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RESEARCH ARTICLE

Does an Effective Theoretically Based Weight Loss Treatment for Middle-Aged Women Work for Young Women?

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ABSTRACT

Background: Young adults gain weight faster and suffer from chronic diseases at a younger age than their older counterparts. Existing behavioral obesity treatments included few young adults, and their effects on young adults remain unknown. **Purpose**: The purpose of this study was to explore whether a behavioral treatment that was effective in weight loss for mostly middle-aged women would be effective for young women. **Methods**: One hundred eleven female undergraduates with obesity recruited from a large public university in the Southeastern United States in 2014–2016 received treatment, including 6 individual exercise support sessions over 6 months and 20 biweekly group nutrition sessions. Measurements include weight, waist circumference, physical activity, diet, mood, and exercise- and eating-related self-regulation and self-efficacy at baseline and at months 3 and 6. **Results**: Attrition was 65.8% at month 3 and 87.4% at month 6. Paired *t* tests show significant reductions in weight and significant improvements in weight loss–related behaviors and psychological variables at month 3. More average weight was lost at month 6. **Discussion**: Despite high attrition, the treatment demonstrated some positive effects for the young college women who continued attending sessions. **Translation to Health Education Practice**: Health Educators should explore reasons for attrition among college students with obesity and develop treatment components to help them lose excess weight.

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Background

The prevalence of obesity among U.S. adults has increased from 13.3% in 1960–1962[1] to 37.7% in 2013–2014.[2] There is considerable evidence that obesity has increased the risk for many chronic diseases, including coronary heart disease, dyslipidemia, hypertension, type 2 diabetes, sleep apnea and respiratory problems, osteoarthritis, gallbladder disease, and certain cancers, and is associated with the deaths from cardiovascular diseases and from all causes.[3] In efforts to stop or slow down the increasing weight among U.S. adults, there have been numerous weight loss programs, among which behavioral weight loss programs that focus on diet and/or exercise behaviors are considered most effective treatments for individuals with obesity.[4]

Though numerous behavioral weight loss programs have been developed for adults with obesity, young adults, especially those aged 25 years and younger, have not been well represented in such trials. Gokee-LaRose et al[5] analyzed data pooled from 3 National Institutes of Health–funded trials and found that less than 1% of the participants were aged 25 years and younger and 7% were aged 35 years and younger. In addition, participants 35 years and younger attended significantly fewer treatment sessions and were significantly more likely to dropout, with a reported 75% lost to follow-up by 6 months. Similar phenomena were also observed by other researchers. For example, in one behavioral obesity treatment that intentionally recruited young adults,[6] 25- to 35-year-olds represented only 25% of the participants and had a significantly higher dropout rates than older participants (73.6% vs 65.2%, $P < .05$) at month 12. In another study,[7] adults aged 25 years and younger represented 4% of the sample, and 67% of them dropped out of the 12-week low-intensity weight loss program.

The problem of very low participation in weight loss research programs by young adults with obesity is further complicated by the fact that young adults are gaining weight at a much faster pace than their parents.[8] For example, obesity rates among youth aged 12–19 have increased nearly 5 times from 4.6% in 1960s[9] to 20.5% in 2013–2014,[2] whereas adult obesity prevalence increased at about half of that pace during the same time period.[9] The average weight gain from the age of 18 to the age of 35 is between 1 and 2 pounds per year and is often more for individuals with high baseline body mass index (BMI).[6] In addition, an increasing number of young people with

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obesity have been diagnosed with many chronic diseases, such as coronary atherosclerosis, hypertension, and type 2 diabetes, that were only seen in adults in the past and are in more aggressive forms.[6,10-12]

Therefore, there is a critical need to have effective weight loss programs specifically designed for young adults. Due to a lack of effective weight loss programs for young adults,[5-7,13] the present study was designed to test the effect of an innovative year-long behavioral weight loss program for women that has sound theoretical foundation and produced better weight loss and weight loss maintenance results than other existing programs[14] among young women with obesity. The treatment utilized within this research is uniquely different from other protocols. It uses exercise support methods emanating from Social Cognitive Theory and self-efficacy theory as a means to develop specific self-regulatory skills (eg, cognitive restructuring, stimulus control). After 2 months of rehearsing and refining those skills in an exercise context, participants start to learn and practice how to adapt and transfer the learned skills to maintaining healthier eating behaviors.[14,15] Unlike most weight loss treatments that attempt to educate individuals on the benefits of physical activity and healthy eating and expecting sustained changes to follow,[16–18] participants are empowered with behavioral skills to counter day-to-day barriers such as slow progress and social and time pressures to eat in an unhealthy manner. Thus, rather than the typical use of exercise to burn calories, it leverages physical activity to increase self-regulation and foster self-efficacy related to one's ability to counter barriers and succeed at eating behavior changes.[14,15] In contrast to the bases of the present intervention model, other researchers have suggested that exercise should be delayed and/or used cautiously for fear that individuals would not have sufficient psychological skills, such as self-regulation, to maintain exercise and healthy eating at the same time.[19]

