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Dietary Restraint and Weight Loss in Relation to Disinhibited Eating in Obese Veterans Following a Behavioral Weight Loss Intervention

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Abstract

Ability to restrain one's dietary intake is a necessary skill for weight loss. However, dietary restraint has been shown to paradoxically increase disinhibited eating in certain populations, thereby negatively impacting weight loss and leading to worse overall health outcomes. The aim of this study was to address gaps in the literature regarding the relationships between separate facets of dietary restraint (intention; behavior) with weight loss and various types of disinhibited eating (binge eating, external eating, emotional eating) in overweight and obese adults who recently completed a weight loss intervention. A sample of mostly male Veterans with overweight and obesity (N=88) self-reported their dietary restraint intention, restraint behavior, and current disinhibited eating following completion of an 8-week behavioral weight loss treatment. Greater dietary restraint intention was related to greater dietary restraint behavior, p <.05. Greater dietary restraint behavior was significantly related to greater recent weight loss, p < .05, while restraint intention was not, p > .05. Greater dietary restraint intention was related to greater current binge eating and external eating, while greater self-reported restraint behavior was related to less binge eating, p < .05. Thus, dietary restraint behavior appears to be adaptive for this population, whereas rigid dietary restraint intention may increase risk for disinhibited eating. To decrease disinhibited eating and improve weight loss outcomes in Veterans, interventions might specifically address rigid rule-following associated with abandonment of weight loss goals and help Veterans develop specific yet flexible eating plans. Future research should examine whether dietary restraint

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intention and behavior differentially predict disinhibited eating and weight loss outcomes prospectively.

Keywords

binge eating; dietary restraint; restrained eating; weight loss; veterans; obesity

Increasing rates of overweight and obesity worldwide have spurred the development of behavioral weight loss interventions. These interventions generally promote dietary restraint as a means of decreasing food intake and producing weight loss. To address the high prevalence of overweight and obesity (OW/OB) in U.S. Veterans, which is estimated at 77% (Kahwati, Lance, Jones, & Kinsinger, 2011), the Veterans Health Administration (VHA) created the evidence- based Motivating Overweight/Obese Veterans Everywhere (MOVE!©) Weight Management Program. MOVE! is a comprehensive lifestyle intervention program available at every VHA hospital facility and over half of VHA's community outpatient clinics. However, mean percent weight loss after six months of MOVE! participation is approximately 1.4% for typical attendees and 3.5% for those attending more sessions or for a longer duration (Kahwati et al., 2011; Littman, Boyko, McDonell, & Fihn, 2012). These weight loss outcomes are below the recommended clinical weight loss guideline of 10% baseline body weight (NIH, 2018).

Binge eating is one potential explanation for the high prevalence of OW/OB and suboptimal weight loss outcomes among Veterans. Binge eating is characterized by recurrent episodes of overeating accompanied by a sense of loss of control and significant distress. Individuals with binge eating episodes occurring at least once per week for three or more months without engagement in compensatory behaviors may meet DSM-5 diagnostic criteria for Binge Eating Disorder (BED) (American Psychiatric Association, 2013). Prevalence rates of (a) OW/OB (Breland et al., 2017; Masheb et al., 2015), (b) binge eating (Higgins et al., 2013), and (c) comorbid OW/OB and binge eating (Higgins et al., 2013; Masheb et al., 2015; Rosenberger & Dorflinger, 2013) are higher among Veterans receiving VHA care than among the general U.S. population. In Veterans, subthreshold binge eating is associated with higher rates of medical and mental health comorbidities (Higgins et al., 2013), and the mere presence of binge eating behavior prior to starting MOVE! is related to significantly poorer weight loss outcomes (Masheb et al., 2015). These findings suggest that binge eating symptoms should be assessed and treated in this population even if binge eating frequency and severity do not meet criteria for BED. The spectrum of binge eating-like behavior, which includes objective binge eating, subjective binge eating, binge eating of low frequency and/or limited duration, overeating without loss of control, and emotional eating, has been conceptualized as a pattern of disinhibited eating (Johnson, Pratt, & Wardle, 2012) or uncontrolled eating (Vainik, Neseliler, Konstabel, Fellows, & Dagher, 2015). Effective interventions for reducing both OW/OB and disinhibited eating among Veterans are needed.

