symptoms in the past week (0=Rarely or none of the time; 3=most or almost all of the time). Scores range from 0 to 60 with higher scores indicative of greater risk for depression. A score of 16 or greater on the CES-D is indicative of elevated risk for clinical depression; this cut-off has demonstrated excellent sensitivity and specificity.(13) In addition to the overall score, the CES-D yields four subscales: depressed affect (e.g., “I felt sad”), positive affect (e.g., “I enjoyed life”) somatic (e.g., “I felt that everything I did was an effort”), and interpersonal (e.g., “People disliked me”).(14) The CES-D has been used extensively in a variety of studies and has demonstrated high levels of reliability and validity in community samples.(12, 13)

Statistical Analyses

Baseline group differences were examined using t-tests or chi-square tests for continuous or categorical variables, respectively. A chi-square was used to examine whether attrition differed between those who met the clinical cut-off for elevated risk for depression at baseline (CES-D score≥16) vs. those who did not. Relationships between baseline BMI and symptoms of depression were examined using a simple correlation. To determine whether IBWL and Control differed on weight change and change in symptoms of depression from pre- to post-treatment, ANCOVAs were conducted. Education differed between the two arms; thus, in all between group comparisons, it was included as a covariate. Percentage of participants in IBWL vs. Control who met the clinical cut-off for elevated risk for depression (CES-D score≥16) at post-treatment was compared using logistic regression.

Results

Baseline characteristics

A total of N=136 were randomized to IBWL or Control. Out of the entire sample, 24% met the clinical cut-off for elevated risk for clinical depression (CESD≥16) at baseline. Ninety-two percent (N=125) of participants completed all measures at baseline and post-treatment. Attrition rates did not differ between those who met the cut-off for depression risk at baseline (3% attrition) and those who did not (10% attrition, p=.22). Overall baseline symptoms of depression and depression subscales were not associated with baseline BMI (Overall score: r=.04, p=.62; Depressed affect: r=-.02, p=.86; Positive affect: r=.11, p=.24; Somatic: r=.08, p=.35; Interpersonal: r=-.07, p=.44). IBWL and Control participants who completed treatment did not differ on overall baseline symptoms of depression (10.9±7.4 vs. 10.3±7.2, p=.64), depression subscales (p’s>.15, see Table 1), percentage of participants meeting the clinical cut-off for depression risk (26.5% vs. 23.8%), or any other baseline characteristics with the exception of education; 74.7% of IBWL participants were college graduates compared to 42.9% of Control participants (p=.001). Thus, education was included as a covariate in between group analyses. See Table 1 for detailed participant characteristics.

Depression and weight loss

As reported previously,(10) IBWL participants lost significantly more weight during treatment (IBWL: 4.1±4.4%, Control: 1.6±4.4%, p=.005). IBWL participants also experienced significantly greater improvements in overall symptoms of depression (p=.02;

Figure 1). Specifically, participants in IBWL experienced a statistically significant decrease in overall symptoms of depression from pre- to post-treatment (10.8±7.4 to 7.8±6.7, p=.0002) whereas Control participants experienced no change (10.3±7.2 to 10.9±9.2, p=.64). In terms of subscales, IBWL participants experienced a significantly greater decrease in depressed affect and somatic symptom subscales relative to Control (p's<.05). See Table 2. Moreover, among the subgroup of participants who met the cut-off for elevated risk for depression at baseline, those randomized to IBWL had significantly greater improvements in depressive symptoms during treatment compared to Control (-8.5±2.0 vs. -2.5±2.9, p=.033) and had significantly greater reductions in depressed affect and somatic symptoms (p's≤.05). Finally, a significantly higher percentage of IBWL participants no longer met the cut-off for elevated depression risk at post-treatment (66.7%) compared to Controls (30.0%, p=.049).

Discussion

This is the first study to examine whether Internet-delivered obesity treatment improves symptoms of and risk for depression in individuals with overweight or obesity. Results showed that an Internet behavioral weight loss treatment yielded clinically meaningful weight losses, produced significant improvements in symptoms of depression, and reduced risk for clinical depression. Moreover, the Internet program produced significantly greater improvements in depressive symptoms compared to a control condition focused on healthy eating and physical activity. Subgroup analyses showed that, among participants who met the cut-off for risk for clinical depression at baseline, those assigned to Internet weight loss treatment had significantly greater improvements in symptoms of depression and better weight loss outcomes. Consequently, at post-treatment, a smaller percentage of Internet behavioral weight loss participants were at elevated risk for clinical depression.

