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Weight Loss and Self-Regulatory Eating Efficacy in Older Adults: The Cooperative Lifestyle Intervention Program

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Objectives. Using the weight efficacy lifestyle questionnaire (WEL), we examined whether a group-mediated intervention for weight loss among older, obese adults resulted in changes in self-regulatory self-efficacy for eating behavior and whether these changes mediated weight loss.

Methods. This was a randomized controlled design, and 288 older adults received 1 of 3 treatments for 6 months: physical activity only (PA), weight loss + physical activity (WL + PA), or a successful aging (SA) health education program. The WEL was administered prior to randomization and again at the 6-month follow-up visit.

Results. A significant treatment effect was observed for the WEL, F (2,249) = 15.11, $p < .0001$, partial $eta^2 = .11$, showing that improvement occurred only in the WL + PA group as compared with PA and SA. Changes in WEL scores partially mediated the effects of the WL + PA intervention on weight loss.

Discussion. These results illustrate that WL + PA can be effective in improving older adults' self-efficacy for the self-regulation of eating behavior and that these changes are prospectively related to the amount of weight loss. Further research is warranted on an expanded concept of self-efficacy as well as controlled experimental studies on eating behavior in older adults.

Key Words: Mindfulness—Older adults—PA—Self-efficacy—Weight loss.

ESTIMATES from the American Heart Association (2006) indicate that more than 80 million Americans have one or more types of cardiovascular disease (CVD). Low levels of physical activity and excessive weight gain are significant risks for CVD and further compromise physical function in older adults with the disease (Ades et al., 2002). Traditionally, the cornerstone of cardiac rehabilitation programs for persons who either have or are at high risk for CVD due to medical complications such as the metabolic syndrome (MetS) has been center-based exercise therapy (Wenger et al., 1995); however, there is growing recognition among experts that the escalating problem of obesity needs to be given increased attention (Savage & Ades, 2006). Because self-regulation is such a critical component of intentional weight loss (Wing, 2002), the current investigation examined the effect of a state-of-the-art six-month weight loss intervention on changes in older adults' confidence to self-regulate both internal states and external circumstances that promote overeating (Clark, Abrams, Niaura, Eaton, & Rossi, 1991). The target population was older, overweight, and obese adults that had the MetS or CVD.

Throughout the relatively brief history of research on weight management, self-regulation has been a key component of treatment (Wing, 2002). Whereas behaviors such as self-monitoring are key to success, in the early 1990s Clark proposed that participants' confidence in their ability to resist eating due to negative internal states and external circumstances such as the availability of food represent an important cognitive dimension of self-regulation (Clark, Wade, Massey, & Van Dyke, 1975). Self-efficacy, the belief that one can successfully perform a behavior in the face of challenging obstacles, is a construct in social cognitive theory (SCT; Bandura, 1997). Specific to weight loss, SCT suggests that individuals with high efficacy expectations will engage in important behaviors related to losing weight, persist in the face of barriers, and achieve superior weight loss compared with those with low efficacy expectations. Research has shown that the successful completion of a behavioral weight loss intervention can lead to improved weight-related self-efficacy and that higher levels of self-efficacy at baseline predict greater weight loss over time (Bernier & Avard, 1986; Jeffrey et al., 1984; Linde, Rothman, Baldwin, & Jeffery, 2006; Richman, Loughnan, Droulers, Steinbeck, & Caterson, 2001; Warziski, Sereika, Styn, Music, & Burke, 2008); however, there are limitations in these studies. That is, the target population has typically been limited to middle-aged adults, with the exception of the study by Warziski and colleagues (2008) the duration of treatment has been brief, and comparison groups have either been absent or less than optimal.