A primary treatment aim of behavioral weight management programs such as MOVE! is to increase dietary restraint, which is to increase intentions to reduce energy intake. However, a prominent theory of binge eating etiology implicates dietary restraint as a causal mechanism

(Herman & Mack, 1975; Howard & Porzelius, 1999; Polivy & Herman, 1985), thereby suggesting that dietary restraint may be contraindicated for disinhibited eating (Howard & Porzelius, 1999). Empirical findings, though, are mixed on the potentially causal link between increased dietary restraint through engagement in evidence-based weight management programs and disinhibited eating in adults with OW/OB (Johnson, Pratt, & Wardle, 2012; Lowe, 2015; Jansen, 2016; Schaumberg, Anderson, D. A., Anderson, L. M., Reilly, & Gorrell, 2016). More recently it has been proposed that the cognitive facet of dietary restraint (i.e., intention to restrain one's intake) in particular has potential to result in perceived deprivation and self-regulation failure, in turn leading to disinhibited eating and failure to lose weight (or weight gain). Conversely, successful dietary restraint behavior (i.e., consistent, sustainable calorie restriction) is proposed to lead to weight loss and weight maintenance without increasing disinhibited eating (Schaumberg et al., 2016). However, empirical studies have largely failed to explicitly distinguish between the cognitive and behavioral components of dietary restraint and compare their effects. Commonly used self-report instruments appear to assess only one facet of restraint or confound them. For example, the Restraint Scale (Herman & Polivy, 1980) assesses intent to limit food intake, regardless of one's success in doing so, whereas the Three Factor Eating Questionnaire assesses enacted dietary restraint behavior (Mills, Weinheimer, Polivy, & Herman, 2018; Stunkard & Messick, 1985). The Dutch Eating Behavior Questionnaire (DEBQ) (Van Strien, Frijters, Bergers, & Defares, 1986), which measures both restraint and disinhibited eating styles in adults with OW/OB, contains items in its Restrained Eating scale which differentiate restraint intention and restraint behavior. Using the DEBQ in participants with OW/OB, one study found that greater restraint intention was related to more disinhibited eating and unrelated to BMI, whereas greater restraint behavior was related to less disinhibited eating and lower BMI (Larsen, van Strien, Eisinga, Herman, and Engels, 2007). In a separate sample of participants across the range of BMI (16.38 to 38.99 kg/m^2), only restraint intention, not behavior, was related to overeating (Rodgers, Fuller-Tyszkiewicz, Holmes, Skouteris, & Broadbent, 2018). Thus, the cognitive (intention) and behavioral facets of dietary restraint may or may not be adaptive for weight loss-seeking adults with OW/OB, as defined by their respective relationships to BMI, weight loss, and disinhibited eating. Yet, research to differentiate the respective roles of dietary restraint intention and behavior is limited.

To our knowledge, dietary restraint and weight change resulting from MOVE! have not been examined in relation to one another or to disinhibited eating. The extent to which weight loss in MOVE! is related to either type of restraint after MOVE! may indicate the relative benefit of high restraint intention or behavior for weight loss outcomes. Further, from a clinical standpoint, it is important to elucidate whether Veterans' relative success in MOVE! is related to patterns of disinhibited eating to inform treatment approaches (e.g., modifications to MOVE! protocol to reduce risk for disinhibited eating; provision of adjunctive treatment for Veterans experiencing disinhibited eating following MOVE!). Weight change likely reflects behavioral influences as well as physiological adaptations, each of which could uniquely impact disinhibited eating. Examining weight change and dietary restraint simultaneously in relation to disinhibited eating can allow for conclusions to be drawn on the relative influence of the physiological aspect of weight loss, above and beyond the

behavioral and cognitive restraint components. Thus, given the suboptimal rates of weight loss following MOVE! participation and high rates of disinhibited eating among Veterans, it is especially important to understand the interrelationship between weight change, dietary restraint and disinhibited eating, and to better elucidate whether the two proposed facets of restraint uniquely predict weight change and disinhibited eating.

Further, despite increasing rates of disinhibited eating among men, research on OW/OB and disinhibited eating has focused almost exclusively on women (Murray et al., 2017; Reas & Stedal, 2015; Valente et al., 2017). Preliminary research suggests that greater restraint might relate to weight loss in men versus weight gain and greater binge eating in women (Hawks, Madanat, & Christley, 2008), though studies have not differentiated between restraint intention and restraint behavior. Additionally, some literature suggests that binge and other disinhibited eating styles and related cognition and behavior differ by race/ethnicity. (Atlas, Smith, Hohlstein, McCarthy, & Kroll, 2002; Lee-Winn, Mendelson, & Mojtabai, 2014; Sánchez-Johnsen, Dymek, Alverdy, & Le Grange, 2003). Given that the majority of U.S. Veterans is male with substantial racial and ethnic diversity, research examining the associations of restraint, weight loss, and disinhibited eating in Veterans requires attention to the role of these socio demographic factors to better inform treatment strategies for this heterogeneous population.

