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ORIGINAL CONTRIBUTIONS

Binge Eating, Loss of Control over Eating, Emotional Eating, and Night Eating After Bariatric Surgery: Results from the Toronto Bari-PSYCH Cohort Study

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Abstract

Objectives We explored the severity of binge eating, loss of control over eating, emotional eating, and night eating before bariatric surgery and annually for 3 years following surgery. We also assessed the impact of post-operative eating psychopathology on weight outcomes.

Methods Eight hundred forty-four patients participated in this prospective cohort study. Demographic factors, self-report measures of eating pathology (BES, NEQ, EES, EDE-Q), and weights (kg) were collected pre-surgery and annually for 3 years after surgery.

Results The severity of problematic eating behaviors decreased after surgery and remained lower than baseline throughout follow-up. An increase was noted in binge eating scores (change in mean score ± SD = 0.85 ± 4.71; $p = 0.002$), emotional eating scores (2.00 ± 13.63; $p = 0.033$), and loss of control eating scores (1.11 ± 7.01; $p < 0.001$) after the first post-operative year that continued to the third post-operative year. There was also an increase in night eating scores between 2 and 3 years post-surgery (2.52 ± 8.00; $p = 0.01$). Higher 1-year post-operative binge eating scores were a significant predictor of lower 2-year % total weight loss ($\beta = -0.39$, confidence interval (CI) − 1.23, − 0.16, $p = 0.012$).

Conclusions The severity of problematic eating behaviors decrease after bariatric surgery, but increase significantly between the first and third post-operative years. Binge Eating Scale score at 1 year post-surgery was the only significant predictor of reduced percent total weight loss at 2 years. Additional prospective studies with adequate power are required to assess the progression of these eating pathologies beyond 3 years and their impact on weight outcomes beyond 2 years.

Keywords Bariatric surgery · Prospective · Post-operative · Eating behaviors · Weight outcomes

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Introduction

Bariatric surgery has proven to be an effective method of treating individuals with class II to III obesity, resulting in significant decreases in weight and improvements in medical comorbidities [1]. A proportion of patients, however, may not achieve the expected weight loss or may experience significant weight regain over the decade to follow. The Swedish Obese Subjects (SOS) study found that by 10 years after surgery 9% of patients who received gastric bypass surgery lost less than 5% or maintained their baseline weight [2].

Several recent studies have indicated the impact of post-operative eating behaviors on weight loss outcomes. Anatomical and physiologic changes with bariatric surgery can alter the ability of patients to consume large portions of food required for a DSM 5 diagnosis of binge eating disorder (BED). However, patients can develop new problematic eating behaviors such as loss of control over eating (LOC_E), grazing, subjective binge eating, or the consumption of small amounts of nutrient dense foods, which circumvent the mechanism of action of the surgery [3]. Additionally, night eating behaviors, which are present in up to 20% of bariatric surgery candidates, were detected in half of patients in an 8-year follow-up study [4, 5]. These eating pathologies may be harbingers for weight regain, highlighting the importance of early identification through appropriate post-operative monitoring to inform timely referral for reassessment and counseling to mitigate weight regain [6]. Therefore, an improved understanding of eating psychopathology in the years following bariatric surgery, the time points at which they re-emerge, and their impact on weight regain may provide insights into timing for post-surgical interventions.

Literature to date indicates that bariatric surgery generally results in a decline in eating psychopathology within the first post-operative year, but recurrence could occur at any time beyond this initial year. In a 12-month follow-up study, BED, night eating syndrome (NES), and uncontrolled eating were reduced after surgery, but patients with pre-operative BED transitioned to eating more frequently and in smaller quantities [7].

A LABS-2 study recently looked at a variety of post-operative lifestyle variables and 3-year weight outcomes in RYGB and LAGB [8] .They used a self-administered questionnaire that, among other eating behaviors, included two items to assess loss of control over eating, a mixture of DSM-IV and DSM 5 diagnostic criteria of BED, and three items to assess night eating. Very few individuals met full diagnostic criteria for BED after bariatric surgery. However, it was found that individuals with post-operative loss of control over eating and night eating behaviors had worse 3-year weight outcomes.

