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Predictive Significance of Changes in Dietary Restraint in Obese Patients with Binge Eating Disorder During Treatment

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Abstract

Objective—To examine whether changes in different aspects of dietary restraint in obese patients with binge eating disorder (BED) participating in a treatment study predict outcomes.

Method—Fifty obese patients with BED in a randomized controlled study of orlistat administered with cognitive-behavioral-therapy, guided-self-help (CBTgsh) completed dietary restraint measures at baseline, during- and post-treatment, and 3-month follow-up.

Results—Change in the restraint scale of the Eating Disorder Examination-Questionnaire did not predict binge abstinence or 5% weight loss. Increased flexible restraint subscale of the Three Factor Eating Questionnaire (TFEQ) during treatment significantly predicted binge abstinence at post-treatment and 3-month follow-up and 5% weight loss at post-treatment. Change in the rigid restraint subscale of the TFEQ predicted binge abstinence at post-treatment.

Discussion—Our findings clarify further pathologic and adaptive aspects of restraint and suggest the importance of enhancing flexible restraint in order to improve both binge eating and weight loss outcomes.

Binge Eating Disorder (BED) is characterized by recurrent binge eating in the absence of inappropriate weight control methods. BED has a prevalence of roughly 3.5% in adults and is strongly associated with obesity and therefore with increased morbidity associated with excess weight (1). BED is also associated with heightened eating disorder psychopathology, psychological distress, and psychiatric problems (2). Evidence supports the validity and the distinctiveness of BED from other eating disorder groups and from obese patients who do not binge eat (2,3).

Effective treatments for BED need to address the disordered eating, associated psychopathology, and excess weight. A number of psychological (4) and pharmacological (5) interventions have efficacy for BED. Critical meta-analytic (6) and qualitative reviews (4) have concluded that a specific form of cognitive-behavioral therapy (CBT) has the strongest empirical support. CBT generally produces binge abstinence in roughly 50% of BED patients, but – like most findings for alternative psychological and behavioral treatments – does not result in meaningful weight loss for most patients (4). Similarly, a meta-analysis of pharmacotherapy treatments concluded that certain medications (anti-obesity and anti-epileptic agents) have a clinically significant advantage over placebo for producing short-term binge abstinence and weight loss, although the weight losses are modest (5). Some studies have found that adding certain medications (such as topiramate or

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orlistat) to CBT may enhance weight losses (7,8); however, most studies of combined psychological and pharmacological approaches have not found additive effects (5).

Finding ways to improve binge eating and weight loss outcomes represents a major research priority. A clearer understanding of the processes involved in treatments with some efficacy is needed in order to further refine these treatments (4). In the case of BED, it seems especially important to elucidate the nature and role of restraint. The excess weight in patients with BED is likely attributable to a combination of the binge eating and a general lack of dietary “restraint.” In contrast, extreme dietary “restraint” is a salient characteristic of other eating disorders and typically results in normal or low weight (3). CBT for BED essentially follows, with a few adaptations, the CBT approaches developed initially for bulimia nervosa (9), which attempts to reduce extreme dietary restraint – a proposed maintaining factor for binge eating. This approach is somewhat at odds with traditional weight loss treatments for obesity that attempt to increase dietary restraint in order to produce weight loss (10). The role of “restraint” in these different patient groups remains poorly understood due, in part, to measurement and conceptual issues regarding the different aspects of “restraint” and its various measures (11,12,13).

The nature of changes in different aspects of dietary restraint during treatment has received little empirical attention although emerging research has been informative. Safer and colleagues (11), in a study of BN patients receiving CBT, found that the restraint scale of the Eating Disorder Examination interview (EDE; 14) significantly declined during treatment and was associated with decreased binge frequency whereas the cognitive restraint scale of the Three Factor Eating Questionnaire (TFEQ; 15) was not associated with binge reduction. Downe, Goldfein, and Devlin (16), in a study of BED patients receiving BWL augmented with either CBT, fluoxetine, or placebo, examined the nature of changes in the TFEQ (also referred to as the Eating Inventory) cognitive restraint scale as well as in changes in its two subscales (flexible restraint and rigid restraint). Both flexible and rigid restraint scores increased during treatment but flexible restraint was more closely associated with post-treatment binge abstinence and weight loss (16). The different findings across these studies likely reflect, in part, several factors. First, BN and BED differ markedly in restraint; BN tends to be characterized by high levels of most forms of dietary restraint including extreme restrictive behaviors whereas BED tends to be associated with low levels of both healthy and unhealthy dietary restraint. Second, Safer et al (11) considered the TFEQ cognitive restraint scale but, unlike Downe et al (16), failed to examine the flexible and rigid subscales whereas Downe et al (16) did not evaluate changes in the EDE restraint scale. Third, Safer et al (11) examined changes with CBT whereas Downe et al (16) examined changes with BWL (augmented with various treatments). Safer and colleagues (11) highlighted the need for continued research to refine further our understanding of dietary restraint in different patient groups and noted that, ideally, research should compare all of these restraint measures throughout a treatment study within specific patient groups.