Current Study

Our main goal in the current study was to examine the cross-sectional relationships between dietary restraint intention (RI), dietary restraint behavior (RB), percent weight change following MOVE!, BMI, and disinhibited eating (binge eating, external eating, emotional eating) in both male and female Veterans with OW/OB following participation in MOVE!. The aims were to examine: (1) the relationship between post-MOVE! RI and RB; (2) the relationships between post-MOVE! RI, RB, and BMI; (3) the relationships between post-MOVE RI, RB and percent weight change in MOVE! calculated retrospectively; and (4) whether RI, RB, or percent weight change in MOVE! were uniquely related to disinhibited eating post-MOVE!. We also evaluated sex and ethnicity differences and considered these variables as potential covariates in analytic models. We hypothesized that RI and RB would be positively related, but that RI would be positively related to disinhibited eating whereas RB would be negatively related to disinhibited eating. We also expected RB to be negatively related to BMI and positively related to weight loss in MOVE!. Findings might inform how to better design treatments to address co- existing weight loss and disinhibited eating treatment goals among Veterans.

Methods

Participants & Procedures

Participants were U.S. military Veterans who had recently participated in the MOVE! program at VA San Diego Healthcare System (VASDHS) and were enrolling in a study of an adjunctive treatment for disinhibited eating (Afari et al., 2018). Baseline measures collected for the adjunctive study were used to address the aims of the current study. Participants were Veterans who had attended at least 60% of sessions of the MOVE! program (i.e., 5 of 8

sessions) and were between 18–75 years old and had BMI ≥ 25 kg/m^2 (OW/OB). Participants did not need to meet a minimum threshold of disinhibited eating to participate. Exclusion criteria included: serious or unstable medical or psychiatric illness (including anorexia and bulimia), or psychosocial instability (e.g., homelessness); conditions in which exercise or weight loss would be detrimental to one's health (including pregnancy); active suicidal ideation or history of suicide attempt within five years; pharmacotherapy for obesity (e.g., Orlistat or Meridia) or bariatric surgery within the past six months; and current participation in group or individual psychotherapy for weight management or binge eating. A research assistant attended the last session of the MOVE! program to recruit participants, who were then screened by telephone and in-person. The baseline assessment was completed following enrollment. A total of 91 participants completed a portion of the baseline assessment but three participants were excluded from the present analyses due to incomplete baseline data on one or more relevant measures. Eight of the remaining 88 participants (9%) met DSM-5 criteria for current BED as determined by the Eating Disorder Examination Edition 16.0 (Fairburn, Cooper, & O'Connor, 2008). The study was approved by the VASDHS Institutional Review Board and Research and Development Committee and all participants provided informed consent.

Measures

Sociodemographic variables.—Participants reported sociodemographic information including age and date of birth, sex, race/ethnicity, education attainment, household income, and marital status. Categorical sociodemographic variables were dichotomized for ease of interpretation. Race/ethnicity was dichotomized as White and non-White. If a participant identified as both White and another race/ethnicity, (s)he was categorized as non-White. Education was dichotomized such that high school or GED, some college, and technical school were categorized as "less than bachelor's degree," and bachelor's degree and graduate school were categorized as "bachelor's degree or more." Household income was categorized as "less than $40,000 per year" or "$40,000 per year or more." Marital status was dichotomized such that single/never married, separated, divorced, and widowed were categorized as "single" and married or living with partner was categorized as "married/cohabiting."

Body Mass Index (BMI) and Percent weight change in MOVE!.—Weight was measured either by a physician or MOVE! clinician prior to MOVE! participation and following MOVE! participation. Using these weights and height, recorded in the participant's medical record, BMI was calculated as weight (kilograms) divided by height (meters) squared. Percent weight change in MOVE! was calculated by subtracting post-MOVE! weight from pre-MOVE! weight and dividing the difference by pre-MOVE! weight. Thus, a positive percent weight change value indicates weight loss and a negative value indicates weight gain.

Disinhibited eating.—Three measures of disinhibited eating were used: Binge Eating Scale (BES), Dutch Eating Behavior Questionnaire (DEBQ) Emotional Eating scale, and DEBQ External Eating scale. The BES (Gormally, Black, Daston, & Rardin, 1982) is a 16-item self- report questionnaire designed to assess the behavioral, cognitive, and emotional

features of binge eating in adults with OW/OB. Participants are instructed to select one statement out of four which best describes their binge eating-related attitudes and behaviors, from 16 groups of questions. Each statement is weighted either 0, 1, 2, or 3, and weights are summed for a total score. An example item weighted 0 is, “I rarely eat so much food that I feel uncomfortably stuffed afterward.” An example item weighted 3 from the same group of statements is, “I eat so much food that I regularly feel quite uncomfortable after eating and sometimes a bit nauseous.” Higher total scores indicate more severe binge eating symptoms. Cronbach’s alpha for BES in this sample was .88.

The DEBQ (Van Strien et al., 1986) is a 33-item self-report questionnaire designed to measure three eating styles common among persons with OW/OB. Two of three scales assess disinhibited eating: Emotional Eating (13 items), and External Eating (10 items). Participants rate items according to how well the items describe the individual on a Likert-type scale from 1 (*never*) to 5 (*very often*). Example items include: “Do you have a desire to eat when you are depressed or discouraged?” (Emotional Eating); “If food tastes good to you, do you eat more than usual?” (External Eating). Scale scores were calculated as the sum of all items in each scale, respectively (Larsen et al., 2007). Higher scores indicate greater disinhibited eating. Cronbach’s alphas for the Emotional Eating and External Eating scales were .97 and .80 in this sample, respectively.

