



# Mediation of Emotional Eating in the Effects of Self-Regulating Eating on Short- And Long-Term Weight Loss: Additional Impacts from Baseline Mood in Women with Obesity

James J. Annesi<sup>1,2</sup>, Sara M. Powell<sup>1</sup>

## Abstract

**Introduction** An improved understanding of psychosocial factors related to weight loss is required to improve the continually poor outcomes of behavioral obesity treatments beyond their first several weeks or months. The aim of this investigation was to inform future research and improve obesity-treatment foci via an increased understanding of interrelations of treatment-associated changes in self-regulation, emotional eating, and weight.

**Method** Stratified randomization yielded matched groups of United States-based White and Black women with obesity within self-regulation-focused or knowledge-focused treatment content lasting 1 year (both  $n = 47$ ; overall  $M_{age} = 48$  years). Changes in self-regulation and emotional eating over 3 months, weight over 6, 12, and 24 months, and baseline mood were assessed, and contrasted by group. Regression analyses assessed the relationship of changes in weight by self-regulation change, with mediation effects of emotional eating change also accounted.

**Results** Effect sizes for improvements in self-regulation, emotional eating, and weight were greater in the self-regulation-focused group on all variables. Incorporating data aggregated across both groups, change in emotional eating significantly mediated the prediction of weight changes by change in self-regulation. Baseline negative mood significantly moderated the emotional eating  $\rightarrow$  weight change relationships within those mediation models.

**Conclusion** Findings suggest value in a self-regulation-centered obesity treatment approach in women. It also indicated that emotional eating and initial mood of participants are factors to carefully address in future behavioral treatments seeking increased short- and long-term weight losses.

Submitted: 27 January 2023  
Accepted: 31 October 2023  
Published online: 07 November 2023

[doi.org/10.29102/clinhp.23003](https://doi.org/10.29102/clinhp.23003)

## About the AUTHORS

1 California State University,  
Monterey Bay, Kinesiology  
Department  
2 Central Coast YMCA, Mon-  
terey, CA

Contact:  
James J. Annesi  
[jamesannes@gmail.com](mailto:jamesannes@gmail.com)

Clin Health Promot 2023;13:e23003

## Introduction

An improved understanding of psychosocial factors related to weight loss is needed to improve the incessantly poor outcomes of behavioral (non-surgical/non-pharmacological) obesity treatments beyond the first several weeks/months (1). Although most such treatments are focused on educating participants in healthier eating and exercise behaviors, others are driven by established behavioral paradigms such as social cognitive theory (2) and self-regulation theory (3). In such interventions, curri-

cula emphasize obtaining and utilizing self-regulatory skills (4) to address common lifestyle and environmental barriers to controlled eating such as time demands, slow progress, and social pressures (5). Some research suggests that emotional eating is the most important psychosocial correlate of weight change (6), especially in women (7). Impacts on weight loss based on the interaction of self-regulation and emotional eating changes are unclear, as are effects associated with initial mood.



## Research and Best Practice

Self-regulation-focused and knowledge-focused protocols were incorporated within a field setting to clarify both treatment and psychosocial impacts on weight in women with obesity over both the short and long term.

Hypotheses were as follows:

- 1) Treatment group membership will significantly predict improvements in eating-related self-regulation, emotional eating, and weight in favor of the self-regulation skill-focused (SRF) vs. the knowledge-focused (KF) group; and baseline mood will significantly improve accounting of those effects.
- 2) Reduction in emotional eating will significantly mediate the prediction of weight loss by increased self-regulation; and baseline mood will significantly moderate path(s) associated with effects derived from hypothesis 1-related analyses.

It was hoped that findings related to (1) the impacts of obesity treatment type (i.e., SRF vs. KF) on self-regulation, emotional eating, and weight loss; and (2) whether the relationship of increased self-regulation on short- and long-term losses in weight are mediated by change in emotional eating; would advance the aims of this study which were to inform future research and large-scale behavioral obesity-treatment targets and foci.

### Method

#### Participants

This investigation was a re-analysis of research on community-based treatments for obesity that had different aims than the present study (8). Through stratified randomization, race was balanced across the SRF and KF groups (41 White, 6 Black, each). This was because racial differences in variables associated with emotional eating were found in women in the United States (9). The 4% of women of other racial/ethnic groups were excluded. There was also no significant group difference in age ( $M_{\text{overall}} = 47.8$  years,  $SD = 7.8$ ), body mass index ( $M_{\text{overall}} = 35.5$  kg/m<sup>2</sup>,  $SD = 3.1$ ), or reported family income (Median<sub>overall</sub> = US\$ 64,500 / year [middle class]). After the protocol received institutional review board (IRB) approval, IRB-endorsed written consent was obtained from participants prior to study start. Principles of the World Medical Association Declaration of Helsinki were maintained.

