

## REVIEW

# Eating Disorders and Problematic Eating Behaviours Before and After Bariatric Surgery: Characterization, Assessment and Association with Treatment Outcomes

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## Abstract

Accumulating evidence suggests that bariatric surgery candidates are likely to present with eating disorders (EDs) and/or problematic eating behaviours (EBs), and research suggests that these problems may persist or develop after bariatric surgery. While there is growing evidence indicating that EDs and EBs may impact bariatric surgery outcomes, the definitions and assessment methods used lack consensus, and findings have been mixed. The aims of this paper were (1) to summarize the existing literature on pre-operative and post-operative EDs and problematic EBs; (2) to discuss the terms, definitions and assessment measures used across studies; and (3) to consider the extent to which the presence of these problems impact surgery outcomes. We highlight the importance of investigators utilizing consistent definitions and assessment methodologies across studies. © 2015 The Authors. *European Eating Disorders Review* published by Eating Disorders Association and John Wiley & Sons Ltd.

## Keywords

bariatric surgery; eating disorders; eating behaviours; outcome

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Published online 27 August 2015 in Wiley Online Library ([wileyonlinelibrary.com](http://wileyonlinelibrary.com)) DOI: 10.1002/erv.2397

## Introduction

Bariatric surgery is currently regarded as the most effective treatment for severe obesity, yet considerable variability in outcome has been reported in the extant literature. The different bariatric procedures are thought to operate through restrictive [e.g. laparoscopic adjustable gastric band; sleeve gastrectomy], malabsorptive (e.g. biliopancreatic diversion) or mixed [Roux-en-Y gastric bypass] processes that significantly alter patients' diets and the amount of food that can be ingested. Weight outcomes have been of particular interest, as some patients experience insufficient or attenuated weight loss, weight regain or, in rare cases, excessive weight loss (Conceição, Orcutt et al., 2013; van Hout, Verschure, & van Heck, 2005). A growing body of research suggests that eating disorders (EDs) and problematic eating behaviours (EBs) are common in bariatric patients and may have a significant impact on bariatric surgery outcomes (van Hout et al., 2005). However, there are methodological inconsistencies in the literature that make it difficult to determine the prevalence of specific eating-related problems and their impact on treatment outcome.

This paper focuses on EDs and specific eating-related problems that are commonly seen in bariatric surgery patients. First, we discuss pre-operative and post-operative EDs. Second, we consider

challenges in the identification of EDs and related symptoms in this population. Third, we review other problematic EBs reported in bariatric surgery patients and the respective assessment measures used with bariatric patients. Finally, we discuss common gastrointestinal problems that are related to eating and their role in treatment outcomes. Throughout the paper, we highlight and evaluate inconsistencies in the terms and definitions used to describe EDs, disordered eating and problematic EBs both pre-operatively and post-operatively.

## Eating disorders

This section focuses on EDs and associated symptoms in patients both prior to and following bariatric surgery. Although a growing number of studies have been published and several reviews have sought to summarize and clarify their findings (Conceição, Orcutt et al., 2013; Marino et al., 2012; Meany, Conceição and Mitchell, 2014), the development of EDs after bariatric surgery remains understudied and poorly understood. The definitions of EDs and the assessment measures used to identify EDs vary widely across studies. Furthermore, symptoms meeting full or subthreshold diagnostic criteria both pre-operatively and post-operatively are likely minimized or underreported (Marino et al., 2012),

resulting in estimates that may not truly represent bariatric surgery populations.

### Pre-operative binge eating disorder

Binge eating disorder (BED) is the second most common psychiatric disorder in bariatric surgery populations, following major depressive disorder (Sarwer *et al.*, 2004). BED is currently considered a distinct ED in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5) and is characterized by recurrent objective binge eating (OBE) episodes that occur in the absence of compensatory behaviours [e.g. self-induced vomiting; American Psychiatric Association (APA), 2013]. OBE episodes are defined as the ingestion of objectively large amounts of food that is accompanied by a sense of loss of control (LOC). The amount of food, which is ingested in a relatively short period of time (e.g. 2 hours), is larger than what most people would eat in the same time frame or situation. LOC is defined as a sense of lack of control over eating, including a feeling of being unable to stop eating or control the amount being eaten (APA, 2013). In order to meet full criteria for BED, these episodes must be associated with the presence of at least 3 out of 5 behavioural indicators signalling LOC over eating (e.g. eating until uncomfortably full) and must be accompanied by marked distress.

Prevalence rates from studies reporting on BED prior to bariatric surgery range from 4% to 49% (Niego, Kofman, Weiss, & Geliebter, 2007). It is important to note that earlier studies of BED used the research criteria proposed in the previous edition of the DSM, which differs from DSM-5 in the required frequency of OBE episodes (i.e. DSM-5 criteria requires OBE at least once per week for 3 months, compared with 2 days per week for 6 months in the previous edition; APA, 2013). The wide range in pre-operative prevalence rates reported in the literature is likely due to varied assessment methods and study designs, including self-report measures, semi-structured clinical interviews, and retrospective, prospective, or cross-sectional approaches (Niego *et al.*, 2007).