Jeffrey and colleagues (1984) was one of the first groups to examine the effect of self-regulatory forms of self-efficacy

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on weight loss among men in a 15-week weight loss program. They found that higher baseline emotional and situational self-efficacy and higher post-treatment situational self-efficacy predicted weight loss at the end of treatment and at a one-year follow-up assessment. In another single-group design that involved an eight-week weight loss program, Linde and colleagues (2006) examined the impact of self-regulatory self-efficacy for eating behavior on participants' weight loss behaviors and subsequent weight loss (mean age = 47 years). Their findings supported previous cross-sectional work (Chao et al., 2010; Schwarzer & Renner, 2000), such that self-regulatory self-efficacy for eating and physical activity behavior was significantly associated with corresponding weight control behaviors. To ascertain the predictive value of self-efficacy in their study, Linde and colleagues tested a mediational model of self-efficacy, weight control behaviors, and change in weight. Analyses revealed that self-efficacy significantly predicted weight change during the intervention, and that this effect was at least partially mediated by weight control practices. Finally, a recent behavioral weight loss study (Warziski et al., 2008) has provided further support for these relationships in a similar cohort of adults (mean age = 44 years), with self-regulatory self-efficacy being significantly related to weight loss after controlling for dietary adherence. Although this study lasted 18 months, both treatment groups involved weight loss and there was no control group for comparison.

A single-session laboratory study of self-regulatory self-efficacy among dieting college students that were identified as being restrained eaters is worth mentioning (Stotland, Zuroff, & Roy, 1991). In this study, restrained eaters that scored either high or low in self-regulatory self-efficacy were randomized to either a preload or no preload condition and then exposed to a 10-min period of eating and rating cookies. The primary outcome measure was the number of cookies eaten with participants low in self-efficacy eating significantly more cookies than those high in self-efficacy. What is also interesting is that the low self-efficacy group felt that they had violated their dietary plan whereas this was not true for those high in self-efficacy. This study is relevant to weight loss because it suggests that individuals with low self-regulatory efficacy may be prone to giving in to cravings and to ruminating about negative thought processes that undermine adherence to dietary regimens.

Because of the growing recognition that excessive weight compromises the health of older adults (Rejeski, Marsh, Chmelo, & Rejeski, 2010), the current study examined the role of self-efficacy for managing negative internal and external barriers related to eating behavior in older adults who had either MetS or CVD and were in an intensive weight loss program for six months. Self-efficacy was assessed by the weight efficacy lifestyle questionnaire (WEL) (Clark et al., 1991). Participants were part of the Cooperative Lifestyle Intervention Program (CLIP) that was a translational research project conducted in conjunction with Cooperative Extension Centers in North Carolina. CLIP was a randomized controlled trial with three treatment groups: physical activity only (PA), weight loss + physical activity (WL + PA), and a successful aging (SA) health education control group. The WL + PA treatment targeted self-regulatory self-efficacy as a specific objective of the group-mediated weight loss intervention, whereas the PA treatment did the same for physical activity behavior only. The primary aim was to test the hypothesis that WL + PA would result in greater improvement in WEL scores than either PA or SA. Because we anticipated weight loss in WL + PA but not in either PA or SA, we conducted a mediational analysis predicting that change in WEL scores would mediate the effect that the WL + PA treatment had on weight loss.

Methods

Overview

The study recruited 288 participants aged 60–79 years from three counties in and around Winston-Salem, NC. Participants within each county were randomized in waves, consisting of approximately 39 participants each, to one of three interventions: PA only, WL + PA, or SA. This provided group sizes of approximately 13 participants. After baseline assessments and randomization to treatment, participants returned for three additional assessment visits at the 6-, 12- and 18-month time points over an 18-month intervention period. Participants were treated in eight successive waves. This paper describes the six-month data because this was the end of the intensive phase of the interventions.

Eligibility

The CLIP eligibility identified ambulatory, older, community-dwelling adults who had a history of a cardiovascular event or the MetS plus evidence of self-reported disability. The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) (Expert Panel on Detection, 2001) criteria were used to diagnose the MetS including three or more of the following: (a) waist circumference greater than 102 cm in men and 88 cm in women, (b) serum triglyceride level of at least 150 mg/dl (1.69 mmol/l), (c) high-density lipoprotein level less than 40 mg/dl (1.04 mmol/l) in men and less than 50 mg/dl (1.29 mmol/l) in women, (d) blood pressure of at least 130/85 mm Hg, or (e) fasting serum glucose level of at least 100 mg/dl (6.1 mmol/l).

