Universidade do Minho
Escola de Psicologia

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Getting Back on Track: Alternative Healthcare Delivery Strategies to Prevent Weight Regain After Bariatric Surgery

julho de 2024

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Marta Francisca Magalhães de Lourdes
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Getting Back on Track: Alternative Healthcare Delivery Strategies to Prevent Weight Regain After Bariatric Surgery

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

Estratégias alternativas de entrega de intervenções psicológicas para prevenir a recuperação de peso após cirurgia bariátrica

Resumo

O reganho de peso após cirurgia metabólica bariátrica (CMB) é um problema crescente. Fatores psicológicos pós-cirúrgicos têm sido descritos como preditores significativos de recuperação de peso, o que reforça a importância das intervenções psicológicas pós-CMB. Num contexto de escassez de recursos, as ferramentas de intervenção online têm atraído um interesse crescente.

Esta dissertação visa obter uma melhor compreensão do comportamento alimentar pós-CMB e expandir o conhecimento sobre a eficácia das intervenções psicológicas em formato *stepped-care* com recurso às novas tecnologias, na prevenção do reganho de peso pós-CMB. Está dividida em 5 partes complementares.

A Part I apresenta a fundamentação teórica deste trabalho. A Parte II explora os mecanismos subjacentes à psicopatologia do comportamento alimentar pós-CB e sugere a influência do desconforto com o excesso de peles, vergonha com a imagem corporal e impulsividade no descontrolo alimentar. Por sua vez, a parte III foca nas metodologias de avaliação e diagnóstico utilizadas para esta população: sugere a adaptação destas medidas ao período pós-CMB e valida um instrumento de auto-relato para avaliação da perda de controlo sobre a alimentação numa amostra pós-CMB. A Parte IV explora o uso de novas tecnologias na entrega de intervenções psicológicas, apresentando o estudo de eficácia do programa APOLO-Bari *stepped-care* – uma intervenção com duração de 18 meses, implementada via Facebook® para prevenir a recuperação de peso pós-CMB. Os resultados do ensaio clínico randomizado demonstram eficácia na manutenção da perda de peso, prevenção de comportamentos alimentares problemáticos e comprometimento psicológico.

Por fim, a parte V reflete sobre as principais conclusões desta dissertação, confirmando a importância do comportamento alimentar pós-CMB e o potencial das intervenções psicológicas com recurso às redes sociais na prevenção da recuperação de peso após CMB. Implicações para a prática clínica e investigações futuras foram sugeridas.

Palavras-chave: cirurgia bariátrica metabólica; comportamento alimentar; intervenções psicológicas online; reganho de peso.

Getting Back on Track: Alternative Healthcare Delivery Strategies to Prevent Weight Regain After Bariatric Surgery

Abstract

Weight regain after metabolic bariatric surgery (MBS) is a growing problem. Post-surgical psychological factors have been described as significant predictors of weight regain, reinforcing the importance of post-MBS psychological interventions. In a context of limited resources, online intervention tools have attracted increasing interest.

This dissertation aims to better understand post-MBS eating behavior and expand knowledge on the effectiveness of psychological interventions in a stepped-care format using new technologies in preventing post-MBS weight regain. It is divided into five complementary parts.

Part I presents the theoretical foundation of this work. Part II explores the underlying mechanisms of the psychopathology of post-MBS eating behavior and suggests the influence of discomfort with excess skin, body image shame, and impulsivity on uncontrolled eating. In turn, Part III focuses on the assessment and diagnostic methodologies used for this population: it suggests adapting these measures to the post-MBS period and validates a self-report instrument for assessing loss of control over eating in a post-MBS sample. Part IV explores the use of new technologies in delivering psychological interventions, presenting the efficacy study of the APOLO-Bari stepped-care program – an 18-month intervention implemented via Facebook® to prevent post-MBS weight regain. The results of the randomized clinical trial demonstrate efficacy in maintaining weight loss, preventing problematic eating behaviors, and psychological impairment.

Finally, Part V reflects on the main conclusions of this dissertation, confirming the importance of post-MBS eating behavior and the potential of psychological interventions using social networks in preventing weight regain after MBS. Implications for clinical practice and future research are suggested.

Keywords: eating behavior; internet-based psychological interventions; metabolic bariatric surgery; weight regain.

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Abbreviation List

WHO – World Health Organization

BMI – Body Mass Index

CBT – Cognitive-behavioral Therapy

MBS – Metabolic Bariatric Surgery

NIH – National Institutes of Health

ASMBS – American Society of Metabolic and Bariatric Surgery

IFSO – International Federation for the Surgery of Obesity and Metabolic Disorders

RYGB – Roux-en-Y gastric bypass

GERD – Gastro-esophageal Reflux Disease

LOCE – Loss of Control Eating

DSM-5 – Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition

OBE – Objective Binge Eating

SBE – Subjective Binge Eating

BED – Binge Eating Disorder

NES – Night Eating Syndrome

EDE – Eating Disorder Examination

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PART I

Introduction

Chapter 1

Theoretical Background

Chapter 2

Research Gaps and Thesis Aims

Chapter 1

Theoretical Background

Obesity: Definition and Comprehensive Assessment

From an evolutionary perspective, humans and their predecessors navigated the challenges of surviving periods of undernutrition. As a result, selection pressure likely played a pivotal role in shaping a genotype predisposed to weight gain rather than weight loss. Individuals capable of enduring prolonged periods of famine and efficiently storing and mobilizing energy might have enjoyed reproductive advantages. This could have led to the overrepresentation of genetic variants promoting the ability to consume food rapidly, absorb calories more effectively, and expand energy stores in adipose tissue with greater efficiency (Yanvski, 2017). Consequently, throughout history, weight gain and fat storage have been perceived as indicators of health and prosperity (Blüher, 2019).

As living standards continue to climb and modern obesogenic environments develop, weight gain and obesity present an escalating threat to global health. The technological advancements of the past century have drastically reduced the need for physical exertion in everyday tasks, such as transportation and household chores. Moreover, sedentary behavior has become more prevalent, particularly in the workplace. Simultaneously, the global food system has shifted towards offering highly processed, energy-dense, and nutrient-poor options. This trend is exacerbated by the marketing industry, which exploits human psychology to optimize food promotion strategies. Processed foods are often marketed as affordable solutions, further contributing to their widespread consumption.

Consequently, excessive weight and obesity are widespread in both developed and developing nations, affecting individuals across age groups, from childhood to adulthood, and spanning all geographical locations, ethnicities, races, and genders (Chooi et al., 2018). The prevalence of overweight and obesity has increased exponentially over the latter half of the 20th century, now supplanting more traditional public health concerns such as undernutrition and infectious diseases, emerging as one of the foremost contributors to adverse health outcomes. The World Health Organization (WHO) describes obesity as an epidemic, with 39% of the adult world population classified as overweight and 14% as obese. This prevalence is anticipated to rise from 14% in 2020 to 24% over the next 15 years and is consequently predicted to affect nearly 2 billion adults, children, and adolescents by 2035 (WOF. World Obesity Federation, 2023). The rapid rise of obesity in children and adolescents is particularly concerning, as it often persists into adulthood and predisposes individuals to several complications (Chong et al., 2023; Reinehr, 2018; Rodriguez-Martinez et al., 2020; WOF. World Obesity Federation, 2023).

Obesity is a chronic and progressive disease characterized by a chronic failure of the body's systems, reliant on external and internal inputs, to effectively regulate energy reserves, resulting in an abnormal and excessive accumulation of body fat detrimentally impacting health (World Health Organization, 2017).

The WHO emphasized that excess weight and obesity are identified and categorized through the Body Mass Index (BMI). Calculated by dividing weight (in kilograms) by the square of height (in meters), a BMI ranging from 25.0 and 29.9 kg/m^2 indicates excess weight or pre-obesity, while a BMI equal to or exceeding 30.0 kg/m^2 indicates an obesity diagnosis. Within the obesity spectrum, and based on BMI classifications, the diagnosis can range from Class I obesity (from 30.0 to 34.9 kg/m^2) to Class II (from 35.0 to 39.9 kg/m^2), and Class III ($\geq$ 40.0 kg/m^2) (World Health Organization, 2017).

While the BMI is now the most widely accepted cut-off point for morbidity and mortality risk stratification, and a valuable tool for monitoring weight over time and predicting outcomes related to obesity in adults, is subject to significant limitations. BMI is a poor estimate of overall adiposity because it fails to distinguish between lean and fat mass as well as between the types of adipose tissue such as visceral and subcutaneous. Numerous studies have consistently underscored that a specific BMI may not proportionally correspond to the level of fatness across diverse populations. For example, extensive research has shown that women generally have more body fat mass than men and that body fat mass tends to increase with age in both sexes, while muscle mass has a concurrent decline (Alemán-Mateo et al., 2024; Bredella, 2017). Moreover, studies have demonstrated that higher amounts of visceral adipose tissue and lower lean mass are associated with a greater risk of adverse cardiovascular events, independent of BMI (Neeland et al., 2015). Thus, it becomes imperative to incorporate additional assessment measures for a more accurate and comprehensive evaluation of metabolic risk and body composition in patients with excessive weight or obesity.

There are several clinically applicable indicators of visceral adiposity, ranging from simple anthropometric indices like waist-to-hip ratio and waist-to-height ratio to advanced body fat imaging analysis (Baioumi, 2019; Ward, 2019). Each biomarker has specific advantages and limitations in assessing body composition, and further investigation is still needed in this field. Importantly, when choosing the method to assess body composition, researchers, clinicians, and other professionals should consider the available financial resources as well as the objectives of their assessment.

With the rising global prevalence of obesity, the precise identification of individuals with excess weight and obesity stands paramount for effective prevention and the ongoing monitoring of treatments within the realm of weight control management.

Risk Factors for Overweight and Obesity and its Medical and Societal Impacts

Despite the extensive research efforts aimed at deciphering the etiology of obesity, the intricate interconnection between all the involved determinants is only incompletely understood. Authors characterize obesity as a heterogeneous chronic condition wherein multiple factors interact, resulting in a positive energy balance that leads to increased body weight (Bray et al., 2017). This perspective underscores that obesity is not caused merely by personal choice or by society but rather by the relationship between biological (e.g., genetics, prenatal determinants, gut microbiome, brain-gut axis, etc.), environmental (e.g., food abundance, socioeconomic status, culture, etc.), and behavioral factors (e.g., eating and sleep patterns, sedentary lifestyles, etc.) (Kadouh & Acosta, 2017). The intricate interplay between the aforementioned factors is observed to cause and exacerbate overweightness and obesity, particularly among adults (Safaei et al., 2021).

In addition to the complex causal factors and their interrelationship in obesity development, extensive research in this field strives to understand the profound impact of this condition on health, life expectancy and quality of life. A recent systematic literature review revised a complex interplay between obesity and a range of comorbidities and major diseases, including metabolic disease (for example type 2 diabetes mellitus and fatty liver disease), cardiovascular disease (hypertension, myocardial infarction and stroke), musculoskeletal disease (osteoarthritis), several types of cancer (for example, breast, ovarian, prostate, liver, kidney, and colon), infertility, as well as respiratory, oral, digestive, neurogenerative and autoimmune diseases (Safaei et al., 2021). These findings align with other studies which suggest the significant negative impact of obesity on individuals' health (Blüher, 2019; Franchini et al., 2022; Kibret et al., 2024; Kolb et al., 2016; Polsky & Ellis, 2015; Sommer & Twig, 2018). In accordance, the Global Burden of Disease Study revealed that, in 2017, elevated BMI was linked to 4.7 million deaths and contributed to 147.7 million disability-adjusted life-years globally (Dai et al., 2020).

Beyond the multitude of negative health implications of obesity, its consequences extend to various societal levels, imposing a substantial socioeconomic burden. Measuring this burden requires consideration of both the direct and indirect costs associated with the disease. Overweight and obesity, by causing individual functional limitations, lead to increased healthcare services utilization, resulting in direct economic burden related to both diagnosis and treatment (Spieker & Pyzocha, 2016). Economic literature suggests a 42% higher direct medical cost for adults with obesity compared to those with normal weight (Finkelstein et al., 2009).

Furthermore, indirect costs, such as absenteeism and presenteeism (reduced productivity at work), further contribute to a significant economic impact. A study on Portuguese workers revealed a noteworthy statistic: workers with obesity missed 66% more workdays compared with their counterparts, independently of other risk factors. Such findings underscore the substantial financial burden imposed on states, amounting to an extra €238 million per year in Portugal (Destri et al., 2022). These insights align with a systematic literature review, illustrating that obesity incurs significant indirect costs, manifested in both absenteeism and presenteeism (Goettler et al., 2017)

Psychosociological Impact of Obesity

The repercussions stemming from absenteeism rates and reduced productivity are not solely linked to the physical manifestations of obesity. Rather, they extend to include the significant impact of overweight on psychological well-being and overall mental functioning. Evidence consistently suggests a significant connection between obesity and depression (Rindler et al., 2023), with indications that the greater the excess weight, the higher the probability of developing depressive symptoms (Jones-Corneille et al., 2012; Pereira-Miranda et al., 2017). Further research also emphasizes that individuals with obesity and overweight exhibit more anxiety symptoms compared to those without obesity (Amiri & Behnezhad, 2019).

From a psychological standpoint, this association may be explained by the notion that individuals with overweight often have negative health perceptions. They may perceive themselves as incapable of participating in routine daily activities, particularly as they develop additional chronic comorbid conditions that lead to functional limitations and a decline in overall quality of life (Abiri et al., 2022; Donini et al., 2020). Furthermore, many individuals facing obesity live on a prolonged cyclical trajectory of weight loss attempts without achieving sustained clinically significant weight loss, or experiencing weight regain (weight cycling or yo-yo effect) (Hall & Kahan, 2018), reinforcing a pervasive sense of failure. In this context, weight bias assumes an important role.

Weight bias involves assumptions that individuals living with overweight are characterized as lazy, incompetent, unmotivated to improve their health, and deficient in willpower and self-discipline (Puhl et al., 2020). Systematically exposed to this stigma, individuals may internalize self-directed stigmatization attitudes engaging in self-derogation based on social stereotypes about their perceived weight status. Particularly impactful on women, weight stigma extends across several domains like employment, education, media, retail and exercise settings, and interpersonal relationships (Fikkan & Rothblum,

2012). Noteworthy, healthcare medical settings and professionals are not immune to experiencing weight bias, as reported by physicians, nurses, medical students, and dietitians (Lawrence et al., 2021). Professionals mentioned face significant barriers, including insufficient knowledge on discussing and managing weight, inadequate training to enhance skills in using appropriate language for weight topics, and a shortage of time to address these matters during consultations (Albury et al., 2020). Furthermore, from the patient's perspective, more than 60% of patients with overweight and obesity reported experiencing previous stigma from medical professionals (Puhl et al., 2021).

In this specific setting, the impact of weight stigma is tremendous, detrimentally affecting the provision of care and ultimately resulting in a delay of preventive screening, or poor adherence to treatment and treatment avoidance (Alberga et al., 2019; Brown et al., 2022) – which perpetuates the obesity epidemic. Additionally, both experience and internalized weight bias can foster the emergence of problematic eating behaviors, less physical activity, unhealthy weight control behaviors, perceived stress, anxiety and depression symptoms, dissatisfaction with body image and deterioration in self-esteem and quality of life (Carels et al., 2024; Pearl et al., 2021; Puhl et al., 2020; Westbury et al., 2023).

Non-surgical Treatment of Obesity

Regarding guidelines for the treatment of overweight and obesity, there is a clear statement that this should be treated as a chronic disease that requires a multicomponent and multidisciplinary long-term approach with regular monitoring contact (Semlitsch et al., 2019). Following weight reduction, weight-maintaining interventions are essential. Patients should comprehend that, given the chronic nature of obesity, the management of weight will be an ongoing and lifelong commitment (Hall & Kahan, 2018).

The recommended therapeutic goal for all adults with overweight and obesity is achieving a 5% to 10% reduction in body weight throughout 6 to 12 months approximately (Garvey et al., 2016; Tahrani & Morton, 2022). As a baseline therapy, a multifaceted lifestyle program that includes a reduction in calorie intake, an increase in physical activity, and measures to support behavioral change is recommended (Garvey et al., 2016; Schutz et al., 2019).

Dietary strategies include structured meal plans, portion control, and meal replacements to create a daily energy deficit of 500 to 750 kcal, with a resulting mean loss of 0.5–0.75 kg per week. It is recommended that roughly 15–20% of daily calories come from protein, 20–35% from fat (with no more than 10% from saturated fat), and the rest from carbohydrates, focusing on fresh fruits, vegetables, and

grains. To achieve desired calorie deficits, reducing portion sizes, as well as limiting excess sugar and fat, are practical strategies (Garvey et al., 2016; Semlitsch et al., 2019).

Physical activity guidelines advocate for at least 150 minutes/week of moderate-intensity aerobic physical activity (such as brisk walking or cycling) 3-5 separate days per week. These recommendations should be complemented with resistance exercise and a reduction in sedentary behaviors (for example decreasing screen time) (Garvey et al., 2016; Semlitsch et al., 2019).

Behavioral therapy should equip individuals with tools to facilitate changes in eating and physical activity patterns. A key challenge in behavioral treatment is identifying the specific eating, activity, cognitive, and emotional factors contributing to overweight or obesity and then focusing efforts on these targets. Initially, therapist and patient should collaboratively establish specific and achievable goals for behavior change, clearly outlining the targeted behaviors and how they will be accomplished. Understanding the importance of self-monitoring is crucial: recording food intake, caloric intake, physical activity, and body weight provides vital information about progress towards goals. Maintaining a daily log assists both the individual and the therapist in recognizing behavioral patterns and identifying areas for focused change. If progress towards a goal is insufficient, the therapist should assist patients in problem-solving strategies, involving the analysis of obstacles to behavioral change and the development of personalized solutions. Through stimulus control, individuals are encouraged to modify cues related to eating and activity in their environment. Additionally, cognitive restructuring techniques are employed to address maladaptive thinking (Garvey et al., 2016; Semlitsch et al., 2019). Behavioral treatment may integrate cognitive-behavioral therapy (CBT) techniques, including motivational interviewing, alongside acceptance-based approaches. Personalization of interventions according to individual preferences and cultural nuances is crucial for optimizing long-term adherence and efficacy (Semlitsch et al., 2019).

Despite combined efforts to integrate multiple therapeutic modalities in tackling obesity, achieving sustainable long-term outcomes remains challenging for both patients and practitioners. In response, substantial progress has been made in the field of pharmacotherapy and new effective drugs such as GLP-1 peptide analogs, which offer superior short and long-term effects and have recently become available on the market. The consensus in the literature is that the use of medications approved for long-term weight management is recommended only as an adjunct to lifestyle interventions. Medication should be considered when adequate weight loss cannot be achieved through lifestyle interventions alone. Specifically, these recommendations apply to adults meeting certain BMI criteria: those with a BMI greater than or equal to 30 kg/m^2, individuals with a BMI greater than or equal to 27 kg/m^2 and

weight-related complications, and those with a BMI greater than or equal to 28 kg/m^2 and additional risk factors (Garvey et al., 2016; Semlitsch et al., 2019).

