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THE ROLE OF EMOTION REGULATION IN LONG-TERM WEIGHT LOSS
MAINTENANCE: A CROSS-SECTIONAL STUDY

A Thesis Presented

by

KARYN M. AIELLO

Submitted to the Office of Graduate Studies,

University of Massachusetts Boston,

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2022

Exercise and Health Sciences Program

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ABSTRACT

THE ROLE OF EMOTION REGULATION IN LONG-TERM WEIGHT LOSS
MAINTENANCE: A CROSS-SECTIONAL STUDY

August 2022

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M.S. Exercise and Health Sciences

Directed by Dr. Julie A. Wright

While many weight loss interventions have resulted in significant weight loss, maintaining that weight loss long-term continues to be challenging for most, with long-term weight loss maintenance (LTWLM) rates as low as 20% among participants of clinical weight loss studies. Those who struggle with LTWLM exhibit many shared characteristics, including lower mental health composite scores; high levels of perceived stress; and lower rates of adherence to WLM behaviors. One explanation for this might be that emotion regulation

(ER) skills are stronger among those who are successful at LTWLM, and therefore more successful at self-regulating for the goal of LTWLM.

The purpose of this study is to determine whether emotion regulation moderates the relationships between LTWLM/adherence to WLM behaviors and a) depression and b) perceived stress; hypothesizing that there is an inverse relationship between a) depression and b) stress with LTWLM—with difficulties in ER moderating these relationships. We hypothesized that this moderation may lead to weight regain by impacting adherence to WLM behaviors, with increased levels of depression/stress associated with decreased rates of adherence to WLM behaviors—with difficulties in ER moderating these relationships. Cross-sectional data were collected via an on-line self-report survey from participants who have lost at least 20 pounds (lbs.) of their highest adult lifetime body weight, measuring: a) amount of greatest weight loss; b) amount of weight loss maintained; c) length of time loss has been maintained/regained; d) degree of adherence to WLM behaviors; e) levels of depression; f) levels of perceived stress; and g) ER skill. Findings from 142 participants (mean age 36; 72% F/28% M; 81% white) confirm that there is a negative association between increased levels of depression ($p=0.018$) and/or stress ($p=0.046$) and LTWLM, however emotion regulation was not found to moderate either of these relationships ($p=0.339$ and $p=0.941$, respectively). No significant association between depression and/or stress and adherence to WLM behaviors ($p= 0.680$ and 0.483 , respectively), nor ER's moderating effect on these relationships ($p=0.713$ and 0.527 , respectively) were found.

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LIST OF ABBREVIATIONS

ABBREVIATION

DERS	Difficulties in Emotion Regulation
ER	Emotion regulation
FFM	Fat free body mass
LTWL	Long-term weight loss
LTWLM	Long-term weight loss maintenance
NWCR	National Weight Control Registry
REE	Resting energy expenditure
RMR	Resting Metabolic Rate
WL	Weight loss
WLM	Weight loss maintenance

CHAPTER 1
INTRODUCTION

Significance of Long-term Weight Loss Maintenance (LTWLM)

Obesity and overweight continue to be among one of the leading health concerns in the U.S., with the Centers for Disease Control and Prevention (CDC) reporting that over a third (36.5%) of Americans have obesity, a leading cause of death and significant health complications, including increased risk for heart disease, type 2 diabetes, hypertension, dyslipidemia, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems, and some cancers (CDC; Jensen et al., 2014; Pi-Syunyer et al., 2007). Obesity is also a costly condition; estimated annual medical costs for people with obesity are \$1,429 higher than those of normal weight individuals (CDC). In response to a huge spike in prevalence of overweight and obesity since the 1980's and 90's (CDC), a large and continuously growing body of research on weight loss has contributed to a better understanding of the determinants of overweight and obesity, as well as resulted in a plethora of various weight loss interventions, many of which have shown significant reductions in weight (most often defined as a loss of 10% or more of one's highest body weight; Gilmartin & Murphy, 2015). Despite this, however, *the majority of those who have lost weight are unable to maintain*

weight loss long-term (Dombrowski et al., 2014; Oshiek & Williams, 2011); see Table I for operational definition of LTWLM. For example, McGuire and colleagues (1999) noted that according to National Weight Control Registry (NWCR) data, of those who lost weight, 35% had gained back 5 or more pounds (lbs.) within their first year. In a randomized study using phone surveys, McGuire et al. (1999) also found that among the 54% of their total survey sample who had lost at least 10% of their body weight, only 47-49% of them were able to maintain the weight loss for at least one year, which dropped to 25-27% when maintenance was evaluated after 5 or more years. Wing & Hill (2001) similarly report that among clinical research weight loss studies, roughly 80% or more of participants fail to maintain their weight loss.

While even modest weight loss inarguably contributes to a significant improvement in health and reduction of obesity-related deaths and illnesses, these benefits are again lost once sufficient weight has been regained to reclassify an individual as overweight or obese. Therefore, there is a need to further identify what barriers still exist between weight loss and long-term weight loss maintenance (LTWLM) for the majority of individuals seeking to maintain weight loss. In response to this need, recent research is focusing more on determinants of and/or barriers to LTWLM, including randomized control trials (RCTs) of interventions specifically focused on maintenance of weight loss (Levy et al., 2010). Despite being specifically designed for long-term maintenance, most of these studies have found only modest improvements to long term weight loss maintenance (Gilmartin & Murphy, 2015; Wing et al., 2009).

Purpose: Emotion Regulation (ER) as a Potential Moderator between Depression, Perceived Stress and LTWLM

Much literature to date on LTWLM has shown that those who are unable to maintain LTWL are not only significantly more likely to report difficulty in maintaining behaviors necessary for WLM but are also significantly more likely to have high levels of depression and perceived stress (Ogden et al., 2012; Wing et al., 2008). Although teaching weight loss maintainers to avoid the use of food as an ER technique is critical to LTWLM, a more effective approach might be to proactively foster adoption of healthy ER skills overall. Rather than focusing on the elimination of only a few ER techniques known to sabotage LTWLM, promoting the adoption of adaptive ER skills may provide maintainers with a broader set of tools to cope with all emotions in ways that do not undermine LTWLM efforts. Furthermore, promotion of adaptive ER skills would likely have the additional benefit of reducing overall levels of depression and perceived stress among a subset of WL maintainers who report higher levels of these distressing emotions (Sumithran & Proietto, 2013; Wester, 2014), improving one's emotional and psychological health in addition to facilitating LTWLM. While these principles have been indirectly employed in studies which emphasize an acceptance/mindfulness-based approach toward WL and WLM, the direct relationship between ER strength and LTWLM has yet to be established (Fulwiler et al., 2016; Lillis & Kendra, 2014; Lillis et al., 2009). Theoretically, adaptive emotion regulation skill may play a role in LTWLM success by way of improving one's ability to manage the intensity and duration of one's emotions, thereby making adherence to self-regulatory behavior easier.

The purpose of this study is to determine whether the associations between LTWLM

success/adherence to WLM behaviors and: a) depression and b) perceived stress are moderated by emotion regulation. Should these relationships exist, it may provide support for more in-depth studies on the role ER skill and overall psychological/emotional health play in successful LTWLM.

Hypotheses

Hypothesis 1a: There is an inverse relationship between depression and LTWLM such that higher levels of depression are associated with a lower level of LTWLM.

Hypothesis 1b: There is an inverse relationship between perceived stress and LTWLM such that higher levels of perceived stress are associated with a lower level of LTWLM.



Figure 1: Model of Hypotheses 1a & 1b

Hypothesis 2a: The inverse relationship between depression and LTWLM is moderated by emotion regulation strength such that the negative association between depression and LTWLM is less pronounced among individuals with lower levels of difficulties in ER (DERS), compared to those with higher levels of difficulties in DERS.

Hypothesis 2b: The inverse relationship between perceived stress and LTWLM is moderated by emotion regulation strength such that the negative association between

perceived stress and LTWLM is less pronounced among individuals with lower levels of DERS, compared to those with higher levels of DERS.



Figure 2: Model of Hypotheses 2a & 2b

Hypothesis 3a: There is an inverse relationship between depression and adherence to WLM behaviors such that higher levels of depression are associated with less adherence to WLM behaviors.

Hypothesis 3b: There is an inverse relationship between perceived stress and adherence to WLM behaviors such that higher levels of perceived stress are associated with less adherence to WLM behaviors.

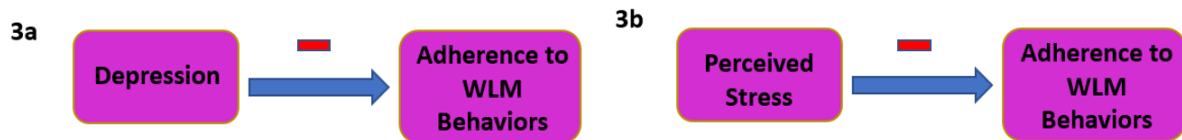


Figure 3: Model of Hypotheses 3a & 3b

Hypothesis 4a: The inverse relationship between depression and adherence to WLM behaviors is moderated by emotion regulation strength such that the negative association between depression and adherence to WLM behaviors is less pronounced among those who have lower levels of DERS, compared to those who have higher levels of DERS.

Hypothesis 4b: The inverse relationship between perceived stress and adherence to WLM behaviors is moderated by emotion regulation strength such that the negative

association between perceived stress and adherence to WLM behaviors is less pronounced among individuals who have lower levels of DERS, compared to those who have higher levels of DERS.

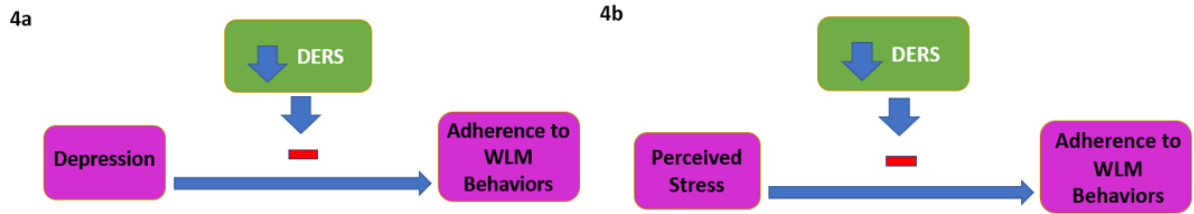


Figure 4: Model of Hypotheses 4a & 4b

Operational Definitions

The hypotheses presented above will be tested using the following operational definitions of variables being examined, as seen in Table 1, below.

Table 1. Operational Definitions and Measurement of Variables

Variable to be Measured	Operational Definition	Measures
Dependent Variable: LTWLM Success	Successful maintenance of a weight loss of at least 20 lbs. for a minimum of 1 year	Weight and medical history survey
Dependent Variable: WLM Behaviors	Adherence to behaviors necessary for LTWLM success: portion control; increased PA; decreased dietary disinhibition; regular self-weighing; avoidance of triggers to over-eat	Weight Control Strategy Scale (WCSS);
Moderating Variable: Emotion Regulation	Acceptance of experienced emotion so as to allow the modulation of its intensity and duration, allowing engagement in behavior which aligns with goals and inhibits impulsive, inappropriate, or behaviors incongruent with one's desired goals (Gratz & Roemer, 2004)	Difficulties in Emotion Regulation Scale (DERS)

Independent Variable: Perceived Stress	As defined by the PSS-14	Perceived Stress Scale (PSS-14)
Independent Variable: Depression	As indicated by the presence of depressive symptomatology	Center for Epidemiological Studies (CES-D), NIMH

CHAPTER 2

LITERATURE REVIEW

Behavioral and Psychological Correlates of WLM

Literature in the field of weight loss and WLM to date has identified a great number of predictors and correlates to both weight loss and WLM. It is now widely accepted that behaviors such as: higher than recommended levels of energy expenditure through physical activity (~1,000 calories per day compared to 500 in weight re-gainers); lower levels of binge eating (implying greater dietary control than those that regain); avoidance of situations that encourage overeating; avoidance of fast food; greater attention to portion sizes; eating breakfast; eating several times throughout the day to stave off hunger; less TV time; self-monitoring behaviors such as frequent self-weighing and calorie counting, and fewer changes in psychological characteristics are predictive of weight loss and LTWLM (Thomas et al., 2009; Valek et al., 2015; Wing et al., 2008). Despite this widely-held knowledge, maintenance of weight loss is still elusive to most who successfully lose weight. In an effort to identify common barriers of WLM, further research has similarly identified now widely accepted predictors of and correlates to weight regain, such as: increased changes in psychological characteristics; increased depressive symptoms; increased disinhibition and

hunger; and higher levels of perceived stress (Brantley, 2014; Ibrahim et al., 2016; Thomas et al., 2009; Valek et al., 2015; Wing et al., 2008).

Physiological Adaptations to Weight Loss

Many physiological adaptations to significant weight loss partially explain why maintaining weight loss is so challenging. When significant amounts of weight are lost, the body exhibits responses which decrease resting metabolic rate; increase hunger hormones; and activate areas of the brain which control dietary inhibition (Greenway, 2015; Johannsen et al., 2012; Myers et al., 2011), with many of these adaptations being shown to persist over time (Fothergill et al., 2016). In a study by Johannsen et al. (2012), 16 severely obese participants lost an average of 1/3 of their starting body weight after 30 weeks of dietary restriction and a vigorous exercise routine designed to preserve fat-free body mass (FFM; i.e., muscle). Despite the relative preservation of FFM in this study, participants showed significantly diminished resting metabolic rates (RMR) of 504 +/- 171 kcal per day than could be accounted for by reduced body mass alone. Therefore, it is inherently more difficult for a reduced-weight person to maintain that weight than it is for an individual of similar weight who has never undergone a body weight reduction of 10% or more, simply because the energy expended by a reduced weight individual is approximately 500 calories less per day than that of their steady-weight counterpart. The reduced weight individual must ingest significantly fewer and/or expend significantly more calories per day to maintain energy balance.