Inclusion criteria were as follows: (a) community-dwelling men and women; (b) age = 60–79 years; (c) sedentary; (d) overweight or obese as defined by a body mass index (BMI) greater than 28 kg/m^2; (e) documented evidence of an myocardial infarction, percutaneous transluminal coronary angioplasty, chronic stable angina, or cardiovascular surgery in the past six months or an ATP III diagnosis of the MetS; (f) mobility disability defined as self-reported difficulty with walking one-fourth mile, climbing stairs, lifting and carrying groceries, or performing other household chores such as cleaning and yard work; (g) stability in residence; and (h) willing to sign an informed consent and a the Health Insurance Portability and Accountability Act authorization form.

Exclusion criteria included the following: (a) BMI greater than 40 kg/m^2 at baseline; (b) bipolar depression or schizophrenia; (c) evidence of unstable angina, symptomatic congestive heart failure, or exercise induced complex ventricular arrhythmias; (d) resting blood pressure greater than 160/100 mmHg; (e) diagnosis of Parkinson's disease, chronic liver disease, systemic rheumatic condition, end stage renal disease, or other systemic diseases; (f) a fasting blood glucose greater than 140 mg/dl, diagnosis of type 1 diabetes, or diagnosis of type 2 diabetes and on insulin therapy; (g) active treatment for cancer other than nonmelanotic skin cancer; (h) significant visual or hearing impairment that could not be corrected and resulted in the inability to use the telephone or hear normal conversation; (i) dementia, delirium, or impaired cognitive function; (j) participation in another medical intervention study; (k) unable to walk unassisted; and (l) unable to speak or read English.

Recruitment, Enrollment, and Randomization

CLIP recruitment occurred more than 2.5 years. We used identical recruitment strategies in the three counties including newspaper ads in major county newspapers and direct mailings. Each participant was randomized into one of the three treatment arms and stratification was done by wave within each county in an effort to minimize confounding between treatment and location.

Measures for the Current Study

Demographics and chronic disease status: Demographics (age, sex, race, education, and income) and comorbidities were collected by self-report.

BMI: Height without shoes was measured to the nearest 0.1 centimeter using a stadiometer. Weight was measured to the nearest 0.1 kg using a calibrated and certified electronic scale. Height and weight were used to calculate BMI (weight [kg]/height [m^2]).

WEL: A 20-item measure developed by Clark and colleagues (1991) was employed to assess self-efficacy for weight management. Participants are asked to rate their confidence to resist the desire to eat using a 10-point scale ranging from 0 *not confident* to 9 *very confident*. A total score is calculated by summing all items and situational domain scores are computed by summing the four items for each of the following five subscales (sample items): Negative emotions, availability, social pressure, physical discomfort, and positive activities.

Measurement of physical activity: The Lifecorder-EX accelerometer was used to assess physical activity (Ayabe et al., 2009) with moderate physical activity in this population corresponding to a MET level of greater than or equal to 3 (Marsh, Vance, Frederick, Hesselmann, & Rejeski, 2007). At baseline and the six-month follow-up, all participants wore the accelerometer for seven days and only removed the device when sleeping, bathing, or participating in other activities that might damage the device.

PA Intervention

The PA intervention was based on an evidence-based program for older adults in cardiac rehabilitation (Rejeski et al., 2003). A primary goal was to shape physical activity in a home-based environment so that within three months of study onset, participants were engaging in 30+ min of moderate intensity activity on most, if not all, days of the week for a total weekly accumulation of 150+ min. Participants were instructed to walk at a moderate intensity of "somewhat hard" as assessed by the Borg RPE scale (Borg, 1998). The walking progression was highly individualized and shaped during the study check-in period at the beginning of each weekly session. For tracking physical activity, participants were given weekly self-monitoring logs.

Contact mode and frequency: The PA intervention consisted of an intensive phase and a maintenance phase. The intensive phase, the first six months, was delivered in group and individual counseling sessions in a mix of three group sessions and one individual session per month. Group sessions lasted approximately 90 min and individual sessions approximately 30 min. During the intensive phase, participants attended weekly group sessions to initiate and gradually build upon their individual walking programs. Each group session started with a 30- to 45-min period of walking followed by an interactive, group-mediated, behavioral-focused session. The intervention focused heavily on the development of self-regulatory skills (Rejeski et al., 2003). The maintenance phase, months 7–18, reduced the frequency of participant contact to a total of two contacts per month: one group contact and a telephone contact.