#### Measures

Eating-related self-regulation was measured by 10 items derived from a taxonomy of theory-driven self-regulatory methods/skills (4). Response options to sentences

such as “I make formal agreements with myself regarding my eating” and “I set eating goals” ranged from 1 = never to 4 = often, which were summed. Internal consistency was reported as Cronbach’s  $\alpha = 0.81$ , with 2-week test-retest reliability at 0.74 (10). In the present sample,  $\alpha = 0.77$ .

Emotional eating was measured by 15 items of the Emotional Eating Scale (11). Response options regarding the extent feelings such as “on edge,” “angry,” and “bored” lead to an urge to eat ranged from 0 = no desire to eat to 4 = an overwhelming urge to eat, which were summed. In women with obesity, internal consistency was reported as Cronbach’s  $\alpha = 0.78$ , with 2-week test-retest reliability at 0.79 (11). In the present sample,  $\alpha = 0.76$ .

Negative mood was measured by the brief form of the Profile of Mood States (12). Its 30 items equally represented dimensions of anxiety, depression, anger, fatigue, confusion, and vigor through 1–3-word items such as “anxious,” “sad,” and “vigorous.” Responses ranging from 0 = not at all to 4 = extremely were summed, with vigor-related items negatively keyed. In women, Cronbach’s  $\alpha = 0.90$ , with 3-week test-retest reliability averaging 0.70 (12). In the present sample,  $\alpha = 0.85$ .

Body weight was measured to the nearest 0.1 kg using a recently calibrated digital scale. Shoes and outer clothing were first removed by the participant.

#### Procedure

In the SRF group, processes focused primarily on the development of participants’ self-regulatory skills (e.g., goal setting/recording incremental goal progress, cognitive restructuring, relapse prevention). There were 6 30-minute (1-on-1) sessions supporting exercise starting at baseline (through month 6), and 13 50-minute small group sessions on eating behavior-change beginning at week 8 (through month 12). The SRF treatment was based on tenets of social cognitive (2) and self-regulation (3) theories.

The KF treatment focused primarily on educating participants on generally accepted principles of healthy eating and exercise. After an initial 1-on-1 meeting of 20 minutes, 16 sets of reading materials (13) were provided, spaced by 2–3 weeks (through month 12). Each was estimated to take 30 minutes to complete and followed by a 20-minute interaction with an instructor to reinforce its content. The KF treatment was based on the health belief model (14).

Both treatments consisted of approximately 13.5 participant/hours. Non-instructor staff administered structured fidelity checks on 10% of treatment sessions (indi-



## Research and Best Practice

**Table 1.** Descriptive statistics and gain scores in study measures, by group.

Measure Group	Baseline		Month		ΔBaseline–month			t	p	d
	M	SD	M	SD	M	SD				
Eating-related self-regulation										
Month 3										
Self-regulation focus	19.40	4.51	24.84	3.68	5.44	5.07	7.35	<0.001	1.07	
Knowledge focus	17.19	4.58	21.16	4.52	3.97	4.62	5.88	<0.001	0.86	
Aggregated data	18.30	4.65	23.00	4.50	4.70	4.88	9.34	<0.001	0.96	
Emotional eating										
Month 3										
Self-regulation focus	28.26	10.75	27.72	9.31	-0.53	9.89	0.37	0.714	0.34	
Knowledge focus	25.00	10.39	28.98	8.68	3.98	7.41	3.68	<0.001	-0.54	
Aggregated data	26.63	10.64	28.35	8.98	1.72	8.98	1.86	0.066	-0.19	
Weight (kg)										
Month 6										
Self-regulation focus	96.40	11.51	90.30	11.65	-6.11	3.86	10.86	<0.001	1.58	
Knowledge focus	94.12	9.59	92.30	9.17	-1.81	3.02	4.12	<0.001	0.60	
Aggregated data	95.26	10.60	91.30	10.48	-3.96	4.07	9.45	<0.001	0.97	
Month 12										
Self-regulation focus	96.40	11.51	90.50	11.96	-5.91	4.60	8.81	<0.001	1.29	
Knowledge focus	94.12	9.59	92.56	9.88	-1.55	4.95	2.15	0.037	0.31	
Aggregated data	95.26	10.60	91.53	10.96	-3.73	5.23	6.92	<0.001	0.71	
Month 24										
Self-regulation focus	96.40	11.51	90.92	14.07	-5.48	8.68	4.33	<0.001	0.63	
Knowledge focus	94.12	9.59	93.06	9.99	-1.06	5.11	1.42	0.162	0.21	
Aggregated data	95.26	10.60	91.99	12.18	-3.27	7.42	4.27	<0.001	0.44	