Whether pre-operative BED impacts bariatric surgery outcomes has been a question of interest to the field. Unfortunately, it is not always clear whether all BED criteria are met, particularly the criteria for objectively large amount of food, LOC indicators and marked distress, which makes it difficult to interpret findings across studies. Some studies suggest a relationship between pre-operative BED, binge eating (BE), LOC and poorer outcomes (Meany *et al.*, 2014). Yet, the majority have not found this association (Meany *et al.*, 2014).

Notably, patients presenting for surgery with BED exhibit higher rates of comorbid psychopathology, which is of concern given that multiple comorbidities have been associated with poorer surgical outcomes (van Hout *et al.*, 2005). While this may have implications for assessing the psychological condition of bariatric surgery candidates, psychiatric comorbidity and eating-related behaviours alone should not preclude patients from getting bariatric surgery (van Hout *et al.*, 2005).

### Post-operative binge eating disorder

The impact of the development of BED post-operatively or the continuation of pre-existing BED on bariatric surgery outcomes is another important issue in the field. However, once again,

drawing firm conclusions from this literature is hindered by the varied terms and definitions used across studies. This literature is further complicated by the anatomical and physiological changes bariatric surgery patients experience as a result of their surgical operations that significantly impact their diet and EBs. Bariatric surgery dramatically alters the physiological capacity of ingestion and digestion, which changes the amount of food patients can eat. Thus, eating objectively large amounts of food in one sitting, as is the definition of an OBE episode, is physically impossible at least for a period of time following bariatric surgery procedures (Meany *et al.*, 2014). However, the experience of LOC eating over smaller amounts of food continues to be reported post-operatively. Further, evidence suggests that the experience of LOC, regardless of the amount of food ingested, may be the most important indicator in defining BE (Mond, Latner, Hay, Owen, & Rodgers, 2010). Therefore, some authors have proposed capturing the experience of LOC over eating smaller amounts of food, in addition to OBE episodes (Meany *et al.*, 2014). These episodes have been termed in the literature as subjective BE (SBE; Conceição, Mitchell, Vaz *et al.*, 2014) or subjective-LOC (Colles, Dixon, & O'Brien, 2008b). Despite the different terminology, subjective LOC identifies SBE episodes (Colles, Dixon, & O'Brien, 2008b).

For instance, in one study assessing both SBE and OBE episodes, no OBE episodes were found 6 months after surgery, but 2 years after surgery, OBE episodes were present for restrictive procedures (Conceição, Mitchell, Vaz *et al.*, 2014). This indicates that patients seem to be able to accommodate increasingly large amounts of food over time (Sarwer *et al.*, 2008). However, in the same study, SBE episodes were reported by patients undergoing both restrictive and malabsorptive procedures in all post-operative assessments (Conceição, Mitchell, Vaz *et al.*, 2014). With the low frequency of OBE episodes post-operatively, the prevalence of full BED is low, ranging from 0% to 10.3% (de Zwaan *et al.*, 2010; Scholtz *et al.*, 2007).

In the bariatric surgery literature, BE has frequently been more broadly defined to identify SBE (Kofman, Lent, & Swencionis, 2010) or the combination of OBE and SBE episodes (Kalarchian *et al.*, 2002). As would be expected, more broadly defined BE appears to have higher prevalence rates than BED in bariatric surgery patients, ranging from 6% to 64% (Niego *et al.*, 2007). However, these rates are drawn from different criteria of BE and different assessment measures (e.g. interview and self-report questionnaires).

Similarly, other studies apply the term LOC to capture the sense of LOC regardless of the amount of food eaten and include both SBE and OBE episodes (Colles, Dixon, & O'Brien, 2008a; Conceição, Bastos, Brandão, *et al.*, 2014; White, Kalarchian, Masheb, Marsha, & Grilo, 2010). On some occasions, these LOC eating behaviours are named 'uncontrolled' eating to highlight the LOC nature of the behaviour (Colles *et al.*, 2008a).

Loss of control eating is common among bariatric patients, with studies reporting LOC eating rates from 13.3% to 61% in patients prior to bariatric surgery (Colles *et al.*, 2008b; White *et al.*, 2010), and in 16.9% to 39% of patients post-operatively (Conceição, Bastos, Brandão, *et al.*, 2014; White *et al.*, 2010).

Despite the varied definitions used in identifying BE and LOC, a growing body of literature seems to suggest that the presence of post-operative BED (e.g. de Zwaan *et al.*, 2010), BE (e.g. Kofman

et al., 2010) or LOC eating (e.g. Colles et al., 2008a; White et al., 2010) may be associated with worse weight outcomes. Out of 12 studies investigating this relationship, only two found non-significant associations with weight outcomes (Sheets et al., 2014).

Given the similarities across the definitions of LOC eating, BE, SBE and OBE, and because these concepts often share the same criteria, Table 1 summarizes the definitions of each term and indicated how they have been referred to in the literature.

### Bulimia nervosa

Bulimia nervosa (BN) is characterized by OBE episodes with LOC, inappropriate compensatory behaviours and overvaluation of shape and weight (APA, 2013). There is a dearth of information regarding the prevalence of BN prior to bariatric surgery, perhaps due to denial or minimization of BN symptoms out of concern for surgery eligibility. Studies point to a frequency of about 3% meeting full DSM-IV criteria for BN prior to surgery (de Zwaan et al., 2010). Pre-operative BN may be associated with more SBE episodes and compensatory vomiting post-operatively (de Zwaan et al., 2010).