WL + PA Intervention

The WL + PA treatment involved the PA protocol described previously, but in combination with WL. The WL program goal was to reduce caloric intake in a nutritionally sound manner that would produce a weight loss of approximately 0.3 kg/week for the first six months of treatment (intensive phase) for a total weight loss of 7–10%. During the maintenance phase, months 7 through 18, participants were encouraged to continue weight loss as long as their BMI did not fall below 20 kg/m^2; however, the primary focus was on weight maintenance. At program inception, participants were assigned a calorie goal based on their baseline weight. A 1200- to 1500-kcal goal was assigned to individuals weighing less than 250 lbs, and a 1500- to 1800-kcal goal to those weighing greater than or equal to 250 lbs.

Recommendations for choices of foods were based on the MyPyramid Food Guidance System, although the focus was primarily on calorie counting. As the intensive phase of the program progressed, more emphasis was placed on diet quality with attention given to both what and how much of each food should be eaten. Participants were given a diet tracking book to document foods eaten, amounts, and the resulting calorie and fat content of each meal. At the end of each day, this information was compiled to derive a total daily count for calories and fat grams consumed. At the end of each week, a seven-day average was calculated for the week and the completed tracking books were then submitted to the intervention staff for review and data entry. The intervention was co-delivered by a trained interventionist and the Family and Consumer Sciences (FCS) agents in the Cooperative Extension Centers for each county.

The intensive phase of the WL + PA sessions lasted approximately 90 min and, as with the PA intervention, relied heavily on the development of self-regulatory skills. The first segment reviewed the participants' progress in implementing the strategies recommended for changing eating or exercise from the previous session. After a private weigh-in, participants provided a progress update and identified any problems that had been encountered. Good progress was highlighted with strong positive feedback. Reported difficulties were dealt with through group support and advice. The second segment involved a group-mediated session that focused on cognitive behavioral self-management skills (e.g., self-monitoring), nutrition (e.g., caloric and fat contents of food), and topics in exercise science (e.g., proper hydration). Cooking demonstrations or food tastings were provided on a monthly basis and illustrated the preparation of palatable, low-fat, low-calorie foods. The final component of each session consisted of a discussion of the ensuing week's goals.

The interventionists employed a mindful-based approach to the group-mediated sessions with a major focus on increasing participants' abilities to self-regulate eating behavior. Throughout the intensive phase of treatment this involved (a) promoting awareness of how different internal and external factors promote eating (Clark et al., 1991), (b) having participants track and discuss personal triggers to eating, (c) teaching participants to stop and think before they initiated or continued to eat, (d) using Perri and colleagues (2001) five-stage problem-solving model to develop specific action plans for difficult situations, (e) normalizing slips and relapses, and (f) using the individual sessions to provide feedback and reinforcement to participants.

As in the PA arm, during the maintenance phase, contact was reduced to one group contact and one telephone counseling call each month. The purpose of the telephone contacts was to cue participants to continue active use of key weight-management strategies, use problem-solving counseling to identify barriers to successful weight maintenance and generate a plan to overcome the problems encountered, and provide support and reinforcement for continued efforts at weight management. They were asked to continue documenting their dietary intake and walking during this maintenance period and given specific action plans that they implemented between scheduled visits.

SA Health Education Intervention

The SA treatment was developed by faculty at North Carolina State University and delivered by FCS agents in each county. The SA group was designed to (a) control for levels of staff and participant time and attention, (b) optimize participant recruitment and to ensure participants' ongoing cooperation and retention in the study, (c) select a control intervention that would have minimal effects on the primary outcome, and (d) utilize an intervention that participants would perceive as offering some benefit. Participants in the SA arm met on a similar schedule to the other two arms.

The SA treatment included an experiential component in which participants learned how to actively take charge of their health in seeking out appropriate medical information and services. Examples of topics covered over the 18-month program included a discussion of what constitutes SA, how our bodies change with age, preventing or delaying disease and dysfunction, good food for good living, and talking to health care providers. The SA intervention differed from the other two arms of the study in that participants did not receive a progressive, supervised program of physical activity or weight loss. The SA intervention was delivered in a small group format augmented by printed materials.