Metabolic Bariatric Surgery

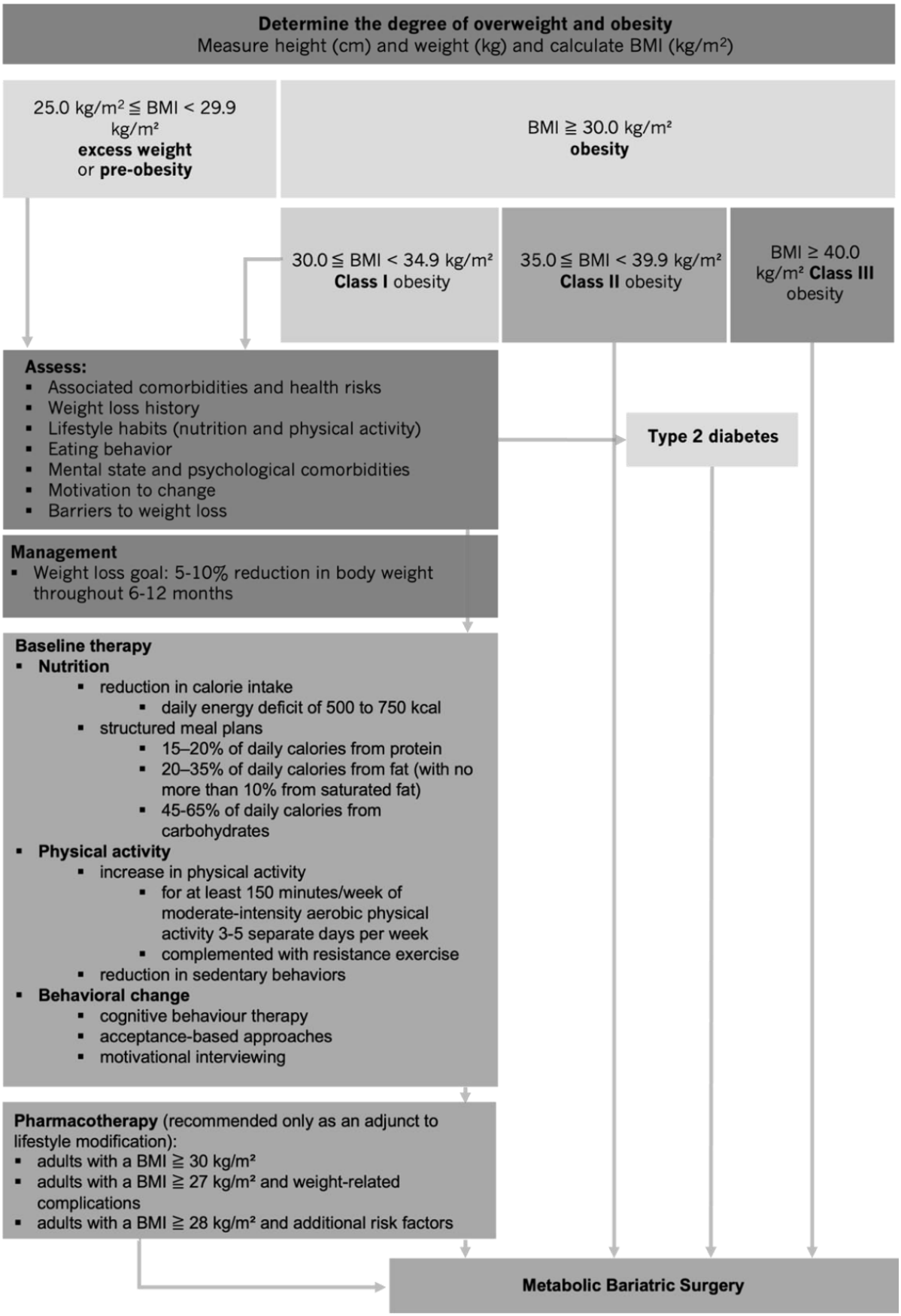
Currently, metabolic bariatric surgery (MBS) represents the most effective evidence-based treatment for obesity, with long-term sustained effects (Di Lorenzo et al., 2020)

Since the National Institutes of Health (NIH) Consensus Development Panel first delineated indications for surgical management of severe obesity in 1991, there has been a continual evolution in our comprehension of the disease process and its treatment methodologies. This progress has led to subsequent updates in guidelines worldwide within this domain.

According to the 2022 American Society of Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) indications, MBS is recommended as the treatment option for individuals living with obesity based on a BMI measurement. The criteria to progress for MBS are BMI > 35 kg/m^2, regardless of the presence, absence, or severity of comorbidities, or BMI > 30 kg/m^2 in patients with type 2 diabetes. MBS can also be recommended for patients with BMI between 30 kg/m^2 and 34.9 kg/m^2 associated with comorbidities in whom surgically induced weight loss is expected to improve – such as metabolic disorders, cardiorespiratory disease, severe joint disease, and obesity-related severe psychological problems. Before being considered for MBS, patients must have attempted sufficient non-surgical weight loss interventions, including dietary, physical activity and pharmacological approaches without achieving long-term substantial or durable results. There is no longer an age limit for surgery, as both younger and older individuals can undergo procedures. However, this decision is made by considering the individual's risk-to-benefit ratio to ensure the most appropriate course of action. Also, MBS is advised for patients who would benefit from significant weight loss before undergoing other major surgical interventions like joint arthroplasty, abdominal wall hernia repair, or organ transplantation (Eisenberg et al., 2022).

Figure 1 illustrates a depiction of the algorithm for the clinical assessment and stepwise management of overweight and obesity in adults.

Figure 1-1. Clinical pathway for overweight and obesity assessment and treatment in adults.



Conducting a multidisciplinary and comprehensive assessment of patients on an individual basis plays a pivotal role in identifying candidates suitable for MBS and in determining the most appropriate type of procedure for each patient.

There are different types of weight loss procedures (Sudlow et al., 2020). Each type of intervention achieves weight loss through different mechanisms and has different advantages and disadvantages. The safety of MBS has been extensively investigated, with studies consistently reporting very low perioperative mortality rates, typically ranging between 0.03% and 0.2% (Arterburn et al., 2020; Hedberg et al., 2024). Currently, the two most widespread MBSs are sleeve gastrectomy and Roux-en-Y gastric bypass (RYGB) (also commonly called simply "gastric bypass") (Angrisani et al., 2024).

Sleeve gastrectomy, a relatively new and minimally invasive procedure, involves a vertical resection of a large part of the stomach (Figure 2). The resected segment, approximately 80% of the body stomach, is removed. This technique is characterized by both restrictive effects – which involve reducing stomach volume consequently limiting food intake, and metabolic effects – which imply decreasing the production of the orexigenic hormone ghrelin, thereby reducing sensations of hunger. Conversely, RYGB is widely recognized as a safe procedure despite more technically demanding as it requires the formation of two anastomoses. The procedure entails the creation of a reduced-size stomach pouch and the rerouting of a segment of the small intestine to bypass a section of the digestive tract. Subsequently, post-procedure, food flows directly from the small gastric pouch to the small intestine, circumventing the lower stomach, duodenum, and upper small bowel (jejunum). Consequently, RYGB orchestrates a synergy of restrictive and metabolic effects with malabsorptive effects (the reduction in calorie absorption in the small intestine) (Figure 3).

Figure 1-2. Sleeve gastrectomy.

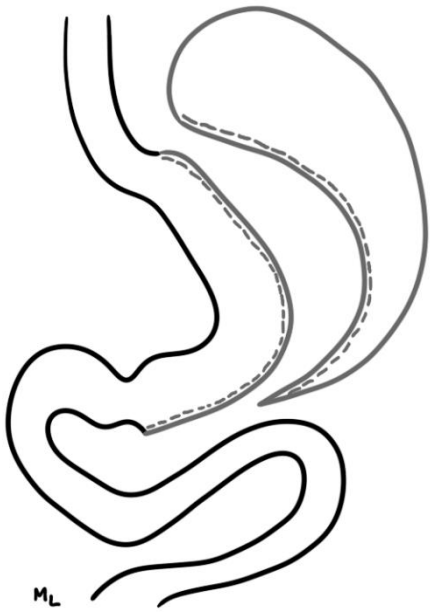
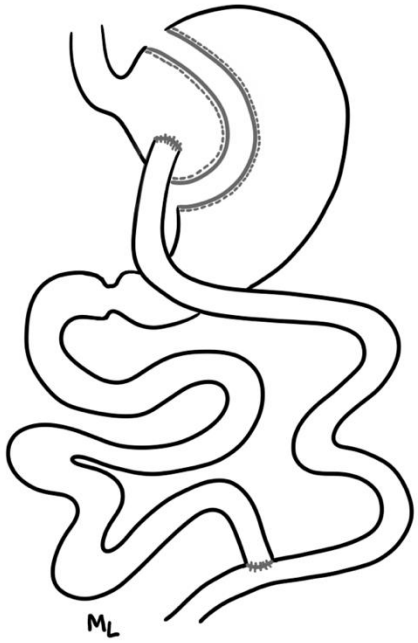


Figure 1-3. Roux-en-Y gastric bypass.



Sleeve gastrectomy has gained worldwide recognition, largely due to its perceived technical simplicity compared to RYGB, resulting in fewer postoperative complications and comparable long-term weight loss outcomes (Biter et al., 2024; Hatami et al., 2023). This perceived simplicity can be attributed to the absence of an anastomosis, and preservation of small bowel anatomy, resulting in shorter surgical duration. However, it is important to note some notable disadvantages of sleeve gastrectomy, including its irreversibility and the risk of gastro-esophageal reflux disease (GERD), which may lead to Barrett's esophagus. Nonetheless, studies have indicated improvements in GERD after RYGB (Tack & Deloose, 2014).

Dumping syndrome represents a prevalent complication of MBS, comprising a spectrum of symptoms that can be subdivided into early and late dumping syndrome. Typically, early dumping syndrome symptoms have a rapid onset, usually manifesting within the first hour after a meal. It is characterized by heightened bowel sounds, nausea, diarrhoea, abdominal pain, bloating, and vasomotor symptoms such as fatigue, flushing, palpitations, perspiration, tachycardia, hypotension, and, rarely, syncope (Tack & Deloose, 2014). This syndrome arises from the rapid transit of nutrients to the small intestine, where the hyperosmolarity of the ingested bolus prompts a shift of fluid from the intravascular compartment to the intestinal lumen (Scarpellini et al., 2020). Patients should be advised to avoid foods high in simple sugar content and instead opt for a diet rich in high-fiber, complex carbohydrates, and protein. Behavioral modifications, including consuming small, frequent meals, eating slowly, thoroughly

chewing food, and spacing solid and liquid intake by 30 minutes, are also recommended. Typically, early dumping syndrome is self-limiting and resolves within 7 to 12 weeks (Ukleja, 2005).

Conversely, postprandial hyperinsulinemic hypoglycemia, previously referred to as "late dumping syndrome", is characterized by neuroglycopenia – manifesting as fatigue, weakness, confusion, hunger, and rarely syncope – and autonomic and/or adrenergic reactivity – evidenced by perspiration, palpitations, tremor, and irritability. These symptoms typically emerge 1–3 hours postprandially. Postprandial hyperinsulinemic hypoglycemia syndrome can be attributed to the development of hyperinsulinemia, or reactive hypoglycaemia. The rapid delivery of carbohydrates to the small intestine results in elevated glucose concentrations, triggering a hyperinsulinaemic response and subsequent hypoglycaemia (Eisenberg et al., 2017; Rossini et al., 2024; Scarpellini et al., 2020). Early dumping syndrome is recognized as the typical and most common manifestation of dumping syndrome, and it can occur either independently or simultaneously with symptoms of postprandial hyperinsulinemic hypoglycemia syndrome. Although dumping syndrome can also occur after sleeve gastrectomy, it is most reported following RYGB (Scarpellini et al., 2020).

Another complication arising from MBS is non-weight-related vomiting – spontaneous or induced vomiting episodes that appeared post-operatively, sometimes used to overcome the physical discomfort in response to intolerable foods, overeating, not chewing properly/eating too rapidly, or plugging. Plugging is characterized by the obstruction of the small opening of the stomach, leading to a sense of food becoming stuck in the upper digestive tract. Approximately 76,3% of patients report experiencing issues related to plugging postoperatively (de Zwaan et al., 2010). The presence of plugging within the first 6 months post-surgery was positively associated with non-weight-related vomiting (Conceição, Mitchell, Vaz, et al., 2014; de Zwaan et al., 2010). However, a subgroup of patients also reported vomiting related to weight – vomiting used as a compensatory behavior to compensate for caloric intake to influence weight (± 12%) (de Zwaan et al., 2010).

Furthermore, nutritional deficiencies have been observed following MBS, with the prevalence and types of deficiencies varying according to the specific surgical technique employed. While postoperative micronutrient depletion may occur after sleeve gastrectomy, it appears less pronounced than with RYGB and typically resolves within five years, potentially leading to a higher quality of life post-surgery compared to RYGB. Conversely, in the RYGB procedure, significant vitamin, and mineral deficiencies, including iron, vitamin B12, vitamin B1, calcium, zinc, vitamin D and folate may occur, necessitating lifelong attention to micronutrient and vitamin supplementation (Argyrakopoulou et al., 2022; Mechanick et al., 2020).

Literature with methodological rigor comparing the advantages and disadvantages of these two surgical procedures is scarce. However, despite the potential medical complications outlined earlier, there is a global consensus that the short- and long-term benefits of MBS outweigh the risks. Both bariatric procedures have demonstrated efficacy in reducing various comorbidities, including alteration in body fat distribution, dyslipidemia, hypertension, insulin resistance, diabetes, non-alcoholic fatty liver disease, vascular reactivity, and obstructive sleep apnea (Wolfe et al., 2016).

Multidisciplinary Perioperative Assessment

The involvement of a multidisciplinary team comprising a medical bariatric specialist, nutritionist, and psychologist is crucial to providing comprehensive assessments and support pre- and post-surgery for individuals considering MBS.

The medical evaluation should encompass a detailed medical history, physical examination, and laboratory tests to assess any comorbid conditions and determine the suitability of the individual as a surgical candidate. The nutritional assessment should delve into the individual's weight history, medication regimen, body composition, energy requirements, and analysis of micronutrient deficiencies. Concurrently, the psychological assessment should encompass an evaluation of psychological functioning, substance abuse, and eating disorders (Mechanick et al., 2013). Patients with acute diseases, such as severe respiratory, heart or kidney failure, may not be approved for surgical treatment if the risk for complications is considered high. Moreover, it's crucial to consider untreated major depression or psychosis, along with uncontrolled or untreated eating disorders, as potential contraindications for MBS. These conditions may necessitate referral for additional preoperative evaluation and intervention. Furthermore, the inability of patients to comply with nutritional needs, such as lifelong vitamin replacement, should also be viewed as a contraindication (Bjørklund et al., 2020; O'Kane et al., 2020; Wolfe et al., 2016).

Patients with obesity should engage in a shared decision-making process with the medical team, weighing the risks and benefits of surgery against continuing with conventional medical and lifestyle interventions. The decision to undergo surgery should primarily reflect the informed preferences of candidates. Patients must fully comprehend the nature of the proposed procedure and the requisite behavioral modifications essential for achieving successful weight loss outcomes. Addressing deficits is fundamental, including training patients to develop coping mechanisms, counselling to address

problematic behaviors, and providing comprehensive education not only on the risks and benefits of surgery but also on the risks associated with obesity itself.

Psychosocial, emotional, and lifestyle expectations should be evaluated to ascertain their realism and the patient's commitment to adhere to postoperative guidelines actively and permanently for improved health (Keyte et al., 2024). It is important to promote tangible and realistic expectations, as patients often nurture unrealistic hopes regarding weight loss outcomes (Conceição et al., 2020), potentially undermining treatment adherence. Moreover, assessing family and social support is essential as greater perceived social support has been linked to lower levels of depression and disordered eating, and greater weight loss outcomes after MBS (Conceição et al., 2019). Strong support networks can positively influence mental health and adherence to postoperative guidelines, enhancing overall success after MBS.

Suboptimal Weight Loss and Weight Regain after MBS

Following MBS surgery, patients typically experience rapid weight loss, with the majority achieving their nadir weight approximately one year after the procedure (Jirapinyo et al., 2019). Significant weight loss results in notable improvements both medically and psychologically. Recent research indicates that one year after surgery, patients predominantly perceive enhanced physical function as the most significant benefit, followed closely by improvements in heart disease and diabetes. Moreover, social and mental health benefits were underscored as key improvements for patients (Alsaqaaby et al., 2024). Consistently with these, several studies have reported significant improvements in psychological well-being following substantial short-term weight reduction, including depression and anxiety symptoms (Dawes et al., 2019; On behalf of The By-Band-Sleeve Collaborating Group, 2024), body image, sexual functioning, and quality of life (Sarwer & Steffen, 2015).

However, maintaining adherence to long-term health behavior changes is a challenge. The positive psychological effects commonly experienced after MBS are often most pronounced during the initial weight reduction phase and may be transient (Paul et al., 2017). Sub-optimal weight loss, characterized by failing to reach a weight reduction of 50% of the baseline excess body weight within 1–2 years (Nedelcu et al., 2016), affects approximately 20% of MBS patients (Cadena-Obando et al., 2020; Geerts et al., 2021). Weight regain – progressive weight regain that occurs after achievement of an initial successful weight loss (defined as Excess Weight Loss > 50%) – is also prevalent (14 % – 87%)

within the MBS population, particularly in long-term (Hatami et al., 2023; King et al., 2018; Pinto-Bastos et al., 2019; Velapati et al., 2018).

Weight regain after MBS can profoundly impact patients, as obesity-related comorbidities that were alleviated through weight loss may reemerge, impairing quality of life (Karmali et al., 2013; King et al., 2018). Yet, our understanding of the underlying mechanisms contributing to these suboptimal results and/or weight regain remains limited, hindering the development of effective interventions.

Research findings suggested that suboptimal weight loss outcomes or weight regain following MBS are influenced by multiple factors. These encompass medical considerations such as metabolic and endocrine changes, anatomical surgical failures, or nutritional deficiencies. Additionally, patient-related factors such as lack of self-monitoring, physical inactivity, poor diet quality, and inappropriate food choices contribute to poor outcomes (El Ansari & Elhag, 2021).

Difficulties in treatment adherence are also commonly reported. A comprehensive systematic review identified a range of factors associated with this domain, which include low motivation, time constraints, inadequate planning, environmental and social pressures, adverse life experiences, negative emotional states, socioeconomic limitations, knowledge gaps, and a lack of support (Burgess et al., 2017). Patients frequently highlight the complexities of adherence, mentioning challenges such as balancing social, work, and family obligations alongside the demands of a rigid diet. Additionally, they encounter difficulties in social situations where adherence to dietary recommendations may hinder socializing. Furthermore, dealing with food environments that do not support healthy eating poses significant obstacles, as does coping with feelings of hunger (Karmali et al., 2013; Raves et al., 2016).

Furthermore, a growing body of research also implicated patients' mental health as a significant cause of poor weight loss outcomes (Cambi et al., 2021; El Ansari & Elhag, 2021; Velapati et al., 2018). Studies indicate depression and anxiety as significant predictors of suboptimal weight loss one year after MBS (Cadena-Obando et al., 2020). Depressive symptoms have been associated with lower quality of life, increased eating disorders psychopathology, and poorer weight outcomes following MBS surgery (White et al., 2015).