In the present study, we examined changes in different aspects of dietary restraint in obese patients with BED receiving cognitive-behavioral-therapy guided-self-help (CBTgsh) combined with either orlistat or placebo and whether changes in these different restraint variables predicted outcomes at post-treatment and at 3-month follow-up. We hypothesized that decreased unhealthy forms of restraint as measured by the restraint scale of the Eating Disorder Examination Questionnaire (EDE-Q; 17) and the TFEQ rigid restraint subscale would predict binge abstinence and that increases in all three restraint scales (EDE-Q restraint, TFEQ rigid restraint, TFEQ flexible restraint) would predict weight loss.

METHOD

Participants

Participants were 50 consecutively enrolled obese BED patients in a randomized placebo-controlled study of orlistat administered with guided-self-help CBT (CBTgsh). A detailed description of the primary treatment study's methods and outcomes has been reported previously (8). Inclusion criteria included: 35–60 years of age, body mass index (BMI) of 30 or greater, and full *DSM-IV* criteria for BED. Exclusionary criteria included: concurrent treatment for eating/weight or psychiatric illness; medical conditions (diabetes or thyroid problems) that influence eating/weight; severe psychiatric conditions requiring different treatments (psychosis, bipolar disorder); and pregnancy. Participants were aged 35 to 58 years (Mean=47.0, *SD*=7.0), 88% (*n*=44) were female, and 88% (*n*=44) were Caucasian. Mean BMI was 36.0 (*SD*=4.7).

Assessment and Measures

The study received full review and approval by the Yale Human Investigation Committee. Assessment procedures were performed by trained doctoral-level research-clinicians. At baseline, BED diagnosis was based on the Structured Clinical Interview for *DSM-IV* Axis I Disorders (SCID-I/P; 18) and confirmed with the Eating Disorder Examination interview (EDE; 14). The EDE was re-administered at post-treatment and 3-month follow-up assessments and was the primary treatment outcome measure. Participants' height and weight were measured at baseline and weight was measured throughout the course of treatment, post-treatment, and 3-month follow-up using a medical balance-beam scale. Self-report measures (described below) were administered at baseline, monthly during treatment, and at post-treatment. These repeated self-report assessments generated the variables used to predict treatment outcomes.

The *Eating Disorder Examination (EDE)* is a well-established interview method for assessing eating disorder psychopathology (19,20) with established reliability (21). Except for diagnostic items, the EDE focuses on the previous 28 days. The EDE assesses the frequency of different forms of overeating, including *objective bulimic episodes (OBEs)*; i.e., binge eating defined as unusually large quantities of food with a subjective sense of loss of control). The EDE comprises four subscales (*restraint, eating concern, weight concern, and shape concern*). In this study, inter-rater reliability for the EDE was assessed using approximately 20% (*N*=32) of interviews conducted at baseline, post-treatment, and 3-month follow-up. Kappa coefficient for BED diagnosis was 1.0. Intraclass correlation coefficient for OBEs was .97.

The *Eating Disorder Examination Questionnaire (EDE-Q; 17)*, the self-report version of the EDE, focuses on the previous 28 days and comprises four subscales, including the *restraint* scale which was a primary focus in this study. The EDE-Q has adequate test-retest reliability (22) and good convergence with the EDE in studies with BED (19,20). The *Three Factor Eating Questionnaire (TFEQ; 15)* comprises three factors: *cognitive restraint, disinhibition, and hunger*. Research has identified two subscales within *cognitive restraint: rigid control* (defined by dichotomous, all-or-nothing approaches to dieting) and *flexible control* (reflecting a moderated approach to dieting) (23). The TFEQ has psychometric support (15) including predictive validity (13,24).

Treatment Conditions

Subjects were randomly assigned, without any restriction, by a computer-generated table to one of two 12-week treatment conditions: CBTgsh+orlistat (*N*=25) or CBTgsh+placebo

($N=25$). Treatment assignment, done after completion of assessments, was performed independently from the investigators by a Yale research pharmacist.