This is the first study to examine whether Internet-based weight loss treatment improves depressed mood in individuals with overweight or obesity. Results are consistent with those from in-person studies.(2, 4) The Internet behavioral weight loss treatment yielded significant improvements in symptoms of depression, both in the entire sample and in the subsample of individuals who met the clinical cut-off for elevated depression risk at baseline. Specifically, 67% of participants in IBWL who met the cut-off at baseline no longer met the cut-off at post-treatment. This result is consistent with previous studies showing that among those with depression at baseline, 40-60% had non-clinical or full remission of depression at post-treatment.(6, 7) However, it's important to note that these studies differed in how they measured depression (e.g., CESD, BDI-II, SCL-20), thus, these comparisons must be interpreted with caution.

Whereas in-person interventions involve larger magnitudes of weight loss (e.g., 7-10% of initial body weight),(15) this Internet-delivered treatment produced modest weight loss outcomes (4%) yet still yielded significantly greater improvements in depressive symptoms relative to the control group. These results suggest that modest weight losses alone are sufficient to yield meaningful improvements in symptoms of depression. Subscale analyses from the depression measure elucidate some potential mechanisms by which Internet treatment improves mood in individuals with overweight or obesity; results showed that the Internet program produced significant improvements in both depressed mood and somatic

symptoms. Given that items on these subscales reflect feeling sad and lack of energy, respectively, it is possible that weight loss and associated improvements in health,(16) body image,(17) and perhaps physical activity (18) may mediate the effects of weight loss on reduction in depressive symptoms. Participants may have also applied some of the cognitive-behavioral strategies presented in the multimedia lessons (problem solving, cognitive restructuring) to their symptoms of depression. Additional research is needed to further understand the mechanisms by which Internet weight loss programs improve symptoms of and risk for depression in individuals with overweight or obesity.

Some of these results are inconsistent with previous findings. Unlike earlier studies,(2-4) we found no link between depressive symptoms and attrition. Trial retention efforts (e.g., assessment appointment scheduling and reminders from well-trained, interpersonally skilled staff (10)) may explain the discrepancy. These results also suggest that perhaps depressive symptoms should not be a focus of participant selection for obesity treatment trials. In addition, we found no correlation between baseline BMI and symptoms of depression. This lack of significant association may be due to restriction of range; all participants in this trial had a baseline BMI $\geq 25 kg/m^2$, which may have statistically attenuated our ability to detect an effect.

This study has some limitations and several strengths. The sample was predominately female and non-Hispanic white. Thus, additional research is needed to determine how Internet weight loss treatment impacts depression in men and racially and ethnically diverse populations with overweight or obesity. Also, the two interventions differed on several dimensions making it unclear as to which components of the weight loss intervention yielded the significantly greater improvements in symptoms of depression. Finally, the mechanisms (e.g., improvements in health, body image, and physical activity) by which weight loss impacts mood were not assessed in this trial and should be explored in future studies. This study has several strengths. The methodology was rigorous and included a randomized design, a reliable and valid measure of depressive symptoms was used, weight was objectively assessed, and retention was excellent. Moreover, this is the first study to show that Internet behavioral weight loss treatment significantly improves symptoms of depression and risk for depression in individuals with overweight or obesity.

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Study Important Questions

- In-person behavioral weight loss interventions for obesity have been shown to significantly improve depression. However, to date, no studies have examined the effects of Internet-delivered weight loss treatment on depression.
- This is the first study to show that Internet-based weight loss treatment yields significant improvements in symptoms of depression and risk for depression in individuals with overweight or obesity.

