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EATING DISORDERS (S WONDERLICH AND S ENGEL, SECTION EDITORS)

Eating Pathology After Bariatric Surgery: an Updated Review of the Recent Literature

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Abstract

Purpose of Review The goal of this paper was to extend the prior literature on eating pathology following bariatric surgery by highlighting themes in data published over the past 3 years and identifying limitations and future directions for research.

Recent Findings Changes in eating pathology after bariatric surgery remain consistent with previous research. Specifically, diagnostic prevalence rates and incidence of related behaviors generally decrease following surgery. However, some research supports that these factors increase and/or remit over time following surgery, and that they subsequently have a negative impact on weight loss outcomes.

Summary While recent findings have extended knowledge on eating pathology following bariatric surgery, the overall body of literature is still relatively limited. Additional research is needed, including work focusing on the standardization of eating pathology definitions, development/validation of standardized eating pathology instruments for bariatric surgery patients, and predictors of risk for continued or new onset eating pathology following surgery.

Keywords Bariatric surgery · Eating pathology · Eating disorders · Eating behaviors · Weight loss outcomes

Introduction

Bariatric surgery remains the most efficacious and durable intervention for severe obesity. However, some patients experience new or persistent eating pathology following surgery, which may ultimately affect weight loss outcomes. While literature concerning the prevalence, temporal course, and severity of eating pathologies before and after bariatric surgery has grown in recent years, available data remain relatively limited. Indeed, traditional eating disorder diagnoses that conform to definitions found in the Diagnostic and Statistical Manual—5th edition (DSM 5) [1] (e.g., anorexia and bulimia nervosa, binge eating disorder) have been most frequently studied to date. Thus, continued review of these empirical findings, which is the primary goal of this current paper, becomes important in our understanding of the impact of psychopathology on surgical outcomes.

While recent data also show that other maladaptive eating behaviors not currently recognized by the DSM 5 (e.g., picking and nibbling, grazing, chewing and spitting, dumping, etc.) are relatively common among patients who have undergone bariatric surgery, a significant limitation in the literature is a lack of consistency with respect to nomenclature used to describe these symptoms. Accepted operational diagnostic criteria and standardized methods of assessment for these behaviors are lacking, leaving comparisons of prevalence rates and interpretation of the data across studies challenging. As such, this review will also discuss some of these issues and highlight areas where additional research data are needed.

Current Review

The current review sought to extend prior literature reviews [2–4] on DSM 5 [1] defined eating pathology after bariatric surgery. Specifically, this review focused on data published

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within the past 3 years in the effort to highlight emerging themes within the literature and identify limitations and future directions for research. Table 1 includes a list of recent studies, sorted by length of follow-up, which look at changes in eating pathology symptoms and behaviors from pre-surgery to at least one time point after surgery. Table 2 lists the research conducted over the past 3 years to help answer the question of whether eating pathology is associated with weight loss outcomes following bariatric surgery. An effort was also made to delineate results across the three bariatric procedure types primarily currently employed in the USA and in recent years: Roux-en-Y gastric bypass (RYGB), adjustable gastric banding (AGB), and vertical sleeve gastrectomy (VSG).

Eating Pathology Before and After Bariatric Surgery

Anorexia Nervosa

Anorexia nervosa (AN) is characterized by low weight, dietary restriction, and intense fear of gaining weight [1]. Given these symptoms, it is not surprising that AN is rare within the bariatric surgery population. AN is generally considered a contraindication for bariatric surgery, as patients demonstrating this type of psychopathology are unlikely to have the recommended body mass index (BMI) of greater than 35 kg/m^2 [29]. Consequently, while there are no data available regarding cases of AN pre-surgery, some evidence for the development of sub-diagnostic AN symptoms post-surgery has been identified [30–33]. Case studies (previously summarized [4, 33]) have demonstrated that some bariatric surgery patients are at risk for developing excessive dietary restriction following surgery. Literature over the past several years has not provided updated prevalence rates of AN before and after surgery. However, given the clinical significance of these behaviors, dietary restriction and other symptoms of AN post-surgery will likely be continually monitored in future research.

Bulimia Nervosa

Bulimia nervosa (BN), characterized by repetitive binge eating and compensatory behaviors [1], is also rare among bariatric surgery candidates. Historically, research has found relatively small prevalence rates (3%) of BN prior to surgery [34], and little-to-no data regarding changes in prevalence of BN following surgery [3]. Data published within the past 3 years generally supports these earlier findings. Recent data from the Longitudinal Assessment of Bariatric Surgery (LABS) cohort demonstrated that two RYGB candidates met criteria for a diagnosis of BN prior to surgery, but that the prevalence rate dropped to 0% by 2 years post-surgery and remained the same through 7 years post-surgery [6]. Further, in a sample of patients receiving VSG, significant reductions in bulimic symptom severity were observed from pre-surgery to approximately 19 months post-surgery [17•].