While the behavioral demands of maintaining weight loss necessitate significantly more restrictive food intake and significantly more energy expenditure, there are additional physiological responses which simultaneously make sustaining those behaviors much more difficult. Circulating levels of leptin (an appetite suppressing hormone secreted by adipose tissue) significantly decreases in response to reduced fat stores (weight loss). Leptin is responsible for communicating the presence of sufficient fat stores, which promotes reduced food intake and increased energy expenditure (Myers et al., 2011). When fat stores have been depleted, the significant reduction of leptin secretion triggers increases in hunger inducing hormones such as ghrelin while hunger inhibiting hormones such as peptide YY (PYY), Cholecystokinin (CCK), and amylin are significantly reduced. The net effect of these changes in hunger-regulating hormones is an overall increase in appetite in weight reduced individuals, which promotes weight regain (Greenway, 2015).

Despite these physiological barriers to weight loss maintenance, long-term weight loss maintenance has been proven to be successful among a subset of those who are able to lose a significant amount of weight (Thomas et al, 2009; Valek et al., 2015; Wing et al., 2008). Much research has been done to determine what predicts long-term weight loss maintenance success, even in the face of such strong physiological resistance to WLM. Many correlates and determinants to LTWLM have been identified, although translation of these predictors of WLM success to the majority of those who successfully lose weight has yet to be demonstrated, indicating that we have either not yet identified all predictors of WLM success, and/or have not sufficiently identified the barriers to consistent adherence to WLM

behaviors and cognitions which continue to preclude the majority of those who lose a significant amount of weight from maintaining it long-term (Dombrowski et al., 2014; Oshiek & Williams, 2011).

Depression and Perceived Stress as Correlates to Weight Regain

In an attempt to define ways in which those who are successful at LTWLM differ from those who are less successful, Ogden et al. (2012) conducted a cluster analysis on roughly 2,000 registrants in the National Weight Control Registry (NWCR). They found 4 clusters that uniquely describe WLMs. “Typical” maintainers comprised 50.5% of WLMs in this study, which reported the highest rates of current weight satisfaction and lowest levels of stress and depression. 26.9% of WLMs were defined as “Struggling” with WLM. This group reported the greatest rates of weight cycling (25.6% in the past year); had the greatest proportion of those trying to lose weight (84.1 %); and the highest rate of major depression prior to weight loss, in addition to 27% of those successfully maintaining long-term weight loss reporting to “struggle” to maintain their weight. This group also had the greatest number of participants reporting WLM to be a challenge, citing particular difficulty maintaining weight during stressful or transitional time periods, such as when on vacation, when sick, when under stress (in addition to reporting the lowest rates of being able to cope with stress) or during seasonal changes. Two additional clusters; “immediate and long-term success” (12.7%) and “less PA” (9.9%) were also identified, though there were no particularly noteworthy variations in their levels of stress and depression.

Additional studies have also looked at the potential influences that negative psychological characteristics and stress appear to have on weight change. For example, in a weight loss intervention study, Wing et al. (2008) found a significant association between increases in depression and weight regain ($p < .0001$), with increases in Beck Depression Inventory scores at follow up of 3.88 units being associated with a 0.95 kg (95% CI = 0.676, 1.222) greater weight gain. In a prospective, observational study, Ibrahim et al. (2016) sought to examine whether perceived stress, emotional eating, anhedonia (an inability to feel pleasure), depression, dietary restraint, hunger and disinhibition were psychological predictors of weight change in a sample of 65 healthy adults not engaged in a weight loss intervention. Their findings showed a correlation in both the short- (6 months) and long-term (12 or more months) between perceived stress and weight gain. In the short term, they found that a 5-point increase in the perceived stress scale was associated with a 0.95 kg weight gain, as well as a significant interaction between perceived stress and positive emotional eating ($p = .009$), with those scoring higher on the perceived stress scale and higher on the positive emotional eating scores gaining the most weight (2.8 +/- 5 kg) compared to (1.1 +/- 3 kg) those scoring high on perceived stress and lower on positive emotional eating scores. Interestingly, in their long-term follow-ups, anhedonia became a significant contributor to the relationship between depression and weight maintenance, with those scoring lower on depression tending to maintain weight; those scoring high on depression and high on anhedonia gaining weight (2.9 +/- 5 kg); and those scoring high on depression and low on anhedonia losing weight (-1.6 +/- 5 kg), suggesting that many emotions, and not only negative emotions, may lead to dysregulation of WLM; and that the ability to experience positive emotions even in the

presence of increased rates of depression may serve as a protective factor against increased rates of regain among those who score higher in depression.

With so many emotional correlates between low emotional health and weight regain, it seems as if one way to improve rates of LTWLM among those who struggle with WLM, many of whom seem to struggle with emotional and psychological health, might be to focus on the improvement of adaptive ER skills for overall emotional health, which may in turn improve psychological and emotional health overall, and/or increase adherence to behaviors necessary for LTWLM. For example, Ibrahim et al. (2016) indicated that both short- and long-term findings support the importance of investigating the role of ER in LTWLM. In relation to their short-term findings, lower reported levels of perceived stress could potentially be contributed to stronger ER skills in these individuals, allowing them to more easily adhere to self-regulatory behaviors consistent with WLM. The long-term relationships found between depression, anhedonia and weight change might also be explained through ER skill; those who report high depression levels, but low anhedonia might have stronger ER skills to cope with higher levels of depression, in turn increasing the ease with which these individuals are able to self-regulate with the goal of continued adherence to WLM behaviors, even in the presence of dysregulated emotions.

While many interventions to address the emotional and psychological correlates of WLM have been developed, with proven efficacy, they primarily focus on avoiding the use of food as an emotion regulation (ER) technique specifically, instead of focusing on promoting

overall ER skill and emotional/psychological health of struggling WLMs. As noted by Lillis and Kendra (2014), “Generally speaking, standard behavioral therapy focuses on behaviors only as they relate to weight control efforts... Thus, if work, or relationships, or general psychological struggles come up in treatment, they are discussed only to the extent that they directly relate to specific instances of eating, sedentary behavior, or poor self-monitoring of food intake.” Kendra (2014) notes that the problem with focusing on emotion regulation only as it relates to WLM behavior is that overeating and sedentary behavior is often associated with psychological struggles, which we already know to be significantly higher in populations who struggle with WLM. Therefore, by focusing only on behavior change, we fail to address the emotional and psychological barriers to WLM behavioral adherence. In other words, we are treating the symptom (poor behavioral adherence) and not the underlying cause (emotional/psychological distress). Additionally, by failing to address the underlying emotional distress being experienced by the maintainer, we do nothing to combat the simultaneous physiological response to stress, which has been shown to be correlated with higher rates of obesity and weight re-gain (Annesi, 2016; Ibrahim et al., 2016; Oshiek & Williams, 2011; Valek, 2015; Wing, 2008). Studies that have looked at the relationship between levels of cortisol, a stress-regulated hormone, and rates of overweight and obesity have found that long-term exposure to cortisol is significantly greater in obese compared to normal weight individuals (Wester, 2014). Furthermore, excess cortisol levels have been shown to lead to weight gain and regain (Sumithran & Proietto, 2013); in a study by Doucet et al. (2000), increased levels of fasting plasma cortisol as well as increased appetite were observed in a sample of men and women who had recently undergone a weight loss

intervention. In a study of rats (Wester, 2014), cortisol was also found to diminish the appetite suppression effect of leptin, a primary hormone involved in homeostatic hunger regulation. The relationship that has been demonstrated between increased levels of cortisol and weight gain suggest that ER may be an important skill to promote adherence to WLM behaviors, but that it also may be important in contributing to the regulation of various hormones and other biological responses to negative emotions, such as stress, that have also been linked to increased body weight.

Self-Regulation for LTWLM

Self-regulation refers to one's ability to manage thoughts, emotions, and behaviors in ways consistent with achieving a specific goal(s). Nader-Grosbois (2011) describes self-regulation as the use of neuropsychological processes which “permit the physical, emotional and social self-control necessary to maintain goal oriented-actions,” which “include inhibition of responses, working memory, shifting attention, cognitive flexibility, planning of actions and fluency” (Corbett et al., 2009). WLM research has identified self-regulatory skill as an important determinant of successful WLM (Annesi, 2016; Vieira et al., 2013), finding significantly higher self-regulation skill in those who maintain weight loss. If self-regulation is critical to LTWLM, then those who struggle with emotion regulation (one's ability to manage one's emotions—a necessary component of self-regulation) may find it challenging to consistently align their thoughts and emotions with WLM consistent behaviors, partially explaining why this subpopulation of WL maintainers inconsistently adhere to behaviors necessary for LTWLM, despite their reported desire to maintain weight loss.

Emotion Regulation: An Integral Component of Self-Regulation

Emotion regulation pertains to one's ability to manage duration and intensity of emotions. Theoretically, the stronger one's adaptive emotion regulations skills are, the easier it will be for one to successfully self-regulate, as they would be better at aligning emotions with behaviors consistent with LTWLM. Leehr (2015) describes emotion regulation as a set of processes by which an individual "assesses, controls and modifies his or her spontaneous emotional responses in order to accomplish his or her goals or to express socially adequate emotional behavior...a person may modify the type of his or her emotional states and the duration of his or her emotional responses or their intensity: the regulation may amplify or inhibit emotional responses using various strategies" (Nader-Grosbois, 2011). Gratz and Roemer (2004) expand upon this definition of emotion regulation to differentiate ER strategies which are adaptive vs. maladaptive, defining maladaptive ER skills as those which allow an individual to regulate their response to emotion (particularly negative emotion) by suppression of the emotion itself, which has been shown to actually increase physiological arousal as well as underlie many psychological disorders (Gross & Levenson, 1997; Stewart et al., 2002; Szczygiel & Maruszewski, 2015). In contrast, they define adaptive emotion regulation skills as those which incorporate acceptance of the emotion being experienced so as to allow the modulation of its intensity and duration, allowing the individual to engage in behavior which aligns with their goals and inhibit impulsive, inappropriate, or behaviors incongruent with one's desired goals (Gratz & Roemer, 2004). This definition of adaptive ER is similar to self-regulation in that it describes the outcome of behavior as dependent

upon one's ability to manage one's internal experiences in ways which lead to desired behavior (or avoidance of undesired behavior). According to Gratz & Roemer (2004), adaptive ER involves "a) awareness and understanding of emotions, b) acceptance of emotions, c) ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions, and d) ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands." Deficiencies in any or all of these skills would "indicate the presence of difficulties in emotion regulation, or emotion dysregulation."

If self-regulation is weaker in populations who have trouble maintaining, a next question to ask might be how to make self-regulation easier for individuals who apparently struggle with it. If research has found a repeated pattern of both low self-regulatory skill and low emotional health in those who struggle to maintain weight loss (Annesi, 2016; Vieira et al., 2013), perhaps a focus on improving *emotional* regulation might in turn make self-regulation easier. Increased management of emotion intensity may in turn reduce the amount of effort it takes to regulate those emotions concurrently with regulation of thoughts and behaviors consistent with WLM; as well as potentially moderate the physiological response to negative emotion, in turn improving WLM success.

Preliminary Support for ER's Role in WLM

Many weight loss and weight loss maintenance studies which strengthen ER skill as part of their interventions have shown significantly higher rates of weight loss and weight loss

maintenance. For example, cognitive-behavioral interventions aim to improve mental health through strengthening one's ability to re-frame negative cognitive thoughts, feelings or beliefs, thereby improving one's ability to regulate emotion and behavioral responses (Mayo Clinic, 2017). In a review of 12 weight loss studies with a cognitive-behavioral intervention, Jacob et al. (2018) found that participants of the cognitive-behavioral intervention groups lost an average of 1.7 kg more weight; and a mean improvement of 0.72 in cognitive restraint (the ability to consciously limit and monitor food intake to achieve or maintain weight in response to emotional eating), despite the fact that improvements in depressive symptoms were not statistically significant.

Acceptance-based (Lillis & Kendra, 2014; Lillis et al., 2009) and mindfulness-based (Fulwiler et al., 2016) interventions have also shown promising WLM results. Lillis and Kendra (2014) reviewed two RCTs which both showed significant improvements in WLM after just a one-time Acceptance-Commitment Therapy (ACT) based workshop. In one study (Lillis et al., 2009), participants who had recently completed a weight loss program and attended a one-day, 5-hour, ACT workshop (with no incorporation of weight-influencing interventions) lost an additional 1.6% of their body weight, compared to the control group which gained 0.3% at a 3-month follow-up, with a significantly higher proportion of ACT participants maintaining or losing weight. In the second study reviewed by Lillis & Kendra (Tapper et al., 2009), women already trying to lose weight either attended a 2-hour, one-day ACT workshop (again, with no incorporation of weight-influencing interventions) or were assigned to a no-treatment group. Women from the ACT group who reported adhering to the

principles learned in the ACT workshop showed a significantly greater decrease (2.3 kg) than those who reported never applying them (Tapper et al., 2009). Finally, Lillis and Kendra (2014) propose that WLM treatment models which integrate both standard behavioral therapy and acceptance-based treatment could significantly improve rates of WLM by focusing on the dissemination and reinforcement of behavioral skills necessary for LTWLM, which would be supplemented by an acceptance-based treatment. The acceptance-based treatment would provide skills for persisting with WLM behaviors when faced with thoughts, emotions, and events which challenge adherence to WLM behaviors.