Annesi and colleagues successfully tested the use of exercise to develop and transfer weight loss–related psychological skills to controlled and healthy eating among women.[14,15,20] Their results suggest that such a program is more effective than state-of-the-art theory-based educational approaches such as the LEARN (lifestyle, exercise, attitudes, relationships, nutrition) Program for Weight Management[21] and Oxford cognitive behavior therapy[19,22] for long-term weight loss results among middle-aged women with obesity.[14,15]

Purpose

The purpose of the study was to explore whether a behavioral treatment that was effective in weight loss for mostly middle-aged women with obesity would be effective for young women with obesity. Though the behavioral weight loss program tested in the present study had an attrition rate of 8%[15] and 14%[14] when used among mostly middle-aged women with obesity, research is needed that would provide attrition and other outcome information when the program is implemented with young women with the same degrees of obesity. The research questions included whether an effective behavioral weight loss program for adult women with obesity would produce similar weight loss results among 18- to 25-year-old college women with obesity and whether the loss to follow-up would be similar between the 2 population groups.

Methods

Design and sample

Due to its exploratory nature, this study employed a nonexperimental time-series study design that was approved by the Institutional Review Board in the university where the researchers are employed. Between May 2014 and May 2016, 111 female students enrolled in a large public university in the Southeastern United States were recruited via campus student e-mail system, digital ads displayed on television monitors throughout campus, and printed flyers posted across campus. The recruitment ad included the purpose of the study, inclusion criteria, and contact information for students who are interested. The study population was female students enrolled in a large public university who meet the study requirements. Inclusion criteria included female students aged 18–25 years with a goal of weight loss, BMI ≥ 30 < 40 kg/m^2, and not physically active (<20 min/week in the past 12 months). Exclusion criteria included being pregnant or planning to be pregnant, current use of medications for weight loss or a psychological/psychiatric condition, and current participation in any weight loss programs. All participants provided written consent at the time of enrollment in the study. There were no financial costs or incentives for participation.

Independent t and χ^2 tests indicated that there were no significant differences ($P > .10$) between participants who completed the month 3 ($n = 38$) measurements and those who did not ($n = 73$) on age (mean = 20.9 years, SD ±2.0, range 18–25), ethnicity (30.9% white, 58.2% African American, 8% Hispanic, and 2.7% other), and self-reported annual household income (35.9% < $25 000, 26.2% $25 000–$50 000, 26.2% $50 000–$99 000, and 10.7% ≥ $100 000).

Intervention

The intervention included an individual exercise support treatment, The Coach Approach protocol,[23] to

improve exercise adherence followed by a small group nutrition treatment to support healthy eating about 2 months later. The Coach Approach used standardized cognitive–behavioral methods and has been accepted into the Research-tested Intervention Programs of the National Cancer Institute.[24] Based on Social Cognitive Theory which suggests that individuals regulate their personal behaviors through self-organization and self-reflection,[25] and self-efficacy theory that views individuals' feelings of ability as driving their behaviors,[26] The Coach Approach has produced desirable results in improving exercise adherence in formerly sedentary adults and adults with obesity.[27] The nutrition treatment is designed to help participants develop and practice self-regulation and self-efficacy skills to overcome barriers to proper eating and to improve mood to manage emotional eating. It includes 2 biweekly 30-min individual sessions focusing on food and calorie tracking, 10 biweekly 60-min small group sessions focusing on active weight loss, and 10 biweekly 45-min small group sessions focusing on weight loss maintenance. All small groups included 8–15 participants.