Dietary restraint.—Though the DEBQ Restrained Eating scale has traditionally been used to examine dietary restraint as a unitary construct, emergent findings support a two-factor structure in OW/OB samples (Larsen et al., 2007) which assesses RI (3 items) and RB (7 items). Thus, two measures of dietary restraint were used in the present study: DEBQ Restraint Intention subscale (DEBQ-RI) and DEBQ Restraint Behavior subscale (DEBQ-RB). Example items include: “Do you try to eat less at mealtimes than you would like to eat?” (DEBQ-RI); “Do you watch exactly what you eat?” (DEBQ-RB). Scale scores were calculated as the sum of items in each scale, respectively. Higher scores indicate greater restraint intention or behavior. Cronbach’s alphas for the combined DEBQ Restrained Eating Scale (10 items), DEBQ-RI (3 items) and DEBQ-RB (7 items) were .85, .65, and .74 in this sample, respectively. Internal reliabilities are expected to be lower for DEBQ-RI and DEBQ-RB given the relatively shorter length of these subscales. To adjust for these differences, the Spearman-Brown Formula (Li, Rosenthal, & Rubin, 1996; Walker & Lev, 1953) was used to estimate internal reliability for the DEBQ-RI and DEBQ-RB were these subscales equal in length to the entire scale (10 items). Estimates of internal reliability using the Spearman-Brown Formula were .86 for DEBQ-RI and .80 for DEBQ-RB.

Statistical Analyses

All statistical procedures were conducted using IBM SPSS Statistics for Windows, version 24 (IBM Corp., Armonk, N.Y., USA), with a $\leq .05$. Distributions of all variables were assessed for normality and presence of outliers to determine if transformations were necessary to meet assumptions of linear regression analyses. No variables required transformation. Given literature citing potential differences in the relationships among study variables by sex (Batch et al., 2017; Hawks, Madanat, & Christley, 2008; Ricca et al., 2000) and race/ethnicity (Atlas et al., 2002; Crago & Shisslak, 2003; Kelly et al., 2012; Lee-Winn

et al., 2014; Sánchez-Johnsen et al., 2003), independent samples *t*-tests were used to test for sex and race/ethnicity group differences on all study variables. There were no group differences based on sex (*p*s > .05); therefore, sex was not entered as a covariate in any of the models. Independent samples *t*-tests found significant race/ethnicity differences for the disinhibited eating variables, so race/ethnicity was entered as a covariate in linear regression models for aim 4 to control for this effect.

Pearson product-moment correlation analysis was used to examine relationships among study variables. Multiple linear regression analysis was used to test all hypotheses regarding the relationships between dietary restraint, BMI, percent weight change in MOVE!, and disinhibited eating. Given significant correlations between RI and RB, and weight change in MOVE! and RB, these predictors were entered simultaneously in regression models, in order to examine their unique effects. For aim 1, RI was entered as the predictor variable for RB as the outcome variable. For aim 2, RI and RB were simultaneously entered as predictors of BMI Post-MOVE. For aim 3, RI and RB, were simultaneously entered as predictors of percent weight change in MOVE!. For aim 4, three models were examined. In the first model, RI, RB, percent weight change in MOVE!, and race/ethnicity were simultaneously entered as predictors of binge eating. In the second model, RI, RB, percent weight change in MOVE!, and race/ethnicity were simultaneously entered as predictors of emotional eating. In the third model, RI, RB, percent weight change in MOVE!, and race/ethnicity were simultaneously entered as predictors of external eating. Sensitivity analyses using data from male participants only ($n = 67$) were conducted for all aims. Multiple linear regression models met assumptions of multicollinearity, normality of residuals (homoscedasticity), and absence of influential data points. Regression coefficients are reported as standardized b-values.

Results

Sociodemographic and Clinical Characteristics

Table 1 provides the sociodemographic and clinical characteristics of the entire sample and by race/ethnicity. Of 88 participants, 61 (69%) were White and 27 (31%) non-White, including 19% Black, 6% Hispanic/Latino, 2% Asian, 1% Pacific Islander, and 3% other. Mean BMI pre-MOVE! was 38.02 kg/m^2 and mean BMI post-MOVE! was 36.89 kg/m^2 for the total sample, both of which fall within the obese range (Centers for Disease Control and Prevention).BMI of nine participants fell within the overweight range (BMI: 25–29.99 kg/m^2) and 79 within the obese range (BMI: 30 kg/m^2 or greater). Mean percent weight change from pre- to post- MOVE! was 2.28% weight loss (*SD* = 4.05%), ranging from 11.10% loss to 11.11% gain. Half of the sample (58%) lost two or more percent of pre-MOVE weight, 20% maintained their weight (0% change to 1.99% loss), and 22% gained 0.1% or more of their starting weight. Mean BES score suggested mild disinhibited eating in this sample (Greeno, Marcus, & Wing, 1995). Mean DEBQ-RB and DEBQ-RI scores were comparable to those in two samples of OW/OB individuals reported by Larsen et al. (2007). Significant race/ethnicity group differences were found for all three measures of disinhibited eating. Table 2 presents the bivariate relationships between measures of restraint, percent