Similar to pre-operative prevalence rates, post-operative rates of BN are either rare or unknown. Nonetheless, the development of BN after bariatric surgery has been reported (Conceição, Vaz, Bastos, Ramos, & Machado, 2013).

### Anorexia nervosa

Anorexia nervosa is marked by low body weight, restriction of intake relative to requirements, fear of gaining weight and

**Table 1** Definitions of loss of control (LOC) eating, binge eating (BE), subjective binge eating (SBE) and objective binge eating (OBE)

LOC	<p>A. Sense of LOC (regardless of the amount of food) over eating, including the feeling that one cannot stop eating or control how much one is eating.</p> <p>B. Manifested in episodes of subjective LOC, SBE, OBE and compulsive grazing.</p> <p>C. Manifested in different degrees of LOC across these eating episodes.</p> <p>D. Sometimes referred to in the literature as a combination of SBE and OBE (e.g. Colles, Dixon, &amp; O'Brien, 2008a; Conceição, Bastos et al., 2014; White et al., 2010).</p>
BE	<p>A. Eating episodes characterized by the following:</p> <ol style="list-style-type: none"> <li>Eating in a circumscribed period of time (regardless of the amount of food eaten).</li> <li>With a sense of LOC.</li> </ol> <p>B. Manifested in episodes of SBE and OBE.</p> <p>C. Sometimes referred to in the literature as SBE (e.g. Kofman, Lent, &amp; Swencionis, 2010) or a combination of SBE and OBE (e.g. Kalarchian et al., 2002).</p>
SBE	<p>A. Eating episodes characterized by the following:</p> <ol style="list-style-type: none"> <li>Eating with a sense of LOC.</li> <li>Ingestion of amounts of food not objectively large but viewed as excessive by the person.</li> </ol>
OBE	<p>A. Eating episodes characterized by the following:</p> <ol style="list-style-type: none"> <li>Eating with a sense of LOC;</li> <li>Ingestion of objectively large amounts of food.</li> </ol> <p>B. Criterion for both BED and BN DSM-5 diagnoses.</p>

overvaluation of weight and shape (APA 2013). Although patients seeking bariatric surgery are typically obese and thus cannot have current anorexia nervosa (AN), there is a dearth of information about a lifetime history of AN in patients seeking bariatric surgery. Among patients receiving specialized care for EDs after surgery, AN-like presentations seem to be rather frequent (Conceição, Orcutt et al., 2013). Several case reports and case series have described patients who develop AN-like symptoms following bariatric surgery, including significant weight loss, fear of weight gain, dietary restriction and disturbances in self-perception of shape and weight (Marino et al., 2012). The post-operative development of AN symptomatology highlights the potentially triggering experiences of rapid weight loss followed by a plateau, physician-recommended dietary restraint and control over eating, and a necessary focus on eating behaviours and patterns (Conceição, Vaz et al., 2013).

### Night eating syndrome

Night eating syndrome (NES) is currently included in DSM-5 as an Other Specified Feeding or ED and is characterized by conscious episodes of evening or nighttime hyperphagia manifested by the ingestion of at least 25% of food consumption after the evening meal and/or nocturnal awakenings and associated emotional distress, at least two times per week (APA, 2013). With pre-operative prevalence ranging from 1.9% (Allison et al., 2006) to 17.7% (Mitchell et al., 2015), there is mixed evidence suggesting that NES rates are maintained (Adami, Meneghelli, & Nicola, 1999) or decreased after surgery (Colles & Dixon, 2006; Colles et al., 2008a). Of note, a substantial portion of patients with post-operative NES (about 6 out of 10 patients) may develop NES post-operatively (Colles et al., 2008a).

There are no clear data to support NES as a risk factor that compromises weight loss after surgery, particularly in the long-term. (Powers, Perez, Boyd, & Rosemurgy, 1999). Further, pre-operative NES has been associated with pre-operative BED (Mitchell et al., 2015), but no association has been observed between pre-operative NES and post-operative problems (Colles & Dixon, 2006).

### Special considerations for eating disorders post-bariatric surgery

Currently, there is no distinction in the DSM-5 between the diagnosis of EDs in bariatric surgery patients and the diagnosis of EDs in the general population. Given the dramatic changes in eating patterns inherent to bariatric surgery, the primary difficulty in assessing EDs, disordered eating and related ED psychopathology following bariatric surgery is distinguishing between pathological behaviours and cognitions and the post-operative consequences of the changes in the gastrointestinal tract and patients' attempts to adhere to strict behavioural plans. Demographic considerations may also be important, as one study found that patients who develop AN or BN post-operatively were significantly older, and the age of onset was much higher than in non-bariatric ED patients (i.e. 50 years or older; Conceição, Orcutt et al., 2013).

An increasing number of assessment instruments have been validated for use in bariatric surgery samples (please refer to Parker and Brennan (2015) for a recent review). However, the assessment of EDs and problematic EBs post-operatively remains

challenging, and there are few instruments available to address the complex nuances of this population and to distinguish eating-related psychopathology from expected post-operative changes in EBs. The self-report measures and clinical interviews that have been used and validated for the bariatric population are described in Appendix A in the Supporting Information. However, the following sections will describe the nuances that are important to consider when assessing both EDs and problematic EBs.