Exercise adherence treatment

The Coach Approach is delivered by a wellness specialist with the assistance of a dedicated computer program. It consists of 6 45-min individual sessions over 6 months in a private office. During the initial meeting, the participant worked with a wellness specialist to develop an exercise plan based on her chosen type of physical activity and tolerance. Self-regulatory skills such as goal setting and behavioral contracting were also discussed and practiced. In each of the subsequent meetings, the wellness specialist helped the participant to modify her exercise plan; develop new short-term goals as needed; develop and practice other self-regulatory skills such as stimulus control, cognitive restructuring, dissociation from discomfort, progress monitoring, controlling behavioral prompts and triggers, and relapse prevention; and use The Coach Approach computer program to view her progress toward her long-term goal(s) through monitoring the status of each short-term exercise goal and the exercise-induced mood changes such as anxiety, depression, and energy levels. Studies of The Coach Approach administered in 53 wellness centers throughout North America and the European Union indicated 40%–50% reductions in exercise dropout and a mean increase in exercise session attendance of 52% over a control condition of usual care.[28,29] In women with obesity, there was a 58% increase in exercise session attendance, with a moderate–large effect size of $d = 0.67$.[27] A comprehensive review of effects of The Coach Approach is available elsewhere.[30]

Nutrition treatment

After about 2 months of The Coach Approach treatment that focused on maintaining the newly developed regular exercise routine, each participant met with a wellness specialist to learn and practice food and calorie tracking in a private office. In the second individual meeting 2 weeks later, the wellness specialist and the participant went over the tracking results, set a daily calorie goal of 1200 kcal/day or higher according to her weight, and identified the foods she should eat more and the foods she should avoid while emphasizing the benefits of increasing fruit and vegetable intake and harmful effects of consuming too much added sugar and too many calories.

After the second individual session on food/calorie tracking and basic nutrition information, participants started the active weight loss phase where they attended 10 biweekly 60-min group sessions that focused on adapting the self-regulation and self-efficacy skills acquired from exercise to controlled eating. For example, the learned feelings of ability to overcome barriers to exercise and recovery from missed exercise session were used to overcome barriers to healthy eating and recovery from eating excessive amount of food/calories. The last 10 biweekly 45-min group sessions focused on applying the learned self-regulatory and self-efficacy skills to maintaining the lost weight while continuing to lose additional weight. All group sessions included brief lectures, individual tasks, and group interactive activities to help participants transfer and practice the self-regulatory and self-efficacy skills acquired from exercise to nutrition context. Facilitated by a wellness specialist during each group session, participants shared and practiced tips and strategies of increasing fruit and vegetable intake, reducing sweets and high-calorie food intake, overcoming barriers to inappropriate eating and overeating, recovering from setbacks, developing and practicing social support and thought restructuring, and other self-regulatory skills in proper eating.

Approximately 10% of treatment sessions were randomly selected to receive fidelity checks based on a standardized form. The fidelity check form included items addressing treatment content (eg, "Goal setting and monitoring progress was framed as an ongoing process"), interactions (eg, "The group was engaged and everyone participated"), and logistics (eg, "The required time frames for program components were maintained") and were scored using a Likert-type format. A score below 85% received attention from study staff. Fidelity checks did not reveal major violations of the treatment protocol. Minor violations typically included failing to maintain the assigned time within a particular curriculum component. The wellness specialists administering the treatment were notified of such violations and corrections were easily handled.

Data collection and analyses

Measures

This study used self-report measures of physical activity level based on weekly energy expenditure (ie, metabolic equivalent of tasks, METs), healthy eating practice based on daily intake of fruits and vegetables and other foods, mood, exercise self-regulation and self-efficacy practice, and controlled eating self-regulation and self-efficacy levels. Body weight, height, and waist circumference were measured after heavy clothing (eg, jackets, shoes) was removed, using a recently calibrated digital stadiometer and tape measure at the narrowest part of the torso (above the umbilicus and below the xiphoid process). A brief description of each measure is provided below.

Physical activity was measured using the Godin-Shephard Leisure-Time Physical Activity Questionnaire,[31] which incorporates METs, which represent the energy costs associated with levels of physical activity intensities (eg, 1 MET equals roughly the use of 3.5 ml of O_2/kg/min).[32] Participants record the number of weekly sessions of strenuous (approximately 9 METs such as running), moderate (around 5 METs such as fast walking), and light (roughly 3 METs such as easy walking) physical exertion for "more than 15 min" each session. The 2-week test–retest reliability is 0.74.[33] Construct validity was established through strong correlations with accelerometer and peak volume of oxygen uptake measurements.[34,35]

Food intake was measured using a self-report survey[36] that measures foods and beverages a person consumed in a typical day in the previous 7 days. Participants are given examples and serving sizes of foods that correspond to the U.S. Department of Agriculture's MyPlate and its former Food Guide Pyramid.[37] Examples used include a small or 4-ounce can of apple, banana, and peach; 2 ounces of raisins and dates; 4 ounces of 100% fruit juice; 4 ounces of vegetables such as carrots, green beans, broccoli, and tomatoes; 8 ounces of leafy vegetables such as raw spinach and kale; and others. The 3-week test–retest reliabilities ranged from 0.77 to 0.83 for women.[38] The scale is validated against comprehensive food frequency questionnaires[39] where previous research indicated strong correlations ($r = 0.70–0.85$) with the full-length Block Food Frequency Questionnaire.[38,39]