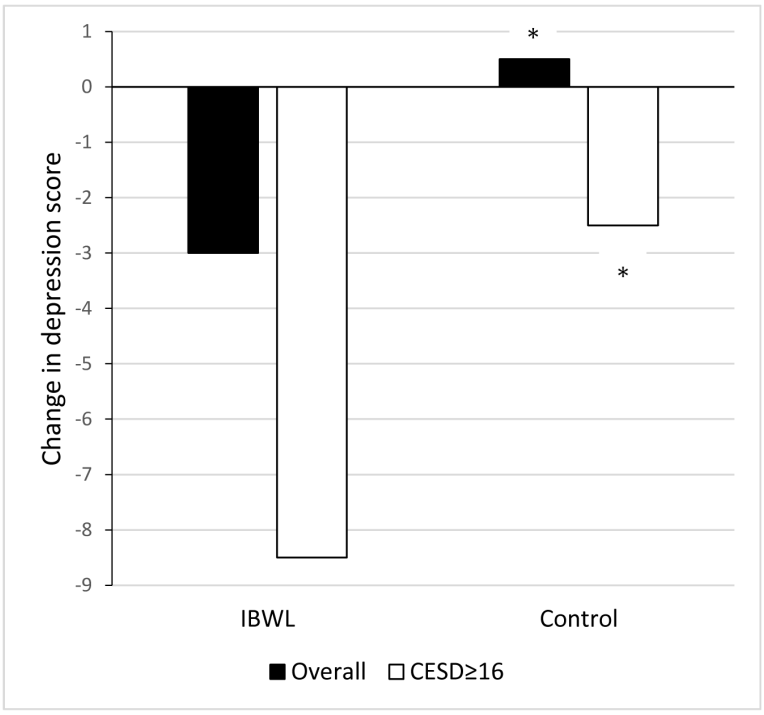

Figure 1.

Changes in depressive symptoms in IBWL vs. control from baseline to post treatment in all participants (overall; N=125) and in the subgroup of participants who met the clinical cut-off for elevated risk for depression at baseline (i.e., CESD≥16; N=32).

* indicates statistically significant ($p<.05$) differences between IBWL and Control.

Table 1

Baseline participant characteristics.

	Overall (N=125)	IBWL (n=83)	Control (n=42)	p-value
Sex (% Female)	81.6	80.7	83.3	.72
Age (M±SD)	46.9±11.5	46.4±12.0	47.8±10.5	.54
Race/ethnicity (% Non-Hispanic White)	90.4	90.4	90.5	.98
Education (% College Grad)	64.0	74.7	42.9	<.001
Baseline BMI (M±SD)	34.9±7.3	34.8±6.4	35.1±8.8	.80
Baseline total CES-D depression score (M±SD)	10.7±7.4	10.9±7.4	10.3±7.2	.64
Baseline % depression score ≥ 16*	25.6	26.5	23.8	.74
Baseline CES-D subscales (M±SD)				
Depressed affect	2.9±3.1	2.9±3.2	2.8±3.1	.91
Positive affect	2.2±2.3	2.2±2.2	2.1±2.5	.78
Somatic	5.0±3.1	5.1±3.1	4.9±3.0	.74
Interpersonal	0.7±1.0	0.8±1.1	0.5±0.8	.15

*CES-D scores ≥ 16 are indicative of high risk for clinical depression

Table 2

Changes in depression from pre- to post-treatment.

	IBWL	Control	p-value
Total sample			
Change in total CES-D depression score (M±SD)	−3.0±6.9	+0.6±7.8	.04
Change in CES-D subscales scores (M±SD)			
Depressed affect	−1.1±3.2	+0.3±2.9	.004
Positive affect	−0.5±2.3	−0.05±2.4	.29
Somatic	−1.0±3.1	+0.4±3.6	.04
Interpersonal	−0.4±1.1	−0.1±0.7	.64
Subsample of those with baseline score ≥16*			
Change in total CES-D depression score (M±SD)	−8.7±5.7	−2.2±7.9	.03
Change in CES-D sub scale scores (M±SD)			
Depressed affect	−3.4±4.5	−0.6±3.9	.03
Positive affect	−1.9±2.6	−1.5±1.8	.68
Somatic	−2.5±4.1	+0.5±4.9	.05
Interpersonal	−0.9±1.0	−0.6±1.0	.68

* CES-D scores ≥ 16 are indicative of high risk for clinical depression