While these early studies—which rely on the improvement of overall ER—show promising improvements in LTWLM success, the underlying relationship between ER strength and WLM has yet to be explicitly demonstrated. Identifying a significant correlation between strong adaptive ER and greater LTWLM success could explain how and/or why these interventions may be more effective at increasing rates of successful LTWLM. Acceptance and mindfulness-based interventions have become increasingly popular in treating a wide variety of psychological disorders, particularly in the treatment of anxiety and depression, and many studies have shown that these interventions significantly improve ER (Carlbring et al., 2013; Mennin et al., 2015). Improved ER could, therefore, improve management of stress and depression among those who struggle to maintain weight loss—a population which also exhibits high scores of stress and depression (Ogden, 2012; Oshiek & Williams, 2011). Better ER skill may improve this specific population’s ability to self-regulate generally, including for the purpose of LTWLM, and/or reduce the body’s WLM-resistant physiological

responses to stress and depression, explaining why interventions focused on improving ER result in greater rates of LTWLM than weight loss/weight loss maintenance studies typically find (Dombrowski et al., 2014; Oshiek & Williams, 2011; Wing & Hill, 2001).

Although no studies to our knowledge have looked at the explicit relationship between emotion regulation and LTWLM, there is currently a study under-way at the University of Massachusetts Medical School testing to see if a mindfulness-based stress reduction intervention will benefit LTWLM through improved behavior change maintenance (Fulwiler et al., 2016). Fulwiler and colleagues (2016) hypothesize that the challenge to maintain weight loss after behavioral intervention may be partially due to failure of these behavioral interventions to target stress and emotional reactivity—which in turn dampen adherence to behavior change. Investigators will enroll 80 participants who intentionally lost and intend to maintain $\geq 5\%$ of their body weight in the past year into a randomized control study in which one group will receive a mindfulness-based intervention and a control group, who will receive a “healthy living course” with a similar intervention structure and format focused on health education instead of mindfulness. Participants will be assessed at baseline, 6 months, 8 months, and 12 months (on self-reported weight only, via phone survey) for functional connectivity (via fMRI); psychological factors, health behaviors, BMI and waist circumference. The study aims to determine if there’s a significantly positive association between mindfulness practice and improvements to functional connectivity, change in psychological factors, depression, and maintenance of weight loss over time, as compared to the healthy living course control group. If results of this study support the relationship

between increased mindfulness skills as hypothesized, which are known to assist in emotion regulation skill development and application (Carlbbring et al., 2013), this could provide indirect support to the hypothesis that increased emotion regulation skill will be correlated with greater LTWLM success.

Although there is a lack of research examining the relationship between ER and WLM, research on ER's role in binge-eating disorder (BED) has provided support for the idea that binge-eating disordered patients turn to binge eating to regulate negative emotions (Brockmeyer et al., 2014). Therefore, a similar relationship between difficulties in ER and those who struggle with LTWLM in those without BED might also exist. In a review of 15 studies in which emotion was manipulated in obese participants with and without BED, most (9 out of 15 studies) showed a consistent pattern of negative emotion induced binge eating or overeating (Leehr, 2015). In 2 of these studies, an increase in reported cravings and food intake after negative emotion induction was observed in obese participants (without BED) who also had negative affect (Leehr, 2015). Since low affect can be an indicator of negative emotional state, this might suggest that in overweight/obese participants without BED, those who were both stress-induced and in a negative emotional state were less able to regulate the negative emotions in a way consistent with maintaining self-regulatory WLM behaviors. The authors note, however, a significant lack of studies which investigate whether induced stress can trigger binge eating episodes in non-BED overweight/obese individuals (only 2 are included in the review), and more studies are needed to determine if negative affect leads to binging behavior; and if so, if strength of ER moderates this relationship.

Logic Model

For the purposes of this study, and in synthesizing the above literature, we propose the following logic model in examining several different potential pathways by which associations between depression and/or perceived stress may influence LTWLM success: 1) There is an inverse relationship between depression and/or perceived stress with LTWLM such that greater levels of depression and/or stress are associated with lower rates of success with LTWLM; 2) that these relationships might be moderated by ER such that greater ER skill strength is associated with greater rates of LTWLM success; 3) that there is an inverse relationship between depression and/or stress such with adherence to WLM behaviors such that greater levels of depression and/or stress are associated with less adherence to WLM behaviors; and 4) that these relationships might be moderated by ER such that greater ER strength is associated with more adherence to WLM behaviors.

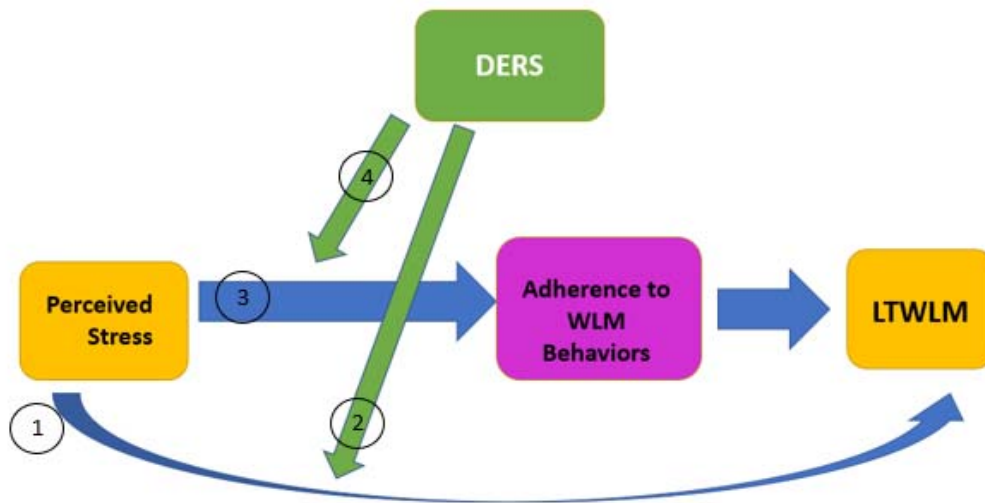
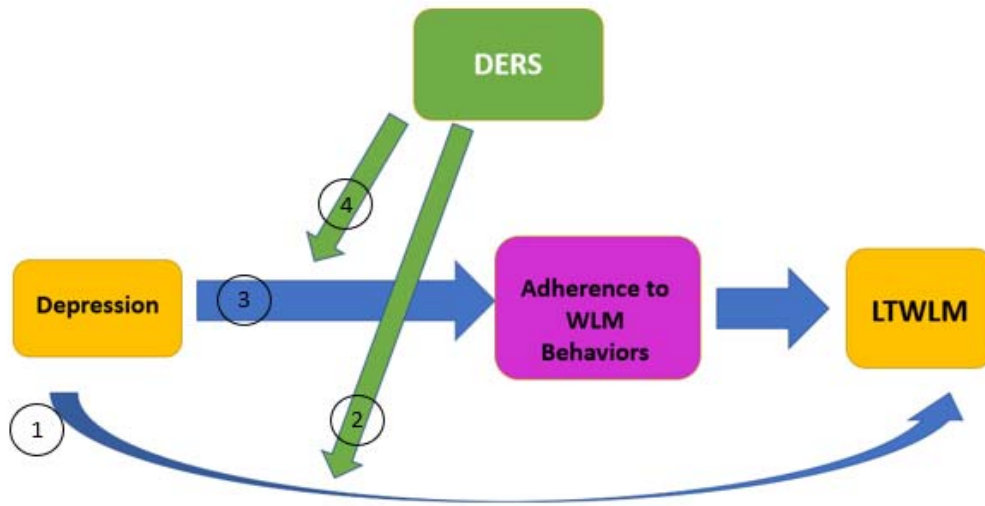


Figure 5: Logic Model of ER's Moderation of LTWLM & Depression/Perceived Stress/WLM Behavioral Adherence

CHAPTER 3

METHODS

Study Design

A cross-sectional study design was used in which participants self-reported responses to an on-line survey designed to measure success in LTWLM; adherence to WLM behaviors; emotional regulation skill; perceived stress; and depression. These variables were measured using a compilation of validated measures listed and described in Table 1. For the purposes of the present study, LTWLM is defined as maintenance of a weight loss of at least 20 lbs. for at least 1 year.

Participant recruitment

IRB-approved participant recruiting techniques were used, including recruitment through the University of Massachusetts Broadcast e-mail system; posting of paper and electronic fliers across campus and at nearby (the Greater Boston area) gyms, weight loss centers (excluding those which use surgical or extreme methods, defined in participant exclusion criteria below), and through Facebook recruitment. Recruiting materials invited participants who met key criteria to complete a secure on-line survey, which included information on how to anonymously enter a raffle to receive 1 of 6 \$25 Amazon gift cards upon survey completion as participation incentive and compensation.

Procedures

A one-time online survey was administered using Qualtrics Analytics software, (Version September, 2020; 2020) between the dates of September 23, 2020 and January 5, 2022. IRB approval was obtained from the University of Massachusetts Boston Institutional Review Board. Full participation included informed consent, a screening survey, and responses to at least 90% of all main questionnaires (WCSS, DERS, PSS14 and CESD; see Appendices A-H). Participants were required to confirm their consent in order to advance to the screening and survey questionnaires. To keep participants blind to the study hypotheses, the consent informed participants that we are interested in learning more about the differences between those who maintain weight loss long-term and those who struggle to maintain weight loss over time. To prevent participants from inferring hypotheses, weight history information was collected first, followed by WLM behavior, then psychological and emotional assessments. The last page of the survey explained how to enter a random drawing for 1 of 6 \$25 Amazon gift cards; a link provided on the same page routed participants to a separate site disassociated from their survey responses where they could leave their email contact information. Emails were assigned a number and 6 numbers were drawn to determine raffle winners, who were then contacted by email to confirm use of the provided email address to receive the gift card electronically.

Informed Consent

Upon entering the on-line survey, participants were asked to read an informed consent document (see Appendix A) and to indicate their consent to enroll in the study by clicking on “Yes, I consent to participate in this research study. I certify that I am 18 years of age or older (or at least of legal adult age in my location).” Clicking on this consent statement was required for advancement into the survey; therefore, those who did not provide consent were unable to provide survey data. Informed consent included information about the purpose of the study; eligibility for the study; anticipated length of time the study would take to complete (~30 minutes); incentive for study participation and how to enter the Amazon gift card raffle; type of data to be collected; methods for insuring data anonymity and confidentiality; potential risks and benefits to participation; contact information of the research team; contact information and location of the UMass Boston IRB; contact information and location of the UMB Counseling Center (for UMB participants) and general contact information for mental health resources. Those who provided consent were directed to the participant screening survey.

Participant Screening

A screening survey (see Appendix B) preceded the full survey to screen out participants who did not meet key eligibility criteria. When a participant replied to any screening question in a way that indicated they did not meet eligibility criteria, they were directed to a different screen (not connected to their survey responses) which terminated the survey and provided the following message: “Thank you for taking the time to participate in our survey.

Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey or shared with any third parties.”

Inclusion criteria. Included in the study were men and women currently between the ages of 18 and 70 who have ever intentionally lost at least 20 lbs. during the same age range, whether none, all, some, or more of originally lost weight was regained over time.

Exclusion criteria. Participants were excluded if their weight loss was obtained as a result of the use of a liquid, starvation (fewer than 1,200 calories per day) or other extreme dieting technique(s); bariatric surgery; prescription medications for weight loss; or illness.

The age range of 18-70 years was selected in order to a) recruit a population comparable to other studies on WLM, which focus on adult participants typically under the age of 70; and b) to exclude children who naturally gain weight as part of their development and therefore cannot be similarly compared to weight loss maintenance trends among adults. Initially, a minimum weight loss of 30 lbs. was selected as an inclusion criterion, which was decided based on results of the 2012 NWCR Cluster Analysis study by Ogden et al., which found that those who reported “immediate and long-term success” with weight loss and maintenance had a significantly lower maximum body weight (BMI of 32 on average) and therefore were maintaining the smallest amount of weight loss (~50 lbs.) over a longer period of time (~11 years on average) than those who reported to “struggle” with LTWLM (on average, maintaining a weight loss of about 100 lbs. with 84% of participants currently trying to lose

weight). A 30 lb. weight loss for most individuals who have a current BMI within the “normal” range indicates that the highest lifetime BMI prior to weight loss would have been at least 32, the point at which weight begins to be classified as “obese.” Because most individuals are not aware of their BMI value, we chose to advertise the criterion as “at least a 30 lb. weight loss”, a measurement that is much more familiar to participants, which we believed would yield more accurate responses. After approximately 7 months of recruiting, we modified this criterion to a loss of at least 20 lbs.—still consistent with other definitions of successful LTWLM used in many studies on WL and WLM—due to difficulty recruiting enough participants who lost at least 30 or more lbs.

Measures

Questionnaires used to assess the primary variables needed to assess the hypotheses are defined in Table 2. A copy of each full questionnaire is available in the Appendix, including a questionnaire developed by researchers to assess demographics and weight loss variables.

Demographic Questionnaire. The full study begins with a demographic questionnaire for the collection of age, race, ethnicity, gender and socioeconomic status.

Weight and Medical History Questionnaire. A weight and medical history questionnaire was developed by researchers in order to collect data about amount of weight loss; timing of weight loss; weight loss methods; whether medications known to affect weight were taken during the weight loss period; and whether participants have gone through or are currently going through menopause. Questions include items such as “Since the age of

18 how many weight loss attempts have you made?” and “How many months or years did you maintain that weight loss within 5-10 lbs.?”