Similarly, research highlights the clinical importance of eating behavior on weight loss outcomes (Conceição & Goldschmidt, 2019; Geerts et al., 2021).

Problematic Eating Behaviors and Weight Loss Outcomes[1]

Changes in eating behavior have received significant attention in recent literature due to their strong association with poorer weight loss outcomes. While traditional assessment focuses on binge eating disorder (BED) or night eating syndrome (NES), recognized categories in the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5), recent studies have underscored the importance of other problematic eating behavior. Although these behaviors may not classify as psychiatric disorders by the DSM-5, they are also linked to suboptimal weight loss outcomes following MBS.

Next, several problematic eating behaviors with a proven impact on weight loss outcomes will be discussed. Identifying these behaviors is critical for both patients and clinicians, including experts in the field of obesity and MBS surgery, who are committed to optimizing the outcomes of these weight loss interventions.

Binge Eating

The episodes of binge eating serve as crucial markers for diagnosing various eating disorders, including Bulimia Nervosa and binge eating disorder (BED). Defined in the DSM-5, an episode of binge eating encompasses two key criteria: the consumption of an objectively large amount of food given the circumstances and a sense of loss of control over eating (LOCE) during the episode. These criteria are not only clinically significant but also equally necessary for making a diagnosis (American Psychiatric Association, 2013a).

However, researchers and clinicians in the field have raised questions about this equality, demonstrating that LOCE, rather than the quantity of food ingested, appears to be the central characteristic of the diagnosis, being more associated with the psychopathology of eating behavior and psychological impairment (Conceição et al., 2018; Conceição & Goldschmidt, 2019).

Moreover, strong positive associations were found between LOCE and more weight control behaviors, disordered eating symptoms, disinhibition during eating and body image concerns, higher levels of emotional dysregulation, more overall depressive symptoms, and lower self-esteem and quality of life in non-clinical populations and patients with eating disorders, obesity or submitted to MBS surgery (Brownstone et al., 2013; Bruzas et al., 2022; Devlin et al., 2018; Goldschmidt et al., 2015; Jenkins et al., 2012). Indeed, the clinical and diagnostic significance of the quantity of food consumed

[1] Adapted from:
Conceição, E., de Lourdes, M., Kussunoki, D., (2020). Outras alterações do comportamento alimentar. In A. Sigal, D. K. Kussunoki, C. C. Freire (Eds), *Cirurgias Bariátricas e Metabólicas: Tópicos de Psicologia e Psiquiatria.* Rubio

during a binge eating episode becomes more apparent when considering MBS patients. The restrictive nature of surgery largely restricts patients from consuming objectively large portions of food. Binge eating episodes are more prevalent among individuals with overweight or obesity compared to those with normal weight (Duncan et al., 2017). In accordance, research suggests a high prevalence of eating psychopathology and related symptoms among candidates for MBS (approximately 30%) (Sarwer et al., 2021). Nevertheless, following bariatric intervention, the frequency of episodes involving the consumption of objectively large amounts of food diminishes due to the anatomical and chemical modifications induced by surgery. However, despite these improvements, some patients continue to struggle with LOCE behaviors (Ivezaj, Barnes, et al., 2018). A prospective longitudinal study aimed at evaluating the clinical significance of LOCE in MBS patients up to 24 months post-surgery found that 61% of participants reported LOCE pre-surgery. These values changed to 31%, 36%, and 39% at 6-, 12-, and 24-months of follow-up, respectively

Reflecting on this evidence, different studies have used the definition proposed by Fairburn and colleagues in the Eating Disorder Examination (EDE). The EDE distinguishes between two types of binge episodes based on the amount of food ingested. Thus, an objective binge eating episode (OBE) includes the ingestion of objectively large amounts of food given the circumstances with associated LOCE, while the ingestion (also associated with LOCE) of amounts of food that are not objectively large but considered excessive by the individual, is referred to as a subjective binge eating (SBE) episodes (Fairburn et al., 2014). Several studies have investigated the difference between these two types of episodes in samples with eating disorders. Literature reveals that both types of eating episodes do not differ in terms of the severity of psychopathological symptoms related to eating behavior, such as food restriction, emotional and uncontrolled eating, concern about weight and body shape, eating concern, as well as overall psychological impairment assessed through levels of depression, anxiety, and stress (Brownstone et al., 2013; Conceição, de Lourdes, et al., 2018a).

In terms of response to CBT, LOCE seems to be more resistant to treatment than the quantity of food consumed. Authors argue that while OBEs tend to decrease rapidly in the early stages of therapy, the frequency of SBEs remains high and appears to change more slowly throughout the treatment. One possible explanation for this phenomenon may be related to self-monitoring, which has an impact on the reduction of OBEs. In contrast, SBEs seem to be associated with a greater number of cognitive distortions. Thus, cognitive restructuring emerges as one of the essential components of treatment to reduce such maladaptive thinking. However, this only occurs in the more advanced stages of therapy,

which explains the persistence of these episodes and their more gradual change throughout the therapeutic process (Niego et al., 1996).

In terms of weight outcomes after MBS surgery, pre-surgical LOCE does not seem to predict poorer post-surgical weight results. This is not the case when this variable is assessed at postoperative moments. Studies show that patients experiencing LOCE after surgery also exhibit poorer weight loss results at 12- and 24-months post-surgery, as well as higher levels of eating behavior psychopathology, depression, and lower quality of life (Freire et al., 2020; White et al., 2010). More recently, a study demonstrated that in a sample of MBS patients with a 7-year follow-up, the presence of post-surgical LOCE was the strongest predictor of poorer weight outcomes. This study also noted that self-monitoring of eating, frequent daily food consumption, older age, male gender, and better self-esteem were associated with a lower likelihood of exhibiting LOCE behaviors (Smith, Orcutt, Steffen, Crosby, Cao, Garcia, Mitchell, et al., 2019).

In summary, literature underscores the need to consider other eating behavior changes that, even if they do not meet the criteria for a formal diagnosis, still have a significant impact on weight outcomes. In this context, the experience of LOCE plays a crucial role and should be taken into account during the evaluation and treatment of patients undergoing MBS.

Grazing

A pattern of eating receiving considerable attention in the field of problematic eating is grazing – characterized by the repetitive and unplanned consumption of moderate amounts of food, not in response to hunger/satiety sensations (Conceição, Mitchell, Engel, et al., 2014a). Grazing is a prevalent behavior within the non-clinical samples, clinical populations with eating disorders, and individuals with obesity and/or submitted to MBS with percentages ranging approximately from 9% to 66.5% (Heriseanu et al., 2017; Teodoro et al., 2021). After MBS, this pattern of eating remains present with studies suggesting high-frequency values varying from 32.3% at 6-months and almost 70% at 10 months post-intervention (Berber et al., 2021; Conceição, Mitchell, Vaz, et al., 2014).

However, there is considerable variability in the reported frequencies across the existing literature, which may result from the utilization of different definitions and/or non-validated assessment methods to capture grazing behavior. This variance hampers comprehension and comparison across studies.

In response to this challenge, researchers consolidated the definitions proposed by multiple authors in the field, proposing a consensus definition. This definition categorized grazing behavior into two distinct subtypes: (1) compulsive grazing, characterized by a sense of inability to resist food, where the person engaging in this behavior feels driven or compelled to eat despite trying to resist; and (2)

non-compulsive grazing – characterized by repeated consumption of food in a distracted and unconscious manner (Conceição, Mitchell, Engel, et al., 2014a). These characteristics, coupled with the unplanned nature of the behavior, suggest the presence of some degree of LOCE in both subtypes of grazing.

In line with this, research indicates a strong association between grazing and various aspects of disordered eating, including higher levels of LOCE, increasing impulsivity in response to negative emotions, heightened uncontrolled and emotional eating, elevated psychological impairment, and reduced dietary restraint (Berber et al., 2021; Conceição, Mitchell, Machado, et al., 2017a; Reas et al., 2019). The strong association underscores the parallels between grazing and eating-related psychopathology, suggesting similarities with binge eating behaviors.

In support of these parallels, Conceição et al. (2018) examined eating episodes of OBE, SBE, and compulsive/non-compulsive grazing concerning the severity of LOCE and eating-related psychopathology in a sample of patients undergoing MBS. Their findings revealed that LOCE emerges as the primary indicator of eating disorder psychopathology. In essence, irrespective of the specific eating behavior exhibited, the severity of LOCE provides the most comprehensive explanation for the eating-related psychopathology observed in patients (Conceição, de Lourdes, et al., 2018a).

These findings align with a recent line of research emphasizing the necessity to conceptualize and evaluate these eating behaviors along a continuum of LOCE and psychopathology, rather than relying on the dichotomous (present/absent) approach commonly used (Conceição, de Lourdes, et al., 2018a; Conceição & Goldschmidt, 2019). These arguments underscore the imperative of considering grazing behavior, both in its compulsive and non-compulsive subtypes, as a clinically significant behavior within the spectrum of eating disorders and related psychopathology. Notably, within the MBS population, grazing is frequently linked with suboptimal weight outcomes and/or weight regain post-surgery (Berber et al., 2021; Pizato et al., 2017). Hence, it's evident that despite the profound impact of surgical interventions on the gastrointestinal tract of MBS patients, thereby altering food intake quantities, the development of eating behavior remains crucial in post-surgery weight loss. Although the diagnosis of grazing is not delineated in the DSM-5, its correlation with eating behavior psychopathology, coupled with its influence on weight outcomes, accentuates the necessity for clinicians and specialists to address this eating behavior during the assessment and subsequent monitoring of MBS patients, to improve outcomes.

Night Eating Syndrome

Night eating syndrome (NES) is recently included in the DSM-5 as an "other specified feeding or eating disorder". Diagnostic criteria included: (1) recurrent episodes of nocturnal eating after awakening from sleep and/or by excessive (>25% daily calorie intake) evening food consumption; (2) awareness and recall of those eating episodes; and (3) significant distress and/or impairment in functioning (American Psychiatric Association, 2013).

Theorized to result from a confluence of disordered eating, mood, and sleep, a central aspect of this psychopathology entails a distressing or impairing alteration in eating and sleeping circadian rhythms, characterized by increased food intake in the evening and nocturnal eating episodes (Allison et al., 2010).

Research on night eating syndrome in MBS patients is relatively scarce. However, studies suggested that the prevalence of this problematic eating behavior appears to be elevated among individuals undergoing MBS, ranging from 2% to 20% (De Zwaan et al., 2015) in contrast to the general population where it ranges from 1.1% to 1.5% (Kucukgoncu et al., 2015). Although the severity of night eating typically decreases immediately after surgery, studies indicate a notable long-term increase (Conceição, Mitchell, Pinto-Bastos, et al., 2017). Night eating syndrome has been identified as a significant contributor to suboptimal post-operative outcomes and weight regain after MBS (Conceição, Mitchell, Pinto-Bastos, et al., 2017; Devlin et al., 2018; Nasirzadeh et al., 2018).

Night eating syndrome is often linked with depressed mood, anxiety, heightened rates of substance use, and other psychiatric disorders, as well as low self-esteem, diminished sleep efficiency, and several eating disorders, which underscores the clinical significance of this syndrome (Kucukgoncu et al., 2015; Vander Wal, 2012). In the case of disordered eating, night eating syndrome has been linked to LOCE, both before and after MBS (McCuen-Wurst et al., 2017). A study suggested that among post-MBS patients exhibiting LOCE, approximately 15% are likely to have NES. This co-occurrence of LOCE and regular night eating was significantly associated with greater eating-disorder psychopathology and depressive symptoms, poor sleep quality, and a lower percentage of total weight loss six months after MBS (Ivezaj et al., 2022).

Future research should aim to elucidate the relationship between night eating and other disordered eating behaviors, as well as to identify individuals at risk for these disordered eating patterns following MBS.

Food Addiction

Recent research, involving studies with both animals and humans, suggests that certain foods have the potential to elicit biological and psychological responses akin to those observed in cases of substance abuse. This concept, known as food addiction, is currently a highly debated subject within both the public and the scientific communities. Food addiction implies that a subgroup of individuals may be particularly susceptible to experiencing addictive-like responses to food, resulting in a pattern of compulsive eating identical to that observed in classic substance use disorders. This behavior may include consuming larger quantities than intended, despite repeated attempts to resist, and facing negative consequences from excessive intake (Hauck et al., 2020).

While food addiction appears more prevalent than BED in patients with overweight or obesity (26.7% versus 12.0%, respectively), research argues for a significant overlap between these two eating-related issues – around 60% of participants with eating disorders also exhibit food addiction. Moreover, both problematic eating behaviors, whether isolated or coexisting, are significantly associated with higher levels of eating-related psychopathology, impulsivity, LOCE, and depression (Carbone et al., 2023; Ivezaj et al., 2016).

In the MBS population, food addiction seems to be more prevalent in pre-surgery assessments but significantly decreases after surgery. A systematic review and meta-analysis examining food addiction prevalence among individuals undergoing MBS found a high-weighted prevalence in preoperative samples (32%), which decreased to less than half (15%) in postoperative samples (Praxedes et al., 2023).

Moreover, in this population, food addiction is also associated with greater levels of eating-related psychopathology, impulsivity, and depressive symptoms (Ivezaj et al., 2019). A study investigating MBS candidates suggests that food addiction shares certain personality traits with substance-related disorders, including neuroticism, conscientiousness, impulsivity, and alexithymia. Interestingly, it also demonstrates a distinctive trait of low extraversion (Brunault et al., 2018).

However, literature regarding the impact of food addiction on weight outcomes remains limited. While food addiction presence in pre-surgery assessments was not linked to poorer weight results 12 months post-surgery, it correlated with more problematic eating behaviors and higher levels of preoperative eating behavior psychopathology and general psychopathology (Ivezaj, Wiedemann, et al., 2018). Moreover, a recent study examining associations between weight loss and postoperative psychosocial and behavioral factors up to an average of 13.7 years after surgery suggested that food addiction symptoms were negatively associated with weight loss (Martin-Fernandez et al., 2022).

In addition to the established link between BED and food addiction, the literature begins to find associations between food addiction and grazing behaviors (Bonder et al., 2018). These associations underscore the importance of assessing and investigating food addiction alongside other problematic eating behaviors. This need becomes even more relevant considering the current food environment, where tempting foods are increasingly prevalent. Future research should aim to clarify this concept, understand its underlying mechanisms, and examine its role as a predictor of postoperative weight outcomes.

Emotional Eating

Contrary to eating in response to physiological hunger cues, emotional eating represents a distinct pattern of consumption triggered by specific situations or negative emotions, such as sadness, anxiety, anger, or loneliness (van Strien, 2018) . While prevalent among individuals with normal weight, emotional eating poses a heightened challenge for those with overweight or obesity (Joshi et al., 2024), serving a critical risk factor for recurrent weight gain (Dakanalis et al., 2023).

This problematic eating behavior is observed in approximately 21% MBS patients and is considered a potential risk factor for less favorable outcomes post-surgery (Büyükkasap, 2023). Moreover, elevated levels of emotional eating before surgery signal increased emotional eating post-surgery, significantly impacting weight loss outcomes (Wiedemann et al., 2018). Similarly, a study investigating postoperative eating behaviors in women undergoing RYGB found that those with higher levels of emotional eating post-surgery were more likely to achieve inadequate weight loss results following surgical intervention. Additionally, a literature review aimed to describe postoperative psychosocial predictors of weight loss identified binge eating, LOCE, grazing, night eating syndrome, sweet eating, and emotional eating as potential predictors of poorer MBS outcomes (Miller-matero et al., 2018; Sheets et al., 2015).

While the link between emotional eating and adverse weight outcomes seems well established, inconsistencies persist regarding the underlying mechanisms of this eating behavior. A line of research has linked insecure attachment styles and difficulties in emotional regulation to emotional eating among MBS candidates, even after accounting for concurrent variables such as anxiety, depression, and general eating disturbances (Taube-Schiff et al., 2015).

Lastly, issues related to body image have also been linked to emotional eating. Recently, a study confirmed that negative attitudes towards body image in MBS patients may lead individuals to eat to soothe or reward themselves, creating a vicious cycle of negative emotions. In this regard, emotional

eating emerges as a mediator in this relationship, leading to an increase in feelings of depression and suicidal thoughts (Geller et al., 2019). A study conducted with MBS patients undergoing sleeve gastrectomy demonstrated that emotional eating – associated with LOCE– was significantly related not only to poorer weight outcomes post-surgery, but also to higher levels of depression and eating behavior psychopathology (Wiedemann et al., 2018).

Sweet Eating

Another disordered eating behavior discussed in the current literature relates to excessive consumption of sweets. Sweet eating has recently been defined as the intake of at least 50% of simple carbohydrates in the total recommended daily carbohydrate intake (Van Den Heuvel et al., 2011). However, various definitions have been used for this eating behavior, making comparisons between studies difficult and hindering solid conclusions regarding its impact on MBS weight outcomes.

Several authors have suggested that patients reporting this eating pattern should be considered for malabsorptive surgeries such as RYGB, as Dumping Syndrome – common after this surgical procedure – prevents excessive sweet consumption. However, in a sample of patients undergoing RYGB, a significant percentage (36%) of participants exhibited sweet eating – possibly because of a gradual long-term increase in sweet tolerance – negatively influencing surgery outcomes (Leite Faria et al., 2009).

In another study investigating predictors of poorer weight outcomes after MBS in patients with morbid obesity, it was found that results were worse in patients exhibiting sweet eating. However, another study concluded that sweet eating behaviors were not associated with less favorable weight outcomes, and therefore should not be used as a criterion for surgical technique selection (Hudson et al., 2002).

Multidisciplinary and Long-term Follow-up Support

Similar to the recommendations for obesity treatment follow-up, the guidelines for monitoring patients after MBS also emphasize a multidisciplinary approach. Regular assessments of the patient's physical, nutritional, and psychological well-being with immediate intervention for emerging complications and difficulties, are crucial (Bjørklund et al., 2020). This support should be extended over time, covering the high-risk phase for developing disordered eating behaviors (Allison et al., 2023; Hilbert et al., 2022).

However, with the increasing demand for bariatric care, one of the greatest challenges encountered is the limited resources available for the necessary frequent monitoring of these patients. This highlights the need for developing innovative intervention strategies that can extend support to a larger population while optimizing resource utilization. The advancement of new technologies has opened doors for new methods of patient contact, bypassing the limitations associated with face-to-face care (Conceição & Goldschmidt, 2019). Additionally, social networks have emerged as prominent channels for disseminating health-related information (Athanasiadis et al., 2020), offering a powerful alternative tool for delivering validated interventions and bridging the gap between clinical support services and patients. Furthermore, due to the inherent variability among patients undergoing MBS, it is crucial to tailor intervention models to individual patient needs. In this regard, stepped-care intervention models have emerged as a recent trend for optimizing healthcare resources (Kalarchian & Marcus, 2018). However, to date, no study has explored the feasibility of applying these models to psychological interventions in MBS populations.

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Chapter 2

Research Gaps and Thesis Aims

Research Gaps and Current Challenges

The findings explored throughout Chapter 1 provide a comprehensive overview of essential concepts related to overweight and obesity, alongside an in-depth examination of their required multidisciplinary treatment. Key aspects of MBS were delineated, with particular emphasis on the issue of weight regain. In examining the determinants of weight regain after MBS, problematic eating behavior emerges as a significant factor (Conceição & Goldschmidt, 2019; Geerts et al., 2021). However, several gaps remain in the literature:

- the literature is insufficient in understanding the core psychopathology of problematic eating behaviors in MBS patients.
- there is a need for further exploration into the suitability of commonly utilized tools for assessing and/or diagnosing eating behaviors or related psychopathology to the particularities of patients undergoing MBS.