Statistical Analyses

Descriptive statistics were used to identify sample characteristics and provide summary indices of selected measures. The primary analyses used linear models with covariates including treatment group, county, wave within county, the baseline value of the WEL score, and sex. Analyses were conducted using SAS 9.2, and the estimates of partial eta^2 were made using a SAS macro (SAS Institute, Cary, NC). MacKinnon's product of coefficients test ($\alpha\beta$) was used to test for an indirect effect (MacKinnon, Fairchild, & Fritz, 2007). This test consists of (a) estimating the effect of the intervention on changes in each potential mediator (α coefficient) by regressing the hypothesized mediator on the intervention arm, controlling for the mediator at baseline; (b) estimating the effect of changes in the mediator on changes in the outcome (β coefficient) by regressing the outcome on the hypothesized mediator, controlling for the intervention effect; (c) calculating the product of coefficients by multiplying the α and β coefficients ($\alpha\beta$); and (d) constructing asymmetric confidence limits based on the distribution of the product using the PRODCLIN program (MacKinnon, Fritz, Williams, & Lockwood, 2007). All models included baseline weight, county, wave within county, and sex as covariates. We used the definition of MacKinnon and colleagues for partial versus complete

Table 1. Characteristics of Study Participants

		Treatment group		
	Overall (N = 261)	SA (N = 84)	PA (N = 83)	WL + PA (N = 94)
Characteristics	Mean ± *SD* or *N* (%)	Mean ± *SD* or *N* (%)	Mean ± *SD* or *N* (%)	Mean ± *SD* or *N* (%)
Age (years)	66.9 ± 4.7	67.1 ± 4.8	66.9 ± 4.8	66.8 ± 4.6
Sex				
Men		27 (32.1)	31 (37.3)	31 (33.0)
Women	172 (65.9)	57 (67.9)	52 (62.7)	63 (67.0)
Race				
White	215 (83.4)	68 (81.0)	66 (79.5)	81 (86.2)
Black	42 (16.1)	14 (16.7)	15 (18.1)	13 (13.8)
Other	4 (1.5)	2 (2.4)	2 (2.4)	0 (0.00)
Education				
Less than high school	4 (1.5)	2 (2.4)	1 (1.2)	1 (1.1)
High school or some college	123 (47.1)	39 (46.4)	39 (47.0)	45 (47.9)
At least associate's degree	134 (51.34)	43 (51.2)	43 (51.8)	48 (51.1)
BMI (kg/m^2)	32.9 ± 3.9	32.7 ± 3.6	32.9 ±4.0	33.1 ±4.1
Comorbidities				
Heart attack	20 (7.7)	10 (11.9)	3 (3.6)	7 (7.4)
Angina	35 (13.4)	10 (11.9)	12 (14.5)	13 (13.8)
High blood pressure	180 (69.0)	54 (64.3)	57 (68.7)	69 (73.4)
Diabetes	44 (16.9)	16 (19.0)	12 (14.5)	16 (17.0)
Arthritis	153 (58.6)	54 (64.3)	42 (50.6)	57 (60.6)
Cancer	52 (19.9)	16 (19.0)	19 (22.9)	17 (18.1)
Salary				
<$35,000	52 (19.9)	15 (17.9)	19 (22.9)	18 (19.1)
$35,000–$49,999	36 (13.8)	11 (13.1)	8 (9.6)	17 (18.1)
$50,000–$74,999	57 (21.8)	16 (19.1)	17 (20.5)	24 (25.5)
>$75,000	67 (25.7)	23 (27.4)	19 (22.9)	25 (26.6)
Refused	49 (18.8)	19 (22.6)	20 (24.1)	10 (10.6)
MetS	148 (56.7)	44 (52.4)	47 (56.6)	57 (60.6)

Notes: There were no treatment group differences for any of the measure listed (p > .05). BMI = body mass index; SA = successful aging; PA = physical activity only; WL + PA = weight loss + physical activity; MetS = metabolic syndrome.

mediation: if αβ and the treatment effect are both significant then the mediation is partial, and if αβ is significant and the treatment effect is not significant then the mediation is complete. The effects of treatment on WEL and weight were estimated using a contrast that compared the average of SA and PA with WL + PA. Tests of activity using accelerometry data used models similar to that for the primary outcome except that baseline activity level replaced baseline WEL score as a covariate. Finally, simple Spearman's correlation coefficients were computed between the total WEL score and self-reported days that a participant's fat and calorie goals were met.