Cognitive-Behavioral Therapy – Guided Self-Help (CBTgsh)—The CBT was administered individually using a guided-self-help approach. Participants were given a copy of *Overcoming Binge Eating* (25), a step-by-step self-help version of the therapist manual (9). The guided-self-help protocol included six brief (15–20 minute) individual meetings with doctoral research-clinicians during the 12-week study. The clinicians focused primarily on (a) maintaining and enhancing motivation; (b) correcting misunderstanding of the information; (c) addressing difficulties with relevant skill-building exercises; and (d) reinforcing the importance of self-monitoring and record keeping.

Pharmacological Treatment With Orlistat—Orlistat, a lipase inhibitor, is a non-centrally acting anti-obesity medication. Orlistat produces a dose-dependent reduction in dietary fat absorption, with a maximum 30% reduction with dosing of 120 mg three times per day, and has demonstrated efficacy for weight loss in obese patients (26). Treatment was administered in double-blind placebo-controlled fashion. Participants received either orlistat (120 mg, fixed dose) or pill placebo 3 times a day with meals during the 12-week study along with basic medication management procedures (26).

Three-Month Follow-up Period

The double-blind of the medication condition was broken *after* the 3-month follow-up visit and completion of all assessments. No treatment (either CBTgsh or orlistat) was provided during the 3-month follow-up period. Participants were encouraged not to seek orlistat prescriptions or start treatments before the 3-month follow-up without notifying the investigators for assistance with treatment-planning. Follow-up assessments revealed no cases reporting that orlistat was obtained or other treatments started. There were a few cases of non-completers for whom such follow-up data could not be obtained. Our analytic method for determining the treatment outcome variables (intent-to-treat analyses using baseline-carried-forward-method) minimizes the likelihood of those few cases impacting the results.

Analyses

Treatment Outcomes—Treatment outcomes were determined using Intent-To-Treat (ITT) analyses in which missing data were replaced by baseline values. Primary outcomes were: (a) “abstinence” from binge eating, defined as zero binges for the past month based on the EDE interview; and (b) “5% weight loss” from baseline weight (see 27,28).

Predictor Variables: Restraint Measures and Changes—The predictive significance of EDE-Q restraint, TFEQ flexible restraint, and TFEQ rigid restraint and *changes* in these measures during treatment were tested. For these variables, we used all available data at each of the relevant time points without imputation. We also included findings for the TFEQ cognitive restraint scale but only as a point of comparison for other studies that employed this scale. Change score variables were computed by subtracting the earlier time point from the later time point; thus, the formula for computing the post-pre change score was: [Post-treatment score - pre-treatment score]. Positive numbers reflect an increase in the variable over the time.

Pearson bivariate correlations with Kendall’s tau-b for nonparametric variables were used to test for significant correlations between predictor and outcome variables. T-tests were used to compare restraint scores between participants who were versus were not binge abstinent as well as those who did versus did not achieve a 5% weight loss. Binary logistic regressions

were used to test whether changes in restraint during three months of treatment significantly predicted binge abstinence (yes/no) and 5% weight loss (yes/no) at post-treatment and 3-month follow-up. To explore the joint and independent contributions of predictor variables on outcome variables, the predictor variables were entered in the same step of the binary logistic regressions. For regressions predicting binge abstinence, baseline OBE frequency was entered as a covariate in Step 1 and the predictor variables were entered in Step 2.

RESULTS

We briefly summarize here the primary treatment outcome findings reported previously (8) as background context for the change and predictor analyses reported here. Participants receiving CBTgsh+orlistat were significantly more likely than those receiving CBTgsh+placebo to report binge abstinence at post-treatment (64% versus 36%; $n = 16$ versus $n = 9$) but not at 3-month follow-up (both groups had 52% abstinence rates; both $n = 13$). Participants receiving CBTgsh+orlistat were significantly more likely to achieve a 5% weight loss at both post-treatment (36% versus 8%; $n = 9$ versus $n = 2$) and 3-month follow-up (32% versus 8%; $n = 8$ versus $n = 2$). Although there were main effects of orlistat on these two primary outcome variables, the treatment groups did not differ significantly on any of the restraint measures at any time point nor did they differ on changes in any of the restraint measures during treatment. Across all conditions, 50% of participants ($n = 25$) achieved binge abstinence at post-treatment and 52% of participants ($n = 26$) achieved binge abstinence at the 3-month follow-up, with an overall mean reduction of 11.67 OBEs ($SD = 8.32$) from baseline to post-treatment, and an overall mean reduction of 11.14 OBEs ($SD = 8.03$) from baseline to the 3-month follow-up. Similarly, across all conditions, 22% of participants ($n = 11$) achieved a 5% weight loss at post-treatment and 20% of participants ($n = 10$) achieved a 5% weight loss at the 3-month follow-up, with an overall mean loss of 5.60 pounds ($SD = 6.86$) from baseline to post-treatment, and an overall mean loss of 5.18 pounds ($SD = 9.38$) from baseline to the 3-month follow-up.