weight change in MOVE!, and disinhibited eating, supporting our aims to further examine these associations in linear regression models.

Relationships Between Dietary Restraint Intention, Dietary Restraint Behavior, BMI, and Percent Weight Change in MOVE!

Table 3 shows the results of multiple linear regression analyses used to examine aims 1–3. The omnibus model for aim 1 was significant, $F(1, 86) = 40.56$, $p < .001$, $R^2 = .32$. RI was significantly associated with greater RB (b = .18, $p < .001$). The omnibus model for aim 2 was not significant, $F(2, 85) = 0.86$, $p = .43$, $R^2 = .02$. Neither RI nor RB were uniquely related to BMI at the end of MOVE!. The omnibus model for aim 3 was significant, $F(2, 85) = 3.36$, $p = .04$, $R^2 = .07$. Greater RB was significantly associated with greater percent weight loss in MOVE! (b = .28, $p = .03$) when controlling for RI. RI was not significantly related to percent weight change in MOVE! when controlling for RB. The directions of relationship and patterns of significant findings were similar in the subset of men only.

Relationships Between Dietary Restraint, Weight Change, and Disinhibited Eating

Table 3 also presents the results of multiple linear regression analyses used to examine aim 4. Three models were examined, each with a different type of disinhibited eating as the outcome variable. The omnibus model for binge eating was significant, $F(4, 83) = 5.19$, $p = .001$, $R^2 = .20$. Greater RI was significantly related to greater binge eating (b = .43, $p < .001$) when controlling for RB, weight change in MOVE!, and race/ethnicity. Greater RB was significantly related to less binge eating (b = −.29, $p = .02$) while controlling for RI, weight change in MOVE!, and race/ethnicity. Percent weight change was not significantly related to binge eating when controlling for RI, RB, and race/ethnicity.

The omnibus model for emotional eating was significant, $F(4, 83) = 4.22$, $p = .004$, $R^2 = .17$. However, none of the predictor variables (RI, RB, percent weight change in MOVE!) were significantly related to emotional eating when controlling for race/ethnicity and the other predictor variables of interest. Finally, the omnibus model for external eating was significant, $F(4, 83) = 3.41$, $p = .01$, $R^2 = .14$. Greater RI was significantly related to greater external eating (b = .28, $p = .03$) when controlling for RB, weight change during MOVE!, and race/ethnicity. Neither RB nor percent weight change were significantly related to external eating when controlling for other predictors and race/ethnicity. In each aim 4 model, race/ethnicity was significantly associated with the outcome variable representing disinhibited eating, such that disinhibited eating was lower among non-White participants after controlling for restraint and weight change variables. With the exception of external eating, overall findings were similar in the subset of men only. Among men, the omnibus model for external eating was not significant, $R^2 = .07$, $F(4, 62) = 1.15$, $p = .34$, and RI was not a significant predictor of DEBQ-External Eating, b = .16, $t(62) = 1.01$, $p = .32$.

Discussion

Effective treatment for weight loss-seeking Veterans with OW/OB must consider the role of dietary restraint in both weight loss and disinhibited eating outcomes. Further, whether weight change is related to disinhibited eating following a weight loss intervention like

MOVE! has clinical implications for treatment. The current study examined two facets of dietary restraint, RI and RB, and their relationship to disinhibited eating and recent weight loss following participation in VHA's standard weight management program, MOVE!. As hypothesized, greater RI was related to greater RB, and only RB was related to greater weight loss in MOVE!. We did not find the previously reported association between RB and lower BMI in this sample (Larsen et al., 2007; Johnson et al., 2012). Consistent with our hypotheses, greater self-reported RB was cross-sectionally related to lower binge eating, while greater RI was related to greater binge eating and greater external eating. Weight change during MOVE! was not uniquely associated with any measure of disinhibited eating when controlling for self-reported RI and RB. Further, contrary to our hypothesis, neither of the restraint variables (intention, behavior) nor weight change during MOVE! were related to post-MOVE! emotional eating.