### Considerations for binge eating and loss of control

Although there has been a significant debate about the utility of the criterion 'definitely larger' for an OBE episode (Mond *et al.*, 2010), this criterion remained in DSM-5. After bariatric surgery, the limited gastric capacity physically limits the amount of food that is possible to eat at one time. Therefore, determining whether the amount of food eaten is a 'large' amount of food in a post-operative population is challenging. As the amount of food eaten should be compared with what would be eaten under 'similar circumstances', it is recommended that standard criteria should not apply to patients who have undergone bariatric surgery. Rather, the type of surgical procedure and the time elapsed since the surgical procedure should be part of the decision about whether an individual has engaged in OBE or SBE.

### Considerations for compensatory behaviours

When assessing for compensatory behaviours, it is important to note that episodic vomiting is frequent among post-operative bariatric samples (Conceição, Orcutt *et al.*, 2013). Individuals may experience spontaneous or induced vomiting post-operatively, which can occur in response to eating certain intolerable foods, eating too quickly, insufficiently chewing or as a means to relieve the symptoms of plugging (Problematic Eating Behaviours). Surgeons may even encourage episodic vomiting to relieve these uncomfortable physical symptoms. Even if vomiting initially occurs spontaneously, individuals may believe this vomiting will lead to weight loss and later facilitate vomiting to control their weight (de Zwaan *et al.*, 2010). Therefore, a careful assessment of the reason for vomiting, as well as the expected outcome of vomiting, is important when considering whether this behaviour should be considered compensatory.

Another common post-operative behaviour that may be used as compensatory behaviour is dumping (Problematic Eating Behaviours). Because dumping is usually associated with the consumption of sweets and/or large amounts of food and can cause excessive diarrhoea, it is important to determine whether individuals are self-inducing dumping as a compensatory behaviour.

Laxative and diuretic misuse post-bariatric surgery has not been routinely assessed or reported in the extant literature, but available data indicate that laxative or diuretic use for weight and shape reasons following surgery is extremely rare (Conceição, Orcutt *et al.*, 2013; de Zwaan *et al.*, 2010). However, it is important that laxative and diuretic use be more routinely assessed for both research and clinical purposes. As with vomiting, it is crucial to distinguish between use of laxatives and diuretics for physiological reasons and weight and shape reasons.

### Considerations for restriction and low weight

Following bariatric surgery, patients undergo a restrictive diet. Limiting meal size, following a strict schedule, weighing food, cutting food into small pieces and avoiding specific foods are all behaviours that are often recommended and encouraged by bariatric surgery teams. Although these behaviours may resemble the restriction and food rituals often seen in patients with AN (Conceição, Orcutt *et al.*, 2013), it is important to distinguish whether these behaviours result from excessive weight and shape concerns or are an effort to be compliant with treatment recommendations. The potential diagnosis of AN post-operatively is further complicated by determining what constitutes a low weight in patients who have lost large amounts of weight post-operatively. Full syndrome AN has been reported in post-operative individuals; however, individuals with atypical AN [i.e. meeting all criteria except below normal body mass index (BMI)] have also been reported (Conceição, Orcutt *et al.*, 2013). Given that there is little agreement about what should be considered underweight in post-operative bariatric patients and the broader definition of low weight in DSM-5, which includes the context of developmental trajectory and physical health (APA, 2013), diagnosing AN in post-operative bariatric patients requires a detailed examination of not only the patient's BMI but also the emotional and cognitive symptoms of AN, lifetime weight trajectory, current EBs and physical health.

### Considerations for weight and shape concerns

The assessment of weight and shape concerns is also complicated in post-operative bariatric patients. Fear of weight (re)gain in this population is, to an extent, realistic. Treatment teams are likely to encourage these individuals to be vigilant about their weight and factors that may contribute to weight (re)gain (Conceição, Vaz *et al.*, 2013). Additionally, shape concerns in this population are different than in other populations, as weight loss is frequently accompanied by loose skin, skin envelopes and fat deposits, and impairment caused by excessive skin is associated with greater body dissatisfaction and depressive symptoms (Ramalho *et al.*, 2014). Traditional assessments of body satisfaction may not capture the complex nuances of body dissatisfaction in a population marked by these specific changes in body shape.

### Summary of considerations for eating disorders post-bariatric surgery

The systematic identification and intervention of individuals who maintain or develop EDs and other problematic eating-related psychopathology post-operatively may improve long-term outcomes. However, existing diagnostic criteria for EDs may not sufficiently capture the atypical presentations seen in bariatric populations. Detection and treatment of these problems following bariatric surgery requires improved screening procedures and the consistent use of valid assessment measures. While it is clear that patients should be monitored post-operatively for the development of EDs, including atypical presentations, guidelines for prevention and intervention need to be developed and consistently applied.