Responses to the Weight and Medical History questionnaire were used to create the variables of “Original WL” (highest weight – lowest weight); “Percent WL” (original WL/highest adult weight); “Current BMI” (lbs./in² * 703); “Amount of WL Maintained” (highest weight-current weight); “Percent of weight loss maintained” (Amount of WL Maintained/Original WL); “Years WL has been maintained” (year current weight recorded – year lowest weight recorded) and “WLM Success” (categorized as “successful” if variable “Amount of WL Maintained” is at least 20lbs. and variable “Years WL has been maintained” is at least 1 year).

Difficulty in Emotion Regulation Scale (DERS). Emotion regulation ability was assessed using the Difficulties in Emotion Regulation Scale, developed by Gratz and Roemer (2004), which measures for the presence of difficulties in ER across six factors: a) Nonacceptance of emotional responses (the tendency to have negative secondary emotional responses to one’s negative emotions); b) difficulties engaging in goal-directed behavior in the presence of negative emotions; c) impulse control difficulties (lack of behavioral control when experiencing negative emotions); d) lack of emotional awareness; e) limited access to emotion regulation strategies (the belief that little can be done to regulate emotions in the presence of negative emotions); and f) lack of emotional clarity (the extent to which one knows the emotions being experienced). The DERS had high internal consistency with a Cronbach’s alpha of .93 for the overall scale, and a Cronbach’s alpha of .80 or above in each subscale ($\alpha = .85$ for Nonacceptance; .89 for Goals; .86 for Impulse; .80 for Awareness; .88

for Strategies; and .84 for Clarity). Construct validity was demonstrated with significant correlations in the expected directions between the DERS overall scores and previously validated measures of a) mood regulation (as measured by the Generalized Expectancy for Negative Mood Regulation Scale: $r = -.69, p < .01$); b) experiential avoidance (as measured by the Acceptance and Action Questionnaire: $r = .60, p < .01$); and c) emotional expressivity (as measured by the Emotional Expressivity Scale: $r = -.23, p < .01$). Test-retest reliability was examined using a second sample of participants recruited from the original test sample to re-take the DERS 4-8 weeks later. Correlations between the first and second administration of the DERS were computed and found to be $\rho_1 = .88, p < .01$. Test-retest reliability was also found among subscales ($\rho_1 = .88$ for nonacceptance; $\rho_1 = .69$ for goals; $\rho_1 = .57$ for impulse; $\rho_1 = .68$ for awareness; $\rho_1 = .89$ for strategies and $\rho_1 = .80$ for clarity with all $p < .01$). The scale asks participants to rate how often each of the 36 survey items apply to themselves using a scale of 1 (*almost never*) to 5 (*almost always*). For the purposes of the current study, the DERS overall score was used in calculating the relationships between the variables being tested, as our primary interest was in the moderating role overall ER skill may play in LTWLM, and not in examining the individual impacts of each ER subscale. Sample items include “I have no idea how I am feeling” and “When I’m upset, I feel like I can remain in control of my behaviors.” Instructions for calculating the DERS overall score were used to create the variable “Difficulties in Emotion Regulation (DERS)”: reverse-scored items were multiplied by -1 and then summed to get a total score. For those who did not complete all questions (13 participants), mean imputation was used to substitute missing values.

Weight Control Strategy Scale (WCSS). To assess engagement with behaviors believed to be integral to weight loss and weight loss maintenance, the Weight Control Strategies Scale (Pinto et al., 2013) was used. This scale was developed to assess behavioral skill, dietary behaviors, physical activity behaviors and psychological coping skills. Participants are asked to respond on a scale of 0 (*never*) to 4 (*always*) to 30 questions across 4 subscales: Dietary Choice (10 items); Self-Monitoring (7 items); Physical Activity (6 items); and Psychological Coping (7 items). Mean subscale scores are calculated by summing the item scores within each subscale and dividing by the number of items in that subscale. A total mean score is computed by summing all item scores and dividing by 30. The total mean score comprised of all sub-scales was used for the variable “Adherence to WLM Behaviors (WCSS)” for the present study. For those who did not complete all items in the WCSS (15 participants), the total mean score was calculated by dividing their total score by the number of questions that were answered (all participants completed at least 28 survey questions).

Tests of the WCSS performed by Pinto et al. (2013) demonstrated good internal consistency, with a Cronbach’s alpha coefficient of .87 in the dietary choices subscale; .89 in the self-monitoring subscale; .88 in the physical activity subscale; and .79 in the psychological coping subscale. Pinto et al. also validated the WCSS against the Eating Behavior Inventory, with significant correlations between WCSS subscale scores and energy intake; fat intake; and energy expenditure. Convergent validity was demonstrated such that the dietary choices subscale was found to be negatively related to daily calories consumed ($p = .004$) and percent of calories consumed from fat ($p = .001$); and the physical activity

subscale was found to be positively correlated to weekly calories expended through physical activity ($p < .001$). Additionally, higher total WCSS scores (indicative of higher use of weight management strategies) at baseline were negatively related to baseline weight ($r = -.28, p = .001$). Construct validity was evaluated by Pinto et al. using additional data on dietary intake, physical activity, treatment session attendance, and weight change from a subsample of participants before and after a 48-week weight loss program. They found three of the four subscale scores increased significantly over the course of the weight loss treatment in correlation with session attendance, with correlation coefficients of: $r_p = .40, p < .001$ for the self-monitoring subscale; $r_p = .27, p = .004$ for the physical activity subscale; and $r_p = .20, p = .031$ for the psychological coping subscale. Finally, change in total WCSS score from baseline to 48 weeks was significantly related to mean weight loss at the end of treatment ($M = -5.3 \pm 6.6$ kg) both before ($r = -.48, p < .001$) and after ($R^2 = .18, p < .001$) adjusting for covariates.

Perceived Stress Scale (PSS-14). Perceived stress was measured with the Perceived Stress Scale (PSS-14) developed by Cohen and colleagues (1983). Reliability was tested in 3 populations: a group of 332 college freshmen (118 males and 209 females); a group of 114 (53 females and 60 males) college students enrolled in an Intro to Personality Psychology course; and a group (27 males and 37 females with a mean age of 38.4 years) undergoing a 6-week smoking cessation treatment program at the University of Oregon. PSS-14 responses were compared in each of the groups to previously validated measures of life events (the College Student Life-Event Scale (CSLES) in the 2 student populations and the Unpleasant Life Events Schedule in the smoking-cessation group); the Cohen-Hoverman Inventory of

Physical Symptoms (CHIPS); and two additional measures in the college samples: the Center for Epidemiologic Studies Depression Scale (CES-D) and the Social Avoidance and Distress Scale (SADS). Cronbach's alpha coefficients were reported to be .84, .85 and .86 in each of the samples. As expected, test-retest reliability was high when the PSS was re-administered after 2 days (0.85), which dropped to .55 when re-administered after 6-weeks. The PSS-14 was significantly correlated ($p < .01$) with the impact of life events scores in all 3 groups ($r = .35$, $r = .24$, and $r = .49$, respectively); and with physical symptomatology ($r = .52$, $r = .65$, and $r = .70$, respectively). In addition, depressive symptomatology was also highly correlated with PSS-14 scores ($r = .76$ and $r = .65$, respectively); and increased social anxiety was significantly correlated with increased perceived stress in both college samples ($r = .37$ and $r = .48$, respectively). The variable "Perceived Stress" was calculated by re-coding reverse-scored PSS14 items to match the scale, then summing all responses. For those who did not complete all questions (2 participants), mean imputation was used to substitute missing values.

Center for Epidemiologic Studies Depression Scale (CESD-R). Depression was assessed using the Center for Epidemiological Studies Depression Scale Revised (CESD-R). Reliability and validity among middle-aged U.S. adults (between 24 and 74 years of age) was assessed using a secondary analysis of a subsample of 1,233 participants from the MacArthur Foundation's Midlife in the United States Study (MIDUS) and consisted of 56.7% female participants with a mean age of 57.3 years ($SD = 11.5$). The CESD was found to have high internal consistency, with a Cronbach's alpha of .90. Coefficient alphas for each factor of the scale were: .86 for depressed affect; .75 for somatic/vegetative factors; .58 for interpersonal;

and .79 for positive affect. Confirmatory factor analysis was used to test the 4-factor structure of the scale using the Tucker-Lewis index, the comparative fit index, the root mean square error of approximation and the standardized root mean square residual. The best goodness of fit was found for the 4-factor structure, with all factor loadings found to be statistically significant. The variable “Depression” was calculated by re-coding reverse-scored CESD items to match the scale, then summing all responses. For those who did not complete all questions (12 participants), mean imputation was used to substitute missing values.

Raffle Entry. Upon completion of the CES-D scale, participants were routed to a different web page, which was set up as its own stand-alone survey, not connected to responses provided to the previous surveys where participants were instructed to leave their email address if they wanted to be entered into a raffle for one of 6 \$25 Amazon gift cards.

Table 2. Operational Definitions, Variable Types and Measurement Tools

Variable to be Measured	Operational Definition	Measures	Variable Type
Dependent Variable: LTWLM Success	Successful maintenance of a weight loss of at least 20 lbs. for a minimum of 1 year	Weight and medical history survey	Percent of WL that has been maintained 1 year after lowest adult body weight was first recorded; higher scores indicate greater success at LTWLM
Dependent Variable: WLM Behaviors	Adherence to behaviors necessary for LTWLM success: portion control; increased PA;	Weight Control Strategy Scale (WCSS);	Mean scores across 30 items rated 0 (<i>never</i>) to 4 (<i>always</i>); higher scores indicate greater

	decreased dietary disinhibition; regular self-weighing; avoidance of triggers to over-eat		adherence to weight control behaviors
Moderating Variable: Emotion Regulation	Acceptance of experienced emotion so as to allow the modulation of its intensity and duration, allowing engagement in behavior which aligns with goals and inhibits impulsive, inappropriate, or behaviors incongruent with one's desired goals (Gratz & Roemer, 2004)	Difficulties in Emotion Regulation Scale (DERS)	Mean scores across 36 items rated 1 (<i>almost never</i>) to 5 (<i>almost always</i>); higher scores indicate greater difficulties in emotion regulation.
Independent Variable: Perceived Stress	As defined by the PSS-14	Perceived Stress Scale (PSS-14)	Mean scores across 14 items rated 0 (<i>never</i>) to 4 (<i>very often</i>); higher scores indicate greater perceived stress
Independent Variable: Depression	As indicated by the presence of depressive symptomatology	Center for Epidemiological Studies Depression (CES-D)	Mean scores across 20 items rated 0 (<i>rarely or none of the time; less than 1 day</i>) to 3 (<i>Most or all of the time; 5-7 days</i>) with higher scores indicating greater depressive symptomatology

Data Analysis

Statistical analyses were performed in STATA? (Version 17; StataCorp, 2021). An alpha level of $p < .05$ was used to determine statistical significance. Data were cleaned by first removing data from participants who did not advance past the informed consent and

screening surveys. Data were then examined for survey completion; data from participants with response rates less than 90% for any questionnaires measuring the main variables of adherence to WLM behaviors, perceived stress, depression and/or emotion regulation were removed, as well as any data from participants who failed to provide: highest adult weight, lowest adult weight, or current weight. Data from participants who provided inconsistent responses (e.g., reporting a weight fluctuation of 200 lbs. with the same month; reporting height under 3 feet or over 7 feet; and reporting households of over 50 people). Finally, participants were removed who reported having lost 20 or more lbs. but have not yet maintained that loss for at least 1 year (thus their WLM success is still unknown).

Descriptive statistics were performed to describe the participant sample, determine covariates, and group participants into either the “successful” or “unsuccessful” WLM categories. Means and Standard Deviations were calculated for the continuous variables of age, start weight, percent of original weight loss, percent of weight loss maintained, emotion regulation, adherence to WLM behaviors, and perceived stress. Frequencies were calculated for the categorical variables of age, sex, gender, marital status, Hispanic/Latinx status, race, education, income, start weight, current BMI, percent weight loss maintained, and years weight loss maintained. The variable “age” was measured as a continuous variable then collapsed into 4 categories: between 18 and 25 years; between 26 and 35 years; between 36 and 45 years, and between 46 and 65 years. Sex was collapsed into “male,” or “female.” Gender was collapsed into “male,” or “female.” Marital status was collapsed into “single” or “not single”. Race was collapsed into “white” or “non-white.” Education was collapsed into

“high school diploma/PhD,” “Vocational School/Other non-college; some college and/or college degree (BA/BS),” and “Some graduate work; Master’s Degree (MA, MBA, MS...) and/or Professional Degree (MD, JD, PhD).” Income was collapsed into the categories of “\$0-\$25,000,” “\$25,001-\$50,000,” “50,001-\$100,000,” and “\$100,001 or more.” Start weight was measured as a continuous variable and collapsed into the categories of “100-150 lbs.,” “151-200 lbs.,” “201-300 lbs.,” and “>300 lbs.” Comparisons between successful and unsuccessful were then examined with t-tests for continuous variables and Pearson Chi Squared analyses for categorical variables. Pearson correlations were used to examine collinearity between the main predictor variables of ER, adherence to WLM behaviors, perceived stress and depression.