Compensatory Behaviors One likely reason that prevalence rates for BN remain low among bariatric surgery candidates is the relatively infrequent occurrence of compensatory behaviors, commonly defined as self-induced vomiting, laxative and diuretic misuse, and excessive exercise [1]. Historically, there has been a dearth of data regarding compensatory behaviors prior to surgery. Consistent with previous hypotheses [3], patients may under-report these behaviors out of fear that it will make them ineligible for surgery. In contrast, research has explained that vomiting commonly occurs post-operatively, both acutely [35] and involuntarily or in response to dysphagia [36]. However, cases of self-induced vomiting related to weight and shape concerns following surgery are rare, and prevalence data have been largely unavailable [33, 34].

Several studies published over the past 3 years have examined changes in compensatory behaviors following surgery. Data from the LABS cohort demonstrated that 7.2% of RYGB and 8.2% of AGB patients engaged in a compensatory behavior prior to surgery, and that the overall prevalence of these behaviors decreased through 7 years post-surgery for both surgical groups [5]. When considering specific compensatory strategies, Moreseth and colleagues [8] identified that 2 out of 60 patients receiving RYGB or the biliary pancreatic diversion with duodenal switch (DS) bariatric procedure engaged in self-induced vomiting prior to surgery, one of those patients (RYGB) maintained the behavior at 6 months post-surgery, and no patients reported the behavior between 1 and 5 years post-surgery. However, when "intense exercise" was examined, a mixed pattern of findings emerged, such that no discernible trends were found across the 5 years of follow-up.

Binge Eating Disorder

Binge eating disorder (BED) is characterized by recurrent binge eating in the absence of any compensatory weight loss behaviors [1]. BED is by far the most common eating disorder prior to surgery, with prevalence rates ranging from 4 to 49% [2, 37]. While examination of BED post-surgery is complicated by issues of measurement (see "Binge Eating Episodes and Loss of Control Eating" below), consensus from the literature is that prevalence of BED decreases after bariatric surgery [24].

Data published over the past 3 years is consistent with prior conclusions. Data from the LABS cohort demonstrated that 12.1% of RYGB and 14.6% of AGB patients met criteria for BED prior to surgery [7••], and that prevalence rates remained lower than pre-surgical estimates through 7 years post-surgery for both surgical groups [6••, 7••]. However, during the follow-up after surgery, rates of BED slowly increased,

Table 1 Studies published between 2016 and 2019 that examine changes in eating pathology after bariatric surgery

Authors, date	Sample size	Assessment type (name of assessment)	Changes Presented by surgery type?	Pre- and Post-surgery timepoints	Eating pathology									Notes
					BED (%)	BN (%)	LOC eating(%)	OBE (%)	SBE (%)	Compensatory behaviors (%)	Night eating behaviors (%)	Eating disorder symptom severity (*M*)	Night eating symptom severity (*M*)	
Devlin et al., 2018 [5••]	*N* = 184 RYGB = 111; AGB = 73	Clinical interview (EDE-BSV)	RYGB	Pre-surgery			16.20	8.10	5.40	7.20	15.30	1.90	13.10	
				Year 1			2.00	0.00	2.00	5.00	2.00	1.00	10.00	
				Year 2			3.30	2.00	2.20	6.70	6.70	0.90	10.60	
				Year 3			5.10	2.50	1.30	6.30	5.20	0.90	10.70	
				Year 4			5.00	1.30	5.00	5.00	0.00	0.90	11.00	
				Year 5			2.60	1.30	2.60	1.30	4.80	0.90	11.30	
				Year 7			5.40[a]	0.00	4.10	2.70	5.60	0.80[a]	11.50[a]	
			AGB	Pre-surgery			9.60	5.50	8.20	8.20	18.10	1.80	12.40	
				Year 1			7.10	2.90	4.30	4.30	12.90	1.40	10.80	
				Year 2			4.60	0.00	6.20	3.10	6.30	1.30	10.30	
				Year 3			9.40	3.80	9.40	3.80	7.80	1.20	10.70	
				Year 4			5.90	2.00	5.90	9.80	8.70	1.10	11.00	
				Year 5			9.80	2.00	9.80	2.00	15.20	1.20	10.50	
				Year 7			8.30	0.00	5.60	0.00	2.90	1.00[a]	10.70[a]	
Kalarchian et al., 2019 [6••]	*N* = 173 RYGB = 104; AGB = 69	Clinical interview (SCID)	RYGB	Pre-surgery	7.70	1.90								Authors note that there was not enough statistical power to test differences in eating disorder rates from pre- to post-surgery.
				Year 2	1.10	0.00								
				Year 3	5.20	0.00								
				Year 4	1.60	0.00								
				Year 5	0.00	0.00								
				Year 7	0.00	0.00								
			AGB	Pre-surgery	3.00	0.00								
				Year 2	1.60	0.00								
				Year 3	0.00	0.00								
				Year 4	0.00	0.00								
				Year 5	2.60	0.00								
				Year 7	0.00	0.00								
Smith et al., 2019 [7••]	*N* = 2156 RYGB = 1640 AGB = 516	Clinical interview (EDE-BSV)	RYGB	Pre-surgery	12.10		33.50							
				Year 1	1.30		21.90							
				Year 2	2.00		29.40							
				Year 3	2.70		31.00							
				Year 4	3.50		29.90							
				Year 5	3.00		28.70							
				Year 7	3.30		25.60							
			AGB	Pre-surgery	14.60		39.70							
				Year 1	4.50		32.90							
				Year 2	4.90		32.70							
				Year 3	5.00		33.80							
				Year 4	5.10		36.60							
				Year 5	5.80		36.40							
				Year 7	6.60		29.10							