Restraint Intention, Restraint Behavior, and Weight Loss

Though RI and RB were related in this sample, only RB was related to successful weight loss in MOVE!. These results are consistent with findings showing that restraint behaviors such as self-monitoring and making deliberate food choices have desirable outcomes on weight for weight loss-seeking adults with OW/OB (Rodgers et al., 2018). The restraint behaviors assessed by DEBQ-RB are the same as those taught in evidence-based behavioral weight loss interventions, such as closely monitoring food intake, choosing foods that promote weight loss, and eating less at night. Thus, the significant, positive relationship between self-reported engagement in these behaviors and retrospective weight loss suggests that those behaviors emphasized in MOVE! may have been effective in producing weight loss in this population of primarily male Veterans. These results are consistent with recent reviews citing the benefits of dietary RB for eating and weight loss outcomes, especially as part of a structured weight loss program for OW/OB adults (Schaumberg et al., 2016; Johnson, Pratt, & Wardle, 2012). Despite the association between RB and weight loss in MOVE!, we did not find a relationship between RB and BMI post-MOVE!, potentially due to the restricted BMI range in our sample. The absence of a significant relationship between RI and weight loss in MOVE! is consistent with previous findings (Larsen et al., 2007) and with theoretical models proposing that RI is not necessarily followed by congruent RB, and therefore intention to restrain dietary intake alone is not necessarily predictive of weight loss (Schaumberg et al., 2016).

Restraint Intention, Restraint Behavior, and Disinhibited Eating

Consistent with the literature, we found that RI and RB showed different relationships to disinhibited eating. Among our sample of Veterans with OW/OB, greater RI was uniquely associated with more binge eating and more external eating, above and beyond the influence of RB. Greater RB was uniquely associated with less binge eating. Interestingly, these relationships were evident following participation in MOVE!, thereby suggesting that restraint intention may be a modifiable treatment target for reducing post-MOVE! risk for disinhibited eating. Veterans with heightened RI following MOVE! completion might also benefit from adjunctive treatment to reduce current disinhibited eating and risk for future disinhibited eating. Further, findings suggest that restraint behavior evident after this type of

intervention is related to less disinhibited eating and is thereby adaptive, rather than problematic as some theories posit.

These findings are consistent with the self-regulation model of cognitive dietary restraint (Schaumberg et al., 2016). In this model, self-regulation has three stages: self-monitoring, self-evaluation, and self-reinforcement. Issues at any stage, such as inconsistent self-monitoring, unrealistic ideals for the rate of weight loss, or failure to achieve dietary and weight loss goals, might result in psychological inertia and inappropriate self-reinforcement, in turn leading to binge eating, weight gain, and greater eating disorder risk. Clinicians delivering MOVE! and similar interventions might explicitly differentiate between restraint intention and behavior in addressing dietary restraint with participants. Enhancing self-regulation strategies might counteract the negative sequelae of high RI by enhancing engagement in successful dietary RB (i.e., increasing congruence between RI and RB).

Notably, emotional eating was not related to either RI or RB. Some have theorized that various forms of disinhibited eating fall on a spectrum of severity, with binge eating representing a more severe form and emotional eating representing a less severe form (Vainik et al., 2015). Previous research found that only disinhibited eating characterized by a sense of loss of control (i.e., binge eating) is related to dietary restraint among men, compared to overeating without a loss of control (e.g., emotional eating) (Kelly, Cotter, & Guidinger, 2018); this is consistent with our findings in the entire sample and men only. Thus, binge eating and external eating seem to be more important forms of disinhibited eating to monitor in relation to dietary restraint, especially in men.

Weight Loss and Disinhibited Eating

Weight change during MOVE! was not uniquely related to post-MOVE! disinhibited eating when accounting for RI and RB. Weight loss reflects the confluence of several behavioral, psychological, and biological influences. Although some researchers have suggested that the behavioral and physiological responses to weight loss predispose individuals to disordered eating (Lowe, 2015), we did not find evidence for that association in our sample of Veterans with OW/OB. Clinically, this finding suggests that provision of adjunctive treatment for binge eating might be appropriate for any Veterans endorsing distress related to disinhibited eating, regardless of relative success in losing weight during MOVE!.

Treatment Implications for Veterans

Our findings suggest that among primarily male Veterans with OW/OB, dietary RI and RB are related but distinct facets of restraint that relate differentially to weight loss and disinhibited eating. Interventions might specifically assess the congruence of RI and RB, and seek to modify high intentions that are unrealistic or unattainable. Given that greater RI was uniquely related to greater binge eating and external eating following participation in MOVE!, additional treatment may be beneficial for participants who endorse disinhibited eating or for whom RI is high upon completion of behavioral weight management programs. Further, identifying and targeting high RI among Veterans during treatment may be crucial for reducing disinhibited eating that undermines weight management efforts. Clinically, high RI might be characterized by intention to follow strict rules (e.g., I will never eat cookies

again), tendency to abandon or discount the use of dietary guidelines and goals if not followed completely, use of fasting or other extreme dietary habits in order to reach ambitious weight loss quickly, and other maladaptive strategies. It is important to note that while RI was consistently related to greater binge eating in the whole sample and men only, RI was not significantly related to greater external eating in men only. If this finding is replicated in larger samples of men, targeting RI in men may not have the same clinical effects as for female Veterans.