The primary outcome variable, LTWM, was calculated using data from 3 different time periods: a) participant’s highest known adult (starting at 18 years of age) lifetime bodyweight and approximate time period (month and year) they last recall being at this weight; b) their lowest (adult) lifetime bodyweight and the approximate time period (month and year) that they first reached this weight; and c) their present weight. The dependent variable of LTWLM was calculated as a percentage by dividing the amount of weight loss that has been maintained (highest lifetime bodyweight – current weight) by the original weight loss (highest weight – lowest weight). This is presented as both a continuous variable and a categorical variable collapsed into the categories of “0%,” “0%-9.9%,” “10%-24.9%,” “25%-49.9%,” “50%-89.9%,” and “90%-100%”. Participants were coded as “successful” if they

have maintained at least 20lbs. of their original weight loss for at least 1 year and “unsuccessful” otherwise.

Hypotheses 1a and 1b (*the association of depression and perceived stress with LTWLM*) were examined with a logistic regression of depression and LTWLM and another run between perceived stress and LTWLM. A multiple logistic regression including the covariates of race, age and start weight was then run.

Hypotheses 2a and 2b (*the moderating role of ER strength in the association of depression and perceived stress with LTWLM*) were examined with a logistic regression with LTWLM as the outcome variable and depression, ER, and their interaction terms (depression * ER) as covariates. A second logistic regression with LTWLM as the outcome variable and perceived stress, ER and their interaction terms (perceived stress * ER) as covariates was also run. Race, age and start weight were controlled for in both regressions.

Hypotheses 3a and 3b (*the association of depression and perceived stress with adherence to WLM behaviors*) were examined with a linear regression of depression and adherence to WLM behaviors, followed by a linear regression of stress and adherence to WLM behaviors. A multiple linear regression was then run with the covariates race, age, start weight, gender and education included as covariates.

Hypotheses 4a and 4b (*the moderating role of ER strength in the association of depression and perceived stress with adherence to WLM behaviors*) were examined with a

linear regression with adherence to WLM behaviors as the outcome variable and depression, ER and their interaction terms (depression * ER) as covariates. A second linear regression was run with adherence to WLM behaviors as the outcome variable and stress, ER, and their interaction terms (stress * ER) as covariates. Both regressions controlled for race, age, start weight, gender and education.

CHAPTER 4

RESULTS

Participants

A total of 1,230 participants responded to the survey, 907 of which were screened out for: not having intentionally lost at least 20 lbs. since the age of 18 (45 participants); having lost 20+ lbs. unintentionally (56 participants); breastfeeding currently or within the past 12 months at the time of data collection (141 participants); using diets less than 1,200 calories per day; liquid diets; weight loss medications and/or bariatric surgeries (81 participants). Of the remaining participants, 676 were removed for not reporting highest adult weight; 4 for not reporting lowest adult weight; 3 for not reporting current weight; 30 for providing less than 90% of any of the main survey measures (DERS, WCSS, PSS14 and CESD); and 14 for inconsistent data reporting (e.g. reporting a weight fluctuation of 200 lbs. with the same month; reporting height under 3 feet or over 7 feet; reporting households of over 50 people); and 38 participants who reported having lost 20 or more lbs. but have not yet maintained that loss for at least 1 year (thus their WLM success is still unknown), leaving a final sample size of n=142.

Demographics and Predictor Variables

Descriptive statistics for all participants and by group are shown in Table 3. Of the 142 participants, 97 were categorized as successful weight loss maintainers and 45 as unsuccessful. Significant differences between groups were found in race ($p=0.04$), percent of WL maintained ($p=0.001$), years WL was maintained ($p=0.038$), difficulties in emotion regulation ($p=0.041$), perceived stress ($p=0.028$) and depression ($p=0.008$). No significant differences were found between groups for the other variables, although there was a trend towards significance for start weight ($p=0.054$) and percent of original weight loss ($p=0.054$).

Table 3. Characteristics of Participants by LTWLM Status

	All Respondents	Group: Successful WLM	Group: Unsuccessful WLM	
Variable	(n=142) n (100%)	(n= 97) n (68.3%)	(n=45) n (31.7%)	p value
Age				
18-25	26 (18.31%)	16 (16.49%)	10 (22.22%)	$\chi^2= 1.729$ df= 3 $p= 0.631$
26-35	53 (37.32%)	35 (36.08%)	18 (40.00%)	
36-45	29 (20.42%)	20 (20.62%)	9 (20.00%)	
46-65	34 (23.94%)	26 (26.80%)	8 (17.78%)	
Age Continuous Variable: Mean (SD)	36.10 (11.46)	36.61 (11.55)	35.02 (11.30)	$t= 0.766$ df= 140 $p= 0.447$
Sex	<i>n=141</i>	<i>n=96</i>		$\chi^2= 0.381$ df= 1 $p= 0.537$
Male	36 (25.50%)	26 (27.10%)	10 (22.20%)	
Female	105 (74.50%)	70 (72.90%)	35 (78.80%)	
Gender	<i>n=139 (98.6%)</i>	<i>94 (96.9%)</i>		$\chi^2= 2.340$ df= 1 $p=0.311$
Male	39 (28.10%)	23 (24.50%)	16 (35.60%)	
Female	100 (71.90%)	71 (75.50%)	29 (64.40%)	
Marital Status				$\chi^2= 2.108$ df= 1 $p= 0.147$
Single	50	38 (39.18%)	12 (26.67%)	
Not single	92	59 (60.82%)	33 (73.33%)	

Hispanic or Latinx? Yes No	18 (12.70%) 124 (87.30%)	9 (9.30%) 88 (90.70%)	9 (20.0%) 36 (80.0%)	$\chi^2= 3.192$ df= 1 p= 0.074
Race White Non-white	115 (80.99%) 27 (19.01%)	83 (85.57%) 14 (14.43%)	32 (71.11%) 13 (28.89%)	$\chi^2= 4.172$ df= 1 p= 0.041
Education High school diploma/GED or less Vocational School/Other non-college; some college and/or college degree (BA/BS) Some graduate work; Master's Degree (MA, MBA, MS...) and/or Professional Degree (MD, JD, PhD...)	9 (6.34%) 87 (61.27%) 46 (32.39%)	6 (6.19%) 59 (60.83%) 32 (32.99%)	3 (6.67%) 28 (62.22%) 14 (31.11%)	$\chi^2= 0.055$ df= 2 p= 0.973
Income \$0-\$25,000 \$25,001-\$50,000 \$50,001-\$100,000 \$100,001+	14 (9.90%) 33 (23.20%) 56 (39.40%) 39 (27.50%)	9 (9.28%) 24 (24.74%) 38 (39.20%) 26 (26.80%)	5 (11.10%) 9 (20.00%) 18 (40.00%) 13 (28.90%)	$\chi^2= 0.456$ df= 3 p= 0.928
Start weight (highest adult weight) 100-150 151-200 201-300 >300	7 (4.93%) 45 (31.69%) 79 (55.63%) 11 (7.75%)	4 (4.12%) 29 (29.90%) 57 (58.76%) 7 (7.22%)	3 (6.67%) 16 (35.56%) 22 (48.89%) 4 (8.89%)	$\chi^2= 1.364$ df= 3 p= 0.714
Start weight—continuous variable	224.44 (52.20)	228.10 (51.32)	216.56 (53.78)	t= 1.2283 df= 140 p= 0.1107
Original Weight Loss (WL) %	0.30 (0.11)	0.31 (0.09)	0.28 (0.13)	t= 1.620 df= 140 p= 0.054
Current BMI Underweight (<18.5) Healthy weight (18.5-24.9) Overweight (25-29.9) Obesity (≥ 30) Not reported (no height data)	1 (0.70%) 29 (20.42%) 38 (26.76%) 62 (43.66%) 12 (8.45%)	1 (1.03%) 27 (27.80%) 25 (25.80%) 36 (37.10%) 8 (8.30%)	0 (0.00%) 2 (4.40%) 12 (28.90%) 26 (57.80%) 4 (8.90%)	$\chi^2= 11.832$ df= 4 p= 0.019
% of WL Maintained 0% 0%-9.9% 10%-24.9% 25%-49.9% 50%-89.9% 90%-100%	8 (5.63%) 7 (4.93%) 21 (14.79%) 20 (14.08%) 71 (50.00%) 15 (10.56%)	0 (0.0%) 0 (0.0%) 4 (4.12%) 14 (14.43%) 64 (65.98%) 15 (15.46%)	8 (17.78%) 7 (15.56%) 17 (37.78%) 6 (13.33%) 7 (15.56%) 0 (0.00%)	$\chi^2= 78.492$ df= 5 p= 0.001
%WL Maintained—Continuous	0.53 (0.31)	0.68 (0.22)	0.20 (0.18)	t= 12.668 df= 140 p= 0.001

Years Weight Loss Maintained between 1 and 2 years between 2 and 3 years between 3 and 4 years between 4 and 5 years 5 or more years	26 (18.31%) 13 (9.15%) 12 (8.45%) 9 (6.34%) 82 (57.75%)	23 (23.70%) 10 (10.31%) 5 (5.15%) 5 (5.15%) 54 (55.67%)	3 (6.67%) 3 (6.67%) 7 (15.56%) 4 (8.89%) 28 (62.20%)	$\chi^2= 10.163$ df= 4 p= 0.038
Emotion Regulation	17.37 (25.82)	14.36 (25.72)	23.84 (25.08)	t= -2.060 df= 140 p= 0.041
Adherence to WLM Behaviors	2.15 (0.65)	2.22 (0.62)	2.03 (0.70)	t= -1.584 df= 140 p= 0.116
Perceived Stress	25.18 (8.54)	24.10 (8.44)	27.49 (8.40)	t= -2.236 df= 140 p= 0.028
Depression	17.08 (10.89)	15.44 (10.78)	20.622 (10.36)	t= -2.695 df= 140 p= 0.008

n (%) or Mean (SD); Chi square test for categorical variable and t-tests for continuous variables

Pearson correlations revealed collinearity of two of the main predictor variables. Emotion regulation was significantly correlated with both depression ($p= 0.001$) and perceived stress ($p=0.001$) as outlined in the table, below. There were no significant correlations between adherence to WLM behaviors and emotion regulation; perceived stress; or depression ($p>.05$).

Table 4. Correlation Among Predictor Variables (n=142)

	Emotional regulation	Adherence to WLM behaviors	Perceived stress
Adherence to WLM behaviors	-0.070 p= 0.406		
Perceived stress	0.702* p= 0.001	-0.047 p= 0.578	
Depression (CESD)	0.792* p= 0.001	0.002 p= 0.980	0.734* p= 0.001

Results of Hypotheses 1a and 1b

Hypothesis 1a and 1b were confirmed. Table 5 displays the results of the logistic regressions.

The unadjusted regressions showed a statistically significant relationship was found between depression and LTWLM ($p= 0.01$); and between perceived stress and LTWLM ($p= 0.03$).

Results of the multiple logistic regression are shown in the last two rows of Table 5.

Statistical significance remained when the model was adjusted for the covariates of race, age and start weight ($p= 0.018$ and $p= 0.046$, respectively).

Table 5. Unadjusted and Adjusted Results for Hypotheses 1a and 1b. Association between depression and perceived stress with LTWLM

	B	Odds Ratio	S.E.	95% Confidence Interval		p-value
				Lower	Upper	
Depression	-0.445	0.96	0.016	0.925	0.989	0.010
Stress	-0.048	0.95	0.021	0.913	0.995	0.030
Depression w/ covariates: race, age (continuous), start weight (continuous)	-0.045	0.960	0.018	0.925	0.995	0.026
Perceived Stress w/ covariates: race, age (continuous), start weight (continuous)	-0.047	0.947	0.023	0.904	0.993	0.024

Results of Hypotheses 2a and 2b

Hypotheses 2a and 2b were not confirmed. Results of the adjusted logistic regressions are shown in Table 6. No statistically significant relationships were found that indicated a moderating relationship of ER between depression and LTWLM nor stress and LTWLM.

Table 6. Adjusted Results for Hypotheses 2a and 2b. The moderating role of ER between depression/perceived stress and LTWLM

	B	Odds Ratio	S.E.	95% Confidence Interval		p-value
				Lower	Upper	
Moderation between depression & LTWLM (age= continuous; start weight= continuous)	0.0007	1.000	0.001	1.000	1.000	0.550
Moderation between stress & LTWLM (age= continuous; start weight= continuous)	0.0000685	0.9997	0.0009	0.998	1.000	0.773

Results of Hypotheses 3a and 3b

Hypotheses 3a and 3b were not confirmed. Results of the unadjusted and adjusted linear regression analyses are shown in Table 7. No statistically significant relationships were observed between either stress or depression and adherence to WLM behaviors.

Table 7. Unadjusted and Adjusted Results for Hypotheses 3a and 3b. Association of depression and perceived stress on adherence to WLM behaviors

	B	S.E.	R ²	p-value
Depression	-0.034	1.359	0.159	0.680
Stress	-0.004	0.006	0.002	0.578
Depression w/ covariates: race, age (continuous), start weight (continuous), gender, and education	-0.020	0.299	0.102	0.502
Perceived Stress w/ covariates: race, age (continuous), start weight (continuous), gender, and education	-0.0045	0.0065	0.069	0.483

Results of Hypotheses 4a and 4b

Hypotheses 4a and 4b were not confirmed. Results of the adjusted linear regressions are shown in Table 8. No statistically significant relationships were found that indicated ER

moderated the relationship between either depression or stress and adherence to WLM behaviors.