Table 1 (continued)

Authors, date	Sample size	Assessment type (name of assessment)	Changes Presented by surgery type?	Pre- and Post-surgery timepoints	Eating pathology									Notes
					BED (%)	BN (%)	LOC eating(%)	OBE (%)	SBE (%)	Compensatory behaviors (%)	Night eating behaviors (%)	Eating disorder symptom severity (*M*)	Night eating symptom severity (*M*)	
Morseth et al., 2016 [8]	*N* = 60 RYGB = 31; DS = 29	Self-report questionnaire (EDE-Q)	RYGB	Pre-surgery 6 months Year 1 Year 2 Year 5				29.00 19.00 3.00 17.00 22.00	29.00 38.00 29.00 28.00 31.00	3.00/10.00 5.00/19.00 0.00/3.00 0.00/10.00 0.00/26.00		2.60 1.80 1.50 2.00 2.30		Data presented for compensatory behaviors is displayed as percentages of vomiting/exercise
			DS	Pre-surgery 6 months Year 1 Year 2 Year 5				32.00 9.00 0.00 17.00 7.00	18.00 23.00 19.00 8.00 25.00	3.00/14.00 0.00/32.00 0.00/23.00 0.00/8.00 0.00/14.00		2.80 1.50 1.40 1.40 1.50[b]		
Goldschmidt et al., 2018 [9•]	*N* = 234 adolescents RYGB = 159; VSG = 63; AGB = 12	Self-report questionnaire (QEWP-R)	No	Pre-surgery 6 months Year 1 Year 2 Year 3 Year 4			27.78 5.13[a] 6.84[a] 10.26[a] 11.54[a] 10.26[a]	15.38 0.85[a] 0.43[a] 1.28[a] 1.71[a] 3.84[a]						Sample included both male and female adolescents
Devlin et al., 2016 [10]	*N* = 183 RYGB = 111; AGB = 72	Clinical interview (EDE-BSV)	No	Pre-surgery Year 1 Year 2 Year 3			40.40 25.80[a] 15.00 11.7[a,c]	30.50 2.30[a] 5.30 3.90[a]	26.30 26.10 15.10 9.00[a,c]	6.40 5.10[a] 6.20 6.30[a]	16.50 5.00[a] 6.20 5.40[a]	1.80 1.10[a] 1.00 1.00[a]	13.00 10.10[a] 10.30 10.60[a]	
Kalarchian et al., 2016 [11]	*N* = 165 RYGB = 98; AGB = 67	Clinical interview (SCID)	No	Pre-surgery Year 2 Year 3	6.10 1.30 3.10	1.20 0.00 0.00								
Schäfer et al., 2018 [12]	*N* = 229 68.1% RYGB; 29.6% VSG; 1.8% balloon-to-VSG; 0.4% AGB	Clinical interview (EDE) Self-report questionnaire (EDE-Q)	No	Pre-surgery Year 2 Year 3								Data not available		Data for eating pathology variables are not reported in the manuscript (i.e., data presented by personality subtype)
Nasirzadeh et al., 2018 [13•]	*N* = 844 RYGB = 760; VSG = 84	Self-report questionnaire (EDE-Q, BES, NEQ)	No	Pre-surgery Year 1 Year 2 Year 3								3.00–3.50 1.00–1.50[a] 1.00–1.50[a] 1.00–1.50[a]	20.00–25.00 15.00–20.00[a] 15.00–20.00[a] 15.00–20.00[c]	Exact scores for eating pathology are not reported in the manuscript. Ranges reported have been approximated from graphs within the manuscript

Table 1 (continued)