Advancing our knowledge in this domain is imperative to provide evidence-based guidance to researchers and clinicians dedicated to intervening with this patient cohort. It is well-established that post-operative long-term multidisciplinary follow-up is necessary to maximize MBS outcomes (Van Zyl et al., 2020). However:

- there is a significant lack of randomized controlled trials investigating the efficacy of cost-effective alternative intervention tools tailored to the specific needs of MBS patients (Kalarchian & Marcus, 2018).

Research Aims

Considering the previously mentioned research gaps in the assessment and treatment of patients submitted to MBS, the current thesis encloses the following main aims:

1. To expand the understanding of the mechanisms underlying post-MBS problematic eating behaviors.
2. To investigate the suitability of tools for assessing loss of control over eating in patients post-MBS.

3. To present an overview on the literature on the use of alternative healthcare delivery strategies, as well as to develop and evaluate the effectiveness of a longitudinal social-media based stepped-care intervention for weight regain prevention after MBS patients.

Thesis Overview

The current thesis is divided into complementary parts. Each part is strategically interconnected, providing vital information and insights that pave the way for the subsequent part.

Part II: Insights into Problematic Eating Behaviors Post-Metabolic Bariatric Surgery: The Role of Loss of Control Eating.

Part II is divided into two chapters that include empirical studies with LOC eating in MBS samples as a common link. Overall, the studies integrated into this section aim to improve our understanding of the psychopathology underlying problematic eating behaviors in patients undergoing MBS:

- **Chapter 3** introduces the first empirical study, which aimed to compare prevalent problematic eating behaviors within the context of eating-related psychopathology, psychological distress, and negative urgency among patients undergoing MBS. This study expands our understanding of subsyndromal eating behaviors that, despite not meeting the criteria for an eating disorder diagnosis, still produce significant clinical impairment.
- **Chapter 4** delves into an examination of uncontrolled eating, exploring the influence of factors such as discomfort with excessive skin, body image shame, psychological distress, eating-related psychopathology, and negative urgency.

PART III: Assessment of Loss of Control Eating Post-Metabolic Bariatric Surgery

Consequently, part II is divided into two chapters that include empirical studies that aim to contribute to refining and advancing crucial LOC eating assessment and diagnosis tools for the MBS population. It consists of two chapters:

- **Chapter 5** assesses the applicability of DSM-5 criteria for identifying LOC eating in adult MBS patients who exhibit binge-eating episodes. Given the unique characteristics of this population post-surgery, this study scrutinizes whether the diagnostic criteria outlined in the DSM-5 adequately capture episodes of LOC eating in this cohort.
- **Chapter 6** expands on the associations between LOCE and psychopathology while exploring if the Loss of Control Over Eating Scale (LOCES) is an adequate instrument to assess LOCE across a Portuguese academic sample and a cohort of patients who underwent MBS.

Remarkably, despite its widespread usage, the LOCES had never been validated for the Portuguese population or samples of individuals undergoing MBS. Hence, this chapter introduces a useful self-report measure that could significantly benefit healthcare professionals and researchers.

Part IV: Psychological Support in Sustaining Weight Loss After Metabolic Bariatric Surgery.

Grounded on the knowledge provided by the previous sections, Part IV seeks to extend the existing knowledge on psychological intervention within MBS patients. This section aims to explore the literature surrounding methodologies and alternative tools for providing psychological support after MBS. Additionally, it evaluates the effectiveness of an innovative and cost-effective longitudinal intervention program for patients after MBS. Part III comprises three chapters:

- **Chapter 7** provides a thorough analysis of current psychological interventions within the domains of obesity and MBS. Drawing upon the latest literature, it discusses the efficacy of interventions both before and after surgery, while also elucidating the fundamental strategies utilized in delivering psychological support.
- **Chapter 8** provides an overview of the use of alternative tools based on new technologies in the assessment and treatment of obesity grounded on different theoretical methodologies.
- **Chapter 9** reflect on the conclusions gathered from the preceding parts and introduces the APOLO_Bari Stepped Care Program. An intervention protocol structured in a stepped-care format that utilize the social networking platform Facebook® to deliver psychological longitudinal follow-up support to post-MBS patients. This program aims to promote the optimization of MBS outcomes, and the prevention of weight regain. Alongside outlining the intervention protocol, Chapter 9 presents the results of a randomized controlled trial that evaluated the efficacy of this approach.

Finally, **Part V** of this dissertation, objects to provide a comprehensive synthesis of the varied findings, critically examine the strengths and limitations of the present dissertation and offer recommendations for future research. Additionally, it delineates the implications for clinical and medical practice derived from the insights collected in this investigation project.

PART II

Insights into Problematic Eating Behaviors Post-Metabolic Bariatric Surgery: The Role of Loss of Control Eating

Chapter 3

Problematic Eating Behaviors in Patients Undergoing Bariatric Surgery: Studying their Relationship with Psychopathology

Chapter 4

Understanding Uncontrolled Eating After Metabolic Bariatric Surgery: The Role of Excessive Skin and Body Image Shame

Chapter 3

Problematic Eating Behaviors in Patients Undergoing Bariatric Surgery: Studying their Relationship with Psychopathology

This chapter was adapted from:

de Lourdes, M., Pinto-Bastos, A., Machado, P. P. P., & Conceição, E. (2021). Problematic eating behaviors in patients undergoing bariatric surgery: Studying their relationship with psychopathology. *Journal of Health Psychology*.

The final publication is available at Sage Journals via:

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Abstract

Introduction: This study explored the associations between individuals presenting different problematic eating behaviors (Objective/Subjective binge-eating – OBE/SBE – and Compulsive/Non-compulsive grazing – C_Grazing/NC_Grazing) and eating disorder related symptoms.

Method: 163 pre- and 131 post-bariatric patients were assessed. Assessment included: Face-to-face clinical interview to assess binge-eating and grazing episodes, and self-report measures to assess eating disorder symptomatology, psychological distress, and negative urgency.

Results: OBE and NC_Grazing were the problematic eating behaviros most and least associated with psychopathology, respectively. OBE and C_Grazing uniquely accounted for the significant variance in the most disordered eating variables.

Discussion: Our findings emphasize the need for the conceptualization of grazing behavior in the spectrum of disordered eating.

Key-words: metabolic bariatric surgery, problematic eating behaviors, binge-eating episodes, grazing, eating-related psychopathology.

Introduction

Binge-eating – defined in the DSM-5 (American Psychiatric Association, 2013a) by both 1) the consumption of an objectively large amount of food in a discrete timeframe, and 2) a sense of loss of control over eating during the episode – is a core symptom of eating disorders, and particularly of binge eating disorder and bulimia nervosa. However, several studies questioned the clinical significance of the episode size, suggesting that the experience of loss of control over eating seems to be the core feature most strongly associated with eating disorder psychopathology and psychological distress (Blomquist et al., 2014; Conceição, de Lourdes, et al., 2018a; Fitzsimmons-Craft et al., 2014a; Goldschmidt, 2017).

The Eating Disorder Examination (EDE) (Fairburn et al., 2014), widely used for the assessment and diagnosis of eating disorders, differentiates two types of overeating episodes to capture the experience of loss of control regardless of the amount of food ingested: objective binge-eating episodes (OBE – eating objectively large amounts of food during the binge-eating episode) and subjective binge-eating episodes (SBE – binge-eating over an amount of food not unambiguously large but considered excessive by the respondent). The current state of the art suggests that binge-eating episodes, regardless of the size, do not differ in the degree of eating disorder-related symptoms associated such as uncontrolled and emotional eating, dietary restraint, weight, body shape or eating concern, and general psychopathology including depression, anxiety, and stress (Latner et al., 2007; Mond et al., 2010). However, past research in this field is limited to clinical samples with binge-eating disorder or bulimia nervosa (Brownstone et al., 2013; Fitzsimmons-Craft et al., 2014b; Latner et al., 2007). Thus, the lack of differences between OBEs and SBEs may be due to the overarching core psychopathology of the eating disorder itself rather than the similarities between these problematic eating behaviors.

It is well known that binge eating is also very common among individuals with overweight or obesity (Duncan et al., 2017), and research has shown that about 20% of bariatric surgery candidates experience problems with binge-eating (Mitchell et al., 2012). After bariatric surgery, the frequency of OBE episodes is known to initially decline (Smith, Orcutt, Steffen, Crosby, Cao, Garcia, Mitchell, et al., 2019) due to the physical restrictions imposed by surgery. However, a substantial proportion of patients continue to endorse loss of control eating behaviors in the long-term (Kalarchian et al., 2002; Smith et al., 2019). The isolated presence of OBEs and SBEs, not in the context of a DSM-5 diagnosis, is strongly associated with suboptimal weight loss, and/or greater weight regain post-operatively (Meany et al., 2014; Sarwer, Ph, et al., 2019; Smith, Orcutt, Steffen, Crosby, Cao, Garcia, Mitchell, et al., 2019).

Besides binge-eating, several studies have stressed that loss of control eating may be associated with another eating behavior – grazing. Grazing behaviour is defined by the consumption of modest amounts of food in an unplanned and repetitive manner, not in response to hunger/satiety sensations (Conceição, Mitchell, Engel, et al., 2014b). Grazing has been increasingly associated with poor weight loss (Colles, Dixon, & O'Brien, 2008) and weight regain (Conceição, Mitchell, Machado, et al., 2017b; Kofman et al., 2010; Pizato et al., 2017) following bariatric surgery. Growing evidence supports the association between grazing and increased eating disordered psychopathology, uncontrolled and emotional eating, negative urgency under unpleasant emotions, weight, and shape concerns (Conceição, de Lourdes, et al., 2018b; Lane & Szabó, 2013), and lower dietary restraint (Colles et al., 2008). The research on this field is still in its infancy and different terminologies have been used to define grazing. Conceição et al. (2014), looking for a consensual description of this behavior, proposed two subtypes: a) compulsive grazing (C_Grazing), characterized by eating food with temptation, that is, with the sense that one is not able to resist and control urges to eat, with some degree of loss of control present; and b) non-compulsive grazing (NC_Grazing) defined by eating in a distracted or mindless pattern.

While several studies have explored the OBE-SBE distinction in clinical and non-clinical samples, research including grazing behavior is limited. Conceição et al. (2018) compared all these problematic eating behaviors (OBE, SBE, C_Grazing, and NC_Grazing) and found preliminary support for its conceptualization on a continuous scale of psychopathology and loss of control over eating, contrarily to the dichotomous (presence/absence) fashion traditionally used. In this continuum, OBE, and NC_Grazing were the problematic eating behaviors associated with the highest and lowest severity of disordered eating psychopathology and loss of control, respectively. Furthermore, C_Grazing was associated with levels of psychopathology and loss of control comparable to those of SBE, which brings attention to grazing as a clinically important eating behavior in the spectrum of disordered overeating. Nevertheless, more evidence for this conceptualization is needed.

The current study explores the associations between individuals presenting these different problematic eating behaviors (OBE, SBE, C_Grazing, and NC_Grazing) and eating disorder psychopathology, psychological distress, and negative urgency in a cross-sectional sample of bariatric-surgery patients. We hypothesized that the different problematic eating behaviours would present commensurate eating disorder psychopathology, as assessed by the self-report measures.

Methods

Participants and procedure

This cross-sectional study assessed two independent samples from two central hospitals in the north of Portugal: 163 bariatric surgery candidates, and 131 postoperative bariatric patients with 12 months or more since surgery. Inclusion criteria included: bariatric surgery candidates with medical approval for surgery or bariatric patients with at least 12 months follow-up, aged between 18 and 70 years. Patients with: (1) illiteracy; (2) serious mental conditions (e.g., psychotic disorder, developmental or intellectual disability); (3) current pregnancy or breastfeeding; and (4) diagnosis of an eating disorder were not eligible for participating in the study. Consecutive patients who fulfilled the inclusion criteria were invited to the study after their appointment with a professional of the bariatric surgery's multidisciplinary team. Accepting participants were then interviewed by a member of the research team with an MSc or PhD degree in psychology and trained in the assessment measures used. Participants then responded to a set of self-report measures. This assessment was separate from the treatment as usual protocol of the multidisciplinary team. The diagnostic interviews were discussed with the research team for a final consensus on the identification of eating episodes.

All participants were informed about the study and the confidentiality of the data collected and signed informed consent before beginning the interview. Participants were aware that the information collected during their participation in this research project was not to be shared with the bariatric surgery team. Institutional review board approval was granted at all institutions involved.

Measure

Face-to-face clinical interview: assessed socio-demographic and anthropometric information. Height and weight information were obtained from hospital charts based on the previous medical appointment. The diagnostic items of the *Eating Disorders Examination, 17th Ed.* (Fairburn et al., 2014) were used to assess OBE and SBE. To identify C_Grazing and NC_Grazing, the *Rep(eat)* interview (Conceição, Mitchell, Engel, et al., 2014a) was used. These are investigator-based interviews composed of mandatory and supplementary questions that should help the subjects to recall whether they had engaged in these problematic eating behaviors in the previous four weeks.

Self-report measures:

Three-Factor Eating Questionnaire – R21 (TFEQ_R21) (Cappelleri et al., 2009; P. Duarte et al., 2018) – 21-items measure composed of three subscales: emotional eating, uncontrolled eating, and cognitive restriction. Cronbach's α for our sample was 0.84 for the total score.

Eating Disorder-15 (ED-15)(Rodrigues et al., 2019a; Tatham et al., 2015) – 15-items measure that assesses behaviors, attitudes and feelings associated with eating disorders and provides two subscales: weight and body shape concern and eating concern. Cronbach's α for our sample was 0.89 for the total score.

Repetitive Eating Questionnaire (Rep(eat)-Q) (Conceição, Mitchell, Machado, et al., 2017a) – 15-item measure that assesses feelings, behaviors, and cognitions related to episodes of grazing and generates a total score and two subscales: repetitive eating and compulsive grazing. For the propose of our study, only the total score was used. Cronbach's α for our sample was 0.95 for the total score.

Depression, Anxiety and Stress Scales (DASS) (Lovibond & Lovibond, 1995; Pais-Ribeiro et al., 2004) – 21-item measure that assesses depression, anxiety, and stress. For this study, a global score was computed as the sum of the three subscales and used as a measure of psychological distress. Cronbach's α for our sample was 0.96 for the total score.

Urgency, Premeditation, Perseverance, and Sensation Seeking scales (UPPS-NU) (Whiteside et al., 2005) **–** measure that assesses impulsivity based on the Five-Factor Model of personality. In this study, only the *negative urgency* subscale was used with higher scores indicating a greater tendency of the individuals to act impulsively under negative emotions. Cronbach's α for our sample was 0.89 for the total score.

Statistical analyses

The IBM® SPSS® Statistics 24 was used for data analysis. Little's Missing Completely at Random (MCAR) analysis was conducted to ensure that missing data were indeed MCAR. This analysis resulted in a non-significant chi-square test for DASS-21 (χ^2 (20) = 11.58, p = .930), confirming that the missing data were unrelated to any predictor variable. Once the frequency of missing data was minimal (≤ 3%), item-level missing data was handled by mean imputation. Pre- and post-operative participants were compared on sociodemographic and clinical information using *T*-tests and chi-squared tests. Spearman's correlation coefficient was used to test associations between problematic eating behaviors frequencies, disordered eating, eating disorder psychopathology, grazing behavior, psychological distress, and negative urgency. Aiming to investigate the clinical associations between individuals presenting different problematic eating behaviors in relation to psychological aspects, General Linear Model (GLM) for gamma distribution was used considering the non-normal distribution of the data. In these analyses, for each dependent variable (i.e., scores in self-reported measures), the continuous independent variables (i.e., the frequencies of OBE, SBE, C_Grazing, and NC_Grazing over the past four weeks) were tested as a set. For GLM analysis, sociodemographic variables (sex, and age) were included as covariates.

There were no significant differences in the proportion of patients reporting each problematic eating behaviour between Pre- and Post-operative patients (see Table 1). Also, correlations between the frequency of problematic eating behaviors, and eating-related symptomatology, psychological distress, and impulsivity showed similar pattern of statistical significance for Pre- and Post-surgery patients (data presented as supplementary material). Thus, statistical analyses were conducted combining the two samples (Pre-, and Post-surgery patients).

Results

Descriptive Statistics

Table 1 displays the detailed sociodemographic and weight-related information, and the distribution of problematic eating behaviors pre- and post-surgery.

Table 3-1. Sociodemographic and clinical information of patients pre- and post-surgery.

	Pre-surgery (n=163) No. (%); Mean (S.D.)	Post-surgery (n=131) No. (%); Mean (S.D.)	t/χ^2
Sociodemographic/clinical information			
Sex (male/female)	32(68.1)/131(53.0)	15(31.9)/116(47.0)	3.620
Age	41.03(11.39)	43.26(9.87)	-1.769
Marital status			
Single	39(62.9)	23(37.1)	
Married/live with partner	100(53.2)	88(46.8)	2.288
Divorced/separated	19(57.6)	14(42.4)	
Widowed	5(45.5)	6(54.5)	
Education level			
Elementary school (5 years or less)	34(57.6)	25(42.4)	
Middle school (6-8 years)	20(40.0)	30(60.0)	
Hight school (9-12 years)	82(58.2)	59(41.8)	5.985
Graduated level	27(61.4)	17(38.6)	
Employment situation			
Student	5(55.6)	4(44.4)	
Employed	82(49.4)	84(50.6)	6.298
Unemployed	63(64.3)	35(35.7)	
Retired	13(65.0)	7(35.0)	
Type of surgery			
Gastric band	-	3(2.3)	-
Gastric bypass	-	80(61.1)	
Gastric sleeve	-	48(36.6)	
Weight-related variables			
Current BMI	42.82(5.66)	29.80(5.95)	19.088, p <.001
Number of patients presenting problematic eating behaviors			
OBE	18(69.2)	8(30.8)	2.195
SBE	13(41.9)	18(58.1)	2.559
C_Grazing	19(51.4)	18(48.6)	0.287
NC_Grazing	22(55.0)	18(45.0)	0.004

Note: BMI – Body mass index; OBE – Objective binge-eating; SBE – Subjective binge-eating; C_Grazing – Compulsive grazing; NC_Grazing – Non-compulsive grazing.

Correlations between problematic eating behaviors and psychological aspects

Correlations analyses between problematic eating behaviors frequencies, disordered eating (TFEQ_R21), eating disorder psychopathology (ED-15), grazing behavior (Rep(eat)-Q), psychological distress (DASS), and negative urgency (UPPS-P) are presented in Table 2. Results also showed that increased frequency of OBE, SBE, C_Grazing, and NC_Grazing is significantly and positively correlated with uncontrolled and emotional eating (TFEQ_R21), and grazing-type patterns (Rep(eat)-Q). The frequency of all disordered eating behaviors, except for NC_Grazing, is significantly and positively correlated with eating concern, weight and shape concern (ED-15), and negative urgency (UPPS-P). Only OBE and C_Grazing frequencies are significantly and positively correlated with psychological distress (DASS). There is no statistically significant correlation between any problematic eating behaviors frequencies and cognitive restraint. OBE and C_Grazing are problematic eating behaviors that correlate significantly with more variables and those with stronger correlations.