Table 8. Adjusted Results for Hypotheses 4a and 4b. The moderating role of ER between depression/perceived stress and adherence to WLM behaviors

	B	S.E.	R ²	p-value
Moderation between depression & adherence to WLM behaviors (age, start weight & gender continuous)	-0.001	0.001	0.033	p= 0.713
Moderation between perceived stress & adherence to WLM behaviors (age, start weight & gender continuous)	-0.001	0.001	0.132	p= 0.527

CHAPTER 5

DISCUSSION

Summary

The present study's intent was to further investigate how the negative associations between the psychological correlates of depression and/or stress might be explained by ER strength. Our main hypotheses of ER moderating the negative associations between depression and/or stress and LTWLM were not supported; as such, we also did not find a moderating effect of ER on depression and/or stress and adherence to WLM behaviors as hypothesized. While we did find a significant negative association between increased levels of depression and/or stress and LTWLM as hypothesized, we were surprised to find that there was no significant relationship between increased levels of depression and/or stress and adherence to WLM behaviors as predicted.

Our findings of significant associations between lower levels of depression and stress and greater rates of WL and LTWLM success is in line with similar research which has also demonstrated significant relationships between these variables. For example, Ibrahim et al. (2016) examined psychological predictors of weight gain of both obese and normal weight individuals not engaged in a weight loss intervention over 6 months and 2 years. Similar to

the present study, their findings indicated that stress and anhedonia (a common symptom of depression) were predictive of weight gain ($r= 0.29$, $p = 0.05$) in both groups. Our study is also akin to other studies on WL and WLM in our attempt to explain the associations between depression/stress and LTWLM by way of moderating and/or mediating variables. In another longitudinal study, Annesi (2016) assessed negative mood (inclusive of depression, tension/anxiety, vigor, fatigue, anger and confusion) and decay in healthy eating and physical activity in a subsample of women from an obesity intervention study who regained at least a third of their original weight loss over the course of 1 year, finding that negative mood change predicted decay in these self-regulatory behaviors. A second study by Annesi et al (2015) also sought to determine whether these psychological predictors of weight gain also predicted emotional eating among a sample of obese women randomly enrolled into either a phone-based or in-person obesity treatment group designed to improve exercise and eating behaviors over 6 months. Results indicated that negative mood change was a significant predictor of emotional eating, and decreased emotional eating was significantly associated with weight loss (all p -values < 0.03).

While the present study shares characteristics with these studies of seeking out psychological correlates of weight gain and regain; and in attempts to determine whether these predictors act by way of changes to behaviors necessary for WL and WLM, there are also several ways in which our study deviates from those reviewed here. Most notably, the majority of these studies are longitudinal while ours is cross-sectional, which may contribute to why we did not find a significant interaction between negative psychological correlates and reduced

adherence to behaviors necessary for WL and WLM as other studies did. Longitudinal studies may better capture adherence to WLM behaviors since they can compare simultaneous changes of the same participants in both psychological correlates and behavioral adherence from one point in time to baseline and/or other time points, whereas a cross sectional study like ours can only identify an association between these psychological correlates and behavioral adherence at one point in time, which does not provide information about how changes in psychological correlates might predict changes in behaviors and/or weight change. Additionally, many studies in this area focus either on obese participants only, participants engaged in a weight loss intervention, or pull from a general population that includes obese and non-obese participants whether or not they've previously engaged in a weight loss intervention, clinical or otherwise (Anessi, 2016; Anessi et al., 2016; Ibrahim, 2016; Reinelt, 2020). For the present study, we sought out a specific population of participants who have lost at least 20 lbs. through any means (except those outlined in our exclusion criteria) whether or not they were able to maintain that loss over time as we're interested not just in how psychological correlates might impact weight change, but specifically how they might work as barriers to LTWLM. While most studies examine weight change 6 months to 1- or 2-years post-weight loss, our study uses 1 year as the minimum amount of time that weight loss maintenance has been attempted, with over 50% of our respondents reporting a maintenance period of 5 years or more. We believe this approach more aptly captures a population of what is considered to be long-term weight loss (McGuire et al., 1999; Wing et al., 2008), whereas many other study populations examine maintenance much more closely to the time of original weight loss, when we know risk of weight regain is

the greatest (Dombrowski et al., 2014; McGuire et al., 1999; 2014; Oshiek & Williams, 2011). This may skew results of such studies in finding significant relationships between predictor variables and weight regain. While this is important to understanding how best to support weight losers during the weight loss phase and the interim period between weight loss and LTWLM, it does not accurately reflect barriers specific to those struggling to keep weight off beyond 1 year.

To our knowledge, this is the first study to comprehensively examine both whether ER contributes to weight maintenance specifically among LTWL maintainers and if so, how. Many studies have demonstrated associations between ER and decreased adherence to WL and WLM behaviors (Anessi, 2016; Anessi et al., 2016; Reinelt et al., 2020), citing emotional eating in particular as a potential explanation for how negative psychological correlates may lead to weight gain and regain (Ibrahim et al., 2016; Raspopow et al., 2013; Shriver et al., 2020). This evidence contributed to our hypotheses that 1) depression and perceived stress would be inversely related not only to LTWLM, but also adherence to WLM behaviors; and 2) ER would moderate both relationships. There exists a large body of evidence to support a predictive effect of emotional eating and weight gain/regain, with some studies showing significant links between obesity and reduced dopaminergic effectiveness, which is associated with increased hunger stimulation, depressive systems, and reward-seeking behavior, often through consumption of calorically dense palatable foods (de Weijer et al., 2011; Di Chiara & Bassareo, 2007; Yau & Potenza, 2013). Additional fMRI evidence also supports a neuromechanistic pathway for emotional eating, with findings that overweight

individuals exhibit weaker neural connectivity between areas of the brain responsible for experience of emotion (such as the anterior insula) and those responsible for executive functioning and impulse control (the prefrontal cortex) compared to normal weight individuals (Steward et al., 2016).

Our findings that there is no significant moderating effect of ER in the relationships between 1) negative psychological correlates and LTWLM and 2) adherence to WLM behaviors and LTWLM are a somewhat new addition to the area of psychological impacts on LTWLM, and provides support for the idea that the impacts of depression and stress on LTWLM cannot be explained by impaired adherence to WLM behaviors—in particular, emotional eating as a maladaptive emotion regulation strategy—alone. While we were unable to find studies which specifically examined this among LTWL maintainers, there is evidence that suggests that the link between depression/stress and weight gain/regain can be explained by factors other than changes to WLM behaviors. For example, Kiecolt-Glaser et al. (2015) found that participants with an increased number of prior day stressors exhibited a resting energy expenditure (REE) of 104 calories less after being given a controlled high fat meal than participants given the same meal with no prior day stressors even after pre-meal REE, age, lean body mass, trunk fat physical activity, and past depression were controlled for, suggesting that stress alone may have a direct impact on REE, and not through its influence on behaviors such as emotional eating. That stress itself induces weight gain has also been supported by numerous studies which find significantly increased risk and incidence of weight gain, overweight, and obesity among those with post-traumatic stress disorder (Kubzansky et al., 2014; LeardMann

et al., 2015; Takemoto, 2021). Similarly, a clinical study (Reinelt et al., 2020) employing an in-patient obesity treatment to 158 adolescents found that more frequent use of the adaptive emotion regulation strategy of reappraisal (the process of reframing negative thoughts into more adaptive patterns) resulted in significantly stronger treatment effects on BMI reduction ($r = -0.25$, $p = 0.0001$) while use of the maladaptive emotion regulation strategy of suppression was not correlated with BMI reduction ($r = -0.14$, $p = 0.072$), despite the fact that all caloric intake and output through physical activity were controlled for.

Although hypotheses of the present study which predicted a moderating effect of ER between depression/stress; and/or adherence to WLM behaviors were not found to be significant, descriptive statistics revealed a significant difference in ER strength between those who are successful at LTWLM than those who are unsuccessful ($p = 0.002$). Levels of perceived stress and depression were also significantly different between successful vs. unsuccessful weight loss maintainers ($p = 0.0224$ and $p = 0.0001$, respectively), indicating that there may still be an association between one's general ER strength and one's ability to keep weight loss off long-term. Furthermore, no significant difference was found in adherence to WLM behaviors between these same groups, again supporting the notion that the relationship between increased levels of depression and/or stress with weight regain cannot be fully explained by their impact on behaviors known to impact weight loss maintenance success, and that other mechanisms for weight regain may exist to explain the relationship between these psychometrics and greater rates of weight regain, such as metabolic, genetic, hormonal, physiological, or other still unknown responses.

Strengths

A significant strength of this study was in examining the role, if any, overall ER plays in LTWLM. Previous studies which look at psychometric associations (between depression and stress in particular) with weight regain have largely sought to explain this relationship through depression's/stress's impact on one's ability to maintain WLM behaviors. As a result, many research-based interventions have focused on improving self-regulatory skills (e.g., interventions which specifically focus only on elimination and replacement of ER techniques maladaptive to WLM, such as emotional eating), which do not address improving one's overall levels of depression and/or perceived stress. If the association between negative psychological characteristics and weight regain is not explained entirely by changes in WLM behaviors, as the present study suggests, then interventions focused on improving self- and emotional-regulatory skills which impact only WLM behaviors will not result in an improvement in WLM among populations with significantly higher rates of depression/stress. Compared to studies that focus on behavioral-based interventions alone, studies which employ mindfulness-based interventions have demonstrated relative success in improving WLM among those with higher levels of depression/stress, although whether or not this was due to an improvement in one's overall emotional health (e.g. by lowering levels of depression and perceived stress in these populations) and/or improved overall ER skill (as opposed to interventions which focus only on elimination and replacement of ER techniques maladaptive to WLM) have not been explored.

Another significant strength of the present study is that it focused specifically on LTWL maintainers that were inclusive of much longer periods of time during the maintenance phase (up to 5+ years). We also developed a model that tested theories posited in prior studies that depression and stress impact WLM through their impact on behavioral adherence, evidence of which has been demonstrated by many studies of weight loss and of attempted weight loss maintenance after a specific intervention, but to our knowledge has never been applied to a population of maintainers whose WLM efforts had been ongoing for at least 1 year.

Limits

There are a number of limitations to the current study. As the study is observational, we are only able to examine the relationships between variables and cannot determine whether causal relationships exist. The cross-sectional design of our data collection methods means the historical data collected on our participants' weight changes over time also did not correspond to the time periods with which we asked them to report their levels of depression and perceived stress. The scales used to collect data on participants' depression and stress asked participants about their experiences of depression and stress within the past 1 week and 1 month, respectively; while we asked participants to report weight data over a span as large as 47 years. Thus, reported rates of depression and/or stress do not necessarily correspond with when fluctuations in weight occurred. For example, a participant may have attained their lowest adult weight 20 years ago and maintained that loss with very few changes to their levels of depression/stress over most of those years, but could have reported higher rates of depression/stress within the past month than they typically experienced over the majority

of this WLM time period. This is of particular concern with the present study, as data collection occurred during the extenuating circumstances of the COVID-19 pandemic when collective rates of depression and stress have been particularly high for most individuals. This may have influenced the strength and/or significance of the relationships (or lack thereof) between our independent variables and LTWLM success found in the present study.

Additionally, to reduce barriers to participant motivation for completing the survey, amount of weight loss reported was not verified through medical or commercial weight records or personal data. Although this provides the opportunity for participants to report false weight loss histories, validity of self-reported weight has been demonstrated in numerous studies (Casey et al., 1991; Stevens et al., 1990) as well as in more recent studies by the NWCR. In McGuire et al. (1999), participant self-reported weight was correlated with weight reported by doctors or weight loss counselors $r = .98$ ($p < .001$) with a mean weight discrepancy between the two weights of 5.4 ± 12.3 lbs. (2.4 ± 5.6 kg). Therefore, we expect very few participants to have erroneously reported weight history.

Self-selection bias is also a significant limitation to the present study. Those who have been relatively successful with LTWLM are more likely to have responded to this survey, which is suggested by the significantly larger proportion of participants who were found to be successful maintainers (68% of 142 respondents) than those who were unsuccessful (32% of respondents) in the present study—in stark contrast to the rates of successful WLM described in WL and WLM literature to date (Dombrowski et al., 2014; McGuire et al., 1999; Oshiek &

Williams, 2011; Wing & Hill, 2001). Similarly, it is possible that self-report bias partially confounded responses to survey questionnaires either consciously or unconsciously (e.g. underestimation or overestimation of self-reported weights and/or levels of experienced depression/stress.) As part of our screening questionnaire, we asked participants to respond to the question “since the age of 18, have you lost 20 or more lbs., whether or not that weight loss was maintained?” Since recruitment flyers explicitly stated a weight loss of at least 20 lbs. was required to be eligible for the study, participants may have replied “yes” to this question even if it was untrue in order to pass the screening and advance to the full survey for entry into the gift card raffle, although the incentive of a \$25 gift card is unlikely to have been motivating enough to falsely report a survey taking 30-45 minutes to complete. Additionally, as part of our full survey we asked participants to report actual weights for highest, lowest, and current adult body weights and removed any participants who did not meet weight-related criteria even if they had advanced past the screening survey.

Another important limitation to the current study is the presence of collinearity among several of our independent variables, which may partially explain the lack of statistical significance while examining ER’s moderating role between depression/stress and LTWLM and between depression/stress and adherence to WLM behaviors. Our finding that ER was significantly correlated with both depression and anxiety was not surprising, as by definition, adaptive ER skills have been linked to less emotional distress—particularly depression—in many studies (Berking et al., 2014; Ehring et al., 2008; Joormann & Stanton, 2016). Since ER is strongly correlated with both depression and stress, examining how ER might moderate

the relationship between these variables and LTWLM is difficult to determine, because as one variable changes (either stress or depression), it inherently also changes the moderating variable of ER by way of their collinearity, thus making it difficult to distinguish each of their independent effects on our dependent variables of LTWLM and adherence to WLM behaviors, respectively. These effects are particularly pronounced when small sample sizes, such as that of the present study, are used. Thus, ER may still play a moderating role despite our contrary findings.