Results

Of the 288 participants that were originally randomized, 90.6% completed the WEL measure at six months that provided the main data set for this paper. The rate of loss to follow-up did not differ as a function of the three treatment groups (p > .05). As illustrated in Table 1, 65.9% of the older adults in this cohort were women and 82.4% were White. They were socioeconomically diverse and participants had multiple comorbidities.

Participants in the SA group attended 80.23% of scheduled sessions, whereas attendance in the PA and WL + PA groups were 84.50% and 86.20%, respectively. Using a linear model similar in structure to the main analysis, levels of moderate PA at six months were significantly higher in PA (p = .0028) and WL + PA (p < .0001) as compared with SA: PA (mean [*SE*]) = 189.5 (13.7) min/week, WL + PA = 223.4 (12.9) min/week, and SA = 123.8 (13.9) min/week. In addition, those in the WL + PA lost 8.6% (17.8 kg) of their body weight in the first six months, whereas weight loss was approximately 1% in both PA (2.7 kg) and SA (2.3 kg). Taken together, these data offer support to the efficacy and fidelity of the study design.

Table 2 provides the raw means (±*SD*) and least-square treatment means (±*SE*) for the WEL measure. Although our primary analysis was on the WEL total score, values for the subscale scores are included. The consistency in group differences across the various scales is noteworthy with the adjusted means suggesting that the WL + PA group experienced a significant improvement in their WEL scores as compared with either PA or SA. The linear model for the WEL total score yielded a significant treatment effect, $F(2,249) = 15.11$, $p < .0001$, partial $eta^2 = .11$, demonstrating that scores improved only in the WL + PA group as compared with PA and SA. Additionally, participants in the WL + PA group that reported greater improvement in the total WEL score lost proportionally more weight from

Table 2. Raw Pre- and Post-*WEL Treatment M (±SD) and LS M (±SE)*

	Treatment groups								
	SA		PA		WL + PA		SA	PA	WL + PA
Scale	Pre	Post	Pre	Post	Pre	Post	LS *M*	LS *M*	LS *M*
Total	119.1 ± 33.2	123.9 ± 32.9	119.6 ± 37.5	120.9 ± 32.5	115.3 ± 38.5	138.1 ± 31.7	123.5 ± 3.0	120.2 ± 3.0	139.7* ± 2.9
Negative emotions	23.8 ± 8.5	24.5 ± 8.6	24.1 ± 8.9	24.0 ± 8.2	22.4 ± 8.9	26.5 ± 8.0	24.4 ± 0.7	23.6 ± 0.7	27.3* ± 0.7
Availability	19.8 ± 7.6	21.0 ± 7.7	20.1 ± 8.6	20.6 ± 7.5	19.3 ± 8.2	25.2 ± 7.2	20.9 ± 0.8	20.4 ± 0.8	25.3* ± 0.7
Social pressure	23.9 ± 7.4	24.9 ± 7.6	23.4 ± 8.0	23.7 ± 7.3	23.3 ± 8.5	28.4 ± 7.0	24.0 ± 0.7	23.5 ± 0.7	28.2* ± 0.7
Physical discomfort	26.3 ± 6.5	27.1 ± 6.6	26.7 ± 7.9	26.3 ± 7.1	25.7 ± 8.3	29.1 ± 6.2	27.3 ± 0.6	26.3 ± 0.6	29.7* ± 0.6
Positive activity	25.4 ± 7.1	26.5 ± 7.1	25.3 ± 7.7	26.3 ± 6.7	24.5 ± 8.3	28.9 ± 6.6	26.5 ± 0.7	26.3 ± 0.7	29.3* ± 0.6

Notes: LS = least square; SA = successful aging; PA = physical activity only; WL + PA = weight loss + physical activity. *For all scales, the WL + PA group had significantly higher scores than both SA and PA using the Tukey–Kramer adjustment for multiple comparisons ($p < .01$).

baseline to the six-month follow-up: $F(1,84) = 16.08$, $p = .0001$, partial $eta^2 = .16$.