Authors, date	Sample size	Assessment type (name of assessment)	Changes Presented by surgery type?	Pre- and Post-surgery timepoints	Eating pathology									Notes
					BED (%)	BN (%)	LOC eating(%)	OBE (%)	SBE (%)	Compensatory behaviors (%)	Night eating behaviors (%)	Eating disorder symptom severity (*M*)	Night eating symptom severity (*M*)	
Pinto et al., 2017 [14]	*N* = 60 RYGB = 60	Self-report questionnaire (NEQ, Portuguese version)	N/A	Pre-surgery Post-surgery (*M* = 16.1 months)							Data not available		14.18 12.32	Percentages of total sample engaging in night eating behaviors are not presented in the manuscript Differences in eating pathology assessed by depressive groups
Conceição et al., 2017 [15]	*N* = 61 RYGB = 17; AGB = 44	Clinical interview (EDE) Self-report questionnaire (EDE-Q)	No	Pre-surgery Post-surgery (approx. 2 years)			6.60 0.00							Primary results report changes in different combinations of LOC and "picking and nibbling"
Ruffault et al., 2018 [16]	*N* = 200 women 54% RYGB; 37% VSG; 1.5% AGB; 12% Conversion	Study-defined dysfunctional eating behaviors checklist	No	Pre-surgery 6 months Year 1 Year 2			Data not available							Data for eating pathology variables are not reported in the manuscript (i.e., data are reported by trauma group)
Figura et al., 2017 [17•]	*N* = 63 VSG = 63	Self-report questionnaire (EDI, German version)	N/A	Pre-surgery Post-surgery (*M* = 19 months)								16.40 12.90[a]		Eating disorder symptom severity score reflects the "Bulimia" subscale from the EDI
Luiz et al., 2016 [18]	*N* = 132 RYGB = 132	Self-report questionnaire (BES, Portuguese version)	N/A	Pre-surgery Year 1								13.58 6.64		Eating disorder symptom severity scores reflect the total score from the BES
Sarwer et al., 2017 [19]	*N* = 119 adolescents	Self-report questionnaire (EDE-Q, NEQ)	N/A	Pre-surgery 6 months Year 1								2.60 1.80 1.60	16.70 17.00 18.40	Sample included both male and female adolescents
Peterhänsel et al., 2017 [20]	*N* = 130 RYGB = 113 (approx.); VSG = 17 (approx.)	Self-report questionnaire (EDE-Q)	No	Pre-surgery 6 months Year 1								Data not available		Data for eating pathology are not reported in the manuscript (i.e., data reported by personality group)

Table 1 (continued)

Authors, date	Sample size	Assessment type (name of assessment)	Changes Presented by surgery type?	Pre- and Post-surgery timepoints	Eating pathology									Notes
					BED (%)	BN (%)	LOC eating(%)	OBE (%)	SBE (%)	Compensatory behaviors (%)	Night eating behaviors (%)	Eating disorder symptom severity (*M*)	Night eating symptom severity (*M*)	
Pinto-Bastos et al., 2018 [21]	*N* = 238 AGB = 122; Re-operative surgery = 116	Self-report questionnaire (EDE-Q)	Primary AGB Re-operative surgery	Pre-surgery 6 months Pre-surgery 6 months				Data not available	Data not available			Data not available		Percentage of patients engaging in OBEs and SBEs and scores for eating disorder symptom severity are not reported in the manuscript

Data presented in the table depict changes in eating pathology after bariatric surgery. Blank sections of the table indicate that the eating pathology was not assessed in that study (unless otherwise noted). Sample size description includes both males and females (unless otherwise noted). Eating pathology abbreviations: "BED" is binge eating disorder, "BN" is bulimia nervosa, "LOC" is loss of control, "OBE" is objective binge eating, "SBE" is subjective binge eating. "%" represents the reported percentage of the sample engaging in that type of eating pathology, "*M*" represents the mean/average eating pathology score for the sample. Surgery type abbreviations: "RYGB" is Roux-en-Y gastric bypass surgery, "AGB" is adjustable gastric banding, "DS" is duodenal switch, "VSG" is vertical sleeve gastrectomy. Assessment type abbreviations: "EDE-BSV" is Eating Disorder Examination, bariatric surgery version, "SCID" is Structured Clinical Interview Diagnostic, "EDE-Q" is Eating Disorder Examination, Questionnaire, "QEWP-R" is Questionnaire on Eating and Weight Patterns, Revised, "BES" is Binge Eating Scale, "NEQ" is Night Eating Questionnaire, "EDI" is Eating Disorder Inventory

[a] Statistically significant difference from pre-surgery

[b] Statistically significant difference compared to the RYGB group at the same time point

[c] Statistically significant difference from year 1/year 2

culminating in 3.3% of RYGB and 6.6% of AGB patients meeting criteria for BED 7 years post-surgery [7••].

Associations with Weight Loss Outcomes An important reason that researchers continue to monitor overall rates of BED following all surgical procedures is to identify risk factors for poor weight loss or weight regain. Broadly, eating pathology *prior* to surgery is an inconsistent predictor of weight loss outcomes, but the existence of eating pathology *following* surgery is a more consistent and robust predictor [24, 38]. In recent data from the LABS cohort, no significant associations were found between history of *pre-surgical* eating disorders (defined as BN or BED) and percent weight change following surgery [6••]. However, being diagnosed with an eating disorder *following* surgery was associated with less weight loss 2 and 3 years post-surgery [11], but not 4 to 7 years post-surgery [6••].