In a follow-up study, the EDE-BSV (Eating Disorders Examination-Bariatric Surgery Version) was used, which had the strength of being a semi-structured interview with questions relevant to the post-operative bariatric surgery population [9]. The authors also used the Night Eating Questionnaire to assess the impact of post-operative night eating behaviors on weight outcomes. Significant reductions in all eating pathologies were found after bariatric surgery. Although pre-surgical eating behaviors were not associated with post-surgical weight outcomes, post-surgical global EDE score and hunger were associated with less percentage weight loss. This study had the strength of using an interview rather than self-report measure. They note in their limitations, however, that the EDE-BSV reported eating episodes that participants felt were "unusually large." Therefore, apart from "overeating associated with loss of control," a greater range of behaviors related to loss of control may not have been assessed.

Emotional eating is another behavior of interest in the bariatric population, present in 38–59% of surgical candidates [10]. It has been linked to other behaviors such as binge eating [11] and food cravings [12]. Emotional eating has been found to improve after bariatric surgery [13], but most studies in the literature on this behavior are limited by short-term follow-up or lack of validated measures.

The primary aim of our study was to assess the progression of eating psychopathology (binge eating, loss of control over eating, emotional eating, and night eating) in a prospective cohort study up to 3 years after bariatric surgery. We aimed to build on prior studies by using additional eating psychopathology scales, specifically the Binge Eating Scale and Emotional Eating Scales. The secondary aim of the study was to assess the impact of post-operative eating psychopathology on weight loss 2 years after surgery. We hypothesized that the severity of eating pathologies would significantly decrease over the first post-operative year, followed by an increase in severity over the second and third years, with possible detrimental effects to weight outcomes.

Methods

Participants

Eight hundred forty-four patients were recruited from the Toronto Bariatric Surgery Centre of Excellence (TBSCE) between 2011 and 2014 as part of the Toronto Bariatric Surgery Psychosocial (Bari-PSYCH) cohort study. Details of the recruitment process, inclusion and exclusion criteria, and pre-operative assessments have been previously described [14, 15]. Participants included in the study were between 18 and 65 years of age with a pre-operative BMI > 40 kg/m^2 or BMI ≥ 35 kg/m^2 with at least one obesity-related comorbidity. All patients were referred for Roux-en-Y gastric bypass, but a sleeve gastrectomy was offered based on surgeon assessment.

Study Procedures

The Research Ethics Board at the University Health Network approved this study. After the initial interview and informed consent, participants provided demographic information and completed a pre-operative bariatric psychosocial assessment questionnaire. The questionnaire was re-administered 6 months after surgery, 1 year after surgery, and annually thereafter for a total of 3 years as part of the Toronto Bari-PSYCH cohort study. Participants' height and weight were also recorded at the pre-operative visit and at each yearly post-operative visit. Individuals lost to follow-up beyond 1 year were considered study non-completers.

Measures

Demographics collected at the pre-operative visit included age, gender, ethnicity, relationship status, occupational status, and level of education. The bariatric psychosocial questionnaire included 26 measures of psychiatric illness, eating disorders, and psychosocial functioning. For the purpose of this study, we analyzed the results of the Eating Disorder Examination Questionnaire (EDE-Q), Binge Eating Scale (BES), Emotional Eating Scale (EES), and Night Eating Questionnaire (NEQ).

The EDE-Q is a 28-item self-report questionnaire with each item measured on a 6-point scale, which correlates with the Eating Disorder Examination (EDE), an investigator-based interview [16] [17] . The EDE-Q is a valid tool that has been used to identify eating pathology in the bariatric population [18]. Participants are asked to indicate the number of days over the last 28 days that they have experienced a particular eating-related behavior, with responses ranging from 0 (no days) to 6 (every day). The EDE-Q contains four subscales (dietary restraint, eating concerns, weight concerns, and shape concerns), and a global EDE-Q score is calculated as the average of the subscale scores.