## Problematic eating behaviours

Apart from formal EDs and associated eating-related psychopathology, other EBs have been implicated in the treatment outcomes of bariatric surgery. A variety of EBs that do not necessarily involve psychological distress have received research attention due to presumed associations with weight outcomes. In this section, problematic EBs that are commonly present in bariatric patients will be characterized. *Appendix A* summarizes the self-report measures frequently used to assess problematic EB in Bariatric surgery literature.

### Grazing and related behaviours

Grazing behaviour is of rising interest in the field. However, different definitions and criteria for this behaviour have been used across studies. Recently, Conceição, Mitchell, Engel, et al. (2014) attempted to provide an integrative and consensual definition of grazing, defining it as the repetitive eating of small/modest amounts of food in an unplanned manner and/or not in response to hunger or satiety sensations. Repetitive was defined as eating more than twice in the same period of time during the day (e.g. morning, evening or throughout the day) with no prolonged gaps between eating episodes. Two subtypes were suggested: (i) compulsive grazing – some degree of LOC over eating is present as it is characterized by attempting to resist but returning to repetitively snack on food and (ii) non-compulsive grazing – repetitively eating in a distracted and mindless way, without the sense of LOC eating but not eating in a controlled manner (Conceição, Mitchell, Engel, et al., 2014).

Grazing needs to be differentiated from other EBs. Some degree of LOC may be associated with grazing, thus highlighting the importance of distinguishing grazing from BE episodes. Generally, the main differentiating features include the degree of LOC during the eating episode, whether the episode was planned, the amount of food eaten in one sitting and the elapsed time associated with the episode. Considering these guidelines, the extreme experience of LOC over eating large amounts of food in a short period of time, as it is required for OBE episodes, markedly distinguishes it from grazing. The eating episode should be considered an SBE episode when LOC is experienced in a circumscribed period of time (e.g. eating a bag of cookies in one sitting, instead of repetitively eating the bag of cookies throughout the day because one could not resist repetitively going back for more cookies). Grazing should additionally be distinguished from eating in accordance with the dietary recommendations of bariatric surgery teams. After surgery, because of the limited gastric capacity, nutritional recommendations suggest that patients follow an eating pattern with planned and repeated meals or snacks throughout the day. If the choice and eating of the food is controlled and patients are mindful of hunger and satiety sensations, this eating pattern would not be considered grazing. Patients may also decide to portion larger amounts of food and repeatedly eat to deliberately overeat. Again, the planned and anticipated nature of this behaviour speaks to its difference from grazing (Conceição, Mitchell, Engel, et al., 2014). Table 2 distinguishes the different eating episodes in relation to the level of control over eating.

The quality of prevalence rates reported, characterization of associated features and the impact on weight outcomes after

**Table 2** Grazing and other maladaptive eating episodes in relation to the degree of LOC

Eating Episode	Degree of LOC	Description
None	0	Plan to repeatedly have small amounts of food throughout the day.
Deliberate overeating	0	Plan to repeatedly have small amounts of food to be able to accommodate large amounts of food in total.
Grazing and non-compulsive subtype	1	'Mindless' eating, eating in distracted way repetitively and eating whatever is available 'on the spur of the moment'. Not planned or anticipated.
Grazing and compulsive subtype	2	Trying to resist but repetitively going back and eating small or modest amounts of food. Not planned or anticipated.
(Subjective) binge eating episode	3	Feeling that one cannot stop eating after starting or cannot control the amount eaten. Eating episode occurs in a circumscribed period of time rather than repeatedly over time.
(Objective) binge eating episode	4	Feeling that one cannot stop eating after starting or cannot control the amount being eaten. Eating extremely large amounts of food in a short period of time.

Adapted from Conceição, Mitchell, Engle et al., 2014.  
LOC, loss of control.

bariatric surgery is compromised by the use of different definitions of grazing and assessment measures not validated for bariatric patients. Nonetheless, grazing is thought to be present in up to 26.4% (Colles et al., 2008a) of bariatric patients pre-operatively and in up to 46.6% post-operatively (Kofman et al., 2010).

The increasing awareness and attention to grazing is due to its supposed association with weight outcomes. Initially, grazing was thought to be a post-operative variant of pre-operative BE, whereby the compulsive nature of this EB remains even if the amount of food eaten has decreased because of limited gastric capacity (Colles et al., 2008a). The findings regarding pre-operative grazing are mixed. However, the literature more consistently finds an association between post-operative grazing and reduced weight loss or increased weight regain in both cross-sectional and longitudinal studies. The unplanned nature of grazing is thought to result in excessive caloric intake, particularly in the long-term (Conceição, Mitchell, Engel, et al., 2014). There is initial, although somewhat inconsistent evidence (Conceição, Mitchell, Engel, et al., 2014), of an association between grazing, LOC eating and BE with depressive symptoms, emotional eating, mindless eating, poorer mental health and quality of life (Colles et al., 2008a; Kofman et al., 2010).

Other problematic EBs with features that overlap with grazing have also emerged in the literature. The terms picking or nibbling and snacking or nibbling have been used to characterize patterns of repetitive eating. Picking or nibbling is defined in the Eating Disorders Examination (EDE; Fairburn & Cooper, 2000) as nibbling food between meals and snacks in a repetitive and unplanned manner. The amount of food should be uncertain at the beginning of the episode and should not be trivial. Its main

differentiating aspect from grazing is LOC eating, which is, to some degree, present in compulsive grazing, but is not present in picking or nibbling. Further, both compulsive and non-compulsive subtypes of grazing do not require initial uncertainty regarding the amount of food eaten or that the repetitive eating happens between meals, as grazing often leads to skipping meals.