Intercorrelations between Restraint Scales

Restraint Scales at Baseline and Post-Treatment—EDE-Q restraint scale and TFEQ flexible restraint subscale were not significantly correlated at baseline ($r = 0.20$, $p = 0.16$) or at post-treatment ($r = 0.13$, $p = 0.37$). EDE-Q restraint scale and TFEQ rigid restraint subscale were significantly correlated at baseline ($r = 0.60$, $p = 0.0001$) and at post-treatment ($r = 0.38$, $p = 0.007$). TFEQ flexible restraint subscale and TFEQ rigid restraint subscale were not significantly correlated at baseline ($r = 0.25$, $p = 0.09$) but were significantly correlated at post-treatment ($r = 0.52$, $p = 0.0001$).

Changes in Restraint Scales—EDE-Q restraint scale pre-post change and TFEQ flexible restraint subscale pre-post change were not significantly correlated ($r = 0.08$, $p = 0.60$). EDE-Q restraint scale pre-post change and TFEQ rigid restraint subscale pre-post change were significantly correlated ($r = 0.33$, $p = 0.02$). TFEQ flexible restraint subscale pre-post change and TFEQ rigid restraint subscale pre-post change were not significantly correlated ($r = 0.26$, $p = 0.081$). TFEQ flexible restraint subscale pre-post change and TFEQ Restraint scale pre-post change were significantly correlated ($r = 0.75$, $p = 0.0001$). TFEQ rigid restraint subscale pre-post change and TFEQ Restraint scale pre-post change were significantly correlated ($r = 0.75$, $p = 0.0001$).

Binge Abstinence

Pearson bivariate correlations tested associations between measures of restraint and binge abstinence at post-treatment and 3-month follow-up. There were no significant correlations between EDE-Q restraint scores or changes in EDE-Q restraint scores and binge abstinence

at any time points. Binge abstinence at post-treatment and 3-month follow-up were both significantly correlated with an increase in TFEQ flexible restraint from baseline to post-treatment ($r=0.44$ and $r=0.44$, respectively, $p \leq 0.001$). Binge abstinence was not significantly correlated with a change in TFEQ rigid restraint from baseline to post-treatment.

Table 1 summarizes t-tests examining whether binge abstainers differed from binge non-abstainers at post-treatment (left side of table) and 3-month follow-up (right side of table) on measures of restraint. Binge abstainers and non-abstainers did not differ significantly on EDE-Q restraint. Participants who achieved binge abstinence at post-treatment reported significantly greater TFEQ total restraint at post-treatment and 3-month follow-up than non-abstainers. Similarly, participants who achieved binge abstinence at 3-month follow-up reported significantly greater TFEQ total restraint at post-treatment and 3-month follow-up as well as a greater increase in TFEQ total restraint over the treatment period than non-abstainers. Binge abstainers at both post-treatment and at 3-month follow-up reported a significantly greater increase in TFEQ flexible restraint over the treatment period than non-abstainers. In addition, binge abstainers at 3-month follow-up also reported greater TFEQ flexible restraint at post-treatment than non-abstainers. For TFEQ rigid restraint, binge abstainers at 3-month follow-up reported significantly greater rigid restraint at post-treatment compared to non-abstainers. There were also significant differences in pre-treatment scores on the TFEQ rigid restraint subscale between binge abstainers and non-abstainers at post-treatment.

The overall binary logistic regression testing whether changes in restraint during three months of treatment predicted binge abstinence at post-treatment was significant ($X^2(4) = 19.92$, $p = 0.0001$, $n = 46$). After taking into account OBE frequency at baseline, a greater increase in TFEQ flexible restraint (Odds Ratio = 3.53, 95% CI = 1.56–7.99, $p = 0.002$) and a smaller increase in TFEQ rigid restraint (Odds Ratio = 0.45, 95% CI = 0.22–0.92, $p = 0.029$) significantly increased the likelihood of binge abstinence at post-treatment. Change in EDE-Q restraint did not significantly increase the likelihood of binge abstinence at post-treatment (Odds Ratio = 1.25, 95% CI = 0.76–2.05, $p = 0.386$). The Relative Risk (RR) or odds ratio of 3.53 can be interpreted as an effect size measure. Thus, for example, increased TFEQ flexible restraint over treatment period increases the likelihood of binge abstinence by 3.53 times.