Table 3-2. Spearman's correlation coefficient between problematic eating behaviors, disordered eating, eating disorder psychopathology, psychological distress, and impulsivity.

	OBE	SBE	C_Grazing	NC_Grazing
OBE				
SBE	-.070			
C_Grazing	.099	.108		
NC_Grazing	-.048	-.042	.101	
TFEQ-21_Uncontrolled eating	**.307*****	**.177****	**.257*****	**.160****
TFEQ-21_Cognitive Restraint	-.106	-.024	-.092	-.043
TFEQ-21_Emotional Eating	**.315*****	**.166****	**.312*****	**.148***
ED-15_Weight and shape concern	**.188****	**.160****	**.185****	-.013
ED-15_Eating concern	**.116***	**.201****	**.174****	.064
Rep(eat)_Total score	**.270*****	**.194****	**.348*****	**.256*****
DASS_Total score	**.170****	.102	**.195****	.056
UPPS-P_Negative Urgency	**.249*****	**.145***	**.215*****	.021

Note: OBE – Objective binge eating; SBE – Subjective binge eating; C_Grazing – Compulsive Grazing; NC_Grazing – Non-compulsive Grazing; TFEQ-21 – Three-factors eating questionnaire; ED-15– Eating Disorder 15; Rep(eat)_Q_ Rep – Repetitive eating questionnaire; DASS – Depression, anxiety and stress scale; UPPS – Urgency, premeditation, perseverance, and sensation seeking scales; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Unique contributions of problematic eating behaviors to psychological aspects

The results of the General Linear Model analyses exploring the variance accounted for in psychological aspects by problematic eating behaviors frequencies are presented in Table 3.

Table 3-3. Association between problematic eating behaviors, disordered eating, eating disorder psychopathology, psychological distress and impulsivity.

	B	SE	Waldχ^2	*p*
Eating Disorder Symptomatology				
Uncontrolled eating – TFEQ-21				
OBE	**.024**	**.005**	**24.984**	**.000**
SBE	.002	.004	.315	.574
C_Grazing	**.006**	**.002**	**5.804**	**.016**
NC_Grazing	.006	.003	3.238	.072
Age	-.006	.002	12.925	.000
Sex	.081	.052	2.437	.119
Cognitive restriction – TFEQ-21				
OBE	**-.009**	**.003**	**10.553**	**.001**
SBE	.001	.002	.356	.550
C_Grazing	**-.005**	**.002**	**10.375**	**.001**
NC_Grazing	-.001	.002	.585	.444
Age	.002	.001	5.235	.022
Sex	-.087	.031	8.004	.005
Emotional eating – TFEQ-21				
OBE	**.023**	**.006**	**14.515**	**.000**
SBE	.001	.005	.041	.839
C_Grazing	**.007**	**.003**	**5.312**	**.021**
NC_Grazing	.005	.004	1.690	.194
Age	-.006	.002	7.064	.008
Sex	-.017	.065	.069	.792
Weight and shape concern – ED-15				
OBE	.027	.016	2.776	.096
SBE	.004	.011	.140	.708
C_Grazing	.005	.007	.506	.477
NC_Grazing	.009	.008	1.245	.265
Age	-.012	.005	4.768	.029
Sex	-.452	.161	7.874	.005
Eating concern – ED-15				
OBE	.014	.011	1.609	.205
SBE	.010	.009	1.108	.293
C_Grazing	-.003	.006	.195	.659
NC_Grazing	.009	.006	2.089	.148
Age	-.012	.004	8.190	.004
Sex	-.239	.122	3.862	.049
Total score Rep(eat)_Q				
OBE	**.053**	**.015**	**12.434**	**.000**
SBE	.007	.010	.587	.444
C_Grazing	**.015**	**.007**	**4.620**	**.032**
NC_Grazing	**.031**	**.011**	**7.740**	**.005**
Age	-.014	.005	7.713	.005
Sex	.178	.147	1.471	.225
Psychological Variables				
Depression, anxiety, and stress scale_ DASS				
OBE	**.030**	**.015**	**3.914**	**.048**
SBE	.002	.011	.020	.889
C_Grazing	.008	.007	1.056	.304
NC_Grazing	.012	.008	2.268	.132
Age	-.006	.005	1.287	.257
Sex	-.288	.153	3.533	.060
Negative Urgency – UPPS-P				
OBE	**.008**	**.004**	**4.044**	**.044**
SBE	.000	.003	.002	.962
C_Grazing	.003	.002	2.662	.103
NC_Grazing	.002	.002	1.071	.301
Age	-.002	.002	1.277	.258
Sex	-.122	.044	7.629	.006

Note: OBE – Objective binge-eating; SBE – Subjective binge-eating; C_Grazing – Compulsive grazing; NC_Grazing – Non-compulsive grazing; TFEQ-21 – Three-factors eating questionnaire; ED-15 – Eating Disorder – 15; Rep(eat)_Q – Repetitive eating questionnaire; DASS – Depression, anxiety and stress scale; UPPS-P – Urgency, premeditation, perseverance, and sensation seeking scales.

Regarding to the TFEQ_R21 scale, as a set, the different problematic eating behaviors frequencies accounted for significant variance in uncontrolled eating (likelihood ratio $\chi^2(6) = 65.848$, $p < .001$), cognitive restriction (likelihood ratio $\chi^2(6) = 39.950$, $p < .001$), and emotional eating (likelihood ratio $\chi^2(6) = 41.780$, $p < .001$). Only OBE and C_Grazing frequencies uniquely accounted for the significant variance in these aspects of eating symptomatology, with greater OBE and C_Grazing being indicative of higher levels of uncontrolled and emotional eating, but lower levels of cognitive restriction.

Regarding the ED-15 subscales, as a set, the different problematic eating behaviors' frequencies accounted for the significant variance in weight and shape concern (likelihood ratio $\chi^2(6) = 19.553$, $p = .003$) and eating concern (likelihood ratio $\chi^2(6) = 16.724$, $p = .010$). Despite the overall significance, none of these problematic eating behaviors frequencies independently accounted for significant variance in these scales.

As a set, all problematic eating behaviors frequencies accounted for a significant variance on the Rep(eat)-Q total score (likelihood ratio $\chi^2(6) = 56.143$, $p < .001$). OBE, C_Grazing, and NC_Grazing frequencies accounted for significant unique variance, with greater OBE, C_Grazing, and NC_Grazing being indicative of higher grazing-type patterns.

In terms of the psychological variables, as a set, problematic eating behaviors frequencies accounted for significant variance in the global score of the DASS (likelihood ratio $\chi^2(6) = 17.446$, $p = .008$). However, only OBE independently accounted for significant variance in psychological distress with more OBE being associated with increased psychological distress.

Finally, concerning negative urgency, problematic eating behaviors frequencies accounted for significant variance in this dimension as a set (likelihood ratio $\chi^2(6) = 22.591$, $p = .001$). Yet, only OBE independently accounted for significant variance in this scale with more OBE being associated with a higher tendency to act rashly under emotional situations.

Discussion

In line with findings from other studies (Conceição et al., 2018a), we found that all the problematic eating behaviors were significantly associated with different dimensions of eating-related psychopathology. Individuals presenting increased frequencies of OBE and C_Grazing showed significantly higher scores and stronger correlations with a larger number of self-report measures assessing eating disorder symptomatology, psychological distress, and negative urgency. On the contrary, individual presenting NC_Grazing showed fewer and weaker correlations with the self-report

measures under study. Similarly, our findings suggested that greater frequency of OBE and C_Grazing was indicative of higher levels of uncontrolled and emotional eating, and lower levels of cognitive restriction. Notably, greater OBE, C_Grazing, and NC_Grazing frequencies were associated with higher repetitive eating patterns. Altogether, these data underline that individuals presenting grazing and binge-eating episodes might be comparable concerning eating disorder related symptomatology, as previously suggested by past research (Colles et al., 2008; Conceição, de Lourdes, et al., 2018a; Lane & Szabó, 2013).

Our results also showed no significant distinctions between individuals presenting different problematic eating behaviors regarding weight and shape concern and eating concern. One possible explanation for these findings might be that individuals with obesity are continuously encouraged to be vigilant about their weight, and fears of weight (re)gain are common (Conceição et al., 2013). Similarly, as this is a sample undergoing obesity treatment, it's expected that all these individuals have received prescribed nutritional plans and present concerns about watching their eating habits (Conceição et al., 2017, 2014; Pinto-Bastos et al., 2018). Hence, it is not surprising that our data suggest that weight and shape concern and eating concern are dimensions of psychopathology that underline all the problematic eating behaviors.

Relatedly to psychological distress, only individuals presenting OBE showed significant associations. In this regard, increased frequency of OBE was significantly and uniquely associated with increased scores of psychological distress. According to previous research, a high amount of variance (56.6%) from OBE is explained by depressive symptoms, which highlights their close link (Schag et al., 2016). Further, evidence suggests that depressive symptoms are indicated as a significant predictor of binge-eating (Cox & Brode, 2018). Likewise, Conceição et al. (2018) found that, although grazing correlates with depressive symptoms, patients reporting OBE presented the highest depression scores. Similarly, our results also suggested that OBE episodes seem to be a major indicator of broader psychological impairment.

Lastly, frequencies on the different problematic eating behaviors accounted for variance in the negative urgency dimension when considered as a set but only individuals presenting OBE were uniquely associated with this construct. Equally, past research suggested that negative urgency relates to the spectrum of pathology presented in women with OBE (Racine et al., 2015). Our results also suggest that individuals who tend to act rashly under negative emotions may engage in problematic eating behaviors, particularly OBE, which highlights the key role of impulsivity in obesity (Schag et al., 2016). Accordingly, a recent line of research suggests that the core of negative urgency is negative

affect, and that impulsivity is related to eating through a maladaptive attempt of emotional regulation – the impulse to eat is an effort to avoid, escape or suppress the intensity of negative affective states (Pivarunas & Conner, 2015). Further investigation exploring the relationship between problematic eating behaviors and the different components of impulsivity and emotional regulation in bariatric patients is needed to provide more nuanced information about these associations.

These results have several implications for clinical and research practice. Paying attention to these eating behaviors is essential as it prevents the current insufficient capture of subsyndromal problematic eating presentations that are commonly found in bariatric populations and have significant clinical impacts. Since changes in these eating behaviors play an important role in postoperative outcomes (Conceição & Goldschmidt, 2019), screening for patients in need of specialized treatment proves fundamental for the long-term success of bariatric surgery.

Notable strengths of this study include the accuracy of the methodology implemented with validated and face-to-face interviews highly recommended for diagnosis in bariatric surgery patients (Parker et al., 2016). Also, the fact that this study investigates a sample that does not meet the full criteria for an eating disorder diagnosis allows us to investigate the unique contribution of problematic eating behaviors themselves to behavioral/cognitive features of psychopathology outside and overarching psychological illness. However, several limitations warrant discussion. First, caution should be paid regarding the generalization of our findings to populations with psychiatric disorders. The differences observed between these problematic eating behaviors may be buffered by the presence of specific cognitive aspects of eating disorders and distress/depression associated with the life impact of the disorder rather than with the type of problematic eating behavior. Secondly, despite the large sample size of individuals undergoing bariatric surgery, the number of participants reporting problematic eating behaviors in our sample was small, which resulted in a low sample size to detect statistically significant differences between groups. Lastly, despite the use of a face-to-face interview to identify problematic eating behaviors, self-report questionnaires were used to assess psychopathology. Nevertheless, measures selected in our study were validated, have been widely used in this population, and showed a good to excellent internal consistency for our sample.

The present study brings novelty to the field by increasing the current state of the art about the relationship between the different problematic eating behaviors and psychopathology. Our findings suggested that individuals presenting grazing episodes showed levels of psychopathology comparable to those reported by participants presenting binge-eating episodes. This provides further support for the conceptualization of these problematic eating behaviors on a continuous scale of psychopathology,

rather than in a dichotomous fashion (this is, rated as a present/absent in the assessment process) (Conceição et al., 2018a; Goldschmidt et al., 2016). Importantly, this continuous approach also highlights the importance of considering grazing behavior, and particularly compulsive grazing, in the spectrum of disordered eating.

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Chapter 4

Understanding Uncontrolled Eating after Metabolic Bariatric Surgery: The Role of Excessive Skin and Body Image Shame

This chapter was adapted from:

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Abstract

Introduction: Excess skin and problematic eating behaviors are referred to as some of the major negative consequences of metabolic bariatric surgery, as well as body image shame. This study sought to explore how discomfort with excessive skin, body image shame, psychological distress, eating-related psychopathology, and negative urgency interact to understand uncontrolled eating among woman submitted to metabolic bariatric surgery.

Method: A cross-sectional sample of 137 women was evaluated postoperatively through self-report questionnaires assessing discomfort with excess skin, body image shame, eating-related psychopathology, negative urgency, and uncontrolled eating in a hospital center in the north of Portugal. Pearson correlations and Structural Equation Modeling (SEM) were performed.

Results: Body image shame mediated the relationship between discomfort with excess skin and eating-related psychopathology. In turn, the relationship between eating-related psychopathology and uncontrolled eating was mediated by negative-urgency.

Discussion: This study highlights the impact of excess skin and body image shame on eating behavior post-bariatric surgery. Considering the proven impact of uncontrolled eating on weight loss results post-surgery, understand the mechanisms underlying this problem is highly important. Our findings provide helpful in-sight for multidisciplinary teams committed to providing care to bariatric patients struggling with body image and eating difficulties.

Keywords: metabolic bariatric surgery; excess skin; body image shame; eating-related psychopathology; uncontrolled eating; negative urgency.

Introduction

Metabolic bariatric surgery (MBS) is currently the most effective and durable treatment for severe obesity, resulting in significant weight loss, substantial improvements in obesity-related comorbidities (Courcoulas et al., 2017), and patients' psychosocial function(Marek et al., 2021). With a variability of weight loss outcomes being observed particularly in the long-term, the mechanisms underlying individual weight-loss trajectories after MBS are not fully understood but are likely due to a complex interplay between surgery- and patient-related factors (El Ansari & Elhag, 2021).

A patient-related factor for poor weight loss outcomes frequently reported in the MBS literature is the presence of problematic eating behaviors, particularly, uncontrolled eating (i.e., feeling that one cannot stop eating or control how much one is eating) (Smith, Orcutt, Steffen, Crosby, Cao, Garcia, Mitchell, et al., 2019). The experience of uncontrolled eating has been associated with insufficient weight loss or weight regain by a growing and consistent body of literature (Conceição, Mitchell, Vaz, et al., 2014; Martin-Fernandez et al., 2021).

In association, negative urgency – the tendency to act impulsively in the face of negative emotions – seems to be in close relation with uncontrolled eating (Sarwer, Allison, et al., 2019; Yeo et al., 2020). Individuals with higher levels of negative urgency are at greater risk of engaging in more frequent binge eating (Emery et al., 2013). Studies also suggested that elevated levels of negative urgency predicted elevated expectancies that eating helps to manage negative affect, which in turn predicted food overconsumption (Pearson et al., 2015). Finally, eating-related psychopathology – that is, restraint and concerns with eating, shape, and weight – are common in the MBS population pre- and post-surgery and have been consistently associated with uncontrolled eating (de Lourdes et al., 2021; Ivezaj, Barnes, et al., 2018).

Another patient-related factor that requires careful attention among MBS patients involves the issue of excess hanging skin following the massive weight loss induced by the surgery. Surplus skin is very common (up to 96%) after the MBS intervention, mainly in the abdominal, upper arm, and inner thighs regions (Klassen et al., 2018). The associated aesthetics can lead to physical discomfort, significant impairment in health-related quality of life, and psychosocial issues such as social withdrawal, and intimacy problems (Kitzinger et al., 2012). This undesirable consequence alters the way patients look at their bodies, becoming extremely self-conscious (Klassen et al., 2012). Despite the satisfactory results on weight loss, continuous feelings of disgust, or contempt for body image impact patients' psychological well-being and lead patients to seek body-contouring procedures (Busetto et al.,

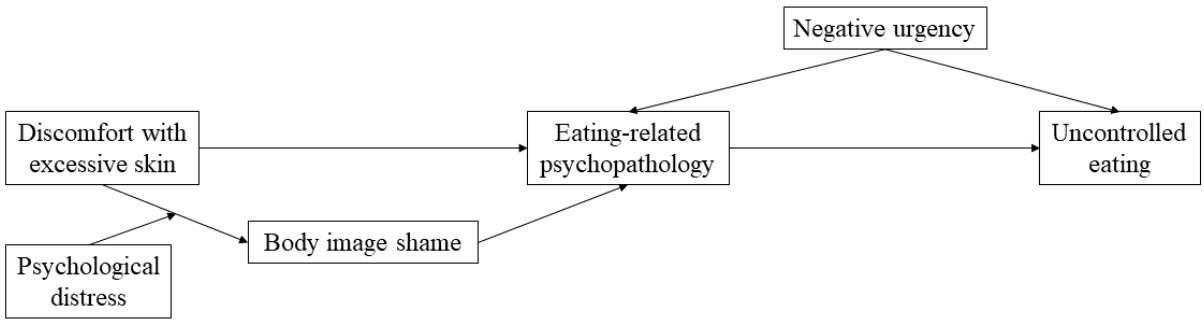
2018; ElAbd et al., 2020). In women submitted to MBS, the discomfort with the excessive skin was shown to be significantly associated with more eating-disorder psychopathology and more depressive symptoms (Ramalho et al., 2015).

In close association with dissatisfaction with excessive hanging skin, body image shame has also been pointed out as a key risk factor for the development and maintenance of eating-related difficulties (Mendes et al., 2021; Oliveira et al., 2017). Gilbert and Andrews (1998) define shame as an unwanted universal human emotion that emerges in the social context when the self perceives that others or the self-evaluate him/her as weak, unattractive, inferior, and/or defective, putting him/her at risk of criticism, judgment, or rejection (Gilbert & Andrews, 1998). Individual responses to feelings of shame are varied. While some individuals can tolerate these types of feelings, others resort to defensive strategies such as hiding, disguising, or camouflaging the parts of the self that are considered sources of shame, which, in turn, tends to precipitate negative emotions (e.g., anxiety, anger and disgust) (Gilbert, 2000). When the focus of shame is weight and body shape, the perceptions of inferiority in comparison to others may predispose people to difficulties in regulating eating behaviour (Duarte et al., 2015, 2017). One study revealed a significant and positive relationship between shame and eating-related psychopathology (Oliveira et al., 2017). Consistent with this perspective, another investigation also showed that the relationship between overall shame and eating-related psychopathology is fully dependent on the presence of body image-related shame and consequent attitudes and behaviours (Duarte et al., 2015). Lastly, past research has identified that greater body image dissatisfaction in women is associated with higher depression (Duarte et al., 2014; Rosenberger et al., 2006). Moreover, and as previously suggested, body image shame is extremely frequent in MBS patients pre- and post-surg (Busetto et al., 2018; Ivezaj & Grilo, 2018; okland Lier et al., 2011), particularly in individuals with poor psychological functioning (Busetto et al., 2018). It is not clear whether a direct correlation exists between weight loss induced by MBS procedures and body image improvement – this is, the rapid change in body shape achieved post-surgery may not be accompanied by psychological changes related to body image. This supports theories about the fragile association between the mental representation of one's body and one's real appearance (Bertoletti et al., 2019). Thus, considering the psychosocial impacts of excessive skin, it is possible that, after the MBS intervention, the discomfort with excessive skin experienced, particularly in patients presenting higher levels of psychological distress, can increase body image shame and consequently increase difficulties with the regulation of eating behaviors.