Binge Eating Episodes and Loss of Control Eating Arguably, the most comprehensive and complicated aspect of eating pathology among bariatric surgery candidates involves the characterization of binge eating symptoms and frequency of binge eating episodes. According to DSM 5, a binge eating episode is defined as eating an objectively large amount of food within a discrete period of time (often referred to as "objective binge eating" or "OBE") and experiencing a sense of lack of control during the episode of eating (referred to as "loss of control" or "LOC") [1]. While relatively prevalent prior to surgery (with current estimates ranging from 5.5% among AGB patients to 8.1% among RYGB patients [5••]), true binge eating characterized by both OBE and LOC is difficult or impossible for patients to display immediately following most contemporary forms of bariatric surgery (e.g., RYGB, VSG) due to the limited capacity of the gastric pouch or sleeve [24]. As such, an emphasis on LOC over OBE is often observed within the bariatric surgery literature, with some additional focus regarding subjective binge eating ("SBE") instead of OBE [3, 37, 39, 40].

Similar to rates of BED, historical prevalence rates for LOC prior to surgery have been quite variable. As previously summarized [24], these rates range from 13% among a sample of AGB patients [41] to 61% among a sample of RYGB patients [42]. Similarly, historical rates of post-operative LOC are also variable, ranging anywhere from 8 to 50% [24]. Unsurprisingly, when looking at the size of the eating binge (i.e., OBEs or SBEs) in addition to LOC when determining criteria for a "binge eating episode," prevalence rates have been particularly difficult to estimate and summarize due to differing assessment methods [43].

Evidence in recent literature for changes in OBEs, SBEs, and LOC following bariatric surgery remains

complicated. Several studies have examined prevalence rates for the engagement in, and subsequent abstinence from, these behaviors following surgery, and such data can be found in Table 1. Specifically, when considering SBEs, data from the LABS cohort suggests that the prevalence of SBEs remain relatively unchanged in the short term (i.e., within 1-year post-surgery) but decrease in the long term (i.e., after 2 years following surgery) [10]. However, another study found no significant changes in frequency of occurrence of SBEs from pre-surgery through 5 years post-surgery [8]. Incidence of OBEs and LOC eating has been shown to decrease overall from pre-surgery through 7 years post-surgery [5••, 7••, 8, 10, 13, 21]. Once again, while prevalence of OBEs and LOC remain lower than pre-surgical estimates, some evidence suggests that these behaviors increase over time following surgery. Data from the LABS cohort suggests that, following an initial decrease, LOC slowly increases and peaks at 3 years post-surgery among RYGB patients and at 4 years post-surgery among AGB patients [7••]. Similar increases following surgery have also been seen for OBE and SBE behaviors; however, rates appear more variable for AGB patients compared to those of RYGB patients [5••]. Ultimately, these findings suggest that some patients may experience an initial reprieve but subsequent resurgence of LOC, OBEs, and SBEs at some point following surgery.

Associations with Weight Loss Outcomes Recent literature has continued to examine LOC, OBEs, and SBEs, and as predictors of weight loss outcomes. Only one recent study found a significant relationship between pre-surgical OBE and post-surgery weight loss, such that patients who engaged in OBEs prior to surgery had less change in BMI 2 and 5 years following RYGB or DS surgery [8]. However, several other recent studies [7••, 10, 15] failed to find similar results with respect to pre-surgical OBEs and LOC. As such, the power of pre-surgical eating-related predictors to predict weight loss outcomes remains weak, a conclusion similar to that drawn within previous review papers [38].

However, when considering the impact of post-surgical eating behaviors, a small group of recent studies examining associations with weight loss provides a much more consistent picture. Conceição and colleagues [15] found that the presence of LOC following RYGB or AGB surgery was associated with a poorer trajectory of weight loss 2 years post-surgery. In addition, when examining associations with several types of eating pathology (e.g., OBE, SBE, LOC, overall eating disorder symptom severity) among the LABS cohort, researchers found that LOC was the only post-surgery symptom that significantly predicted less weight loss through 3 years following RYGB or AGB surgery [10]. Finally, through the 7 years of follow-up among the LABS cohort, researchers demonstrated that LOC was associated with less weight loss when both were measured at the same timepoint (but not prospectively or cumulatively), ultimately arguing that post-surgical LOC is a proximal but not distal risk factor for poor weight loss outcomes following surgery [7••].

Night Eating Syndrome and Night Eating Behaviors

Night eating syndrome (NES) is currently listed as an "other specified" eating disorder in DSM 5 and is characterized by recurrent eating after an evening meal or after awakening from sleep [1]. Historically, prevalence rates for NES prior to surgery have been estimated at 1.9% [44] to 17.7% [45]. Further, the existing evidence for changes in NES following surgery has been mixed [3], with some research suggesting that rates decrease post-surgery [46] while others have shown no notable change [47].