The prevalence of these EBs among pre-operative patients range from 29.5% (Conceição, Mitchell, Vaz *et al.*, 2014) to 42.7% (Busetto *et al.*, 2002). Post-operatively, these EBs seem to occur at higher frequencies, with prevalence rates varying from 32.2% (de Zwaan *et al.*, 2010) to 47.1% (Conceição, Mitchell, Vaz, *et al.*, 2014). Two studies assessing 'picking or nibbling' pre-operatively and post-operatively found no association with weight loss (Busetto *et al.*, 2002; de Zwaan *et al.*, 2010). However, a significant association between post-surgery 'picking or nibbling' and poor weight outcomes has been reported (Conceição, Mitchell, Vaz *et al.*, 2014).

### Emotional eating

Emotional eating has been described as 'the tendency to eat in response to emotional distress and during stressful life situations' (Canetti, Berry, & Elizur, 2009). Emotional eating is estimated to be present in 38% of bariatric surgery candidates (Miller-Matero *et al.*, 2014) and thought to be more frequent in women than in men (Gade, Rosenvinge, Hjelmæsæth, & Friberg, 2014).

The literature on the impact of emotional eating on weight outcomes is inconsistent. Some findings have not supported an association between pre-operative or post-operative emotional eating and long-term weight loss (Banerjee, Ding, Mikami, & Needleman, 2013; Fischer *et al.*, 2007). Other studies suggest that, post-operatively, eating in response to emotional cues negatively impacts weight loss and that weight change is inversely related to emotional eating (Mathus-Vliegen, 2007). Emotional eating has been found to fully mediate the relationship between neurotic predisposition and weight outcomes, suggesting it may be a significant predictor of weight loss (Canetti *et al.*, 2009).

Emotional eating has been associated with a variety of problematic EBs, including BE, grazing, 'uncontrolled eating' and snack eating in both pre-operatively and post-bariatric patients (Chesler, 2012; Fischer *et al.*, 2007). Although BE and more frequent eating in response to external cues may be associated with emotional eating pre-operatively, this association has not been shown post-operatively (Fischer *et al.*, 2007).

Despite limited data, the greatest relevance of emotional eating may be its association with BED, grazing, 'uncontrolled' eating and other maladaptive EBs (Chesler, 2012; Fischer *et al.*, 2007), all of which have been shown to result in weight regain or poorer weight loss after bariatric surgery.

### Sweet eating

Sweet eating is usually characterized by overeating of highly caloric sweet foods, but its definition varies across studies, making comparison of data across studies difficult. Solid conclusions about the relevance of sweet eating to bariatric surgery outcomes cannot be made.

Pre-operatively, prevalence of sweet eating among bariatric surgery candidates has been estimated to range from 30.4% to 43.8%, with no differences in prevalence between patients with

and without BED (Busetto *et al.*, 2002, 2005). Initially, post-operative sweet eating was thought to be less prevalent among patients who underwent malabsorptive bariatric procedures as the association between sweet eating, and dumping syndrome only occurs after these surgical procedures (Dumping Syndrome). Nonetheless, a significant percentage of patients who underwent Roux-en-Y gastric bypass report sweet eating, probably as a result of a gradual increase in tolerance for sweets in the long-term (Faria, Kelly, Faria, & Ito, 2009). Interestingly, many patients undergoing restrictive procedures experience a loss of cravings for sweets (Himpens, Dapri, & Cadière, 2006). For 35–50% of laparoscopic adjustable gastric band and sleeve gastrectomy patients, respectively, cravings for sweets diminish for approximately 1 year after surgery (Himpens *et al.*, 2006). Sweet eating is estimated to be reported by 36% to 62% in post-operative patients (Faria *et al.*, 2009; Lindroos, Lissner, & Sjöström, 1996).

There has long been a common belief that patients undergoing malabsorptive procedures would avoid eating sweets to prevent dumping syndrome, that dumping would account for less calorie absorption, and that those who engage in sweet eating undergoing purely restrictive procedures would have poorer weight loss (Hudson, Dixon, & O'Brien, 2002). However, two studies tested the impact of post-operative sweet eating on weight outcomes and did find an association (Faria *et al.*, 2009; Lindroos *et al.*, 1996). New data from more comprehensive studies including different surgical procedures and longitudinal designs raise questions about the negative impact of sweet eating on weight outcomes in long-term post-operative assessments (Hudson *et al.*, 2002; Lindroos *et al.*, 1996). Surprisingly, non-sweet eating has been associated with poor weight loss (Busetto *et al.*, 2002; Lindroos *et al.*, 1996). However, adjusting for gender eliminates the initial significant association (Busetto *et al.*, 2002) and Lindroos *et al.* (1996) conclude that these associations may be a proxy for changes in other aspects of the diet and should not be discussed in terms of causality.

Thus, recent data suggest that regardless of the type of procedure, those who engage in sweet eating are just as likely to successfully lose weight as those who do not. Therefore, these EBs should not be a contraindication for any type of bariatric surgery (Hudson *et al.*, 2002).