Table 3 provides the results for the direct effects in the mediational analysis. In this table, α represents the effect of the treatment contrast—WL + PA versus PA and SA—on WEL scores, β the effect of WEL scores on six-month weight controlling for treatment, and τ' the effect of the treatment contrast on six-month weight. To test for mediation, we used the approach of MacKinnon (MacKinnon, Fairchild, & Fritz, 2007) to estimate the $\alpha\beta = \tau - \tau'$, a test for mediation. The αβ effect was 1.06 ($p < .001$, 95% confidence interval 0.37, 1.96). However, the effect between the contrast and weight loss remained significant with the WEL score in the model ($p < .0001$) indicating that the WEL score was a statistically significant, partial mediator of six-month weight loss.

In post hoc analyses, we also examined the relationships between WEL scores at six months with compliance to daily goals for both total calories and saturated fats. WEL scores were significantly related to the number of days individuals met their calorie ($r = .25$, $p = .02$) and saturated fat ($r = .29$, $p < .01$) goals.

Discussion

Obesity is a serious chronic health condition for older adults and it is well-established that self-regulation is important to food consumption (Wadden & Osei, 2002; Wing, 2002). Self-efficacy is an important component of self-regulation and the role that self-efficacy plays in weight control is receiving increased attention (Schwarzer, 1998; Stotland et al., 1991). However, most previous studies have focused on young to middle-aged adults, and, as noted by Linde and colleagues (2006), few studies have tested the predictive value of self-efficacy within the context of traditional weight loss interventions. To date, no studies have evaluated whether self-efficacy is a mediating variable between treatment and weight loss.

Table 3. Direct Effects in Mediational Analysis

Effect tested	Estimate	*SE*	*t* Value
α	−15.91	4.19	−3.80*
β	−0.066	0.02	−3.53*
τ'	15.12	1.27	11.91*

*$p < .0001$.

The current study evaluated the effects of the intensive phase of a state-of-the-art weight loss intervention on changes in self-efficacy for managing internal and external barriers to eating behavior (Clark et al., 1991) among older adults with CVD or the MetS. Subsequently, we examined whether changes in self-efficacy mediated the effects of the treatment on weight loss. A unique feature of the study is that it provided two different comparison groups: one that was involved in a group-mediated PA intervention that paralleled behavioral change methods used in WL + PA and a SA control group. Additionally, we investigated the relationships between change in weight-related self-efficacy and weight loss practices.

The results confirmed that WL + PA had a significantly greater total score on the WEL measure than did either PA or SA, a pattern observed for all subscale scores. This finding is consistent with research by Warziski and colleagues (2008); however, Linde and colleagues (2006) actually reported decreases in a modified WEL measure with a short-term weight loss intervention. Although it is not clear why Linde and colleagues observed a decrease in WEL scores over time, it may well have been due to the brevity of the intervention—eight weeks—and the fact that the duration of their treatment did not provide the time required to initiate and reinforce such skills. What is notable about the current study is that WEL scores were unchanged in the PA group. Recall that the PA group was taught how to manage difficult internal and external conditions that promote sedentary behavior, whereas WL + PA received the same behavior change strategies but applied to both sedentary behavior and eating. This pattern in the data suggests that self-regulatory training is behavior specific. In addition, the magnitude of change in WEL scores observed in the WL + PA group was much larger than those reported by Warziski and colleagues (2008). It is unclear whether this difference in the responsiveness of the WEL measure to treatment was due to our focus on older adults or to the structure of the intervention itself. In either case, the intensive phase of the WL + PA intervention was successful at enhancing participants' self-regulatory self-efficacy for eating behavior.