M = mean; SD = standard deviation; p-values are 2-tailed. d = Cohen's measure of effect size for within-group change where 0.20, 0.50, 0.80, and 1.30 represent small, moderate, large, and very large effects, respectively. A negative d value indicates change in the unfavorable direction. Δ = change in score during the designated temporal period. Self-regulation focused group, n = 47 (degree of freedom [df] for dependent t test = 46). Knowledge focused group, n = 47 (df for dependent t = 46). Aggregated data, N = 94 (df for dependent t = 93).

cating strong protocol compliance) and participant measurements at baseline and months 3, 6, 12, and 24.

### Data analyses

Suggested criteria (15) indicated no systematic bias in the 17% of missing cases which facilitated use of the expectation-maximization algorithm for imputation and the desired intention-to-treat format. Based on the planned regression analyses, an overall sample size of 91 was required to detect a moderate effect of Cohen's  $f^2 = 0.15$  at the statistical power of 0.80 (16). Variance inflation factor scores of < 2.0 indicated acceptable multicollinearity. Statistical significance was set at  $\alpha < 0.05$  (2-tailed). SPSS version 28 incorporated the Process 4.1 macro-instructional models 4 and 14, with 20,000 percentile-method bootstrap resamples (17).

Significance of gain scores on eating-related self-regulation, emotional eating (baseline–month 3), and weight (baseline–months 6, 12, and 24) were first calculated. Using aggregated data, bivariate regression analyses assessed associations of group (coded: SRF = 1, KF = 0) with those score changes. Baseline negative mood score was then entered in their step 2 to determine significance of associated increases in  $R^2$  values. Next, incorporating a lagged variable analysis format to enhance confidence

in directionality of relationships (18), weight changes were predicted by self-regulation change, with change in emotional eating entered as a mediator. Baseline mood was then entered as a moderator of the above path(s) wherever the  $R^2$  change-value(s) described above was significant.

### Results

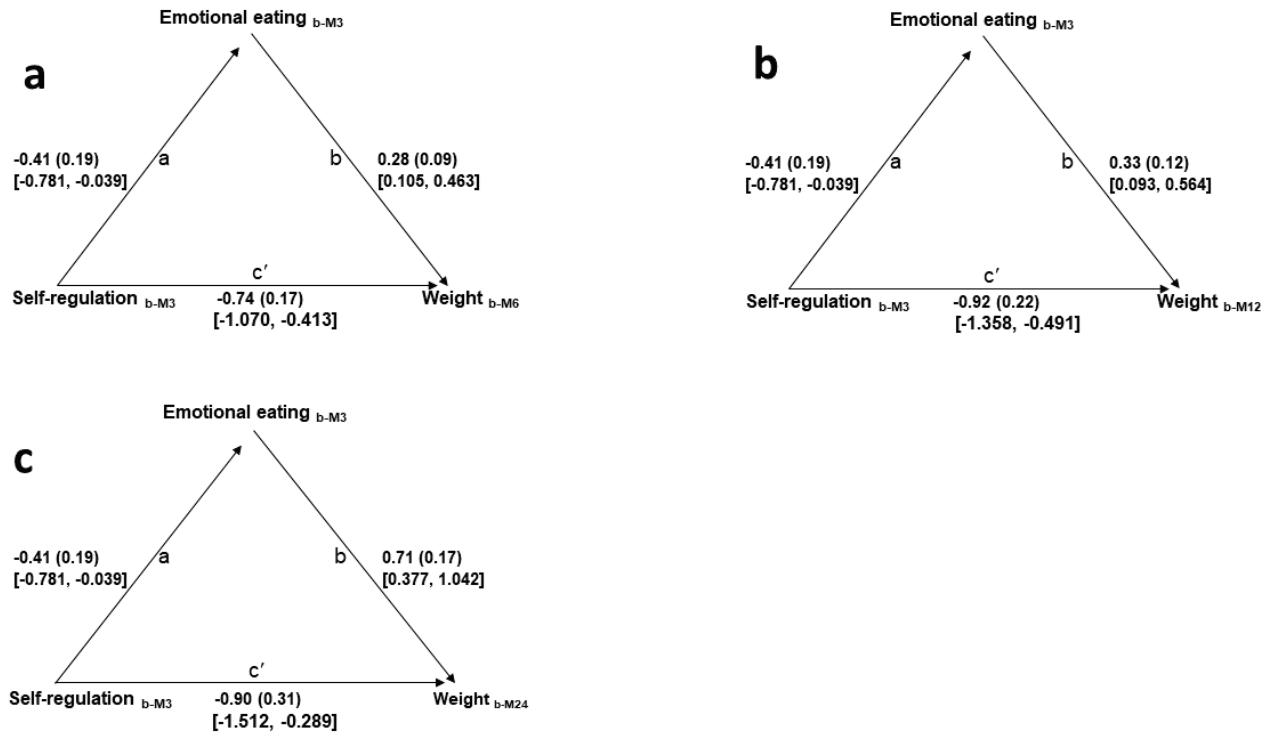
Improvements in self-regulation and weight, but not emotional eating (where  $p = 0.066$ ), were significant at all temporal intervals, overall (Table 1). Effect sizes for improvements were greater in the SRF group on all variables. Using aggregated data, improvement in emotional eating was significantly predicted by group,  $R^2 = 0.06$ ,  $p = 0.014$ . Subsequent entry of baseline mood ( $M = 24.76$ ,  $SD = 13.25$ ) significantly increased the explained variance,  $R^2_{\text{change}} = 0.05$ ,  $p = 0.024$ . The explained variance in change in self-regulation,  $R^2 = 0.02$ ,  $p = 0.145$ ; and change in weight over 6 months,  $R^2 = 0.29$ ,  $p < 0.001$ ; 12 months,  $R^2 = 0.18$ ,  $p < 0.001$ ; and 24 months,  $R^2 = 0.09$ ,  $p = 0.003$ ; was not significantly increased by the entry of baseline mood, p-values > 0.40.