### Cravings

Food cravings are different from homeostatic hunger and are instead intense physiological or psychological drives to eat or seek the ingestion of a specific food (Crowley *et al.*, 2012). Food cravings are thought to be high in bariatric surgery candidates compared with normal weight controls and are also present in the majority of post-bariatric patients. In fact, Guthrie, Tetley, and Hill (2014) found that only about 10% of post-operative patients did not experience food cravings. Cravings were most often experienced at home, with others and later in the day, were most often exhibited for savoury foods and were not associated with negative mood or hunger.

Although not an EB in and of itself, the relevance of food cravings in bariatric surgery populations relates to its link to problematic EBs, such as snacking, sweet eating, poor dietary compliance, BE and overeating (Crowley *et al.*, 2012). Food craving has been shown to be associated with weight regain in non-bariatric

surgery weight loss-seeking samples (Guthrie et al., 2014); however, only a few studies have investigated how food cravings change with surgery and its impact on post-operative weight loss. Cravings are thought to decrease after surgery, especially for sweets and fast food (Pepino, Bradley et al., 2014).

Crowley et al. (2012) found that guilt associated with cravings has been associated with less weight loss after bariatric surgery. In contrast, cravings that were elicited by contextual cues were associated with greater weight loss. These authors suggest that bariatric surgery patients may be more successful in coping with contextual or external cues that can be avoided than with emotional or internal cues. However, the short (6 months) follow-up period limits the validity of this conclusion. Guthrie et al. (2014) found no significant associations between cravings and time since surgery, current BMI or weight loss following surgery in a study with a long follow-up time (mean 12.3 months; range 4–38).

### Food addiction

In recent years, a new body of literature has emerged, which argues that compulsive overeating has compelling similarities to drug addiction models, and that BED shares clinical features and biological mechanisms with addictive disorders. This hypothesis has been partially supported by evidence that some foods or specific ingredients exert activation in similar brain pathways of reward as drugs of abuse (NeuroFAST, 2013). Despite the overlap with respect to the rewarding properties of food, this does not validate the concept of food addiction. Further, there is no evidence supporting the existence of a specific food item causing a type of addiction seen in substance addiction (NeuroFAST, 2013).

However, because a subgroup of individuals may experience an addictive-type eating behaviour manifested by cravings, persistent thinking about food or eating, it has been suggested that eating addiction or addictive eating would be a better suited term (Hebebrand et al., 2014). Yet, to date, only food addiction, and not addictive eating, has been investigated in bariatric patients.

Food addiction has been assessed using self-report questionnaires and estimates range from 16.9% to 40% (Miller-Matero et al., 2014) of bariatric surgery candidates meeting classification criteria. In pre-operative patients, food addiction has been associated with BED, eating disorders psychopathology, attentional impulsivity (Meule, Heckel, Jurowich, Vögele, & Kübler, 2014), depressive symptoms (Miller-Matero et al., 2014), emotional and external eating Dutch eating behavior questionnaire (DEBQ) subscales (Pepino, Stain et al., 2014) and nighttime eating (Koball et al., 2015). However, the presence of food addiction pre-operatively has not been associated with post-operative outcomes such as weight loss, rehospitalization or attendance at follow-up medical appointments (Koball et al., 2015). Food addiction is also thought to remit post-operatively in 93% of patients presenting with pre-operative food addiction (Pepino, Stain et al., 2014).

### Other problematic eating behaviours

A variety of other EBs and meal patterns have been reported in pre-operative bariatric patients such as eating when not hungry, eating past satiation, eating when full, skipping breakfast, eating meals at fast food restaurants (Mitchell et al., 2015), drinking large volumes of calories and eating large amounts of soft foods

(van Hout et al., 2005). However, data are limited to make conclusions about the extent to which these behaviours impact weight outcomes post-operatively.

Chewing and spitting out food is another EB that may occur in bariatric patients and has been estimated to be present in about 30.5% of patients post-operatively (de Zwaan et al., 2010). Chewing and spitting is typically not related to weight control or psychological distress but rather to avoid plugging (de Zwaan et al., 2010). In rare cases, chewing and spitting may be regarded as an alternative to BE and a strategy to prevent weight (re)gain (Conceição, Orcutt et al., 2013).

### Summary of problematic eating behaviours

A variety of maladaptive EBs have been associated with bariatric surgery outcomes, particularly weight loss and weight regain. Nonetheless, for most problematic EBs or meal patterns, research is still scarce, and myriad definitions have been used, which limits comparisons across studies. Moreover, because the literature has not been consistent in finding clear pre-operative psychological predictors of weight loss, more research is needed to investigate the impact of the post-operative presentation of these EBs. Moreover, it is possible that rather than these behaviours individually impacting outcome, they occur together in a disorganized eating pattern, and the overall extent of problematic eating and poor compliance is what strongly impacts treatment outcomes. Additional research is needed to investigate maladaptive eating patterns as predictors of treatment outcome, and study designs should include more inclusive and comprehensive models of the different EBs.