Implications of COVID-19

Data collection for this study was performed during the height of the COVID-19 pandemic. This presented numerous challenges, including difficulty collecting data from participants. Our original data collection plan included posting flyers at various weight loss centers and gyms, however these locations were shut down for months at the start of the pandemic in March 2020, and when they reopened, they did so at reduced capacity. Furthermore, because risk of COVID-19 contraction remained high, and the requirement to adhere to strict and uncomfortable masking protocols were still in place well through 2021, many individuals still did not return to gyms or weight loss centers in person, instead opting to participate in these activities over Zoom or halting participation with weight loss and/or fitness centers altogether. While we did still advertise at these locations, we relied much more heavily on on-line recruitment methods, largely through Facebook advertising. While this presented a challenge to data collection, it is also possibly a strength of the study as our participant

sample's diversity may have benefitted from a largely online recruitment method instead of relying predominantly on college populations and/or geographical limits.

In addition to presenting challenges to data collection, the COVID-19 pandemic itself introduced a level of communal stress that is unprecedented to studies on weight and weight loss, which could have directly influenced the results. Significant weight fluctuations during this period among the general population have been found, with many studies reporting significant increases in weight gain, eating in response to stress, increased alcohol consumption, increased snacking, decreased levels of physical activity, and impaired sleep (APA's Stress in America poll, 2021; Lin et al., 2021; Zachery et al., 2020), although these trends vary depending on the population being examined. For example, in response to findings of increased weight during the pandemic from Lin et al. (2021) and a survey conducted by the American Psychological Association (APA, 2021), Alban et al. (2021) compared weight gain during the COVID-19 pandemic of the general population (using data pooled from 128 healthcare organizations spanning 49 states) to weight change in adults the year prior to the pandemic and found that approximately as many patients lost weight (35%) as those who gained weight (39%) during the pandemic; and found that weight gain patterns were not significantly different from pre-pandemic trends. Alban et al., however, presented their findings as coming from a pooled population, while other studies that have compared weight changes among groups of individuals have revealed varying trends in pandemic weight management. 42% of all US adults surveyed by the APA reported undesired weight gain of 29 lbs. on average. When broken down, however, adults ages 18-24; parents; and

essential workers reported the greatest frequencies of undesired weight gain with 52% of adults ages 18-24; 51% of parents; and 50% of essential workers gaining an average of 28-38 lbs.). In comparison, adults ages 57 and above and all Asian adults reported the fewest instances of weight gain and a lower average weight gain of 12-16 lbs.—more than 50% lower than the average weight gain among groups with higher rates of regain—suggesting that stress-induced weight gain resulting from the pandemic varied greatly among different subsets of populations, possibly because some populations (such as healthcare and other essential workers forced to risk contracting and/or spreading COVID-19 to their families; and parents who suddenly had to transition to working from home full-time while simultaneously monitoring and connecting their children to remote educational resources) experienced disproportionate levels and/or types of stress. Of particular relevance to the present study, some research has also demonstrated that individuals who were overweight or obese prior to pandemic lockdowns were at increased risk of weight gain (Zeigler, 2021) compared to normal weight individuals. That already obese individuals would be at greater risk of weight gain would be expected if what we theorize about increased levels of stress and depression among already excess weight individuals and their neurologic, psychologic, and emotional regulatory responses are true.

Conclusion

This study confirmed that there is a negative association between increased levels of depression and/or stress and LTWLM, however emotion regulation was not found to moderate either of these relationships. Interestingly, we did not find any significant

association between depression and/or stress and adherence to WLM behaviors; as such, ER's moderating role was irrelevant as there was no association to be moderated.

Directions for Future Research

Future studies should further examine the role ER might play in improving the overall psychological health of individuals who have high levels of depression and/or perceived stress and are unsuccessful at LTWLM which also control for the significant collinearity between ER and levels of depression and/or perceived stress. One way to do this might be to look at whether there is a mediating and/or moderating role of adherence to WLM behaviors in the relationships between 1) depression and LTWLM; 2) perceived stress and LTWLM; and ER and LTWLM. Studies with significantly larger sample sizes would also reduce the effect of collinearity which may present different results even in the current studies' methods are used. Clinical trials which compare interventions designed specifically for LTWLM that incorporate ER skills training to LTWLM intervention control groups with no ER skills training could also be helpful in determining what role, if any, ER might play in moderating the negative impact stress and depression appear to have on LTWLM. One that is longitudinal in design, following cohorts through years could also provide valuable information about whether and to what extent ER skills training might help mitigate the high rates of weight re-gain so frequently seen among significant weight losers among participants who undergo varying levels of depression/stress over time.

Finally, our particularly noteworthy finding of no significant difference in adherence to WLM strategies between successful and unsuccessful participants suggests that additional research is needed to examine what variables might exist other than behavioral strategies (monitoring and limiting food intake; increased PA; frequent self-weighing; etc...) most frequently focused on during weight loss and WLM efforts. Our findings highlight the importance of continuing to pursue research on what additional factors such as biological, psychological, physiological, genetic, environmental, and/or other still unknown variables may have on WL, WLM, and their mechanisms of action.

APPENDIX

A. CONSENT FORM FOR WEIGHT LOSS MAINTENANCE STUDY

Informed Consent Form for: THE ROLE OF EMOTION REGULATION IN LONG-TERM WEIGHT LOSS MAINTENANCE: A CROSS-SECTIONAL STUDY

Introduction and Contact Information

You are being asked to take part in this survey for a research project that is investigating people's experiences with maintenance of past weight loss. The researcher is Karyn Aiello, MS Student of the Department of Exercise and Health Sciences at the University of Massachusetts Boston. The faculty advisor is Dr. Julie Wright, Chair and Associate Professor of the Department of Exercise and Health Sciences at the University of Massachusetts Boston. Please read this form before providing consent below. Please feel free to ask questions by contacting either the researcher at Karyn.Aiello@umb.edu, (617) 942-1706; or the faculty advisor at Julie.Wright@umb.edu, (617) 287-3808.

Description of the Project:

The purpose of this study is to investigate people's experiences with maintenance of past weight loss and factors that may influence maintenance. Your participation in this study will take 30-45 minutes. Because the study survey must be completed in one session (you will not be able to save your progress and return to complete the survey at a later time), please make sure to take the survey in a private location when you have at least 30 minutes to complete the survey. If you decide to participate in this study, you will be asked to complete several brief online questionnaires related to your experiences with weight loss and weight loss maintenance and to provide some general demographic information. You may terminate participation at any time without consequence, or you may choose not to answer any specific questions. After completion of these questionnaires, you will be offered an opportunity to enter a raffle for a \$25 Amazon gift card. You will need to provide your contact information to be eligible for the raffle, however your contact information will be disassociated from your survey responses to maintain confidentiality.

Risks or Discomforts:

There is minimal risk involved in this study. The primary risks associated with this study are inconvenience or the emergence of negative or distressful feelings in completing questions

about your weight history and/or emotions. If at any time you feel too distressed to continue, please feel free to withdraw your participation or not respond to the questions causing distress. You may also contact the faculty advisor of this study, Dr. Julie Wright, to discuss any distress or other issues related to study participation, or may utilize University counseling services available to all UMass Boston students through the University Counseling Center, located on the 2nd floor of the Quinn Administration Building, room 02-07. The University Counseling Center can be reached at 617-287-5690. Additional Counseling Center details are available at https://www.umb.edu/healthservices/counseling_center. Counseling services may also be obtained through individual health insurance coverage and can be sought by contacting one's health insurance company to obtain a referral for mental health services and/or a referral by one's primary care physician. The US Department of Health and Human Services also offers a free, confidential, 24/7 hotline for persons seeking referral and information for mental health services at: 1-800-662-HELP(4357).

Benefits:

There is no direct benefit to you for participating in this study. Your participation may help us learn more about factors that may influence long-term weight loss maintenance.

Confidentiality and Anonymity:

Your participation in this research is confidential. That is, the information gathered for this project will not be published or presented in a way that would allow anyone to identify you. To ensure your confidentiality, information gathered for this project will be password protected and only the research team will have access to the data. Data will be labeled by number and will not be connected to your name. At the end of the survey, you will be routed to a different survey where you will be asked to provide your contact information for entry into the raffle. This information will not be connected to your survey responses. You will also be asked to indicate whether or not you would like to be contacted for future studies. Indication of willingness to be contacted for future studies is not required for entry into the raffle.

Voluntary Participation:

You are being asked to participate in a research study. **Participation is voluntary.** If you do decide to take part in this study, you may terminate participation at any time without consequence, or you may choose not to answer any specific questions. If you wish to end your participation, you may exit the survey at any time by clicking the "exit survey" link and closing all web browsers. Whatever you decide will in no way penalize you or involve a loss of benefits to which you are otherwise entitled.

Rights:

You have the right to ask questions about this research before you agree to be in this study and at any time during the study. If you have further questions about this research or if you have a research-related problem, you can reach the study researcher, Karyn Aiello, at

Karyn.Aiello@umb.edu or (617) 942-1706 or the faculty advisor of the study, Dr. Julie Wright, at Julie.Wright@umb.edu or 617-287-3808. This study has been approved by the UMass Boston Institutional Review Board, which oversees human research. If you have any questions or concerns about your rights as a research participant, please contact a representative of the Institutional Review Board (IRB) at the University of Massachusetts, Boston. The Institutional Review Board may be reached at the following address: IRB, Quinn Administration Building-2-080, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 01825-3393. You can also contact the Board by telephone or e-mail at (617) 287-5374 or at human.subjects@umb.edu.

****YOU MUST BE 18 OR OLDER TO PARTICIPATE IN THIS STUDY****

I HAVE READ THE CONSENT FORM. MY QUESTIONS HAVE BEEN ANSWERED. MY RESPONSE BELOW INDICATES THAT I CONSENT TO PARTICIPATE IN THIS STUDY. I ALSO CERTIFY THAT I AM 18 YEARS OF AGE OR OLDER.

If you have read and understand the above statements, please click on the "Continue" button below to indicate that you are over 18 and that you consent to participate in this study.

- Yes, I consent to participate in this research study. I certify that I am 18 years of age or older.

[Continue →](#)

B. PARTICIPANT SCREENING SURVEY

We are interested in individuals who have lost weight in the past. The purpose of this survey is to determine your eligibility for completion of the remainder of this survey. Most of the following questions ask about various methods and experiences of weight loss you may have undergone. In answering these questions, please consider only your experiences with weight loss attempts you had from the age of 18 and older. Please do not report on weight loss experienced before the age of 18.

1. Since the age of 18, have you lost 20 or more pounds, whether or not that weight loss was maintained?

Yes No

A “No” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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2. Was this weight loss intentional? (Weight loss was not due in full or part to illness, injury, or side effects of medications or other treatments for an unrelated condition.)

Yes No

A “No” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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3. Are you currently pregnant or breastfeeding?

Yes No

A “Yes” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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4. Have you been pregnant or breastfeeding within the past 12 months?

Yes No

A “Yes” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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In answering the following questions, please consider only your weight loss attempt(s) which resulted in a weight loss of 30 lbs or more. If more than one method applies, please indicate “yes” for every method which contributed to this weight loss attempt(s).

5. Since the age of 18, I have used a calorie restriction diet which averaged 1,200 daily calories or less as a method for losing 20 lbs. or more.

Yes No

A “Yes” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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6. Since the age of 18, I have used a liquid diet as a method for losing 20 lbs. or more. (A liquid diet is made up of only fluids and foods that are normally liquid at room temperature.)

Yes No

A “Yes” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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7. Since the age of 18, I have used weight loss medications prescribed by a licensed medical professional as a method for losing 20 lbs. or more. Examples of weight loss medications include, but are not limited to, Orlistat (Xenical); Lorcaserin (Belviq); Naltrexone; Contrave (a combination of Naltrexone and bupropion); Liraglutide (Saxenda); Phentermine, Qsymia (a combination of Phentermine and topiramate); ephedra.

Yes No

A “Yes” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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8. Since the age of 18, I have used weight loss surgery as a method for losing 20 lbs. or more. Weight loss surgeries include gastric bypass; laparoscopic adjustable gastric banding (Lap Band); sleeve gastrectomy; and/or duodenal switch with biliopancreatic diversion.

Yes No

A “Yes” response will direct participants to the following screen:

Thank you for taking the time to participate in our survey. Unfortunately, you do not meet the criteria for eligibility for the current study. If you wish to be considered for future studies, please provide your email address below. Your response will not be connected to responses provided in the present survey.

Email Address:	
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C. DEMOGRAPHIC INFORMATION

The following questions are intended to help us describe the participants who complete this survey, and to see if our findings vary among people from different backgrounds. While we have attempted to include a breadth of categories, we know that it is not possible to capture the full complexities of each individual. If you are uncomfortable answering any particular question, or do not feel the options adequately describe your identity, please remember that you may choose not to respond to any individual question.

What is your current age (in years)? _____

What is your biological sex?

Male Female Intersex

What is your gender identity?

Male Female Transgender Genderqueer Non-binary Other: _____

What is your marital status?

Single Married Cohabiting Separated Widowed Divorced

Is English your first language?

Yes No

Are you hispanic or latinx?

What is your race (check all that apply)?

Alaskan Native/Native American/Indigenous

If known, tribal affiliation: _____

Asian

Pacific Islander

Black

Latino(a)/ Hispanic (White)

Latino(a)/Hispanic (Non-White)

White

Other: _____

What is the highest grade in school, year in college, or post-college degree work you've completed?

8th grade or less

1-3 years of high school

12th grade/high school diploma or GED

Vocational school/other non-college
1-3 years of college
College degree (B.A., B.S.)
Master's degree (MA, MBA, MS...)
Professional degree (MD, JD, PhD...)