A second binary logistic regression testing whether changes in restraint during three months of treatment predicted binge abstinence at the three-month follow-up was significant ($X^2(4) = 13.98$, $p = 0.007$, $n = 46$). After taking into account OBE frequency at baseline, increased TFEQ flexible restraint over the treatment period continued to significantly increase the likelihood of binge abstinence at the 3-month follow-up (Odds Ratio = 2.75, 95% CI = 1.33–5.66, $p = 0.006$). Change in TFEQ rigid restraint did not significantly predict binge abstinence at the 3-month follow-up (Odds Ratio = 0.89, 95% CI = 0.53–1.48, $p = 0.648$). Change in EDE-Q restraint was not a significant predictor of binge abstinence (Odds Ratio = 1.16, 95% CI = 0.72–1.87, $p = 0.531$). Figure 1 depicts the changes in TFEQ flexible restraint over time for binge abstainers versus non-abstainers.

Weight Loss

Pearson bivariate correlations tested for associations between measures of restraint and 5% weight loss at post-treatment and 3-month follow-up. EDE-Q restraint was not significantly correlated with successful 5% weight loss at either time point. TFEQ rigid restraint was also not significantly correlated with successful 5% weight loss at either time point. However, increased TFEQ flexible restraint during treatment was significantly positively correlated with successful 5% weight loss at post-treatment ($r = 0.30$, $p \leq 0.05$), and TFEQ flexible

restraint at post-treatment was significantly positively correlated with 5% weight loss at 3-month follow-up ($r = 0.31, p \leq 0.05$).

Table 2 summarizes t-tests examining whether individuals who successfully lost 5% of their body weight by post-treatment (left side of table) and 3-month follow-up (right side of table) were significantly different from individuals who did not successfully lose 5% of their body weight on the different measures of restraint. EDE-Q restraint scores did not significantly differ between those who achieved and did not achieve a 5% weight loss at post-treatment and 3-month follow-up. Individuals who lost 5% of their body weight by post-treatment reported a greater increase in total restraint over the course of treatment than individuals who did not lose 5% of their body weight. Individuals who lost 5% of their body weight by the 3-month follow-up reported greater total restraint at post-treatment and at the 3-month follow-up. For TFEQ flexible restraint, individuals who lost 5% of their body weight at post-treatment reported a greater increase in flexible restraint over the course of treatment than individuals who did not lose 5% of their body weight. Similarly, individuals who lost 5% of their body weight at the 3-month follow-up reported greater flexible restraint at post-treatment and at 3-month follow-up than individuals who did not lose 5% of their body weight. There were no significant differences in TFEQ rigid restraint between individuals who did and did not lose 5% of their body weight, whereas there were significant differences in TFEQ flexible restraint, suggesting that differences in TFEQ total restraint appears to be predominantly captured by changes in flexible restraint and not rigid restraint.

The overall binary logistic regression testing whether changes in restraint during treatment predicted 5% weight loss at post-treatment was significant ($X^2(3) = 8.12, p = 0.044, n = 46$). Increased TFEQ flexible restraint significantly increased the likelihood of 5% weight loss at post-treatment (Odds Ratio = 1.65, 95% CI = 1.01–2.71, $p = 0.047$). Change in TFEQ rigid restraint was not a significant predictor (Odds Ratio = 0.88, 95% CI = 0.52–1.51, $p = 0.65$), nor was change in EDE-Q restraint a significant predictor (Odds Ratio = 1.61, 95% CI = 0.93–2.79, $p = 0.091$). A second binary logistic regression testing whether changes in restraint during treatment predict successful 5% weight loss at 3-month follow-up was not significant ($X^2(3) = 3.09, p = 0.38, n = 46$). Figure 2 depicts changes in TFEQ flexible restraint over time for participants who did and did not achieve a 5% weight loss.