Also incorporating aggregated data, change in emotional eating significantly mediated the prediction of weight



## Research and Best Practice

**Figure 1.** Mediation of change in emotional eating in the prediction of weight changes over 6 (a), 12 (b), and 24 (c) months by eating-related self-regulation change (N=94).



change over 6 months, 95% confidence interval (CI) = [-0.271, -0.002], 12 months, 95% CI = [-0.345, -0.002], and 24 months, 95% CI = [-0.739, -0.019], by change in self-regulation. The model  $R^2$ -values were 0.30, 0.26, and 0.27, respectively,  $p$ -values < 0.001. Associated path data are given in Figures 1a, 1b, and 1c, respectively. Baseline negative mood significantly moderated the prediction of weight change by emotional eating change (paths b) over the same 3 intervals, 95% CI-values = [-0.018, -0.001], [-0.025, -0.001], and [-0.043, -0.002], respectively. The model  $R^2$ -values were 0.38, 0.36, and 0.38, respectively,  $p$ -values < 0.001.

Data are from both groups aggregated. b-M3, change from baseline to month 3 (or another designated month). Path data are given as unadjusted beta, (its associated standard error), and [95% confidence interval].

### Discussion

Based on the more-pronounced improvements in eating-related self-regulation, emotional eating, and weight which supported hypothesis 1, findings suggest value in a treatment approach that is primarily focused on the

development of self-regulatory skills. Hypothesis 2 was also supported though the finding that much of the positive effect of increased self-regulation on weight over both the short-term and long-term was through its significant effect on emotional eating in the present sample of women with obesity (see paths a, Figure 1). That corroborates research indicating the importance of addressing emotional eating for weight change (19). The significant moderation of initial mood in the embedded emotional eating → weight change relationships further supported hypothesis 2, and suggests that mood should also be accounted for within behavioral treatments. As previously proposed (20), and substantiated by other research (21), manageable amounts of exercise might be initiated for mood-improvement purposes prior to focusing on eating behavior changes.

Limitations such as a specific sample type, possible expectation effects, self-report biases, and effects of volunteerism should be acknowledged. Nevertheless, the present research indicated importance of (1) a self-regulation-centered treatment approach, (2) an explicit focus on emotional eating, and (3) consideration of initial



## Research and Best Practice

mood—areas that had only been indirectly addressed in cross-sectional research or studies of a briefer duration (22). Considering the field setting of the present study, its aims of informing large-scale behavioral obesity-treatment targets were met. Hopefully, extensions will account for other, possibly salient, psychosocial variables such as body image, eating disorders, and depressed mood in efforts to better-facilitate weight loss via behavioral means.

### Conclusion

Findings suggest value in a self-regulation-centered obesity treatment approach in women. It also indicated that emotional eating and initial mood of participants are factors to carefully address in future behavioral treatments seeking increased short- and long-term weight losses.

### Contributors:

Conception and design: JJA. Acquisition of data: JJA. Analysis and interpretation of data: JJA, SMP. Drafting, revising and final approving of the article: JJA, SMP.