Alternately, strategies to improve RB and reduce maladaptive RI in the context of behavioral weight loss interventions may focus on building flexibility in one's approach to dietary guidelines and weight management. Encouraging a training/learning mindset wherein improving weight control skills takes time and practice, and lapses are an opportunity to refine/optimize one's plan for the next week, may enhance long-term engagement in weight control efforts. Additionally, utilizing personalized goals aligned with self-identified benefits of weight loss and a healthier lifestyle rather than the guilt, shame, and fear of not meeting fitness standards commonly seen in this population may increase motivation for weight management. Interestingly, race/ethnicity was consistently associated disinhibited eating, suggesting that any interventions addressing disinhibited eating may need to be adapted for different groups.

Limitations

To our knowledge, this is the first examination of the relationships between the cognitive and behavioral aspects of dietary restraint, and their respective relationships to weight change in MOVE! and disinhibited eating among Veterans. However, this study has several limitations. First, due to the cross-sectional nature of the data and analyses, we cannot infer causal relationships. Future research should examine whether dietary RI and RB differentially predict changes in disinhibited eating and weight change longitudinally. Second, our self-report data were based on retrospective recall and may have been subject to recall errors and other reporting biases. Ecological momentary assessment methods in conjunction with 24-hour dietary recall may provide a more accurate assessment of dietary restraint and disinhibited eating behavior (Engel et al., 2009). Thus, future research in Veterans should examine the longitudinal relationship between restraint and disinhibited eating using these methods. Third, our relatively small sample size precluded us from examining race/ethnicity or sex as potential moderators. Given that we found significant race/ethnicity group differences in each measure of disinhibited eating, further examination of the possible role of racial/ethnic differences is warranted. Though we found no cross-sectional differences in study variables by sex, extant literature suggests that longitudinal relationships may differ by sex (see Hawks, Madanat, & Christley, 2008 for review). Additional research is needed to examine sex as a possible moderator of the prospective relationships among dietary restraint, weight loss, and disinhibited eating in Veterans. Fourth, the internal consistency of the RI and RB subscales were lower than those reported in other samples (Larsen et al., 2007; Rodgers et al., 2018), and the reliability of RI and RB subscales should be evaluated in larger, diverse samples of Veterans. Finally, we did not recruit participants based on clinical levels of disinhibited eating, and only 9% of participants met diagnostic criteria for BED. Therefore, our findings may not generalize to populations with both OW/OB and BED.

However, findings are likely to generalize to typical weight loss-seeking Veterans seen in primary care and weight management programs. Given that the MOVE! program was delivered to the present sample in a strictly clinical setting, results of the present study are likely ecologically valid for informing treatment decisions in real-world settings.

Conclusion

Dietary RI and RB appear to be separate constructs which relate differentially to weight loss and disinhibited eating in primarily male Veterans with OW/OB. Intention to restrain one's dietary intake might relate to greater disinhibited eating while successful dietary restraint behavior relates to greater weight loss and less disinhibited eating. Elevated or extreme intentions to restrain one's eating may therefore be problematic for weight loss-seeking Veterans. Weight management programs can seek to intervene by addressing strict rule following, irregular eating, and use of extreme weight loss attempts. Future studies should continue to differentiate between dietary RI and RB, and examine how these constructs relate to weight change and various types of disinhibited eating prospectively, paying special attention to potential differences by sex and race/ethnicity.

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Table 1

Sociodemographic and Clinical Characteristics for Total Sample and Race/Ethnicity Groups

Measure	Total N = 88	Race/Ethnicity		t
		White (n = 61)	Non-White (n = 27)	
Demographics				
Age, M (SD)	56.60 (10.06)	57.08 (10.38)	55.19 (9.34)	0.81
Male, %	76	-	-	-
Annual Income less than $40K, %	53	-	-	-
Education less than Bachelors, %	60	-	-	-
Single or not living with partner, %	59	-	-	-
Days	37 (54)	30.93 (35.68)	49.33 (79.31)	−1.51
Weight & BMI				
BMI Pre-MOVE!, M (SD)	38.02 (7.50)	38.00 (7.28)	38.05 (8.09)	−0.03
BMI Post-MOVE!, M (SD)	36.89 (7.20)	37.15 (7.15)	36.98 (7.53)	0.11
Weight Pre-MOVE!, M (SD)	256.93 (1.43)	254.89 (56.94)	261.53 (71.51)	−0.37
Weight Post-MOVE!, M (SD)	250.66 (59.33)	249.11 (55.55)	254.89 (56.94)	−0.47
%WCMOVE, M (SD)	2.28 (4.05)	2.17 (4.04)	2.51 (4.12)	−0.36
Disinhibited Eating				
BES, M (SD)	16.35 (8.91)	17.67 (8.07)	13.37 (10.11)	−2.13 *
DEBQ Emotional Eating, M (SD)	39.61 (12.78)	42.89 (10.98)	32.04 (13.44)	3 89 ***
DEBQ External Eating, M (SD)	31.81 (5.51)	32.90 (4.74)	29.37 (6.37)	2.89 **
Dietary Restraint				
DEBQ-RI, M (SD)	8.59 (2.17)	8.61 (2.23)	8.56 (2.08)	0.10
DEBQ-RB, M (SD)	20.80 (4.37)	20.97 (4.06)	20.44 (5.06)	0.52