DISCUSSION

This study examined the predictive significance of changes in various aspects of dietary restraint on two primary treatment outcomes (binge abstinence and 5% weight loss) in a consecutive series of obese patients with BED who participated in a 12-week RCT receiving CBTgsh plus either orlistat or placebo. We examined the EDE-Q restraint scale and the TFEQ cognitive restraint scale, along with its two empirically-derived subscales (flexible and rigid restraint). The various restraint measures and their changes had different patterns of associations with the binge abstinence and weight loss outcomes. Major findings were that changes in EDE-Q restraint did not significantly predict binge abstinence or 5% weight loss. Changes in TFEQ flexible restraint predicted binge abstinence at post-treatment and 3-month follow-up and predicted 5% weight loss at post-treatment. Changes in TFEQ rigid restraint predicted binge abstinence at post-treatment but not at 3-month follow-up.

Restraint and Binge Abstinence

As hypothesized, a greater increase in TFEQ flexible restraint during treatment significantly predicted binge abstinence at post-treatment and at 3-month follow-up. These findings contrast with another study (16) where binge abstainers did not report a significantly greater *increase* in TFEQ flexible restraint over the course of treatment than non-abstainers. However, similar to our findings, Downe et al (16) found that binge abstainers reported

greater TFEQ total restraint, flexible restraint and rigid restraint at post-treatment than non-abstainers. Changes in TFEQ rigid restraint during the treatment period significantly predicted binge abstinence at post-treatment although it did not significantly predict abstinence at 3-month follow-up. Although TFEQ rigid restraint scores did increase over the treatment period, it was those individuals who reported a *smaller* increase in rigid restraint over the treatment period who were more likely to achieve binge abstinence at post-treatment. A previous study with BED (16) found that binge abstainers reported greater flexible restraint and greater rigid restraint but did not specifically assess whether changes in those measures predicted abstinence. These findings contrast with those from a previous study with BN (11) which found that the TFEQ cognitive restraint did not change significantly over time. This apparent discrepancy perhaps reflects, in part, the well-established prominence of extreme restraint in BN relative to BED and failure to consider the specific flexible and rigid subscales of the TFEQ cognitive restraint scale.

Contrary to hypothesis, EDE-Q restraint changed little during treatment and did not significantly predict binge abstinence. In contrast, CBT for BN generally decreases EDE/EDE-Q restraint (11, see 4). This discrepancy likely reflects the well-documented salient differences in restraint behaviors between BED and BN. Research with diverse recruitment methods has consistently found that BN has significantly higher levels of extreme dietary restraint (as tapped by the EDE/EDE-Q restraint scale) than BED (3,29). This is evident when comparing the Safer et al (11) study to ours. In the Safer et al (11) study, the BN patients had a mean pre-treatment and post-treatment EDE restraint scores of 3.30 ($SD=1.37$) and 1.63 ($SD=1.5$), respectively. In contrast, the corresponding mean pre- and post-treatment EDE interview scores in our obese BED individuals were 2.03 ($SD=1.42$) and 2.05 ($SD=1.20$), respectively. Thus, EDE restraint scale, which reflects extreme and highly restrictive weight loss behaviors is uncharacteristic of BED and thus tends to change little during CBTgsh treatment.

Restraint and Weight Loss

As hypothesized, a greater increase in TFEQ flexible restraint during treatment significantly predicted 5% weight loss at post-treatment. These results are consistent with the study by Downe et al (16) in which TFEQ flexible restraint was significantly correlated with weight change over the course of treatment. Contrary to hypothesis, TFEQ rigid restraint and EDE-Q restraint were not significant predictors of successful 5% weight loss at either post-treatment or 3-month follow-up. A cross-sectional study (30) found that greater TFEQ rigid and flexible restraint were both significantly associated with lower BMI. That study, however, did not specifically examine *changes* in restraint or BMI over time. It is unclear why changes in rigid restraint were not predictive of weight loss in our sample. This finding could reflect the focus of CBTgsh on increasing flexible restraint instead of rigid restraint and that there was not a large enough change in rigid restraint to achieve 5% weight loss. Another possibility is that our findings that a *smaller* increase in rigid restraint increased the likelihood of binge abstinence and that greater rigid restraint did not predict weight loss provide some support for the Restraint theory, which posits that greater rigid restraint leads to binge episodes which precludes weight loss (31).