Research regarding NES among bariatric surgery patients has been steadily increasing over the past several years. Studies published over the past 3 years that provide data on NES severity or behaviors (also referred to as "regular evening hyperphagia") prior to surgery demonstrate prevalence rates ranging from 10 to 17% [5••, 10, 14]. A clearer message also appears across recent papers examining changes in NES after surgery. Several studies demonstrated decreases in NES severity in the first 2 years post-surgery [5••, 13•, 14]. With reference to actual night eating behaviors, several studies showed that patients receiving RYGB or AGB surgery experienced significant decreases in the frequency of these behaviors through 3 years post-surgery [10, 14]. Among the studies examining associations between night eating symptomatology and weight loss following surgery, no significant relationships emerged at any timepoint after surgery [10, 14].

Emerging Themes in the Recent Literature

As the literature on changes in eating pathology following bariatric surgery continues to grow, researchers have begun to narrow in on specific topics that may provide more clinically useful information for individuals working with bariatric surgery patients. Several emerging themes in the recent literature are briefly outlined in an effort to highlight the different directions of current research in the field.

Adolescents

Adolescents have gained greater attention in the bariatric surgery literature over the past several years. The primary data in this area comes from the "Teen-LABS" study, in which psychosocial variables, including LOC with OBE (i.e., "LOC-OBE") or continuous LOC eating without the consumption of objectively large amount of food (i.e., LOC-C), were measured prior to surgery (RYGB, VSG, or AGB) and through 48 months post-surgery [9•]. Pre-surgical estimates of LOC-

Table 2 Is eating pathology associated with less weight loss and/or more weight regain following bariatric surgery?

Type and time of eating pathology assessment in relation to surgery		Time of weight loss assessment						
		6 months	1 year	2 years	3 years	4 years	5 years	7 years
BED	Pre	–	–	No [11]	No [11]	–	–	No [6••]
	Post	–	–	Yes [11]	Yes [11]	–	–	–
BN	Pre	–	–	No [11]	No [11]	–	–	No [6••]
	Post	–	–	–	–	–	–	–
LOC eating episodes	Pre	–	No [10]	No [10]	No [10]	No [22]	–	No [5••, 7••]
	Post	–	Yes [10]	Yes [10, 22]	Yes [10, 22]	Yes [22]	–	Yes [5••, 7••]
OBE	Pre	No [21]	No [10]	Yes/No [8]/[10]	No [10]	–	Yes [8]	–
	Post	No [21]	–	–	–	–	–	–
SBE	Pre	No [21]	No [10]	No [10]	No [10]	–	–	–
	Post	No [21]	No [10]	No [10]	No [10]	–	–	–
Compensatory behaviors	Pre	–	–	–	–	–	–	–
	Post	–	–	–	–	–	–	–
Night eating behaviors	Pre	–	No [10]	No [10]	No [10]	–	–	–
	Post	–	No [10]	No [10]	No [10]	–	–	–
Eating disorder symptom severity	Pre	No [21]	No [10]	No [10]	No [10]	–	–	No [8]
	Post	No [21]	Yes [10, 23]	Yes[a,b] [10, 13•, 15, 17•]	Yes [10]	–	–	Yes [5••]
Night eating symptom severity	Pre	–	No [10]	No [10]	No [10]	–	–	–
	Post	–	No[c] [10, 14]	No [10]	No [10]	–	–	–

This table represents data published between 2016 and 2019. For a summary of findings prior to 2016, see [24–28].

BED binge eating disorder, *BN* bulimia nervosa, *LOC* loss of control, *OBE* objective binge eating, *SBE* subjective binge eating, – no data available

[a] Data from [13•] reflect scores from the Binge Eating Scale

[b] Data from [17•] represent scores from the Bulimia subscale of the Eating Disorders Inventory (EDI). Results are presented in reverse direction in the manuscript, such that lower EDI scores post-surgery reflected greater weight loss.

[c] Average time post-surgery is 16 months for data presented from [21]

OBE and LOC-C eating were 15.4% and 27.8%, respectively. Results demonstrated that both types of LOC eating significantly decreased at 6 months post-surgery, but then slowly increased over time, culminating in a prevalence of 3.8% LOC-OBE and 10.3% LOC-C at 4 years post-surgery. Further, those patients reporting some form of LOC eating following surgery consistently demonstrated the smallest change in BMI.

Sarwer and colleagues [19] also utilized Teen-LABS data to examine changes in global eating disorder symptom severity and night eating symptoms following surgery, and also compared the surgical group to a matched cohort of adolescents engaging in non-surgical lifestyle modification for weight loss. Results showed that teens receiving bariatric surgery experienced significantly greater reductions in overall severity of disordered eating symptoms, but not night eating symptoms, at 6 and 12 months post-surgery compared to the non-surgical group. No significant associations between eating disorder symptom severity and weight loss following surgery were observed. Ultimately, these findings from Teen-LABS argue for continued consideration of the function of eating pathology towards weight loss outcomes among teen bariatric surgery candidates.