Self-regulation for exercise (SR-exercise) and self-regulation for controlled eating (SR-eating) were assessed using a 10-item SR-exercise scale (eg, "I set physical activity goals") and SR-eating scale (eg, "I choose healthy foods that are enjoyable to me") adapted from a previously validated scale.[40,41] Internal reliability coefficients (Cronbach's α) were .83 and .80, respectively,[14] and .73 and .90, respectively, for the present sample.

Self-efficacy for exercise (SE-exercise) was assessed using the Exercise Self-Efficacy Scale.[42] The scale starts with "I am confident I can participate in regular exercise when, …" and ends with 5 possible barriers to exercise such as "I don't have time" and "The weather is bad." Responses ranged from 1 = *not at all confident* to 7 = *very confident* and are summed. A higher level of self-efficacy is indicated by a higher score. Internal consistency coefficients (Cronbach's α) were .80[14] and .78 for the present sample.

Self-efficacy for controlled eating (SE-eating) was assessed using the Weight Efficacy Lifestyle Scale.[43] The 20-item scale includes 5 4-item subscales measuring beliefs of own ability to control eating during each of the following situations: food availability (eg, "I can resist eating even when I am at a party"), negative emotions (eg, "I can resist eating when I am angry [irritable]"), physical discomfort (eg, "I can resist eating when I am very tired"), social pressure (eg, "I can resist eating even when others are pressuring me to eat"), and positive activities (eg, "I can resist eating when I am happy"). Responses range from 0 for *not confident* to 9 for *very confident* and are summed. A higher level of self-efficacy is represented by a higher score. Internal consistency coefficients (Cronbach's α) ranged from .74 to .81[14] and .70 to .84 across its subscales for the present sample.

Overall mood (mood) was measured using the Profile of Mood States Short Form of Total Mood Disturbance.[44] It includes 30 items (5 items per factor) assessing feelings during the previous week on anger (eg, "angry"), confusion (eg, "forgetful"), depression (eg, "gloomy"), fatigue (eg, "sluggish"), tension/anxiety (eg, "uneasy"), and vigor (eg, "lively"). Responses range from 0 for *not at all* to 4 for *extremely* and are summed after the score for vigor is reversed. A better mood is indicated by a lower score. Internal consistency coefficients (Cronbach's α) were .79–.89[14] and .71–.87 across subscales for the present sample.

Data collection

All measures were planned to be obtained at baseline and months 3, 6, 12, and 24. Despite multiple reminder e-mails, phone calls, and text messages, many participants failed to attend the group sessions that were scheduled based on their reported availability. Among the 111 participants, 38 completed the month 3 measurements (65.8% attrition) and only 14 completed month 6 measurements (87.4% attrition), leading to early study termination after month 6. Data from baseline, month 3, and month 6 were compared and reported below. In addition to high attrition, 51.7% of the participants

completed half of the individual exercise support sessions, and only 20% attended at least 5 group nutrition sessions, with an overwhelmingly large majority of the participants missing 5 or more group nutrition sessions.

Data analysis

Data were analyzed using SPSS Ver 24 (IBM Corp., Armonk, NY). Statistical significance level was set at alpha = .05 (1-tailed) based on previous research that demonstrated clear directionalities in changes of the present measures.[20] The Bonferroni correction was applied where appropriate. Chi-square tests and independent *t* tests were used to compare whether participants who completed the month 3 measurements differed significantly from those who did not at baseline. Among those who completed the month 3 and 6 measurements, paired *t* tests, with each using only cases that have valid data for all pairs of tested variables, were used to compare the changes in physical activity level, food intake, self-regulation and self-efficacy for exercise and for eating, mood, body weight, and waist circumference between baseline and month 3 and between baseline and month 6. Follow-up *t* tests examined whether between-group differences and within-group changes showed significant improvements with a Bonferroni correction applied separately to each category of measures based on the number of corresponding scales used. Specifically, the significance level for measures of body weight and waist circumference, physical activity, eating behaviors, psychological factors, and mood was set at $P \leq .025$ (.05/2), .05, .008 (.05/6), .0125 (.05/4), and .008 (.05/6), respectively. For the independent and dependent *t* tests, effect sizes were expressed as Cohen's *d* ($[M_{group2} - M_{group1}]/SD_{pooled}$) and ($[M_{Time2} - M_{Time1}]/SD_{baseline}$),[45] respectively, where 0.20, 0.50, and 0.80 represent small, moderate, and large effects, respectively.