Note. Days = Days between end of MOVE! participation and questionnaire completion; %WCMOVE = percent weight change in MOVE!; BES = Binge Eating Scale; DEBQ Emotional Eating = Dutch Eating Behavior Questionnaire Emotional Eating; DEBQ External Eating = Dutch Eating Behavior Questionnaire External Eating; DEBQ-RB = Dutch Eating Behavior Questionnaire Restrained Eating Behavior; DEBQ-RI = Dutch Eating Behavior Questionnaire Restrained Eating Intention.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2

Correlations among study variables (N=88)

Measure	1	2	3	4	5	6	7
1. DEBQ-RI	-						
2. DEBQ-RB	.57***	-					
3. BMI Post-MOVE	.14	.06	-				
4. %WCMOVE	.14	.27**	-.04	-			
5. BES	.25*	−.07	.09	−.17	-		
6. DEBQ Emotional Eating	.12	.04	.17	-.05	.65***	-	
7. DEBQ External Eating	.19	.01	.15	.02	.55***	.70***	-

Note. DEBQ-RB = Dutch Eating Behavior Questionnaire Restrained Eating Behavior; DEBQ-RI = Dutch Eating Behavior Questionnaire Restrained Eating Intention; %WCMOVE = percent weight change in MOVE!; BES = Binge Eating Scale; DEBQ Emotional Eating = Dutch Eating Behavior Questionnaire Emotional Eating; DEBQ External Eating = Dutch Eating Behavior Questionnaire External Eating.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Linear Regression Analyses of Relationships Between Measures of Restraint, BMI, and Percent Weight Change in MOVE (N=88)

Outcome variable	Predictor variables	*B* (*SE*)	β	95% CI	*P*
1. DEBQ-RB	DEBQ-RI	1.14 (0.18)	.18	[0.78, 1.49]	< .001
2. BMI Post-MOVE!	DEBQ-RI	0.51 (0.43)	.15	[−0.35, 1.37]	.24
	DEBQ-RB	−0.04 (0.22)	.22	[−0.47, 0.49]	.84
3. %WCMOVE	DEBQ-RI	−0.05 (0.24)	−.03	[−0.52, 0.42]	.85
	DEBQ-RB	0.26 (0.12)	.28	[0.03, 0.50]	.03
4a. BES	DEBQ-RI	1.75 (0.50)	.43	[0.78, 2.72]	.001
	DEBQ-RB	−0.58 (0.25)	−.29	[−1.08, −0.08]	.02
	%WCMOVE	−0.30 (0.23)	−.14	[−0.75, 0.15]	.18
	Ethnicity	−4.42 (1.90)	−.23	[−8.19, −0.65]	.02
4b. DEBQ-Emotional Eating	DEBQ-RI	0.95 (0.71)	.16	[−0.47, 2.37]	.19
	DEBQ-RB	−0.20 (0.37)	−.07	[−0.92, 0.53]	.60
	%WCMOVE	−0.12 (0.33)	−.04	[−0.77, 0.54]	.72
	Ethnicity	−10.68 (2.77)	−.39	[−16.18, −5.18]	< .001
4c. DEBQ-External Eating	DEBQ-RI	0.70 (0.31)	.28	[0.07, 1.32]	.03
	DEBQ-RB	−0.22 (0.16)	−.18	[−0.54, 0.98]	.17
	%WCMOVE	0.06 (0.14)	.04	[−0.23, 0.35]	.68
	Ethnicity	−3.46 (1.21)	−.31	[−6.04, −1.22]	.004

Note. B = unstandardized regression coefficient; SE = standard error; β= standardized regression coefficient; CI = confidence interval; %WCMOVE = percent weight change in MOVE!; DEBQ-RB = Dutch Eating Behavior Questionnaire Restrained Eating Behavior; DEBQ-RI = Dutch Eating Behavior Questionnaire Restrained Eating Intention; BES = Binge Eating Scale; DEBQ Emotional Eating = Dutch Eating Behavior Questionnaire Emotional Eating; DEBQ External Eating = Dutch Eating Behavior Questionnaire External Eating