What is your current total household annual income level?

\$0-\$15,000	\$15,001-\$25,000	\$25,001-\$35,000	\$35,000-\$50,000
\$50,001-\$75,000	\$75,001-\$100,000	\$100,001-\$200,000	More than \$200,000

What is the total number of people (including yourself) who currently rely on this income?

Growing up, your family's average annual income level was:

\$0-\$15,000	\$15,001-\$25,000	\$25,001-\$35,000	\$35,000-\$50,000
\$50,001-\$75,000	\$75,001-\$100,000	\$100,001-\$200,000	More than \$200,000

What is the total number of people (including yourself) that relied on this income?

Of the parent(s) who raised you, what is the highest level of education completed?

8th grade or less

1-3 years of high school
12th grade/high school diploma or GED
Vocational school/other non-college
1-3 years of college
College degree (B.A., B.S.)
Some Graduate work
Master's degree (MA, MBA, MS...)
Professional degree (MD, JD, PhD...)

Are you currently taking any medications for any psychiatric or emotional difficulties?

Yes No

Have you ever, or are you currently engaged in therapy for any psychiatric or emotional difficulties?

No, never Yes, in the past Yes, currently

D. WEIGHT AND MEDICAL HISTORY SURVEY

What is your height?

What is your birthdate?

What was your highest adult (age 18 or older) weight in lbs?

At approximately what time (month and year) were you last recorded to be at this weight?

What was your lowest adult (age 18 or older) weight in lbs?

At approximately what time (month and year) were you FIRST recorded at this weight?

What is your present weight?

At what time (month and year) was this weight last measured?

Are you currently (or within the past 6 months) experiencing symptoms of menopause (irregular periods, vaginal dryness, hot flashes, chills, night sweats, sleep problems, mood changes, unexplained weight gain, thinning hair, dry skin, loss of breast fullness)?

Have you gone through menopause?

If yes, please provide the approximate date menopause was experienced:

In answering the following questions, please refer only to weight loss that resulted in a loss of 20 or more pounds and occurred between 18 and 70 years of age.

What was your PRIMARY method of weight loss?

- commercial weight loss program (for example: WW, Jenny Craig, TOPS, Nutrisystem)
- online commercial weight loss program (WW, Noom...)
- use of a website or phone app (my fitness pal;)
- adoption of a specific diet (atkins; south beach; keto; DASH; paleo; gluten-free)
- group therapy
- individual therapy
- help from a nutritionist
- help from a personal trainer/fitness coach
- weight loss surgery

- None of the above/I lost weight without the use of a specific program or technological application.
- Other: _____

Did you take any of the following types of medications while you were losing weight?

Antipsychotics/Mood Stabilizers

Yes No

If yes, name of medication(s): _____

Corticosteroids

Yes No

If yes, name of medication(s): _____

Beta Blockers

Yes No

If yes, name of medication(s): _____

Medication(s) for Diabetes

Yes No

If yes, name of medication(s): _____

Medication(s) for Seizures/Migraines

Yes No

If yes, name of medication(s): _____

What is your PRIMARY method for weight loss maintenance?

- commercial weight program (for example: WW, Jenny Craig, TOPS, etc...)
- online commercial weight program (WW Online, Noom, Diet.com, etc...)
- use of a website or phone app (MyFitnessPal; Lose It!, SparkPeople, etc...)
- adoption of a specific diet (atkins; south beach; keto; DASH; paleo; gluten-free, etc...)
- group therapy
- individual therapy
- help from a nutritionist
- help from a personal trainer/fitness coach
- I maintain my weight without the use of a specific program or technological application.
- None of the above/ I do not have a specific method for maintaining my weight loss

Other: _____

Since the age of 18, how many weight loss attempts have you made?

During your most successful weight loss attempt, how much did you lose?

How many months or years did you maintain that weight loss within 5-10 lbs?

E. DIFFICULTIES IN EMOTION REGULATION SCALE (DERS)

Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item.

-----1-----2-----3-----4-----5-----
almost never sometimes about half the time most of the time almost always
(0-10%) (11-35%) (36-65%) (66-90%) (91-100%)

(r) = reverse scored

NONACCEPTANCE: 29, 25, 15, 14, 33, 27

AWARENESS: 7, 3, 12, 18, 9, 39

GOALS: 30, 22, 16, 38, 24

STRATEGIES: 20, 19, 35, 40, 32, 26, 41, 34

IMPULSE: 37, 31, 17, 23, 4, 28

CLARITY: 6, 5, 10, 8, 1

1. I am clear about my feelings. (r)
2. N/A
3. I pay attention to how I feel. (r)
4. I experience my emotions as overwhelming and out of control.
5. I have no idea how I am feeling.
6. I have difficulty making sense out of my feelings.
7. I am attentive to my feelings (r)
8. I know exactly how I am feeling. (r)
9. I care about what I am feeling. (r)
10. I am confused about how I feel.
11. N/A
12. When I'm upset, I acknowledge my emotions. (r)
13. N/A
14. When I'm upset, I become angry with myself for feeling that way.
15. When I'm upset, I become embarrassed for feeling that way.
16. When I'm upset, I have difficulty getting work done.
17. When I'm upset, I become out of control.
18. N/A
19. When I'm upset, I believe that I will remain that way for a long time.
20. When I'm upset, I believe that I'll end up feeling very depressed.
21. When I'm upset, I believe that my feelings are valid and important. (r)
22. When I'm upset, I have difficulty focusing on other things.
23. When I'm upset, I feel out of control.
24. When I'm upset, I can still get things done. (r)
25. When I'm upset, I feel ashamed with myself for feeling that way.
26. When I'm upset, I know that I can find a way to eventually feel better. (r)
27. When I'm upset, I feel like I am weak.
28. When I'm upset, I feel like I can remain in control of my behaviors. (r)
29. When I'm upset, I feel guilty for feeling that way.

30. When I'm upset, I have difficulty concentrating
31. When I'm upset, I have difficulty controlling my behaviors.
32. When I'm upset, I believe that there is nothing I can do to make myself feel better.
33. When I'm upset, I become irritated with myself for feeling that way.
34. When I'm upset, I start to feel very bad about myself.
35. When I'm upset, I believe that wallowing in it is all I can do.
36. *N/A*
37. When I'm upset, I lose control over my behaviors.
38. When I'm upset, I have difficulty thinking about anything else.
39. When I'm upset, I take time to figure out what I'm really feeling. (r)
40. When I'm upset, it takes me a long time to feel better.
41. When I'm upset, my emotions feel overwhelming.

F. WEIGHT CONTROL STRATEGY SCALE

Instructions: The following statements describe strategies and behaviors that individuals may engage in when they are trying to lose weight or maintain their weight loss. Using the scale below, circle the number that best describes how often you did each of the following **during the past month**. Please respond to every item.

0 = Never; 1 = Occasionally; 2 = About half the time; 3 = Most of the time; 4 = Always

1. I had several servings of fruits and/or vegetables each day.
2. I kept high calorie, high fat foods (e.g., chips, cookies, cakes) out of sight so they would not tempt me.
3. I avoided fried foods.
4. I kept low-calorie foods (e.g., fruit, raw vegetables, unbuttered popcorn) accessible for a healthy snack.
5. I limited my intake of regular soda.
6. I ate lower-fat meats (e.g., chicken, turkey, fish) or meat substitutes (e.g., lentils).
7. When eating dairy products (e.g., milk, yogurt, cheese), I chose reduced fat or fat free options.
8. I ate meats, fish, or vegetables that were baked, broiled, or grilled.
9. I chose low-calorie and/or low-fat foods to eat instead of higher calorie options.
10. I ate high-fiber foods (e.g., whole grain breads or cereals, fruit, vegetables).
11. I set a daily calorie goal for myself.
12. I kept a record of the type and amount of food I ate.
13. I weighed and/or measured the foods I ate.
14. I kept a record of the calories and fat in the foods I ate.
15. I kept a record of my minutes of exercise.
16. I weighed myself daily.
17. I kept a graph of my weight.
18. I set exercise goals for myself.
19. I had a plan for getting my exercise in if the weather was bad and I couldn't exercise outside.
20. I engaged in moderate-intensity exercise like brisk walking or something similar to brisk walking for at least 30 minutes a day.
21. If I missed exercising on one day, I made up for it by exercising longer another day.
22. I scheduled exercise into my day.
23. I kept my exercise clothes or shoes where I could see them as a reminder to exercise.
24. If I overate, I thought about what led up to my overeating.
25. If I overate on one day, I made up for it by eating less the next day.
26. When I reached my calorie goal for the day but still felt hungry, I tried a pleasant activity to take my mind off of the hunger.

27. If I got off track with my eating or exercise, I encouraged myself by thinking positively.
28. When I met a goal related to my eating, exercise, or weight loss, I rewarded myself with something special that did not involve food.
29. If I had negative thoughts about my weight loss progress, I tried to catch myself and stop that kind of thinking.
30. If I regained weight, I thought about my past successes and reminded myself that I could get back on track.

Scoring Information

To obtain a total WCSS score that ranges from 0-4, add all item scores and divide by 30. To obtain WCSS subscale scores, add item scores for each subscale and divide by the number of items in that subscale as follows:

WCSS-DC (10 items): 2, 6, 7, 10, 13, 17, 19, 18, 27, 30

WCSS-SM (7 items): 1, 3, 12, 15, 16, 23, 28

WCSS-PA (6 items): 4, 8, 11, 22, 24, 26

WCSS-PC (7 items): 5, 9, 14, 18, 20, 25, 29

G. PERCEIVED STRESS SCALE (PSS-14)

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate *how often* you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

For each question choose from the following alternatives:

0 = never; 1 = almost never; 2 = sometimes; 3 = fairly often; 4 = very often

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and "stressed"?
4. In the last month, how often have you dealt successfully with irritating life hassles?
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?
6. In the last month, how often have you felt confident about your ability to handle your personal problems?
7. In the last month, how often have you felt that things were going your way?
8. In the last month, how often have you found that you could not cope with all the things that you had to do?
9. In the last month, how often have you been able to control irritations in your life?
10. In the last month, how often have you felt that you were on top of things?
11. In the last month, how often have you been angered because of things that happened that were outside of your control?
12. In the last month, how often have you found yourself thinking about things that you have to accomplish?
13. In the last month, how often have you been able to control the way you spend your time?
14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Scoring: "PSS scores are obtained by reversing the scores on the 7 positive items (0=4; 1=3; 2=2...) and then summing across all 14 items. Items 4,5,6,7,9,10 and 13 are the positively stated items."

H. CENTER FOR EPIDEMIOLOGIC STUDIES DEPRESSION SCALE (CES-D), NIMH

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

During the past week:	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of time (3-4 days)	Most or all of the time (5-7 days)
1. I was bothered by things that usually don't bother me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I did not feel like eating; my appetite was poor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I felt I could not shake off the blues even with help from my family or friends.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I felt I was just as good as other people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I had trouble keeping my mind on what I was doing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I felt depressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. I felt that everything I did was an effort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I felt hopeful about the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I thought my life had been a failure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. I felt fearful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. My sleep was restless	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I was happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I talked less than usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. I felt lonely	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15. People were unfriendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16. I enjoyed life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17. I had crying spells	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. I felt sad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19. I felt that people dislike me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20. I could not get “going”	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SCORING: zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.

I. THANK YOU SCREEN

Thank you for taking the time to participate in our research study!

We are interested in examining the role emotion regulation—the ability to moderate the intensity and duration of experienced emotion—plays in long term weight loss maintenance. Previous research on long-term weight loss maintenance has shown a correlation between emotions (stress and depression, in particular) and higher rates of weight regain after weight loss. While the experience of distressing emotions is a normal and unavoidable part of everyday life, we're interested in whether or not how one copes with experienced emotion may, directly or indirectly, impact weight loss maintenance. We hypothesize that stronger emotion regulation skill may be related to greater success with long term weight loss maintenance even in the presence of higher levels of distressing emotions. Your survey responses will help us determine whether or not this relationship exists, and may inform future studies on long term weight loss maintenance and future development or improvements to weight loss and weight loss maintenance interventions. If you have questions about the study, please feel free to contact either the researcher at Karyn.Aiello@umb.edu, (617) 942-1706; or the faculty advisor at Julie.Wright@umb.edu, (617) 287-3808.

Thank you again for contributing to an important area of research!



UNIVERSITY OF MASSACHUSETTS BOSTON

**HAVE YOU LOST 20 LBS OR MORE BETWEEN
THE AGES OF 18 AND 70?**

**HAVE YOU FOUND IT DIFFICULT TO KEEP
YOUR WEIGHT LOSS OFF?**

**HAVE YOU BEEN ABLE TO KEEP ALL, SOME, OR
NONE OF THE WEIGHT LOSS OFF?**

We are interested in learning more about the potential differences between those who struggle to keep weight loss off, and those who do not. The present study seeks participants to complete an anonymous, on-line survey which will take 30-45 minutes to complete.

To be eligible for this study you must:

- Have lost 20 lbs. or more as an adult (between the ages of 18 and 70) **WHETHER OR NOT YOU HAVE KEPT ANY OR ALL OF YOUR WEIGHT LOSS OFF**
- Have not used prescription or over-the-counter medications to assist with weight loss
- Have not had any type of bariatric surgery (gastric bypass; lap-band; etc...)
- Have not been pregnant or breastfeeding within the past 12 months

Participants will be entered into a raffle to **receive 1 of 6 available \$25 Amazon gift cards** upon survey completion.

To participate in the study, please visit [SURVEY.URL](#)

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