Results

There were no statistically significant differences ($P \geq .10$) between participants who completed the month 3 ($n = 38$) measurements and those who did not ($n = 73$) on any of the weight loss–related behaviors and psychological variables. Attrition was 65.8% at month 3 and 87.4% at month 6.

Changes from baseline to month 3

Weight, waist circumference, and physical activity

From baseline to month 3 (Table 1), there was a mean 5.2 pound reduction in body weight (2.44%; mean lbs = 212.69 vs 207.5, $P = .013$, $d = 0.17$) and a significant decrease in waist circumference (mean inches = 38.37 vs 37.51, $P = .001$, $d = 0.27$). During the same time period, there were significant increases in weekly physical activity outputs (mean METs/week = 15.83 vs 34.86, $P < .0001$, $d = 1.68$). Though the effect size was small to moderate for change in waist

Table 1. Paired *t* test comparing the means between baseline and month 3 ($N = 38$).

	Mean ± SD Baseline	Mean ± SD Month 3	*t*	*P*	*d*
Changes in weight and waist circumference					
Body weight (lb)	212.69 ± 30.20	207.5 ± 27.83	−2.345	**.013**	0.17
Waist circumference (in)	38.37 ± 3.21	37.51 ± 3.23	−3.319	**.001**	0.27
Change in physical activity	15.83 ± 11.30	34.86 ± 16.44	6.946	**<.001**	1.68
Changes in eating behaviors					
Fruits	1.46 ± 1.05	2.32 ± 1.51	3.353	**.001**	0.82
Vegetables	1.40 ± 0.92	2.54 ± 1.82	4.862	**<.001**	1.24
Sweets	2.32 ± 1.76	1.05 ± 0.90	−4.410	**<.001**	0.72
Starchy foods: Bread, cereal, rice, pastas	3.54 ± 1.77	2.62 ± 1.71	−3.189	**.002**	0.52
Meat, poultry, fish, beans, eggs, nuts	3.21 ± 2.08	2.95 ± 1.11	−0.713	.240	0.13
Dairy foods: Milk, yogurt, cheese	1.96 ± 1.38	1.67 ± 0.85	−1.272	.106	0.21
Changes in psychological factors					
SR-exercise	22.87 ± 5.76	30.78 ± 5.17	7.401	**<.001**	1.38
SR-eating	22.24 ± 4.80	29.89 ± 4.91	7.689	**<.001**	1.59
SE-exercise	29.32 ± 7.87	26.03 ± 9.87	−1.688	.050	−0.42
SE-eating	98.51 ± 29.73	123.73 ± 27.35	5.973	**<.001**	0.85
Changes in mood					
Mood: Anger	4.68 ± 3.96	3.11 ± 3.547	−1.968	.029	0.40
Mood: Confused	7.82 ± 3.93	6.24 ± 2.936	−2.655	**.006**	0.40
Mood: Depression	6.00 ± 3.8203	3.84 ± 3.789	−2.780	**.004**	0.56
Mood: Fatigue	9.18 ± 5.146	5.82 ± 4.876	−3.399	**.001**	0.65
Mood: Tension	5.93 ± 4.18	3.37 ± 3.56	−3.717	**<.001**	0.61
Mood: Vigor	6.32 ± 3.89	9.74 ± 4.665	4.302	**<.001**	0.88

Note: Bonferroni correction was applied separately to each category of measures based on the number of corresponding scales used. Specifically, significance levels for measures of body weight and waist circumference, physical activity, eating behaviors, psychological factors, and mood were set at $P \leq .025$ (.05/2), .05, .008 (.05/6), .0125 (.05/4), and .008 (.05/6), respectively. Bonferroni-adjusted significance levels are presented in bold type. There were unusable data for 1 participant in weight and psychological measures. Cohen's $d = (M_{Month3} - M_{baseline})/SD_{baseline}$.

circumference, a large effect size was found for increased physical activity (Table 1).

Eating behaviors

While the daily intake of fruits and vegetables increased from baseline to month 3 (mean servings = 1.46 vs 2.32, $P = .001$, $d = 0.82$ and 1.40 vs 2.54, $P < .001$ $d = 1.24$), daily intake of sweets and starchy foods such as bread, cereal, rice, and pastas decreased (mean servings = 2.32 vs 1.05, $P < .001$, $d = 0.72$, and 3.54 vs 2.61, $P = .002$, $d = 0.52$). Though large effect sizes were found for increased fruit and vegetable intake, moderate to large effect sizes were found for decreased daily intake of sweets and starchy foods such as bread, cereal, rice, and pastas (Table 1).