The EDE-Q also reports loss of control eating (LOC_E), which we defined as the number of times over the last 28 days that the participant reported having lost control while subjectively overeating, as has been previously described [19]. Loss of control over eating is not an official validated subscale of the EDE-Q.

The Binge Eating Scale (BES) is a 16-item self-report questionnaire designed to assess binge eating and related behaviors in individuals with obesity [20]. Items are rated on a 4-point scale and total scores range from 0 to 46. Scores at or above 27 indicate high severity of binge eating, between 18 and 26 indicate moderate severity of binge eating, and scores below 17 indicate minimal or absent binge eating. The BES has been found to be a valid tool in the bariatric population [21].

The Emotional Eating Scale (EES) is a 25-item self-report questionnaire [22] designed to assess a respondent's propensity to eat in response to negative emotions such as anger, anxiety, or low mood states. Three subscales are generated by the test, specifically EES-anger, EES-anxiety, and EES-depression. Each item is rated on a 5-point Likert scale. Total EES scores were calculated as the sum of subscale scores and ranged from 0 to 100. The EES has been shown to have good construct validity and internal consistency [22] and has been used in the bariatric population [11].

The Night Eating Questionnaire (NEQ) was used to measure symptoms of NES. The NEQ is a 14-item questionnaire that has been found to be a valid tool in patients with obesity [23]. It includes nine questions related to eating behaviors prior to sleeping. Items are rated on a 4-point scale, from 0 to 4, with total scores ranging from 0 to 52.

Statistical Analyses

All statistical analyses were performed on IBM SPSS Statistics 24. Alpha was set at 0.05 for all analyses. The Kolmogorov–Smirnov test was significant, necessitating a Wilcoxon signed-rank test to compare mean ranks of eating pathology measures between various time points. Comparisons were made between pre-operative scores and the first, second, and third post-operative year scores, as well as between the first and second, second and third, and first and third post-operative year scores.

Weight loss was measured as percent total weight loss (%TWL), calculated as (baseline weight − current weight)/baseline weight. Two separate multiple linear regressions were calculated to predict %TWL 1 year and 2 years post-op based on pre-operative weight, gender, and 1 year post-operative scores of BES, EES, EDE-Q global score, and number of LOC_E episodes.

Mann–Whitney *U* test was used to compare scores on eating pathology measures between groups who did and did not experience weight regain. One definition of weight regain used by the Ontario Bariatric Network is a regain of > 25% of the total weight lost. Given our 2-year follow-up of weight outcomes, there were an insufficient number of patients with > 25% TWL regained for statistical analysis. Therefore, we defined weight regain as a weight gain between the first and second post-operative years of 10% of the total weight lost during the first post-operative year. Weight regain of > 10% TWL is a definition that has been used by other authors in the literature [24].

Results

Participant Characteristics

Eight hundred forty-four participants in our study had eating psychopathology data at the pre-operative time point and at least one post-operative time point at or beyond 1 year.

Demographic data and pre-operative weights of the 844 participants included in this study are reported in Table 1. There were no significant differences in pre-operative weight, BMI, or demographic factors between study completers ($n = 544$, 64.5%) and study non-completers ($n = 300$, 35.5%). Study completers had lower pre-operative BES scores (mean ± SD = 15.63 ± 8.11) than non-completers (mean ± SD = 17.0 ± 18.52; $p = 0.036$). There were no significant differences between completers and non-completers in pre-operative EES, NEQ, EDEQ-global, or number of LOC_E episodes.