Despite the growing body of evidence regarding the association between each of these patient-related factors and disordered eating, to the best of our knowledge, no study explored how these

aspects interact with each other to explain uncontrolled eating, particularly in bariatric surgery populations. Thus, taking into consideration the findings previously described, this study sought to explore the proposed model depicted in Figure 1. In this model, we hypothesize that discomfort with excessive skin, especially in patients with higher levels of psychological distress, would be associated with more body image shame which would be positively and significantly associated with eating-related psychopathology. In turn, eating-related psychopathology would increase uncontrolled eating via higher levels of negative urgency. Since body image shame in bariatric populations occurs mainly due to excess skin (Klassen et al., 2012, 2018) understanding how these aspects interact to promote uncontrolled eating behaviors might have important implications for clinical practice.

Figure 4-1. Hypothesized the model.



Note: Hypothesized the model: Body image shame as a mediator between discomfort with excessive skin and eating-related psychopathology and negative urgency as a mediator between eating-related psychopathology and uncontrolled eating. Psychological distress as a moderator between discomfort with excessive skin and body image shame.

Methods

Procedure and participants

This cross-sectional study is part of a larger longitudinal study conducted at a central hospital in the north of Portugal that assessed patients undergoing primary and re-operative bariatric surgery preoperatively and at different follow-up times (Pinto-Bastos et al., 2019). For this study, patients were included if they had more than 12 months of surgery. Participants were invited to the study after the medical follow-up appointments at the hospital and responded to a set of self-report measures. This assessment was separate from the treatment as usual protocol of the multidisciplinary team. All participants were informed about the aims of the study and the voluntary nature of their participation

and signed an informed consent form. Participants were aware that the information collected during their participation in this study was not to be shared with the multidisciplinary team.

Specific exclusion criteria included a severe cognitive compromise that limited patients' autonomy, acute presentation of psychiatric conditions with severe impairment of global functioning, pregnancy during the period until the follow-up assessment, not being able to understand written and spoken Portuguese, and not submitted to any body contouring surgery.

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board of both hospitals and the university center involved approved the study protocol.

Measures

Sahlgrenska Excess Skin Questionnaire (SESQ) (Biörserud et al., 2013) – self-report measure used to assess patients' experience of excess skin after massive weight loss. This measure comprehends, on its original version, 29 items. However, for this study, only 11 items were used: two items about the number of body parts where the subjects consider have excess skin ("Do you consider that you have excess skin in how many areas of your body? Which are?"); and nine combined items about the impact of excess skin in daily life routines answered in a 4-point Likert scale from 0 – "ever" to 4 – "never". These nine items were combined to produce a global score where higher scores are indicative of less discomfort with excessive skin. Cronbach's α for our sample was 0.78.

Body Image Shame Scale (BISS) (Duarte et al., 2015) – self-report measure to evaluate body image shame in its external and internal dimensions. For the present investigation, only a global score was used with higher scores indicating greater body image shame. Cronbach's α for our sample was 0.92 for the total score.

Depression Anxiety Stress Scale (DASS) (Lovibond & Lovibond, 1995; Pais-Ribeiro et al., 2004) – self-report measure used to assess depression, anxiety, and stress symptoms. In this study, only the global score was used with higher scores expressing greater psychological distress. Cronbach's α for our sample was 0.96 for the total score.

Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn et al., 2014; Machado et al., 2014) – self-report measure used to assess eating disorder psychopathology and associated features through 4 subscale scores - restraint, eating concern, shape concern, and weight concern – as well as a global score. For this study, only the global score was used. Higher scores indicate greater eating disorder psychopathology. Cronbach's α for our sample was 0.83 for the global score.

Three-Factor Eating Questionnaire – R21 (TFEQ_R21) (Cappelleri et al., 2009; P. Duarte et al., 2018) – self-report measure used to study different types of eating behaviors. Only the uncontrolled eating subscale was used to assess the tendency to overeat as a result of loss of control over eating. Higher scores express more uncontrolled eating. Cronbach's α for our sample was 0.91 for this subscale.

Urgency, Premeditation, Perseverance, and Sensation Seeking scales (UPPS-NU) (Whiteside et al., 2005) – self-report measure that assesses impulsivity based on the Five-Factor Model of personality. For this study, only the negative urgency subscale was used with higher scores indicating a greater tendency of the individuals to act impulsively under negative emotions. Cronbach's α for our sample was 0.88 for the total score.

Statistical analysis

The different weight-related variables were computed as follows: body mass index (BMI): weight/(height2); percentage of BMI lost (%BMIL) = [(BMI_pre-surgery – BMI_current)/BMI_pre-surgery] x 100; Weight regain (kg) = BMI_current – BMI_lowest. BMI_pre-surgery represents the BMI before the participant was submitted to bariatric surgery; BMI_current represents the BMI at the follow-up assessment; and BMI_lowest represents the lowest BMI achieved since surgery.

The normality of all variables was analysed, and non-parametric tests were used when the assumptions for the normality of the data were not assumed. Descriptive statistics were used to examine sociodemographic, weight-related, and psychological characteristics. Partial correlation analyses controlling for follow-up assessment, primary vs re-operative, and type of surgery were used to investigate the relationship between variables under study. This set of analyses was performed using the IBM® SPSS® Statistics 24.

The path analyses were conducted using the "lavaan" package (39) for the R statistical environment (version 4.0, R Development Core Team, 2019). Model goodness fit was examined using the following indices: chi-square statistic/ degrees of freedom (χ^2/df) with values smaller than 5; the Tucker–Lewis's index (TLI) and the comparative fit index (CFI) with values > 0.95; the root mean square error of approximation index (RMSEA) ≤ .06, and the Standardized Root Mean Square Residual (SRMR) ≤ .08 (37). Variables with *p* values ≤ .05 were considered statistically significant (Holbert & Stephenson, 2002; L. T. Hu & Bentler, 1999).

Results

The study included 137 women aged between 24 and 67 years (M = 46.41, SD = 10.659), submitted to primary (n = 62, 45.3%) or reoperative (n = 75, 54.7%) bariatric surgery. Five participants refuse participation in the study and six were pregnant. Ninety-one (66.4%) participants underwent Gastric Bypass, and 42(30.7%) received Gastric Sleeve. Most women were married (n= 86, 49.6%), and 23 (16.8%) were single. Thirty-seven (27.0%) participants had completed elementary school (5 years or less), and 25 (18.2%) had completed high school (9-12 years). Most women were employed (n=72, 52.6%), while 35 (25.5%) were unemployed. Sixty-one (44.5%), 31 (22.6%), 20 (14.6%), and 25 (18.2%) participants had 12-, 18-, 24-, and 36-month follow-up, respectively.

Considering the excessive skin, only 25 (18.2%) participants reported not feeling any discomfort with excess skin, 34(24.8%) participants reported discomfort in only one body area, and 77(56.2%) participants presented discomfort in two parts of the body. Table 1 presents detailed sociodemographic, weight-related, and psychological information of our sample.

Table 4-1. Characterization of the sample: Sociodemographic, weight-related, and psychological information.

	Mean (S.D.)/ n (%)	Min. (Max.)
Sociodemographic and weight-related information		
BMI_pre-surgery	43.74 (5.581)	32.13 (60.96)
BMI_current	30.00 (5.038)	19.84 (46.46)
%BMIL	31.29 (8.742)	-2.08 (52.38)
Weight regain (Kg)	0.76 (1.235)	-0.08 (6.36)
Classification according to BMI (kg/m²)	Pre-surgery	Current
Normal (18.5 < IMC < 24.9)	0 (0.0%)	21 (15.3%)
Overweight (25 < IMC < 29.9)	0 (0.0%)	45 (32.8%)
Obesity Class I (30 < IMC < 34.9)	7 (5.1%)	45 (32.8%)
Obesity Class II (35 < IMC < 39.9)	25 (18.2%)	17 (12.4%)
Obesity Class III (IMC > 40)	101 (73.7%)	5 (3.6%)
Psychological information		
SESQ_Global score	28.26(7.01)	5(36)
BISS_Global score	16.30(12.86)	0(56)
EDE-Q_ Global score	1.52(1.10)	0(5.48)
DASS_Global score	13.78(12.08)	0(51)
UPPS_Negative urgency	2.10(0.64)	1(3.83)
TFEQ_Uncontrolled eating	1.44(0.51)	0.89(3.22)

Note: BMI – body mass index; %BMIL – percentage of BMI lost; Weight regain – Increased weight (in Kg) after reaching the lowest weight since surgery; SESQ – Sahlgrenska Excess Skin Questionnaire; BISS – Body Image Shame Scale; BISS_EDE_Q – Eating Disorder Examination Questionnaire; DASS – Depression Anxiety Stress Scale; UPPS – Urgency, Premeditation, Perseverance, and Sensation Seeking scales; TFEQ – Three-Factor Eating Questionnaire

Correlation analysis between variables under study (Table 2) suggested that discomfort with excess skin (SESQ) was negative and statistically significantly correlated with body image shame (BISS), eating-related psychopathology (EDE-Q), and psychological distress (DASS). In turn, body image shame (BISS) presented positive and statistically significant correlations with eating-related psychopathology (EDE-Q), and psychological distress (DASS). Lastly, uncontrolled eating (TFEQ_R21) showed positive and statistically significant correlations with eating-related psychopathology (EDE-Q), and negative urgency (UPPS-NU).

Table 4-2. Correlations between psychological and weight-related information.

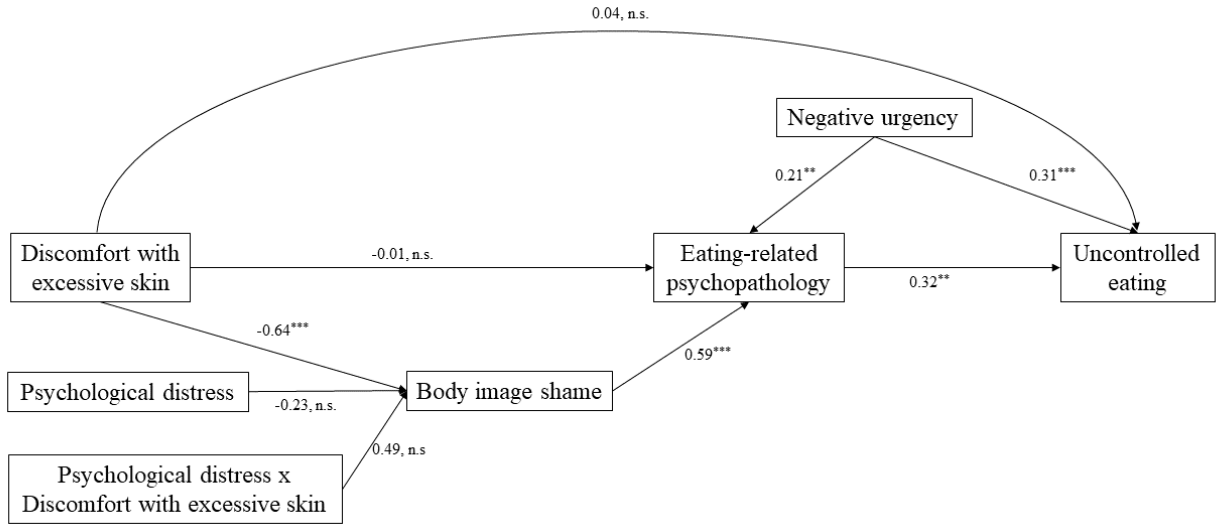
	1	2	3	4	5	6	7	8
1.SESQ_Global score	-							
2.BISS_Global score	-.565***	-						
3.EDE_Q_Global score	-.426***	.621***	-					
4.DASS_Global score	-.365***	.435***	.370***	-				
5.UPPS_Negative urgency	-.396***	.442***	.453***	.576***	-			
6.TFEQ_Uncontrolled eating	-.074	.228**	.371***	.194	.393***	-		
7.Weight regain	-.021	-.020	.137	.206**	.082	.145	-	
8.%BMIL	.169	-.030	-.176*	-.031	-.037	-.150	-.394***	-

Note: SESQ – Sahlgrenska Excess Skin Questionnaire; BISS – Body Image Shame Scale; BISS_EDE_Q – Eating Disorder Examination Questionnaire; DASS – Depression Anxiety Stress Scale; UPPS – Urgency, Premeditation, Perseverance, and Sensation Seeking scales; TFEQ – Three-Factor Eating Questionnaire; %BMIL – percentage of BMI lost; Weight regain – Increased weight (in Kg) after reaching the lowest weight since surgery.

Figure 2 depicts the final mediation model and parameters. The final model showed a good fit to our data ($\chi^2(6) = 7.561$, $p = .272$, CFI = .990, TLI = .976, RMSEA = .048, and SRMR = .019. We found that body image shame mediated the relationship between dis-comfort with excess skin and eating-related psychopathology (Effect = -.122, SE = .060, z-value = -2.025, $p = .04$). Additionally, results also suggested that the relationship between eating-related psychopathology and uncontrolled eating was

mediated by negative urgency (Effect = .067, SE = .035, z-value = 1.912, p = .05). Neither psychological distress and the interaction between psychological distress and discomfort with excessive skin moderate the relationship between discomfort with excessive skin and body image shame (Effect = -.044, SE = .057, z-value = -0.769, p = .44), (Effect = .092, SE = .093, z-value = .982; p = .33), respectively.

Figure 4-2. Graphic representation of the mediation model.



Note: with estimated standardized coefficients: the mediating role of body image shame in the relation between discomfort with excessive skin and eating-related psychopathology and the mediating role of negative urgency in the relation between eating-related psychopathology and uncontrolled eating. SESQ – Sahlgrenska Excess Skin Questionnaire; BISS – Body Image Shame Scale; BISS_EDE_Q – Eating Disorder Examination Questionnaire; DASS – Depression Anxiety Stress Scale; UPPS – Urgency, Premeditation, Perseverance, and Sensation Seeking scales; TFEQ – Three-Factor Eating Questionnaire; *p < 0.01; ***p < 0.001.

Discussion

In this study, we explored how discomfort with excessive skin, body image shame, psychological distress, eating-related psychopathology, and negative urgency interact to understand uncontrolled eating among a sample of women submitted to MBS.

Overall, our results are following our hypothesized model and most of the associations between the variables under study. Our data showed that increased discomfort with excessive skin was associated with higher levels of eating-related psychopathology, and this relationship seems to be mediated by body image shame. Contrary to our hypothesis, psychological distress was not identified as a moderator between discomfort with excess hanging skin and body image shame. Interestingly, these data suggest that body image shame was influenced by the discomfort experienced with the surplus skin resulting from MBS beyond and independently of the individual's psychological state. These findings follow previous studies arguing that body image is a multifaceted construct that is not exclusively dependent on weight loss results (Ghai et al., 2014). In other words, despite the massive weight loss and effective improvement of co-morbidities after bariatric surgery, the side-effect of excess hanging skin can continuously impact individual perception of their one's body maintaining negative thoughts and behaviours centered around appearance (Baillot et al., 2017; Biörserud et al., 2016).

Consequently, negative feelings about body image seem to not serve as a motivator for engaging in more healthy eating thoughts/behaviors but rather increase restraint eating and concerns about food, weight, and shape (Mendes et al., 2021; Oliveira et al., 2017).

Consistent with past research, our data also suggested an interplay between eating-related psychopathology, negative urgency, and uncontrolled eating. Specifically, the tendency to act rashly under negative emotions seems to be a mediator of the relationship between eating-related psychopathology and uncontrolled eating. This is, the lack of control over impulses is more important than the eating psychopathology to explain the lack of control over eating. These findings are consistent with previous studies, suggesting more support for the argument that impulse control is a central factor in disordered eating behavior (de Lourdes et al., 2021; Sarwer, Allison, et al., 2019).

While this study has significant strengths, several limitations must be acknowledged. The limited number of patients included in our study may prevent us from detecting statistically significant associations. Moreover, some concerns should be made regarding the generability of our findings. Firstly, our sample was constituted exclusively by women which compromises the generability of our findings. Although research in the field showed that women report more excess skin discomfort compared to men (Baillot et al., 2017; Biörserud et al., 2016), future research should replicate these findings with men samples. Secondly, the cross-sectional design of our study does not allow conclude causality between the variables studied. For example, past research sought to explore preoperative factors that may predict body image concerns after bariatric surgery demonstrating that postoperative body image concerns were associated with low self-esteem preoperatively (Pona et al., 2015). In this way, bariatric surgery candidates presenting psychological risk factors may be more vulnerable to body image shame after bariatric surgery, which can induce disordered eating-behaviors. Longitudinal studies are mandatory to promote a more in-depth understanding of the body image shame construct. Lastly, in this study, we assessed discomfort with excessive skin reported by participants which allows us to explore the subjective experience of patients – an aspect often overlooked during treatments. Yet, although understanding patients' subjective experience represents important clinical implications it can, not rarely, vary from the objective experience. Thus, future investigations exploring differences between self-reported and objective measurements of excess skin would be useful to study whether a distortion of body image is related to the discomfort caused by excessive hanging skin.

Results of our study bring novelty to the field demonstrating that, in women submitted to bariatric surgery, the discomfort with excessive skin in patients with body image shame leads to more eating-related psychopathology which – associated with more negative urgency – prompts uncontrolled eating.

The evidence provided in this study strongly supports the clinical impact of excessive skin and body image shame on uncontrolled eating, bringing helpful insight for multidisciplinary teams committed to providing care to bariatric patients struggling with body image and eating difficulties. Future investigations should explore the impact of intervention programs targeting modifiable factors, informing about the potential impacts of excess skin on their daily life, and promoting realistic expectations, body acceptance, and healthy eating behaviors to optimize the results of bariatric surgery.

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PART III

Assessment of Loss of Control Eating Post-Metabolic Bariatric Surgery

Chapter 5

The Utility of DSM-5 Indicators of Loss of Control Eating for the Bariatric Surgery Population

Chapter 6

Understanding Loss of Control over Eating in a Portuguese Academic Sample and Patients Undergoing Metabolic Bariatric Surgery

Chapter 5

The Utility of DSM-5 Indicators of Loss of Control Eating for the Metabolic Bariatric Surgery Population

This chapter was adapted from the publication:

Conceição, E., de Lourdes, M., Peixoto, A., Pinto-Bastos, A., Goldschmidt, A., & Vaz, A. (2020). The utility of DSM-5 indicators of loss of control eating for the bariatric surgery population. *European Eating Disorders Review*, *28*(4), 423–432.

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Abstract

Introduction: This study investigated the utility of DSM-5 indicators of loss of control (LOC) eating in adult bariatric surgery patients who presented with binge-eating episodes.

Methods: Participants (all women) were 40 preoperative and 28 postoperative bariatric surgery patients reporting objective binge-eating (OBE), 46 preoperative, and 52 postoperative with subjective binge-eating (SBE), 53 bulimia nervosa (BN) controls, and 34 binge-eating disorder (BED) controls. Face-to-face Eating Disorder Examination interviews and questionnaires were administered. ANOVAS, *T*-test, χ^2, and regressions compared the groups in terms of LOC indicators endorsed, and to explain disordered eating psychopathology.