Psychological variables

For weight loss–related psychological variables between baseline to month 3, there were significant increases in self-regulation for exercise and self-regulation for controlled eating (mean scores = 22.87 vs 30.78, $P < .001$, $d = 1.38$, and 22.24 vs 29.90, $P < .001$, $d = 1.59$). Though the increase in self-efficacy for exercise had a significance level of $P = .05$, self-efficacy for controlled eating was increased significantly (mean score = 98.514 vs 123.73, $P < .001$, $d = 0.85$) from baseline to month 3. Large effect sizes were found for increased self-regulation for exercise, self-regulation for controlled eating, and self-efficacy for controlled eating (Table 1).

Mood

When compared with the baseline status, participants reported significant improvement in their moods at month 3. Specifically, participants reported significantly lower level of anger (means = 4.684 vs 3.11, $P < .029$, $d = 0.40$); confusion, depression, fatigue (7.916 vs 6.24, $P = .006$, $d = 0.40$; 6.00 vs 3.84, $P = .004$, $d = 0.56$; 9.18 vs 5.82, $P = .001$, $d = 0.65$); and tension (means = 5.86 vs 3.59, $P < .001$, $d = 0.61$) while feeling significantly more vigor (means = 6.32 vs 9.74, $P < .001$, $d = 0.88$). Though small to moderate effect sizes were found for decreased anger and confusion, moderate to large effect sizes were found for decreased depression, fatigue, and tension. The effect size for increased vigor was large (Table 1).

Changes from baseline to month 6

Weight, waist circumference, and physical activity

As shown in Table 2, participants who completed the month 6 measurements had a significant loss of 12.43 pounds of weight (−5.7%) on average (mean lbs = 218.29 vs 205.86, $P = .001$, $d = 0.33$), along with a significant reduction in waist circumference and BMI (means = 37.94 vs 35.58, $P = .001$, $d = 0.70$, and 35.26 vs 33.15, $P < .001$, $d = 0.42$), when compared with their baseline measurements. From baseline to month 6, a significant increase in weekly physical activity outputs was observed (mean METs/week = 18.71 vs 37.14, $P = .001$, $d = 1.32$). Though there were small to moderate effect sizes for reduction in weight and BMI, we found a moderate to large effect size

Table 2. Paired *t* test comparing the means between baseline and month 6 ($N = 14$).

	Baseline	Month 6			
	Mean ± SD	Mean ± SD	*t*	*p*	*d*
Changes in weight and waist circumference					
Body Weight (lb.)	218.29 ± 38.13	205.86 ± 38.50	−4.004	**0.001**	0.33
Waist Circumference (in.)	37.94 ± 3.38	35.58 ± 3.23	−3.887	**0.001**	0.70
Changes in Physical Activity	18.71 ± 13.99	37.14 ± 16.30	3.912	**0.001**	1.32
Changes in eating behaviors					
Fruits	1.71 ± 1.20	2.79 ± 1.358	2.077	0.029	0.89
Vegetables	1.61 ± 1.04	2.82 ± 1.64	2.880	**0.006**	1.17
Sweets	2.75 ± 2.42	1.43 ± 1.43	−1.642	0.062	0.55
Bread, Cereal, Rice, Pastas group	4.14 ± 1.88	2.82 ± 1.48	−2.173	0.025	0.70
Meat, Poultry, Fish, Beans, Eggs, Nuts	3.18 ± 1.30	2.96 ± 0.97	−0.520	0.306	0.17
Milk, Yogurt, and Cheese group	2.29 ± 1.59	2.00 ± 1.22	−0.622	0.272	0.18
Changes in psychological factors					
Self-Regulation: Exercise	25.57 ± 6.71	32.07 ± 5.11	5.101	**<0.001**	0.97
Self-Regulation: Eating	24.07 ± 5.58	31.71 ± 4.83	7.198	**<0.001**	1.37
Self-Efficacy: Exercise	30.21 ± 5.29	26.21 ± 13.03	−1.052	**<0.001**	−0.76
Self-Efficacy: Eating	84.50 ± 24.65	140.64 ± 24.97	7.241	**<0.001**	2.28
Changes in mood					
Mood: Anger	5.21 ± 4.58	1.71 ± 2.05	−2.504	0.013	0.76
Mood: Confused	8.07 ± 4.51	6.07 ± 2.34	−1.667	0.060	0.44
Mood: Depression	5.79 ± 3.51	3.38 ± 3.25	−2.223	0.023	0.75
Mood: Fatigue	8.50 ± 4.72	4.43 ± 5.68	−2.072	0.030	0.86
Mood: Tension	5.643 ± 3.565	1.93 ± 3.05	−2.691	0.009	1.04
Mood: Vigor	8.29 ± 4.322	12.57 ± 5.65	3.052	**0.005**	0.99