Table 1 Baseline demographic information of participants and post-surgical weight outcomes

Characteristic	*n* (%)	Available sample size (of 844 participants)
Gender		810
Female	658 (81.2)	
Male	152 (18.8)	
Age: mean (25%, 75%)	45 (38, 53)	811
Type of surgery		844
Roux-en-Y gastric bypass surgery	760 (90.0%)	
Sleeve gastrectomy	84 (10.0%)	
Race/ethnicity		580
White (Caucasian)	497 (85.7)	
Black (African American)	27 (4.7)	
Latin/South American	20 (3.4)	
Other	36 (6.2)	
Employment		619
Full-time	402 (64.9)	
Part-time	54 (8.7)	
Unemployed	46 (7.4)	
Disability	68 (11.0)	
Retired	35 (5.7)	
Social assistance	14 (2.3)	
Marital status		630
Married/common law	347 (55.1)	
Divorced or separated	84 (13.3)	
Single, never married	138 (21.9)	
Common law	52 (8.3)	
Widowed	9 (1.4)	
Pre-op BMI (kg/m^2): mean (SD)	48.6 (7.8)	736
Weight (kg): mean (SD)		
Pre-surgery	136.3 (27.1)	599
1 year post-surgery	89.4 (20.4)	361
2 years post-surgery	89.1 (21.2)	183
3 years post-surgery	89.9 (20.7)	55
% total weight loss: mean (SD)		
1 year post-surgery	34.1 (8.7)	361
2 years post-surgery	33.4 (11.6)	180
3 years post-surgery	32.6 (10.7)	55

Weight Changes from Pre-surgery to 3 years Post-surgery

A significant decrease in weight (mean change in weight ± SD = − 47.11 ± 17.59 kg; $p < 0.001$) was noted from pre-surgery to the first year post-surgery. While, a significant increase in weight (4.28 ± 7.12 kg; $p = 0.001$) was noted between the second and third post-operative years.

Changes in Eating Pathology from Pre-surgery to 3 years Post-surgery

Eating pathology scores decreased significantly from pre-surgery to the first year post-surgery (Figs. 1 and 2, Table 2). These included BES (change in mean score ± SD = − 10.04 ± 9.19; $p < 0.001$), EES (− 21.43 ± 23.53; $p < 0.001$), NEQ (− 4.10 ± 7.53; $p < 0.001$), EDEQ-global (− 1.87 ± 1.23; $p < 0.001$), and LOC_E (− 3.05 ± 6.60; $p < 0.001$). With the exception of night eating 3 years post-surgery, eating pathology scores were significantly lower at 1, 2, and 3 years post-surgery than they were prior to surgery. Between the first and second year after surgery, there was a significant increase in BES scores (change in mean score ± SD = 0.85 ± 4.71; $p = 0.002$), EES (2.00 ± 13.63; $p = 0.033$), and LOC_E scores (1.11 ± 7.01; $p < 0.001$) that continued to the third post-operative year. There was a significant increase in NEQ scores between 2 and 3 years post-surgery (2.52 ± 8.00; $p = 0.01$).

Multiple Regression Analysis to Assess 1 year Post-operative Eating Behaviors as Predictors of 2-year Weight Loss

Multiple regression analysis examining various forms of eating pathology 1 year post-surgery as predictors of %TWL 2 years post-surgery identified pre-op weight ($\beta = 0.30$,

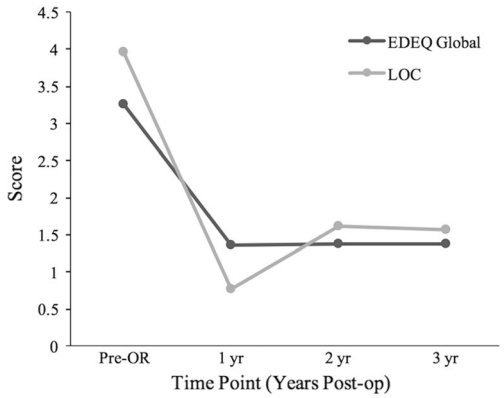

Fig. 1 Mean EDE-Q Global scores and mean frequency of LOC eating episodes at baseline and each post-operative year. Sample size (*n*) for each time point: EDEQ-Global Pre-OR: $n = 746$, 1 year: $n = 548$, 2 years: $n = 375$, 3 years: $n = 235$. LOC Pre-OR: $n = 809$, 1 year: $n = 598$, 2 years: $n = 401$, 3 years: $n = 244$