**Competing interests:** None declared.

**Funding:** This research received no external funding.

**Patient content:** Not applicable.

**Ethics approval:** Approval from Kennesaw State University institutional review board was obtained for the study protocol (study approval 17173). Written informed consent was obtained from all study participants. Ethical requirements of the World Medical Association Declaration of Helsinki and the American Psychological Association were upheld.

**Availability of data and materials:** Available from the first author upon reasonable request.

### References

- Dombrowski SU, Knittle K, Avenell A, Araújo-Soares V, Sniehotta FF. Long term maintenance of weight loss with non-surgical interventions in obese adults: systematic review and meta-analyses of randomised controlled trials. *BMJ* 2014; 348:g2646. doi:10.1136/bmj.g2646.
- Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice Hall 1986.
- Vohs KD, Baumeister RF. Eds. *Handbook of Self-Regulation: Research, Theory, and Application*. 3rd ed. New York, NY: Guilford 2016.
- Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy. *Psychol Health* 2011; 26:1479–98. doi:10.1080/08870446.2010.540664.
- Bandura A. The primacy of self-regulation in health promotion. *Appl Psychol-Int Rev* 2005; 54:245–54. doi:10.1111/j.1464-0597.2005.00208.x.
- Koenders PG, van Strien T. Emotional eating, rather than lifestyle behavior, drives weight gain in a prospective study in 1562 employees. *J Occup Environ Med* 2011; 53:1287–93. doi:10.1097/JOM.0b013e31823078a2.
- Péneau S, Ménard E, Méjean C, Bellisle F, Hercberg S. Sex and dieting modify the association between emotional eating and weight status. *Am J Clin Nutr* 2013; 97:1307–13. doi:10.3945/ajcn.112.054916.
- Annesi JJ. Behavioral weight loss and maintenance: a 25-year research program informing innovative programming. *Perm J* 2022; 26:98–117. doi:10.7812/TPP/21.212.
- Heather D. Are there differences in gender, race, and age regarding body dissatisfaction? *J Hum Behav Soc* 2016; 26:499–508. doi:10.1080/10911359.2015.1091240.
- Annesi JJ, Marti CN. Path analysis of exercise treatment-induced changes in psychological factors leading to weight loss. *Psychol Health* 2011; 26:1081–98. doi:10.1080/08870446.2010.534167.
- Arnou B, Kenardy J, Agras WS. The Emotional Eating Scale: the development of a measure to assess coping with negative affect by eating. *Int J Eat Disord* 1995; 18:79–90. doi:10.1002/1098-108X(199507)18:1<79::AID-EAT2260180109>3.0.CO;2-V.
- McNair DM, Heuchert JWP. *Profile of Mood States Technical Update*. North Tonawanda, NY: Multi-Health Systems 2009.
- Brownell KD. *The LEARN Program for Weight Management*. 10th ed. Dallas, TX: American Health Publishing 2004.
- Green EC, Murphy EM, Gryboski K. The Health Belief Model. In Sweeny K, Robbins ML, Cohen LM. Eds. *Wiley Encyclopedia of Health Psychology*. Hoboken, NJ: Wiley 2020:211–4. doi:10.1002/978111905784.
- White IR, Horton NJ, Carpenter J, Pocock SJ. Strategy for intention to treat analysis in randomised trials with missing outcome data. *BMJ* 2011; 342:d40. doi:10.1136/bmj.d40.
- Cohen J. A power primer. *Psychol Bull* 1992; 112:155–9. doi:10.1037/0033-2909.112.1.155.
- Hayes AF. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. 2nd ed. New York, NY: Guilford 2018.
- Cromwell JB, Hannan MJ, Labys WC, Terraza M. *Multivariate Tests for Time Series Models*. Thousand Oaks, CA: Sage 1994.
- Frayn M, Knäuper B. Emotional eating and weight in adults: a review. *Curr Psychol* 2018; 37:924–33. doi:10.1007/s12144-017-9577-9.
- Annesi JJ, Whitaker AC. Weight loss and psychologic gain in obese women-participants in a supported exercise intervention. *Perm J* 2008; 12:36–45. doi:10.7812/TPP/07-134.
- Arent SM, Walker AJ, Arent MA. The effects of exercise on anxiety and depression. In Tennenbaum G, Eklund RC. Eds. *Handbook of Sport Psychology*. 4th ed. Hoboken, NJ: Wiley 2020:872–90.
- Ling J, Zahry NR. Relationships among perceived stress, emotional eating, and dietary intake in college students: eating self-regulation as a mediator. *Appetite* 2021; 163:105215. doi:10.1016/j.appet.2021.105215.