[a]Bonferroni correction was applied separately to each category of measures based on the number of corresponding scales used. Specifically, significance levels for measures of body weight and waist circumference, physical activity, eating behaviors, psychological factors, and mood were set at $P \leq .025$ (.05/2), .05, .008 (.05/6), .0125 (.05/4), and .008 (.05/6), respectively. Bonferroni-adjusted significance levels are presented in bold type. There were unusable data for 1 participant in the waist circumference measure. Cohen's $d = (M_{Month6} - M_{baseline})/SD_{baseline}$.

for waist circumference decrease and a large effect size for increased physical activity.

Eating behaviors

From baseline to month 6, there were significant increases in daily fruit and vegetable intake (mean servings = 1.71 vs 2.79, $P = .029$, $d = 0.89$, and 1.40 vs 2.33, $P = .006$, $d = 1.17$) and decreased intake of starchy foods (mean servings = 4.14 vs 2.82, $P = .025$, $d = 0.70$). Though there is a moderate to large effect size for decreased starchy food intake, the effect size for daily fruit and vegetable intake was large (Table 2).

Self-regulation and self-efficacy

Significant increases in self-regulation for exercise and self-regulation for controlled eating were also observed at month 6 (means = 25.57 vs 32.07, $P < .001$, $d = 0.97$, and 24.07 vs 31.71, $P < .001$, $d = 1.37$). Though self-efficacy for exercise did not change significantly, self-efficacy for controlled eating was increased significantly (means = 84.50 vs 140.64, $P < .001$, $d = 2.28$) at month 6. Large effect sizes were found for increased self-regulation for exercise, self-regulation for controlled eating, and self-efficacy for controlled eating (Table 2).

Mood

When compared with baseline scores, participants reported significant improvement in their moods at month 6. Specifically, participants reported significantly lower levels of anger and depression (mean scores = 5.21 vs 1.71, $P = .013$, $d = 0.76$, and 5.79 vs 3.38, $P = .023$, $d = 0.75$) while feeling significantly less tension and more vigor (means = 5.64 vs 1.93, $P = .009$, $d = 1.04$, and 8.46 vs 13.54, $P = .005$, $d = 0.99$). Though there is a small to moderate effect size for lower level of confusion, we found moderate to large effect sizes for anger and depression and large effect sizes for increased vigor and decreased fatigue (Table 2).

Discussion

Results from this study suggest that the behavioral weight loss treatment that has produced positive results of weight loss and weight loss maintenance among mostly middle age women in community settings[14,15] could be effective in improving weight loss–related behaviors and reducing weight for young women aged 18–25 years with obesity in a college setting if the young women could remain in the program and attend treatment sessions. Although the majority of the participants dropped out within the first 3 months, no statistically significant differences existed on any baseline measures or demographic characteristics between those who completed the first 3 months of the program and those who discontinued. Although statistically speaking, results obtained at month 3 could be generalized to all participants because all participants were similar at baseline, such an assumption has no practical implication. The fact that the majority of the participants discontinued their participation in the study indicates that there are participant differences that need to be identified in future studies. Since only 14 participants completed the month 6 measurements, comparing the results of weight loss and changes in weight loss–related behaviors should be very cautious and an intention-to-treat analysis might have yielded substantially different results. Therefore, no conclusions should be drawn based on the 6-month results. A follow-up study has been designed to explore the reasons for high attrition among young adults with obesity enrolled in behavioral obesity treatment, which will help develop effective programs to prevent attrition for that group.