Results: The indicator most reported by bariatric patients with OBE was "*feeling disgusted*" (90% and 75% of pre-and postoperative groups), and the least endorsed was "*eating alone*" (40% and 28.6%). These indicators were reported by >84.9% of the BN and BED. Bariatric patients (pre- or post-surgery) with OBE only reported a higher number of indicators than patients with SBE only ($t(150) = 2.34$, $p = .021$). A higher number of indicators reported was associated with increased eating-related psychopathology ($F(1,134)=31.06$, $p<.001$), but only for the post-surgery patients.

Discussion: The LOC indicators proposed by DSM-5 need to be refined or revised for the bariatric population.

Keywords: Binge-eating episodes, DSM-5 Loss of control indicators, Loss of control, metabolic bariatric surgery.

Introduction

Binge-eating is a core symptom of several eating disorders including binge-eating disorder (BED) and bulimia nervosa (BN) (American Psychiatric Association, 2013a). The Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) defines a binge-eating episode as the consumption of an objectively large amount of food in a discrete timeframe, accompanied by a sense of loss of control over eating (LOCE) (American Psychiatric Association, 2013a). Although both the consumption of large amounts of food and the experience of LOCE during the episode are required by the DSM-5 in the conceptualization of binge-eating episodes, recent investigations suggested that LOCE – characterized as the feeling of being unable to stop eating or control the amount of food eaten regardless of the amount ingested – should be considered the core feature of binge-eating (Goldschmidt, 2017).

The DSM-5 describes five indicators purported to reflect impaired control over eating. Although developed based on anecdotal rather than empirical evidence, these indicators are intended to assist diagnosticians in determining the presence of LOCE during binge-eating episodes. The indicators include eating much more rapidly than normal; eating until feeling uncomfortably full; eating large amounts of food when not feeling physically hungry; eating alone because of embarrassment over how much one is eating; and feeling disgusted, guilty, or depressed after binge eating (American Psychiatric Association, 2013a). Although recent studies have provided empirical support for these LOCE criteria, research on the efficacy and validity of these indicators presents conflicting findings. A retrospective study from White & Grilo (2011) showed that each of the five indicators of LOC has a high predictive value regarding binge-eating in individuals with BN and BED. According to the authors, the indicators "eating large amounts of food when not feeling physically hungry" and "eating alone because of embarrassment over how much one is eating" hold the best overall prognostic value for correctly identifying binge-eating. Findings also reveal that "eating alone because of embarrassment over how much one is eating" acts as the best inclusion criterion overall, that is, the presence of this indicator seems to be able to predict with greatest precision the presence of binge-eating. In turn, "feeling disgust, guilt, or depression after binge eating" was the best exclusion criteria, indicating that the absence of this indicator was associated with the absence of a binge-eating. Another study, using a momentary ecological assessment design, suggested that, among adults with obesity, all indicators of LOCE except "eating much more rapidly than normal" were uniquely associated with self-reported binge-eating (Goldschmidt et al., 2018). However, other authors found that the indicators of LOCE have

low internal consistency and nonsignificant associations with distress and binge-eating diagnosis (Klein et al., 2016).

The construct of LOC over eating has also been widely investigated in bariatric populations, primarily due to its association with poor weight and psychological outcomes (Conceição & Goldschmidt, 2019). After surgery, patients experience anatomical and physiological changes that dramatically alter their ingestion capacity. As a result, eating objectively large amounts of food in one sitting is difficult, particularly in the initial post-operative stage (Meany et al., 2014). Nevertheless, a significant number of patients continue to experience feelings of LOCE over smaller amounts of food (Ivezaj et al., 2017a; Meany et al., 2014), which is associated with poorer weight loss outcomes (Conceição, Mitchell, Pinto-Bastos, et al., 2017) and elevated psychological distress(Colles et al., 2008; Ivezaj et al., 2017a) to a similar extent as binge eating involving large amounts of food (Ivezaj et al., 2017a). As time since surgery elapses, the influence of postoperative LOC eating on weight outcomes also becomes more pronounced. Indeed, recent research shows that concurrent postoperative LOCE is the best predictor of poor weight outcomes (Smith, Orcutt, Steffen, Crosby, Cao, Garcia, Mitchell, et al., 2019).

Considering the aforementioned assumptions, a rising number of studies have used the terminology proposed in the Eating Disorder Examination (Fairburn et al., 2014) to distinguish objective binge-eating episodes (OBE – eating objectively large amounts of foods while experiencing LOCE), and subjective binge-eating episodes (SBE – experiencing LOCE while eating an amount of food that is not unambiguously large but is considered excessive by the respondent). Different authors found similarities between these two types of binge-eating episodes with respect to eating disorder psychopathology and psychological impairment in both clinical and non-clinical samples (Latner et al., 2007; Mond et al., 2010). Recent research showed that individuals undergoing bariatric surgery who meet all DSM-5 criteria for BED except for eating amounts of food that are not objectively large, are comparable to those with a full-blown BED diagnosis in overall eating-disorder psychopathology and depressive symptoms (Ivezaj, Barnes, et al., 2018).

Given the prevalence and clinical significance of LOCE in bariatric surgery outcomes (Conceição & Goldschmidt, 2019; Conceição et al., 2015a; M. White et al., 2010), as well as its complexity and variability in phenotypic presentation, clarifying the nature of this construct in the bariatric population would present important advances for identification, evaluation, and treatment of patients at high risk for poor weight and psychological outcomes after surgery (Conceição & Goldschmidt, 2019; Goldschmidt et al., 2016). Therefore, the present study sought to validate the DSM-5 indicators of LOCE

in patients undergoing bariatric surgery and to compare their presentation in the DSM-5 diagnostic groups for which these indicators were proposed (BED), or in which LOCE is the central criteria (BN). Specific aims are to 1) explore the frequency of these indicators in bariatric patients pre- and post-surgery; 2) compare frequency rates across different diagnostic groups, including non-bariatric patients with BN and BED diagnoses, and bariatric patients reporting OBE and SBE episodes; and 3) investigate the degree of eating-related psychopathology as a function of the number of LOCE indicators endorsed during binge-eating episodes.

Methods

Participants and procedure

The present cross-sectional study used data collected from larger studies conducted by the research team. These studies were carried out in two main hospital centers in the north and south of Portugal. These studies assessed bariatric patients pre-surgery and post-surgery (see (Conceição, Mitchell, Pinto-Bastos, et al., 2017; Conceição, Mitchell, Vaz, et al., 2014; Pinto-Bastos et al., 2018), as well as patients with BN or BED presenting for eating disorders treatment in a specialized care center and assessed in their first medical appointment (Vaz et al., 2013). For this work, four distinct groups of patients that presented with OBE episodes were included: (1) pre-bariatric surgery patients (Pre_Bari group); (2) post-bariatric surgery patients with 12 months or more since surgery (Post_Bari group); (3) and (4) patients with a diagnosis of BN or BED, respectively. Patients from these four groups are required to report at least one OBE in the previous month, although OBE might co-occur with SBE for some individuals. For these four groups, the indicators tested are those reported during OBE episodes. Finally, (5) a fifth group of bariatric patients, including patients pre- and post-surgery, presenting only with SBE episodes (and not reporting OBE) was investigated to better characterize the phenomenon of LOCE (SBE_only group). This SBE_only group of patients was compared to a subgroup of patients from the Pre_Bari and Post_Bari groups who reported OBE only (OBE_only group). For these two groups (SBE_only and OBE_only) there is no overlap of OBE and SBE, i.e., patients in the SBE_only group did not report any OBE and patients within the OBE_only group did not report SBEs.

Participants were interviewed by trained psychologists and completed a set of self-report measures. Participants were informed about the confidentiality of the data collected and signed an

informed consent form before beginning the interview. All aspects of the study design were approved by the review boards of the institutions involved.

Measures

Sociodemographic questionnaire: assessed self-report sociodemographic (age, gender, educational level, marital and professional status), and anthropometric information (height and current weight) measured in the corresponding medical appointment.

Face-to-face clinical interview*:* The diagnostic items of the *Eating Disorders Examination, 17th Ed.* (Fairburn et al., 2014) were used to assess OBE and SBE episodes. The EDE is an investigator-based interview composed of mandatory and supplementary questions designed to help respondents recall whether they had engaged in binge-eating episodes in the four weeks before the assessment. Binge-eating episodes are defined based on two criteria: 1) the experience of LOCE, and 2) the amount of food ingested. When assessing the experience of LOCE, the investigator asked about the endorsement on each of the LOCE indicators and rated the binge eating (OBE or SBE) episode according to the amount of food ingested. When patients reported both OBE and SBE, the investigator asked about the LOCE indicators associated with each episode separately.

Self-report measure: The Eating Disorder Examination – Questionnaire (6.0), EDE-Q V6 (Fairbun & Beglin, 2008; Machado et al., 2014) is a 28-item self-report version of the Eating Disorder Examination interview used to evaluate core eating-related psychopathology focusing on the past 28 days. This questionnaire generates four subscales scores: shape concern, weight concern, eating concern, dietary restraint, and a combined global severity score. Higher scores indicated greater psychopathology. Internal consistency was excellent for all samples (Cronbach's $\alpha_{Pre_Bari} = .89$; $\alpha_{Post_Bari} = .9$; $\alpha_{BN} > .94$; $\alpha_{BED} > .9$). Several studies showed that the EDE-Q possesses excellent reliability scores for different populations (Berg et al., 2012), strong correlations with similar constructs suggesting excellent convergent validity in different population (Berg et al., 2012) including in bariatric patients (Parker et al., 2016), and can discriminate between cases and control groups showing great discriminant validity(Berg et al., 2012; Machado et al., 2014).

Statistical Analysis

The IBM® SPSS® Statistics 24.0 was used for data analyses. Descriptive statistics examined sociodemographic and clinical characteristics. The four groups presenting with OBE episodes (Pre_Bari, Post_Bari, BN, and BED) were compared on demographic and eating-related psychopathology, using Univariate Analyses of Variance (ANOVA). Chi-square test was also used to test for the group differences in the presence/absence of each of the LOC indicators. Independent T-test investigated differences in the number of LOC indicators reported by bariatric patients presenting only OBE episodes vs. bariatric patients presenting only SBE episodes. Lastly, to test if the number of LOC indicators reported was correlated with the degree of eating-related psychopathology for pre- and post-bariatric patients, separately, logistic linear regressions were used. Pairwise deletion was used to deal with missing data and p values <.05 were considered significant.

Results

Characterization of patients reporting OBE: Pre-Bari, Post-Bari, BN, and BED

The sample of patients presenting OBE (with or without SBE) includes a total of 155 participants. These participants included 40 individuals (25.8%) from the Pre_Bari group, 28 (18.1%) from the Post_Bari group, 53 (34.25%) from the BN group, and 34 (21.9%) from the BED group. All patients were women.

Generally, BN and BED patients were younger, and the majority were single, while most bariatric patients were married or lived with a partner.

Table 1 displays the detailed sociodemographic information for each diagnostic group.

Table 5-1. Socio-demographic and surgery-related characteristics of participants presenting only OBE.

	Pre-surgery (n=40) No. (%); Mean (S.D.)	Post-surgery (n=28) No. (%); Mean (S.D.)	BN (n=53) No. (%); Mean (S.D.)	BED (n=34) No. (%); Mean (S.D.)
Age	42.25 (12.12)	45.93 (9.46)	28.67 (9.22)	29.50 (8.54)
Marital status				
Single	9 (22.5)	3 (10.7)	26 (50.0)	23 (67.6)
Married/Live with partner	24 (60)	21 (75)	20 (38.4)	9 (26.5)
Separated/divorced/ widowed	7 (17.5)	4 (14.2)	6(11.5)	2 (5.9)
Employment situation				
Employed	25 (62.5)	11 (39.3)	32 (61.5)	22 (64.7)
Unemployed	11 (27.5)	12 (42.9)	3 (5.8)	1 (2.9)
Retired	2 (5.0)	5 (17.9)	1 (1.9)	0(0)
Student	2 (5.0)	0(0)	16 (30.8)	11 (32.4)
Education level				
Basis (4years) or less	24(60.0)	16(72.2)	n.a.	n.a.
9-12 years	5 (12.5)	2 (9.1)	n.a.	n.a.
Uncompleted graduated level	2 (5.0)	2 (9.1)	n.a.	n.a.
Completed graduated level	8 (20.0)	2 (9.1)	n.a.	n.a.
Post-graduated level	1 (2.5)	0(0)	n.a.	n.a.
Type of surgery				
Gastric band	-	13 (46.4)	-	-
Gastric bypass	-	13 (46.6)	-	-
Gastric sleeve	-	2 (7.1)	-	-
Months since surgery				
	-	29.57 (22.26)	-	-

Note: Pre-surgery – Pre-surgery group; Post-surgery – Post-surgery group; BN – Bulimia Nervosa group; BED – Binge eating disorder group; n.a. – Information not available.

Comparisons between the groups of patients reporting OBE on eating disorder psychopathology

Table 2 presents the mean scores and standard deviations of weight and disordered eating aspects. On average, the Post_Bari group reported fewer OBE episodes than the BN and BED groups. The Pre_Bari group also reported fewer OBE episodes compared with BN group. Concerning the number of the LOCE indicators reported by patients in each group, the Pre_Bari and Post_Bari groups endorsed, on average, significantly fewer indicators compared to the BN and BED groups. Pre_Bari and Post_Bari groups did not differ statistically from each other although Post_Bari patients endorsed, on average, less than 3 indicators, and overall fewer indicators than the Pre_Bari group.

Regarding the EDE-Q scores, the bariatric groups (Pre_Bari and Post_Bari) scored lower on restraint eating, shape and eating concerns, and general eating-related psychopathology (global score) than the BN and BED groups. Concerning the weight concern subscale, only the Post_Bari group scored significantly lower than the BN and BED group.

Table 5-2. Comparisons between the groups with OBEs (Pre_Bari, Post_Bari, BN, and BED) on weight and disordered eating aspects.

	Pre_Bari N=40	Post_Bari N=28	BN N=53	BED N=34	F(df) ηp^2	Post-hoc comparison
Clinical information M(SD)						
BMI	43.92 (5.56)	36.64 (5.50)	22.71 (4.30)	27.65 (7.73)	115.31*** (3,149) .7	Pre_Bari > Post_Bari, BED, BN
OBE	11.45 (13.37)	8.18 (9.70)	25.51 (28.36)	20.09 (24.40)	5.34** (3,151) .1	BN, BED > Post_Bari;BN > Pre_Bari
Number of LOC indicators	3.78 (0.97)	2.89 (1.45)	4.66 (0.88)	4.79 (0.41)	28.14*** (3,151) .36	BN, BED > Pre_Bari, Post_Bari
EDE-Q M(SD)						
Restraint	1.63 (1.33)	1.53 (1.28)	3.71 (1.54)	2.76 (1.49)	19.00*** (3,131) .3	BN, BED > Pre_Bari, Post_Bari; BN > BED
Shape concern	4.12 (1.27)	3.27 (1.71)	4.96 (1.00)	4.84 (1.35)	10.5*** (3,131) .2	BN, BED > Pre_Bari, Post_Bari;
Eating concern	1.93 (1.48)	1.64 (1.67)	3.95 (1.37)	3.67 (1.40)	21.63*** (3,132) .33	BN, BED > Pre_Bari, Post_Bari
Weight concern	4.22 (1.02)	3.12 (1.68)	4.60 (1.31)	4.50 (1.38)	6.63*** (3,132) .13	BN, BED > Post_Bari
Total score	2.94 (0.90)	2.39 (1.35)	4.29 (1.08)	3.94 (1.13)	20.24*** (3,132).32	BN, BED > Pre_Bari, Post_Bari

Note: Pre-surgery – Pre-surgery group; Post-surgery – Post-surgery group; BN – Bulimia Nervosa group; BED – Binge eating disorder group; BMI - Body mass index; OBE – Objective bulimic episode; LOC indicators – Percentage of patients endorsing each of the loss of control indicators; EDE-Q – Eating Disorder Examination Questionnaire; ***$p \leq .001$.

Table 3 displays the frequency of patients reporting each of the LOCE indicators for each type of eating episode (OBE vs. SBE). Overall, the LOCE indicator most reported by the two groups was "*feeling disgust, guilt, or depression after binge eating*," and the least reported was "*eating alone because of embarrassed over how much one is eating* ". The proportion of patients endorsing each of the LOCE indicators did not differ significantly as a function of the binge-eating episode (OBE vs. SBE). However, there was a statistically significant difference on the mean number of LOCE indicators endorsed (t (150) = 2.34, p = .021, Cohen's d = .39). Patients presenting OBE episodes reported a higher mean number of LOCE indicators (M = 3.37, SD = 1.32) than patients presenting SBE episodes (M = 2.87, SD = 1.24). OBE and SBE groups did not differ on eating-related psychopathology scores (EDE-Q global score; t(124) = .517, p=.606).

Table 5-3. Comparisons between groups on each of the indicators for loss of control eating.

	Comparison between the groups with OBE						Comparison between the groups with OBE only and SBE only		
	Pre_Bari n (%)	Post_Bari n (%)	BN n (%)	BED n (%)	$\chi^2(3)$ (Phi)	Post-hoc comparison	OBE n (%)	SBE n (%)	χ^2 (1)
Eating much more rapidly than normal	33(82.5)	17(60.7)	45(84.9)	33(97.1)	14.46** (.31)	Pre_Bari, BN, BED > Post_Bari	41(75.9)	63 (64.3)	2.183
Eating until feeling uncomfortably full	32(80.0)	15(53.6)	50(94.3)	33(97.1)	28.11*** (.42)	Pre_Bari; BN, BED > Post_Bari; BED > Pre_Bari	37(68.5)	53(54.1)	3.005
Eating large amounts of food when not feeling physically hungry	34(85.0)	20(71.4)	50(94.3)	34(100.0)	15.27** (.31)	BN, BED > Post_Bari; BED > Pre_Bari	41(75.9)	61(62.2)	2.952
Eating alone because of embarrassed over how much one is eating	16(40.0)	8(28.6)	51(96.2)	29(85.3)	57.60*** (.61)	BN, BED > Post_Bari; BN, BED > Pre_Bari;	19(35.2)	21(21.4)	3.398
Feeling disgust, guilt, or depression after binge eating	36(90.0)	21(75.0)	51(96.2)	34(100.0)	14.77** (.31)	BN, BED > Post_Bari	44(81.5)	83(84.7)	.261

Note: Abbreviations: BED, binge eating disorder group; BMI, body mass index; BN, bulimia nervosa group; EDE-Q, eating disorder examination questionnaire; LOCE indicators, percentage of patients endorsing each of the loss of control indicators; OBE, objective bulimic group; post-surgery, post-surgery group; pre-surgery, pre-surgery group; SBE, subjective bulimic group.**p ≤ .01; ***p ≤ .001.

Psychopathology as a function of the number of LOCE indicators

Lastly, a linear regression investigated psychopathology as a function of the number of LOCE indicators for all bariatric patients including patients with OBE and SBE. This model was tested for Pre_Bari and Post_Bari groups separately. The results revealed that, for the Pre_Bari group, the model was not statistically significant suggesting that the number of LOCE indicators endorsed is not associated with the degree of eating disorder psychopathology (EDE-Q global score; F (1,74)=.050, p = .823, β = .025). However, for the Post_Bari group, despite of the small effect size, the model showed to be statistically significant with a positive direction, this is, a greater number of LOCE indicators was significantly associated with greater eating disorder psychopathology (EDE-Q global score: F (1,62) = 7.710, p = .007, β = .303, $_{adj}R^2$ = 0.112).