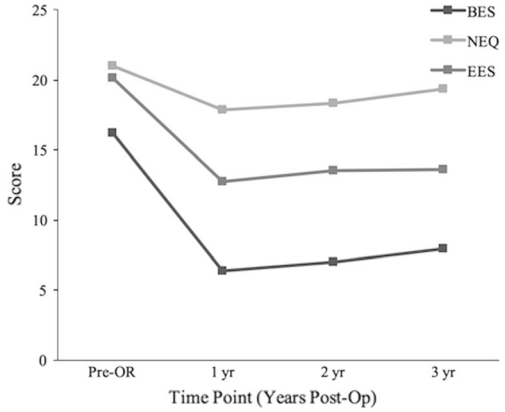

Fig. 2 Mean BES scores, EES average subscore, and NEQ scores at baseline and each post-operative year. Sample size (n) for each time point: BES Pre-OR: $n = 468$, 1 year: $n = 481$, 2 years: $n = 348$, 3 years: $n = 197$. NEQ Pre-OR: $n = 557$, 1 year: $n = 65$, 2 years: $n = 172$, 3 years: $n = 83$. EES-Anger Pre-OR: $n = 659$, 1 year: $n = 549$, 2 years: $n = 382$, 3 years: $n = 234$. EES-Anxiety Pre-OR: $n = 663$, 1 year: $n = 570$, 2 years: $n = 387$, 3 years: $n = 236$. EES-Depression Pre-OR: $n = 698$, 1 year: $n = 581$, 2 years: $n = 394$, 3 years: $n = 240$

confidence interval (CI) 0.04, 0.22, $p = 0.004$), gender ($\beta = -0.28$, CI −14.31, −2.29, $p = 0.007$), and 1 year post-operative BES score ($\beta = -0.39$, CI −1.23, −0.16, $p = 0.012$) as significant predictors of %TWL 2 years post-surgery (Table 3). Lower pre-op weight, male gender, and higher 1 year post-operative BES score all predicted less %TWL 2 years post-surgery. A similar regression analysis was performed, examining the impact of eating pathology 1 year after surgery on %TWL 1 year after surgery. In this model, only pre-op weight ($\beta = 0.245$, CI 0.032, 0.125, $p = 0.001$) and male gender ($\beta = -0.194$, CI −7.55, −1.10, $p = 0.009$) were significant predictors of %TWL. BES score, EES score, EDE-Q global score, and loss of control over eating at 1 year after surgery did not significantly impact 1 year %TWL.

Rates of Weight Regain and Differences in Eating Pathology Scores Between Groups With and Without Weight Regain

At 2 years post-surgery, 21.9% of patients ($n = 40$) had regained > 10% of TWL (total weight lost in the first year), 11.5% ($n = 21$) had regained > 15% of TWL, and 4.9% of patients ($n = 9$) had regained > 25% of TWL. A Mann–Whitney test indicated that BES, EES, EDE-Q global, and LOC_E at 1 year post-surgery were not significantly different between groups with > 10% TWL regain and those without.

Discussion

Along with a significant decrease in weight during the first year after bariatric surgery, participants demonstrated significant declines in eating pathology including binge eating, loss of control over eating, night eating, emotional eating, as well as global scores on the EDE-Q. However, between the first and third years after surgery, there were significant increases in mean scores of all eating measures with the exception of global EDE-Q score. This result may be due to the measurement of general rather than specific eating pathology by the EDE-Q. Binge eating scale scores 1 year after surgery predicted lower %TWL only at 2 years post-surgery in our sample. No other eating pathology measures predicted %TWL. Despite increases in eating pathology scores and weight gain

Table 2 Comparison of eating pathology between baseline (pre-op) and 1-, 2-, and 3-year time points after surgery and between post-operative time points