Psychosocial Correlates of Change in Eating Pathology

As basic knowledge regarding changes in eating pathology after bariatric surgery has increased, research has turned towards examining the impact that various psychosocial variables have towards eating pathology after bariatric surgery. For instance, Pinto and colleagues [14] examined associations between depression and night eating. They found that night eating symptom severity significantly decreased at approximately 16 months post-surgery for those patients who demonstrated symptoms of depression prior to surgery, but not among those patients without baseline symptoms of depression. Similarly, Ruffault and colleagues [16] examined relationships between lifetime history of trauma and various types of eating behavior both before and after surgery, finding that patients with a lifetime history of trauma were more likely to engage in "overeating" behaviors, but not "impulsive" or night eating behaviors, 1 year following surgery. Two studies produced mixed findings regarding whether personality subtypes affected eating behavior following surgery. One study found that patients with greater emotion dysregulation demonstrated greater eating disorder symptom severity 3 years post-surgery [12]. However, another study concluded that no significant differences on any eating pathology outcome were found between emotionally dysregulated and high functioning patients 1-year post-surgery [20]. Overall, given the clinical importance of understanding the nature of changes in eating pathology after bariatric surgery, research will likely continue to target relevant psychosocial correlates.

Limitations in the Existing Literature and Suggestions for Future Research

While it is important to continue assessing the occurrence of eating pathology before and after bariatric surgery, the ability to draw firm conclusions from these findings is confounded by several inherent issues with assessment and measurement.

Need for a New Nomenclature

In bariatric surgery research, problematic eating behaviors that are not included in the DSM-based diagnostic criteria for traditional eating disorders are beginning to receive more attention. Unfortunately, these other behaviors are often not consistently defined, and their assessments are generally not well standardized. For example, the ingestion of excessive amounts of high calorie fluids [48, 49], "emotional eating" [3, 50], eating when not hungry, and eating when already "full"/beyond satiety [51] have gained some attention in the recent literature, but require more research and attention towards definition before they can be adequately summarized. Other behaviors, as addressed below, have gained greater empirical support, but have not been included in the broader eating disorder nomenclature. Nonetheless, clinicians working with bariatric populations frequently encounter problems associated with these behaviors, suggesting that these concerns need to be further addressed. As such, the field is clearly in need of a more comprehensive and standardized nomenclature.

Grazing/Picking and Nibbling The interchangeable terms "grazing" and "picking and nibbling" characterize what is apparently one of the most frequent problematic eating behaviors that occur after bariatric surgery, affecting approximately 30% of bariatric patients [52–54]. Results of a survey regarding the proper characteristics of the term grazing suggest that there is considerable variability in the opinions of professionals [55]. While the most consistently endorsed descriptor/criterion was "repetitive," followed by "small/modest amount of food" and "unplanned," there was little agreement regarding whether LOC was a central characteristic. Ultimately, Conceição and colleagues synthesized these opinions and proposed that grazing be defined as an eating behavior characterized by the repetitive eating of small/modest amounts of food in an unplanned manner, and/or not in response to hunger/satiety [55].

The available literature suggests that some patients develop new onset grazing post-surgery, although pre-operative LOC eating appears to be a risk factor for the subsequent development of this problem [43]. Grazing is usually engaged in without prior planning and can often result in the cumulative consumption of substantial amounts of high-calorie foods or drinks. As such, grazing has been associated with post-operative attenuated weight loss and/or greater weight regain, suggesting the clinical importance of addressing this behavior to maximize weight loss over time [56].

Dumping, Chewing, and Spitting Dumping after bariatric surgery is a common complication, although it appears to decrease in both prevalence and frequency in the first few years post-surgery [36, 57]. Dumping is often associated with the ingestion of sweets or dairy products and is characterized by a variety of physical symptoms, including abdominal pain and diarrhea [57]. While cases of self-induced dumping as a weight control technique have been seen (J. E. Mitchell, personal communication, 2019), they are probably extremely rare. Importantly, clinicians who work with these patients should be careful when differentiating self-induced dumping from "late" dumping (otherwise considered reactive hypoglycemia), a potentially serious complication of surgery. While a comprehensive review of these issues is beyond the scope of this article (see [58] for more information), it should be noted that overvaluation of weight and shape is likely the most critical indicator of self-induced dumping among this population [4].

Chewing and spitting out food can also occur after surgery, although well-established prevalence/frequency data are not

available. Some patients indicate they engage in this behavior to obtain the pleasure of the tastes of foods that they are afraid to swallow, such as certain kinds of meat, sweets, or pasta. While recent publications have documented that this behavior is also seen in restrictive eating disorders, the reasons for which bariatric surgery patients may engage in such behaviors may be quite different, thus warranting future research [59, 60].