### Gastrointestinal problems related to eating

#### Dumping syndrome

Dumping syndrome is a gastrointestinal complication of malabsorptive surgical procedures and consists of gastrointestinal and vasomotor symptoms associated with the consumption of highly concentrated, carbohydrate or sugar-containing foods and/or eating excessively post-operatively (Deitel, 2008). 'Early dumping' typically occurs 10–30 minutes after the ingestion of triggering foods and occurs as a reaction to the rapid passage of calorie-dense food to the small bowel, which exerts hyperosmolar load in the intestine, and results in rapid fluid shifts (Deitel, 2008). Usually assessed with the Sigstad Diagnostic Index (de Zwaan et al., 2010), dumping syndrome is estimated to occur in 43% to 76% (Banerjee et al., 2013) of patients in the months following malabsorptive procedures, but it may remit 18–24 months after surgery once patients learn to avoid these symptoms by correct choice of food and adequate speed of food ingestion (Banerjee et al., 2013).

Similar symptoms (dizziness, fatigue, diaphoresis and weakness) can be found in 'late dumping'. Contrary to early dumping, late dumping typically takes place about 1 to 3 hours after a meal (Deitel, 2008) and involves a different physiological process that relates to an exaggerated insulin response to hyperglycaemia and subsequent reactive hypoglycaemia. The term 'neuroglycopenia' is preferable, including glucose deprivation in the brain, a potentially dangerous development (Himpens, 2014).

Because early dumping results in diarrhoea, dumping was hypothesized to be related to increased weight loss in malabsorptive procedures. However, this hypothesis has not been supported (Banerjee et al., 2013). Still, as discussed previously in this paper, dumping has been used as a maladaptive compensatory behaviour in patients who developed EDs after surgery (Conceição, Orcutt et al., 2013). Additionally, to date, no other association has been established between dumping and post-operative problematic EBs (Conceição, Mitchell, Vaz, et al., 2014).

### Vomiting and plugging

Vomiting and plugging are side effects of bariatric surgery. Spontaneous or provoked vomiting not related to weight control is thought to be common in both malabsorptive and restrictive procedures (Kalarchian, Marcus, Courcoulas, Cheng, & Levine, 2014), with prevalence rates varying from 21% to 79% in both short-term (6 months) and long-term (>10 years) follow-up (Conceição, Mitchell, Vaz et al., 2014; Powers et al., 1999). Usually, vomiting occurs or is induced in reaction to physical discomfort after eating intolerable foods, plugging (the sense of food becoming stuck in the small pouch), overeating, not chewing properly or eating too rapidly. Vomiting not related to weight control has been significantly associated with plugging, but no significant associations have been found with other EBs such as LOC eating episodes or grazing (Conceição, Mitchell, Vaz et al., 2014). However, as addressed earlier, spontaneous or induced vomiting can occur as a means to regulate weight and compensate for previous food ingestion in patients who develop formal EDs after bariatric surgery.

### Discussion

This paper aims to summarize the main findings and pitfalls in the extant literature on EDs and EBs before and after bariatric surgery. The intent was to provide a concise summary of the definitions, assessment strategies and impact on treatment outcomes of a variety of eating-related behaviours and diagnoses.

The role of EDs and problematic EBs in bariatric surgery poses new challenges for ED researchers and clinicians, as well as bariatric surgery teams, especially given EDs are serious psychological conditions that may require specialized treatment (Conceição, Orcutt et al., 2013). Data show that ED diagnoses, particularly BED and other potentially problematic EBs are present in this population and may have important implications for treatment outcomes. However, the unique eating-related behaviours and

psychopathology presentations in bariatric surgery patients have created inconsistencies in the literature related to assessment methodology, diagnosis and treatment. Indeed, the lack of consensus has limited our ability to draw clear conclusions and make appropriate treatment recommendations both pre-operatively and post-operatively. The limitations in the existing data underscore the need for specific and uniform guidelines to assess and address EDs and EBs.

Although awareness is growing about the presence of EDs in bariatric surgery patients, particularly the possibility of EDs developing post-operatively, no pre-operative predictors of post-operative ED onset have been identified. Likewise, the presence of pre-operative and post-operative EBs and other eating-related sequelae has been established in the literature, yet evidence guiding treatment for these patients is lacking. The identification of factors associated with poor outcomes is the crucial next step toward ultimately informing prevention and intervention strategies for those at highest risk.

Future research on EDs and EBs pre-operatively and post-operatively may add to existing literature by using consistent terminology and operational definitions across studies, as well as more rigorous assessment and classification methods. Research investigating the association between both pre-operative and post-operative EDs and EBs and their association to outcomes will add to a growing literature. However, it is crucial that future studies also examine how different EDs and EBs may overlap. These findings will lead to the development and eventual testing of models, including those that comprise different EBs and/or psychological features. This research may help our understanding of the complex association between EDs and EBs and weight loss or other outcomes after bariatric surgery.

### Acknowledgements

This research was partially supported by the Fundação para a Ciência e a Tecnologia/Foundation for Science and Technology through European Union COMPETE program grant to Dr Conceição (IF/01219/2014) and (PTDC/MHC-PCL/4974/2012). Dr Utzinger and Dr Pisetsky were supported by grant T32 MH082761 (PI: S.J. Crow) from the National Institute of Mental Health.

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