To date, relatively few prospective epidemiological studies and no randomized controlled trials have examined the effects of self-regulatory self-efficacy on weight loss. Although self-efficacy was not significantly related to greater weight loss in obese individuals seeking outpatient treatment (Fontaine & Cheskin, 1997), in a study of middle-aged men, Jeffery and colleagues (1984) found that both baseline and post-treatment self-regulatory self-efficacy predicted weight loss after 15 weeks of treatment and again at a 1-year follow-up assessment. In a subsequent study of predominantly middle-aged women (87%), Linde and colleagues (2006) found that baseline self-regulatory self-efficacy predicted both weight related behaviors and subsequent weight loss following eight weeks of active treatment, but not at three- to six-month follow-up assessments. More interesting is the fact that, in the Linde and colleagues study, retention was low (62%) and there was a decrease in self-efficacy with treatment. Finally, in the longest study to date (18 months), Warziski and colleagues (2008) found that WEL scores improved significantly with treatment and that this improvement predicted weight loss. As mentioned previously, however, there was no control group for comparison and the mean age was 44.1 years.

To our knowledge, the current study is the only randomized controlled clinical trial to examine WEL scores and their potential role as a mediating variable between treatment and weight loss among older men and women. We found that WEL scores were related to weight loss and that they partially mediated the effects of the WL + PA treatment on weight loss when compared with participants in PA and SA. The fact that WEL scores did not completely mediate change in weight is not surprising. It is well known that weight loss involves multiple determinants that are biological, social, and psychological in origin. Moreover, given that self-efficacy for weight management can be conceptualized as being related to (a) internal/external barriers, (b) the perception of one's ability to reach specific caloric targets, or (c) the ability to lose weight (Stotland & Zuroff, 1991), future studies should consider a broader conceptualization of the self-efficacy construct than used in the current trial.

As noted by Linde and colleagues (2006), the effect of self-efficacy on weight loss should be contingent on its relationship to weight control behaviors. For example, adherence to a prescribed diet is essential to weight loss success (Dansinger, Gleason, Griffith, Selker, & Schaefer, 2005) as is a reduction in dietary fat (Warziski et al., 2008). Additionally, Linde and colleagues found that self-regulatory behaviors related to weight loss are directly influenced by self-regulatory self-efficacy. In the current study we found that, within the WL + PA group, WEL scores were directly related to how well participants met their calorie and saturated fat goals.

Before closing our discussion, we want to point out that perhaps investigators should not expect a strong relationship between a trait-related measure such as the WEL measure (Clark et al., 1991) and the confidence that people have in managing internal and external urges to eat when confronted with food cues in a state of temporary food restraint common to weight loss programs. In a recent laboratory study, Rejeski and colleagues (2010) assessed trait cravings of students in the early morning, food deprived them for 6 hrs, exposed them to food and neutral cues, and following the cues assessed state craving, affect, and startle magnitude. Increases in startle magnitude occur as a result of threat/negative affect (NA) registered by the lower brain. In addition, half of the participants were randomized to a short delay for food availability manipulation—immediately after the experimental session had been completed—whereas the other half were informed that they would have to fast for another 6 hrs. Interestingly, whereas trait craving was unrelated to affect and startle magnitude during the experimental manipulation, food cues provoked higher levels of state craving than neutral cues and startle responses failed to habituate as quickly to food cues as they did to neutral cues. In addition, cue exposure created the highest NA among high state cravers in the long delay of consumption condition. In light of these results, we are exploring the development of interventions that provide training for participants in how to self-regulate internal and external states when confronted by food cues in conditions where appetite has been elevated due to short-term restraint.

Finally, we would be remiss in not commenting on the absence of a weight loss (WL) only treatment group because one could argue that it was exposure to WL rather than changes in WEL scores that mediated changes in weight. Although we cannot rule out this possibility, WL does not occur in the absence of conscious cognitive and behavioral processes. In addition, weight loss programs for older adults may pose a health risk due to a reduction in lean mass, a concern that emphasizes the need for investigators to assess body composition. Whereas we did conduct dual-energy x-ray absorptiometry scans in CLIP, follow-up data for this measure were only collected at the 18-month visit.

In summary, this study found improvement in WEL scores as a result of exposure to a six-month intensive phase of WL + PA treatment and that this effect was a partial mediator between treatment and change in weight. Additional research is required to examine mediational processes in weight loss and to explore a more comprehensive conceptualization of the self-efficacy construct within the context of weight loss including a distinction between trait and state-like confidence for self-regulating eating behavior.

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