Our study has certain strengths and weaknesses which we note to provide a context for interpreting our findings. Strengths include use of prospective data collected using complementary assessments with documented strengths (19) during a controlled treatment trial (8). We considered different complementary measures of restraint following prior research (11,16) to predict important treatment outcomes assessed at post-treatment and at a 3-month follow-up using different established methods (i.e., EDE interview and measured weight) which reduced potential method artifact or tautology. Predictor variables were all self-report to eliminate method variance and outcome measures used were interview and

experimenter-measured data. In terms of limitations, we note our relatively small sample size and limited power which might explain why several predictors of binge abstinence and weight loss did not remain statistically significant at the 3-month follow-up. Treatment involved CBTgsh and it is uncertain whether the findings would generalize to longer or more intensive CBT methods. The CBTgsh was delivered by specialist doctoral-level clinicians, and it remains unclear whether either similar outcomes or process findings would be observed for CBTgsh or other treatments delivered by generalists in different treatment settings. Lastly, we focused on different widely-used measures of different aspects of restraint. It is important to note that recent studies have found that these restraint scales are not correlated with actual caloric intake (12).

With these strengths and weaknesses in mind, we offer several conclusions. Our findings suggest that different aspects of dietary restraint differ in important ways in their prognostic significance for obese patients with BED who receive CBTgsh. Our findings suggest that rigid and extreme forms of restraint, unlike the case for BN, are not prominent and appear to have little prognostic significance in obese patients with BED. Further, our findings suggest the importance of enhancing flexible restraint in order to improve both binge eating and weight loss outcomes. To our knowledge, there have been no studies investigating which specific treatment components augment flexible restraint. Although it is unclear why increases in flexible restraint appeared to be helpful in our sample, it could be that, for obese patients with BED, adopting flexible restraint over rigid restraint may require less behavioral change, is more psychologically desirable, and is more sustainable. Future research should examine which CBT techniques enhance flexible restraint, how to increase the duration of flexible restraint on eating behaviors, and why flexible restraint is particularly effective to improve binge eating and weight loss outcomes.

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Figure 1.

Mean TFEQ flexible restraint scores for binge abstainers and binge non-abstainers at pre-treatment, post-treatment (PT) and 3-month follow-up (FU)

Note: PT-Yes represents binge abstainers at post-treatment; PT-No represents binge non-abstainers at post-treatment; FU-Yes represents binge abstainers at 3-month follow-up; FU-No represents binge non-abstainers at 3-month follow-up.

Figure 2.

Mean TFEQ flexible restraint scores for patients who did and did not achieve 5% weight loss at pre-treatment, post-treatment (PT), and 3-month follow-up (FU)

Note: PT-Yes represents patients who achieved 5% weight loss at post-treatment; PT-No represents patients who did not achieve 5% weight loss at post-treatment; FU-Yes represents patients who achieved 5% weight loss at 3-month follow-up; FU-No represents patients who did achieve 5% weight loss at 3-month follow-up.

Table 1
Comparison of binge abstiners and non-abstiners at post-treatment and 3-month follow-up on restraint scores.

	Time point	Abstiners at Post-treatment			Abstiners at 3-Month Follow-Up		
		Yes (n=25)	No (n=25)	t	Yes (n=26)	No (n=24)	t
EDE-Q Restraint	(n=50) Pre-tx	2.24 (1.44) ^a	1.94 (1.27)	-0.79	1.97 (1.37)	2.22 (1.36)	0.65
	(n=50) Post-tx	2.94 (1.32)	2.62 (1.08)	-0.91	2.81 (1.12)	2.75 (1.31)	-0.17
	(n=50) 3 mnth f-up	2.54 (1.24)	2.04 (1.01)	-1.57	2.42 (1.23)	2.15 (1.06)	-0.84
	(n=50) Δ Post-Pre	0.70 (1.78)	0.69 (1.35)	-0.02	0.84 (1.59)	0.53 (1.55)	-0.69
TFEQ Restraint^b	(n=44) Pre-tx	7.30 (3.47)	7.62 (3.33)	0.32	7.68 (3.48)	7.27 (3.29)	-0.40
	(n=46) Post-tx	12.10 (4.18)	9.58 (4.29)	-2.00*	12.39 (4.12)	9.07 (4.06)	-2.75*
	(n=41) 3 mnth f-up	11.48 (4.60)	7.43 (3.74)	-3.11*	11.11 (5.02)	7.60 (3.45)	-2.62*
	(n=42) Δ Post-Pre	4.33 (4.98)	1.94 (2.78)	-1.98	4.48 (4.56)	1.46 (2.72)	-2.61*
TFEQ Flexible	(n=50) Pre-tx	2.01 (1.32)	2.45 (1.38)	1.14	2.15 (1.29)	2.32 (1.45)	0.42
	(n=49) Post-tx	3.59 (1.90)	2.61 (1.67)	-1.92	3.69 (1.72)	2.47 (1.78)	-2.44*
	(n=42) 3 mnth f-up	3.01 (2.00)	2.29 (1.51)	-1.30	3.10 (1.90)	2.16 (1.55)	-1.76
	(n=49) Δ Post-Pre	1.70 (1.74)	0.16 (0.97)	-3.81**	1.65 (1.75)	0.16 (0.93)	-3.75**
TFEQ Rigid	(n=48) Pre-tx	2.91 (1.73)	2.00 (1.41)	-2.01*	2.76 (1.71)	2.09 (1.47)	-1.45
	(n=49) Post-tx	3.58 (1.53)	3.00 (1.78)	-1.23	3.76 (1.56)	2.79 (1.67)	-2.10*
	(n=42) 3 mnth f-up	3.85 (1.79)	2.27 (1.45)	-3.15*	3.52 (1.75)	2.52 (1.72)	-1.87
	(n=47) Δ Post-Pre	0.55 (2.02)	1.00 (1.26)	0.94	0.88 (1.96)	0.70 (1.29)	-0.37