Participants lost an average of 5.2 pounds (−2.4%) of weight by month 3, which is statistically significant. Similar to the findings reported by Annesi et al,[14,15] the present study found significant improvements by month 3 in key weight loss–related behaviors, including physical activity, fruit and vegetable intake, and sweet intake; and weight loss-related psychological variables including mood, self-regulation for exercise and for controlled eating, and self-efficacy for controlled eating. Because the research literature shows that regular exercise, increased fruits and vegetables intake, and reduced sweet intake are associated weight loss[46-49] and that improved mood, self-regulation for exercise and for controlled eating, and self-efficacy for controlled eating predict successful weight loss,[14,46] the significant improvement in those behaviors observed at month 3 in the present study indicates that the effect of continued weight loss could be achieved by month 6, which is the time marked as the end of weight loss phase.[19] In fact, the few participants who did complete the month 6 measurements in the present study achieved an average 5.7% loss of the baseline weight (12.43 lbs, or 5.64 kg.), which is comparable to that reported by Annesi et al.[14,15] and Cooper et al.[19] It is unfortunate that the extremely high attrition prevented this study from confirming the weight loss effect by month 6 and testing the effect of the weight loss maintenance component of the behavioral weight loss treatment by Annesi et al.[14,15] Nevertheless, because treatment session attendance has been shown to relate to greater weight loss[50] and young adults who completed programs often lost more weight than other age groups in the same programs,[6] it could be assumed that if participants could remain throughout the program and attend more treatment sessions, the behavioral

weight loss program being tested in the present study[14,15] might be just as effective for young females with obesity as it is for mostly middle-aged women with obesity in reducing weight and maintaining the lost weight.

Although the present research was designed to explore whether a behavioral treatment that was effective in obtaining and maintaining >6% loss of weight in mostly middle-aged women[14,15] would be effective for young women with obesity, the original research purpose was not fully achieved. The results presented in this report highlight the challenges of high attrition in behavioral treatment for young adults with obesity. Without fully understanding the unique characteristics and challenges faced by young adults with obesity, weight loss programs may not be able to retain young adults with obesity. The very high attrition at month 6 and poor treatment session attendance that occurred in the present study are significantly higher than those reported in previous research that included adults age 35 years old and younger.[5,6] It is possible that younger adults between 18 and 25 years old are more likely to drop out of behavioral weight loss studies than 26- to 35-year-old adults. It is also possible that college students have unique and not yet identified characteristics that make them differ from the general population. The 18- to 25-year-old participants belong to the emerging adulthood age group, the age group first identified by Arnett.[51] According to Arnett, emerging adults experience significant life transitions such as leaving the parental home, having financial independence, and making important decisions without parental guidance for the first time.[51] In addition to managing academic obligations, reestablishing their social support system, and dealing with other social stressors, college students must address those life transitions and exercise more self-reliance and self-sufficiency than they have ever previously.[52] Yet, many emerging adults are weak in self-reliance and lack self-sufficiency skills such as responsibility for self and important decision making.[51] Those unique characteristics of emerging adults may help explain the reasons for the high attrition and low treatment attendance in the present study. In addition, practical difficulties and logistics have been identified as the most important reasons for attrition.[53] A few participants in this study who provided reasons for their discontinuation also cited practical difficulties, such as lack of time due to academic demand and the need to hold multiple part-time jobs to overcome financial constraints, schedule conflicts due to frequent and unexpected job and internship schedule changes, moving away, and unplanned pregnancies, as reasons for their inability to continue their participation. Future research should thoroughly examine the reasons for dropout and develop effective programs to prevent attrition and increase treatment adherence for young adults with obesity. For example, certain treatment sessions could be delivered electronically rather than in face-to-face group meetings. Although group meetings are advantageous for social support, the use of social media might be equally effective for this age group, reduce time demands, and be more feasible and acceptable for this age group. Additional treatment modifications that address the specific barriers experienced by young adults also need to be tested for their effectiveness in future research.

Translation to Health Education Practice

Despite its limitations, the present study revealed that the primary target behavior of a weight loss treatment for young adults with obesity should be treatment session attendance. Without being exposed to weight loss treatment where the behavioral and psychological skills that will lead to weight loss and weight loss maintenance are introduced and practiced, the participants cannot experience the benefits of the treatment. Extending Social Cognitive Theory which suggests that an individual's self-organization and self-reflection regulate one's behavior,[24] and the self-efficacy theory that believes that an individual's behaviors are driven by the individual's feelings of ability,[25] it may be necessary to design specific strategies that help young adults with obesity develop self-regulation and self-efficacy skills related to managing day-to-day tasks and attending treatment sessions. Such strategies should be introduced and practiced in the first few sessions in a program when the participants are most likely to attend. The fact that the behavioral weight loss treatment programs could not retain young participants shows that the treatment protocols may need to be revised to include specific strategies to encourage young adults with obesity to remain in the program and attend more treatment sessions. The nonexperimental design limited the ability to determine the true effects of the program on young adults, and the present study only tested one of many behavioral weight loss programs among 18- to 25-year-old college women with obesity. Although an experimental design would be ideal in examining the program effects of behavioral weight loss programs on young adults with obesity, the issues of high attrition and low treatment session attendance in behavioral weight loss treatment must be first investigated and addressed.

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