Recurring Versus New Onset Eating Pathology Following Surgery

One caveat for considering changes in eating pathology after surgery involves the timeframe of occurrence. When examining literature in this area, five patterns emerge. First, pathological eating behavior that occurs pre-operatively may simply remit/resolve after surgery. Second, some eating behaviors may persist following surgery, demonstrating little change in prevalence rates from pre-surgery to post-surgery. Third, these behaviors may remit immediately following surgery but re-occur over time. Fourth, eating pathology may develop "de novo," or for the first time, post-surgery. A strong example of these first four patterns is found in data recently published by Smith and colleagues [7••]. Using data from the LABS cohort, these authors demonstrated that some patients developed LOC or BED for the first time following surgery, while others experienced recurrence or remittance in these aspects of eating pathology during the 7 years of follow-up post-surgery. Similar patterns for LOC and picking and/or nibbling behaviors have also been recently outlined [15].

The fifth possible pattern is that behaviors present before surgery may present differently post-surgery. Indeed, Smith and colleagues [7] demonstrated that 9.2% of their sample experienced remittance of BED, but that almost half of those individuals continued to report LOC post-surgery. Similar data also suggests that individuals engaging in LOC pre-operatively may develop picking and/or nibbling behaviors (without LOC) following surgery [15].

Overall, these differing timeframes may help to explain some of the large discrepancy in rates in eating pathology before and after surgery and point towards the importance of carefully addressing time in the measurement of these constructs. Ultimately, additional research is needed to define (1) the temporal relationship between bariatric surgery and symptom reemergence, (2) risk periods for new onset symptomatology, and (3) which patients may be at highest risk of eating pathology following surgery.

Reliability and Validity Issues with Assessment Methods

When assessing these different aspects of eating pathology, the method in which diagnostic information is gathered is also a likely source of discrepancies in the literature. The "gold standard" for measurement of eating pathology among bariatric surgery patients is the Eating Disorder Examination—Bariatric Surgery version (EDE-BSV) [34], a semi-structured interview adapted from the original version of the Eating Disorder Examination (EDE) [61] specifically for bariatric surgery patients. However, substantial varieties of other self-report measures of eating pathology are also employed in research (see [62] for a complete review). Unfortunately, none of these questionnaires were originally developed specifically for use with bariatric surgery patients, and many lack adequate psychometric properties when normed for this population. As such, issues with cohesiveness in this literature can be attributed, in part, to the fact that there are no recommended assessment tools for measuring eating pathology among bariatric surgery candidates.

Future research would benefit from the creation and designation of a single measure in which to assess eating pathology. In order to improve consistency in the empirical literature, this measure would ideally assess eating pathology in a comprehensive manner, be appropriate specifically to the bariatric population, and be sensitive to changes from pre- to post-surgery. In the effort of promoting more accurate measurement of eating pathology, future research would also benefit from the use of more ecologically valid assessment methods. For example, a substantial body of literature on eating pathology among non-bariatric surgery patients utilizes ecological momentary assessment (EMA) [22] to assess maladaptive eating behaviors and other related affect and cognitions as they occur in the individual's natural, day-to-day environment [23]. This type of data collection improves upon issues of retrospective self-report bias by collecting information on psychological variables in closer proximity to when they occur in time. Such momentary data would likely benefit the validity of eating pathology measurement and may help further elucidate mechanisms of such behavior among pre- and post-surgical bariatric patients.

Conclusions

In the last 3 years, the literature on eating pathology has grown to help improve our understanding of the temporal relationship between bariatric surgery and eating pathology onset, resolution, and reemergence. As seen throughout this review, benefits of recent literature include more longitudinal data, with evidence describing eating pathology as far as 7 years distal to surgery emerging, as well as greater availability of data on the topic of eating pathology following VSG. Yet, this body of literature is still relatively limited and additional research is needed to improve our understanding in several major areas. First, standardization of the definitions of various forms of eating pathology (e.g., grazing, chewing and spitting) is needed so that comparisons across samples can be made.

Second, development and validation of standardized assessment measures and improved assessment methodology that provide consistent assessment of eating pathology in bariatric surgery patients is strongly needed in light of the wide variety of definitions for these various disorders and behaviors across studies. Third, additional longitudinal data concerning VSG, and data comparing VSG to RYGB, are needed given the predominance of VSG in the USA at this time [63]. Finally, predictors of patients at risk of continued or new onset eating pathology should be identified, associations of eating pathology with bariatric surgery outcomes should be further elucidated, and interventions aimed at preventing or treating at-risk patients should be investigated.

Compliance with Ethical Standards

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Human and Animal Rights and Informed Consent All reported studies/experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

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- • Of importance
- •• Of major importance

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