	BES	EES	NEQ	EDE-Q Global	LOC_E
Pre-op vs. year 1	−10.0**	−21.4**	−4.1**	−1.9**	−3.1**
	(−11.1, −9.0)	(−23.7, −19.1)	(−6.2, −1.9)	(−2.0, −1.8)	(−3.6, −2.5)
Pre-op vs. year 2	−8.6**	−20.1**	−2.2**	−1.8**	−2.3**
	(−9.8, −7.4)	(−22.7, −17.4)	(−3.5, −0.9)	(−2.0, −1.7)	(−3.1, −1.5)
Pre-op vs. year 3	−8.3**	−21.4**	−1.8	−1.8**	−2.3**
	(−10.5, −6.1)	(−25.3, −17.5)	(−3.7, 0.2)	(−2.0, −1.6)	(−3.3, −1.4)
Year 1 vs. 2	0.8**	2.0*	3.4	0.03	1.1**
	(0.2, 1.5)	(0.1, 3.9)	(−1.3, 8.1)	(−0.1, 0.2)	(0.2, 2.0)
Year 2 vs. 3	0.8	0.2	2.5*	0.001	0.2
	(−0.2, 1.8)	(−2.3, 2.7)	(−0.6, 5.7)	(−0.2, 0.2)	(−0.6, 1.1)
Year 1 vs. 3	2.6**	4.9**	−0.3	0.1	1.1**
	(1.5, 3.7)	(1.9, 8.0)	(−7.3, 6.8)	(−0.04, 0.3)	(0.4, 1.7)

Mean change in score between time points and 95% confidence intervals (LL, UL). Significance of Wilcoxon signed-rank test between corresponding time points denoted by *$p < 0.05$, **$p < 0.01$. EES is calculated as the total of anger, anxiety, and depression sub-scores. LOC_E is measured as the number of incidences of overeating associated with loss of control in the last 28 days. Sample sizes for each measure at each time point have previously been indicated in Figs. 1 and 2

Table 3 Multiple regression for measures of eating pathology predicting %TWL at 2 years post-op ($N = 180$)

1 year predictors of 2 year %TWL				
Variable	Sample size (N)	Standardized Coefficient β	LL 95% CI	UL 95% CI
Pre-op weight	599	0.30**	0.04	0.22
Gender	810	− 0.28**	− 14.31	− 2.29
BES	481	−0.39*	−1.23	−0.16
EES	531	0.15	− 0.07	0.29
EDE-Q global	548	0.12	− 1.40	3.98
LOC_E	598	0.18	− 0.18	1.65

Standardized coefficient β is adjusted to units of standard deviation. Gender: female coded "1", male coded "2"
*$p < 0.05$; **$p < 0.01$

between the first and third post-operative years, the 3-year mean eating psychopathology scores and weights remained significantly lower than pre-surgery.

Findings regarding changes in binge eating after bariatric surgery vary in the literature, in part due to the variability of measures used. One study that used a DSM IV diagnosis of BED found that patients with pre-operative binge eating transitioned to behaviors like grazing or subjective binges that were associated with a loss of control but not necessarily large volumes of food [7]. To better represent the bariatric surgery population, some authors have responded by using modified BED measures for their analyses [9, 25]. However, these measures often still ask about a subjectively "large" amount of food. The BES, despite not being a gold standard interview, does address subtler behaviors such as speed of eating, eating while bored, detection of satiety, and control over urges to eat. There is debate in the literature about the clinical relevance of objective binge eating to the post-operative bariatric population; however, our findings suggest that the BES may capture symptoms related to binge eating including core features related to LOC_E. Higher BES scores were the only post-operative eating measures that significantly predicted decreased %TWL, but the clinical relevance of these weight outcomes remain unclear. Nonetheless, our results align with another study that used the BES, which showed an association between higher post-operative BES scores and worse weight loss outcomes [26]. LOC_E, as we derived from the EDE-Q, is not a validated scale like the BES. Our measure of LOC_E significantly increased beyond the first post-operative year, but did not predict worse weight outcomes. These findings contrast with a few studies that demonstrated a detrimental effect of LOC_E on post-operative weight outcomes [10, 11, 27]. However, in the study by Devlin and colleagues, LOC_E was not associated with weight loss in a multivariable analysis.