^aMeans (Standard Deviations).

^bThe sample size for the TFEQ Total Restraint varied across assessment time periods due to inconsistent completion of TFEQ restraint items required to calculate the TFEQ Total Restraint scale.

*
p ≤ 0.05,

**
p ≤ 0.001

Table 2

Comparison of patients with and without 5% weight loss at post-treatment and 3-month follow-up on restraint scores.

	Time point	5% weight loss at Post-treatment			5% weight loss at 3-Month F-Up		
		Yes (n=11)	No (n=39)	t	Yes (n=10)	No (n=40)	t
EDE-Q Restraint	(n=50)						
	Pre-tx	1.82 (1.18) ^a	2.16 (1.40)	0.74	2.06 (0.84)	2.09 (1.46)	0.10
	Post-tx	3.09 (1.05)	2.69 (1.24)	-0.97	3.06 (1.13)	2.71 (1.23)	-0.82
TFEQ Restraint^b	(n=50)						
	3 mnth f-up	2.36 (1.10)	2.27 (1.18)	-0.23	2.40 (1.14)	2.27 (1.16)	-0.33
	Δ Post-Pre	1.27 (1.95)	0.53 (1.42)	-1.41	1.00 (1.69)	0.62 (1.54)	-0.69
TFEQ Flexible	(n=44)						
	Pre-tx	6.95 (3.57)	7.61 (3.34)	-0.53	8.89 (1.55)	7.21 (3.55)	-1.23
	Post-tx	12.30 (2.91)	10.29 (4.65)	-1.29	13.88 (3.56)	10.07 (4.28)	-2.34*
TFEQ Rigid	(n=41)						
	3 mnth f-up	12.22 (4.21)	8.49 (4.41)	-2.26*	13.00 (3.74)	8.42 (4.36)	-2.73*
	Δ Post-Pre	5.69 (4.68)	2.33 (3.62)	-2.24*	3.75 (2.99)	2.86 (4.15)	-0.46
TFEQ Total Restraint	(n=50)						
	Pre-tx	2.21 (1.14)	2.24 (1.42)	0.05	2.66 (1.01)	2.13 (1.42)	-1.12
	Post-tx	4.00 (1.61)	2.83 (1.83)	-1.91	4.20 (1.93)	2.81 (1.72)	-2.22*
TFEQ Total Restraint	(n=42)						
	3 mnth f-up	3.78 (2.05)	2.32 (1.59)	-2.30*	3.88 (2.23)	2.34 (1.55)	-2.32*
	Δ Post-Pre	1.79 (1.74)	0.67 (1.47)	-2.13*	1.54 (1.58)	0.76 (1.57)	-1.40
TFEQ Total Restraint	(n=48)						
	Pre-tx	2.50 (1.58)	2.42 (1.65)	-0.14	3.13 (1.25)	2.30 (1.67)	-1.32
	Post-tx	3.60 (0.70)	3.21 (1.84)	-1.07	4.00 (1.66)	3.13 (1.65)	-1.44
TFEQ Total Restraint	(n=42)						
	3 mnth f-up	3.44 (1.51)	2.91 (1.86)	-0.79	3.63 (1.06)	2.88 (1.90)	-1.06
	Δ Post-Pre	1.22 (1.72)	0.68 (1.65)	-0.88	0.57 (1.51)	0.83 (1.69)	0.37

^a Means (Standard Deviations).

^b The sample size for the TFEQ Total Restraint varied across assessment time periods due to inconsistent completion of TFEQ restraint items required to calculate the TFEQ Total Restraint scale.

* $p \leq 0.05$