We also found that NEQ scores significantly increased between the second and third post-operative years. Although studies on post-operative night eating are scarce, night eating has been shown to decrease in severity following bariatric surgery, but patients without a history of the disorder have also been found to develop NES after surgery [7]. Night eating symptoms have been reported by patients up to 8 years after bariatric surgery [5]. Literature examining the effects of post-operative NES on weight loss outcomes is inconclusive to date. One prospective study found that patients with NES had higher weights than those without NES at 1 year post-op, but this difference was no longer present at an average follow-up of 5.5 years post-op [28]. Similarly to night eating, there is limited post-operative data on emotional eating in the literature. In our study, emotional eating subscale scores including EES-anger, EES-anxiety, and EES-depression, were found to significantly decrease after surgery, but increase in the subsequent years. EES scores were not a predictor of post-operative weight loss. Our findings align with another study that used the EES to quantify emotional eating and found no statistically significant difference in weight outcome as a result of emotional eating scores 8 months after surgery [11].

The findings of our study should be interpreted in the context of several limitations. Firstly, 35.5% of our initial database of participants was lost to follow-up after 1 year, meaning that they did not attend their 2- or 3-year post-operative appointments. High rates of study non-completion are common in the bariatric surgery literature [29]. The higher proportion of females to males in our study sample is typical of bariatric surgery studies and reflects the patient population. Although dropouts did not differ significantly from completers on most eating pathology measures, they did have significantly higher scores on the BES. Therefore, the true rate of post-operative binge eating beyond 1 year may have been underestimated in our study. Furthermore, we were unable to incorporate 1-year NEQ scores into the multiple regression analysis for 2-year %TWL due to insufficient sample size. Our sample size of weight data decreased beyond 2 years and we were therefore unable to analyze predictors of weight outcomes beyond 2 years with sufficient statistical power. When we examined weight regain rather than weight loss as an outcome, there was no difference between groups with or without > 10% regain of TWL in eating pathology scores. However, most studies looking at weight regain have follow-up beyond 2 years [24, 30] and one study found that their weight regain group had an

average of 6 years elapsed since surgery [31]. Longer follow-up could allow for further analysis of weight regain as an outcome. In addition, we used self-report measures of eating pathology, which have been shown to overestimate the presence of eating disorders [16]. Our questionnaires were not anonymous, which also may have led to an underreporting of pre-operative eating psychopathology, given the motivation of candidates to remain eligible for surgery. Finally, our study commenced prior to the publication of two psychometrically validated measures of LOC_E and future research could consider inclusion of these scales [32, 33].

Conclusions

Our prospective cohort study found that the severity of eating pathology and maladaptive eating behaviors, specifically binge eating, night eating, emotional eating, and loss of control eating decreased significantly after bariatric surgery, but increased significantly between the first and third post-operative years. A higher BES score at 1 year was predictive of lower total percentage of weight loss at 2 years after surgery, but no other forms of eating pathology were predictive of weight outcomes. These findings provide further evidence that remission of eating pathology 1 year after bariatric surgery does not guarantee the complete resolution of these behaviors. Problematic eating behaviors can re-emerge and may contribute to worse weight outcomes in subsequent years. Future prospective studies focusing on long-term outcomes are needed to inform the development of appropriate early follow-up procedures and treatment programs post-bariatric surgery. Finally, given that weight loss is just one outcome of interest in bariatric surgery, the impact of post-operative eating pathology on comorbidity improvement and quality of life will also be important areas of future research.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent Statement Informed consent was obtained from all individual participants included in the study.

Abbreviations SD, standard deviation; CI, confidence interval; β, standardized beta (coefficient beta standardized to unit of standard deviation)

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