Discussion

The present study sought to validate the LOCE indicators proposed by the DSM-5 among adult patients undergoing bariatric surgery. Compared to BN and BED patients, bariatric patients (pre- and post-surgery) endorsed fewer LOCE indicators during OBE episodes. Participants in the Pre_Bari group, compared to the Post_Bari group, reported an average of more than three LOCE indicators (3.78) – the reference value required by the DSM-5 to identify LOCE eating in a binge-eating episode for the diagnosis of BED. Post-surgery patients report, on average, fewer than 3 indicators (2.89).

In line with findings from Ivezaj et al. (2017), *"feeling disgust, guilt, or depression after binge eating"* was the LOC indicator most reported by bariatric surgery patients, although the Post_Bari group presented significantly lower values compared to the BN and BED groups. This was also the most frequently reported indicator among bariatric patients with OBE and SBE. This supports previous research suggesting that binge-eating episodes, regardless of size, are associated with some level of distress and psychopathology (Conceição et al., 2018).

The indicators "*eating until feeling uncomfortably full*" and "*eating much more rapidly than normal"* were reported by nearly half of the Post_Bari patients. However, in the Pre_Bari group, the percentage of patients endorsing these LOC indicators was like patients with BN and BED. After surgery, a considerable number of patients present with gastrointestinal problems such as plugging or dumping which can result in involuntary or, in some cases, self-induced vomiting to alleviate physical discomfort (Conceição et al., 2013). To prevent these complications, patients are continuously encouraged to avoid

eating too much or too fast. Thus, it is not unexpected that this group of patients may not endorse these indicators as much as the other diagnostic groups.

Finally, "*Eating alone because of embarrassed over how much one is eating"* was the least reported LOCE indicator by the bariatric groups (Pre- and Post_Bari) with only 28.6% of post-surgery patients reporting this indicator during OBE episodes. These findings are consistent with a recent study examining LOCE severity following sleeve gastrectomy in which this same LOC indicator was the least frequently reported by participants (Ivezaj et al., 2017b). Recent research with BN and BED individuals suggested that this indicator acts as the best general inclusion criterion, this is, the presence of this indicator seems to be able to most accurately predict the presence of a BED diagnosis (White & Grilo, 2011). Thus, these findings suggest that the indicator "*eating alone because of embarrassed over how much one is eating"* seems to be a key indicator in identifying eating-related psychopathology among patients with OBE. Consistently, we showed that patients who endorsed a greater number of indicators, thus with greater chances of reporting the indicator for eating alone, scored higher on measures of eating-related psychopathology.

We also found that each of the LOCE indicators was similarly reported by bariatric patients (pre- and post-surgery) presenting with OBE only or SBE only. However, the mean number of indicators endorsed differed significantly with bariatric patients presenting with OBE only reporting more indicators compared with bariatric patients presenting with SBE only. Previous research found that OBE episodes are associated with a greater degree of LOCE experienced (Conceição et al., 2018), and it could be that the number of LOC indicators endorsed during a binge-eating episode is a function of the degree of LOCE experienced. The same authors also found that OBE episodes in bariatric patients are associated with increased eating-related psychopathology compared to SBE and that this relationship is mediated by the degree of LOCE experienced. Accordingly, we found that patients with OBE endorse more LOCE indicators and that a higher number of LOCE indicators is associated with increased eating-related psychopathology for post-bariatric patients. Another hypothesis could be that the content of the indicator may not be appropriate for episodes in which a large amount of food is not eaten, or for post-bariatric patients. For instance, embedded in the indicator "*Eating large amounts of food when not feeling physically hungry*" is the ingestion of a large amount of food. This item could be particularly problematic for post-surgical patients given that they may be physically unable to accommodate large amounts of food in their new stomach pouch (Conceição et al., 2015). Alternatively, when reflecting on SBEs, patients could see this item as irrelevant because of the "large amounts of food" prompt. However, it should be noted that although SBEs are considered "not large" by clinical rating standards,

they are considered large by the respondent. In fact, our results show that the indicator "*Eating large amounts of food when not feeling physically hungry*" is one of the three indicators most reported during SBEs (by 62.2%) and OBEs. Moreover, the percentage of patients reporting each of the indicators follows a similar distribution during OBEs and SBEs (with the most frequently reported being "*Feeling disgust, guilt, or depression after binge eating*" and the least frequently reported being "*Eating alone because of embarrassed over how much one is eating*").

Finally, it was notable that a greater number of indicators was related to greater eating disorder psychopathology in post- but not pre-surgery patients. One reason for this finding might be that bariatric candidates usually present with an overall disordered eating patter in which binge eating episodes are not the only problematic eating behavior. Bariatric candidates are known to engage in episodes of overeating under emotional states, eating behind satiation or when not hungry, night eating or evening hyperphagia, grazing throughout the day or skipping meals, eating out at restaurants, or eating fast food (Conceição et al., 2015; Mitchell et al., 2015). These varied and often unspecified problematic eating behaviors may account for the high level of eating disorder psychopathology often seen in the preoperative population. However, their eating pattern is known to normalize after surgery and the surgery itself helps patients to limit their food intake. Additionally, patients are frequently reminded by the multidisciplinary team about what and how much they can eat and are provided with strategies to organize their eating patterns. Notwithstanding, the experience of LOCE is still possible (Conceição et al., 2015), and it could be that LOCE eating episodes, which implicate the endorsement of the LOCE indicators, are the only problematic eating behaviors presented by these patients. Future research should test these hypotheses.

Taken together, these findings suggest that some of the five DSM-5 LOCE indicators may need to be adjusted for the post-bariatric surgery population. Notwithstanding, the larger the number of LOCE indicators endorsed, the greater the eating disordered psychopathology scores among post-bariatric patients. This suggests that, in the presence of a greater number of LOCE indicators, patients may be more likely to present with psychopathology warranting an eating disorder diagnosis. Thus, we suggest that professionals should exercise caution when using such indicators to assess and identify LOCE episodes among post-surgery patients but be particularly attentive to patients endorsing a large number of indicators. As a final remark, our results also provide evidence for the appropriateness of the DSM-5 LOC indicators for patients with BED, adding to the few studies supporting the validity of these indicators in BED (Goldschmidt et al., 2018b; White & Grilo, 2011). While these indicators are only

proposed by the DSM-5 for the diagnosis of BED, our results also support their use to assess LOCE in patients with BN.

Some potential limitations in this study should be considered when interpreting the findings such as the small sample size and the fact that our sample includes only female patients which limits the generalizability of the results. Further, results were cross-sectional and included separate pre- and post-surgery groups, thus the findings cannot be used to infer the prognostic value of the LOCE indicators during the surgical process. Finally, a few studies have shown inconsistencies in the factor structure of the EDE-Q in bariatric surgery samples. Some research suggests that a twelve (Hrabosky et al., 2008) or seven-item (Grilo et al., 2013) short version of the EDE-Q (resulting in four or three subscales, respectively) would fit better to the bariatric population. In the current study we used the original structure of 28 items and 4 four subscales proposed by Fairbun & Beglin (2008), thus caution should be used when interpreting the results.

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Chapter 6

Loss of Control Eating (LOCE) in Academics and Post-Bariatric Surgery Patients: Psychometric Properties of the LOCE Scale

This chapter was adapted from the:

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Abstract

Introduction: Loss of control eating (LOCE) is crucial in understanding eating disorders and poor weight loss outcomes post-bariatric surgery. The LOCE Scale (LOCES) and its brief version (LOCES-B) are comprehensive tools for assessing LOCE. This study examines the psychometric properties of LOCES and LOCES-B in academic and post-bariatric surgery women.

Methods: A cross-sectional study included 341 individuals from an academic context (341=246(72.1%) women and 95(27.9%) men) and 262 women post-bariatric surgery.

Results: LOCES/LOCES-B demonstrated robust validity evidence in both samples, showing better adjustment for the bariatric surgery sample compared to the academic sample. LOCES/LOCES-B were invariant across sex, sample (academics versus bariatric surgery patients), and time (12-, 18-, and 24 months post-surgery). LOCES/LOCES-B scores correlated with eating disorder psychopathology, depression, self-criticism, and emotion regulation difficulties. Scores at 12 months post-surgery predicted BMI at 18 months, indicating predictive validity.

Discussion: LOCES/LOCES-B are reliable and valid for assessing LOCE in academics and post-bariatric surgery women. The study highlights the clinical importance of LOCE and its role in predicting poor weight loss outcomes post-surgery, advocating for early use of LOCE measures in assessment and intervention.

Keywords: LOCES, loss of control eating, self-report measure, psychometric properties.

Introduction

Loss of control eating (LOCE) is described as the subjective experience of an inability to self-regulate eating behavior, irrespective of the food intake, including the feeling that one cannot stop eating or control how much one eats (Latner et al., 2014). Within the current Diagnostic and Statistical Manual of Mental Disorders criteria, experiencing LOCE and consuming a significantly large amount of food in a discrete period are considered the two features defining binge eating – a core behavior across several eating disorders (American Psychiatric Association, 2013).

Research consistently highlights the clinical significance of LOCE, emphasizing its role as a primary indicator of eating disorder psychopathology and psychological impairment across various demographic and clinical groups, including adults (Goldschmidt et al., 2015) and patients under treatment for severe obesity (Conceição et al., 2018). LOCE is highly prevalent among individuals with overweight/obesity and in those undergoing bariatric surgery (Smith, Orcutt, Steffen, Crosby, Cao, Garcia, & Mitchell, 2019). Within these patients, converging evidence indicates that LOCE following surgery is related to less weight loss or weight regain (Smith, Orcutt, Steffen, Crosby, Cao, Garcia, & Mitchell, 2019). Additionally, LOCE has been consistently associated with broader transdiagnostic constructs of disordered eating, including depressive symptoms, emotion dysregulation, self-criticism, and negative urgency (Conceição et al., 2022). Based on this growing body of evidence substantiating the clinical significance of LOCE, authors have been advocating for the need to conceptualize and assess LOCE in a continuous manner rather than dichotomously (Conceição et al., 2018).

The Loss of Control Over Eating Scale (LOCES) was developed as a comprehensive tool to assess the multidimensional nature of LOCE across clinical and non-clinical populations (Latner et al., 2014). Its 7-item brief version, LOCES-B, was derived to facilitate expedited applications (Latner et al., 2014). Both versions have demonstrated robust psychometric properties and efforts have been made to translate the LOCES into different languages and cultural contexts (He et al., 2021; Sahlan et al., 2021) and within samples with varied degrees of psychopathology (He et al., 2021; Stefano et al., 2016; Vannucci & Ohannessian, 2018).

Despite the widespread use of LOCES, its validity within the Portuguese population and metabolic bariatric surgery treatment remains unexamined. This paper aims to assess the psychometric properties of the Portuguese version of LOCES and LOCES-B in academics and patients undergoing metabolic bariatric surgery by examining two types of validity evidence: one related to the internal structure, the other based on the relations to related variables, in both an academic sample (AS) and a sample of post-metabolic bariatric surgery patients (MBSS). The following hypotheses were proposed:

H1: The three-factor structure of the LOCES, and the one-factor structure of the LOCES-B will demonstrate a good fit for AS and MBSS, confirming its original dimensionality; H2: The LOCES/LOCES-B will demonstrate adequate evidence validity in terms of the reliability of the scores; H3: The LOCES/LOCES-B will show measurement invariance across sex, samples (i.e., AS, and MBSS) and longitudinally (i.e., 12-, 18-, and 24-months post-bariatric surgery); H4: The LOCES/LOCES-B will demonstrate adequate validity evidence based on the relation to other variables, namely convergent and predictive validity.

Methods

Sampling

This cross-sectional study included participants from two different samples obtained via a non-probability convenience sampling method: individuals sourced from an academic context (AS) and patients who underwent metabolic bariatric surgery (MBSS). The AS sample recruitment was conducted on a university campus in northern Portugal where the academic community received study invitations. No exclusion criteria were used.

Regarding, the MBSS participants, they were individuals coming in for their 12-month appointment post-metabolic bariatric surgery at University Hospital Center of São João. Inclusion criteria included: women aged 18-65 years who underwent Roux-en-Y Gastric Bypass or Gastric Sleeve and were 10 to 24 months postoperative. Exclusion criteria included: being under weight-loss medications, having acute psychiatric or medical problems, pregnancy or lactation, and illiteracy.

Data Collection

Regarding the AS, a study invitation was sent via official email channels and included the web address for the questionnaires hosted on Google Docs. Social media tools were used to expand the sample. Participants entered a raffle draw for a €20 voucher after survey completion to enhance response rates.

MBSS participants were contacted by phone and invited to participate in the study. A blind randomization process was used to allocate participants into intervention and control groups. The

intervention group received an online program designed to prevent weight regain, while the control group received standard hospital care. Assessments were conducted at baseline (approximately 12 months after bariatric surgery), 6-, and 12-month intervals. Self-report measures were completed online via Google Forms.

Participants received comprehensive information about the study's objectives, and its voluntary and confidential nature, and provided informed consent. The studies were approved by the ethical committees from the respective institutions.

Measures

Sociodemographic and Anthropometric Questionnaire – Sociodemographic variables (age, gender, educational level, marital and professional status), and anthropometric information (current and lowest weight, BMI).

The Loss of Control over Eating Scale (LOCES) (Latner et al., 2014) **–** The LOCES consists of a 24-item self-report measure to assess the degree of LOCE. Responses ranged from 1 ("*never*") to 5 ("*always*") focuses in the past 28 days. The items are organized into a total score and three factors: (1) the behavioral aspects of LOCE (e.g., "*I kept eating although I was no longer hungry*"), (2) the cognitive/dissociative aspects of LOCE (e.g., "*I could not concentrate on anything other than eating*"), and (3) the positive/euphoric aspects of LOCE (e.g., "*While eating, I felt a sense of relief or release*"). A 7-item brief version (LOCES-B) was also proposed. Higher scores indicate higher LOC eating. The Portuguese version of LOCES using a back-translation procedure: LOCES was initially translated from English to Portuguese by a bilingual expert familiar with the LOCE construct. This translated version was then independently translated back into English by another bilingual expert who had no prior knowledge of the original version. The two English versions were compared to identify discrepancies, which were then discussed and resolved to refine the Portuguese translation. The Portuguese version of LOCES is present as supplementary material.

Eating Disorder-15 (ED-15) (Rodrigues et al., 2019) – The ED-15 is a 15-item self-report measure that assesses behaviors, attitudes and feelings associated with eating disorders. This questionnaire generates a combined global severity score, and two subscales' scores: Weight, and Body

Shape Concern, and Eating Concern. Higher scores reveal greater eating disorder psychopathology. For the present study, only the 10 items that constitute the total score and subscales were used.

Depression, Anxiety and Stress Scales (DASS*)* (Lovibond & Lovibond, 1995) – The DASS is a self-report measure that assesses the magnitude of three negative emotional states: depression, anxiety, and stress. Higher scores express greater distress. For this study, only the 7-item depression scale of this questionnaire was.

Urgency, Premeditation, Perseverance, and Sensation Seeking scales (UPPS-NU) (Whiteside et al., 2005) – The UPPS-NU, a 12-item subscale of negative urgency was used, that assess an individual's tendency to surrender to strong impulses, particularly under situations of negative emotions. Higher scores express more negative urgency.

Difficulties in Emotion Regulation Scale Short-form (DERS-SF) (Veloso et al., 2011) – The DERS-SF is an 18-item self-report measure that assesses clinically relevant difficulties in emotion regulation through a total score and six dimensions: nonacceptance of emotional response, difficulties engaging in goal-directed behavior when distressed, impulse control difficulties, lack of emotional awareness, limited access to effective emotion regulation strategies, and lack of emotional clarity. Higher scores indicate more difficulties with emotion regulation. For the present study, only the total score was used.

Forms of Self-Criticizing and Reassuring Scale (FSCRS) (Castilho & Gouveia, 2011) – The FSCRS is a 22-item self-report measure that assesses how people tend to self-criticize and self-reassure themselves, towards failure and error situations. It generates three subscales: inadequate self, reassured self, and hated self. Higher scores express more self-criticism.

Data Analysis

The statistical analysis was conducted using the program *R* (R Core Team, 2024), via the integrated development environment, *RStudio* (Posit Team, 2024). The kurtosis (*ku*) using the "sample excess" method and the skewness (*sk*) using the "sample" method, both were estimated using the *PerformanceAnalytics* package (Peterson & Carl, 2020). Severe univariate normality violations were considered for absolute values of $|sk| > 3$ and $|ku| > 7$ (Finney et al., 2016; Marôco, 2010).

Confirmatory factor analysis (CFA) was employed to assess the dimensionality of the measurement model. The analysis utilized several goodness-of-fit indices, including the Normed Fit Index (*NFI*), Tucker-Lewis Index (*TLI*), Comparative Fit Index (*CFI*), Root Mean Square Error of Approximation (*RMSEA*), and Standardized Root Mean Square Residual (*SRMR*). The scaled versions of *CFI*, *TLI*, *NFI*, *RMSEA*, and χ^2 estimates were applied. According to Hu and Bentler (Hu & Bentler, 1999), values exceeding 0.95 for NFI, TLI, and CFI are deemed good. Byrne (Byrne, 2010) suggests that *SRMR* and *RMSEA* values should be below 0.08. The analyses were conducted using the *lavaan* package (Rosseel, 2012) with the Weighted Least Squares Means and Variances (WLSMV) estimator, as proposed by Muthén (Muthén, 1983). The choice of WLSMV was guided by its appropriateness for the ordinal response scales of the psychometric instruments employed. When the fit of the model proved unsatisfactory, modification indices (MI) exceeding 11 (indicating $p < .001$) were examined in the context of the underlying theoretical framework. The *semPlot* package (Epskamp, 2015) and the *semTools* package (Cheung & Lai, 2023) were utilized to generate the diagrmans for the CFA.

A multidimensional polytomous Rasch model, as described by Briggs and Wilson (Briggs & Wilson, 2003), was implemented as a particular instantiation of the Multidimensional Random Coefficients Multinomial Logit Model (MRCMLM; Adams et al., 1997). The analysis involving the MRCMLM was conducted using the *TAM* package (Robitzsch et al., 2021). Additionally, the Wright Map, which visually represents item and person parameters, was generated using the *WrightMap* package (Irribarra & Freund, 2020). Both *Infit* and *Outfit* mean square fit statistics assess the fit of the model to the data. For rating scales the acceptable range of item mean square estimates is (0.6; 1.4) (Bond et al., 2020).

The reliability of the first-order latent factors was evaluated using the Average Variance Extracted (*AVE*) criterion, as proposed by Fornell and Larcker (Fornell & Larcker, 1981), McDonald's ω coefficient (McDonald, 1999) and the ordinal α (Gadermann et al., 2012). Thresholds for acceptable reliability are set at *AVE* values of .5 or higher, and values of .7 or higher for ω and α. For the assessment of second-order latent factors, several internal consistency estimates were computed: $\omega_{partial\ L1}$, which represents the variance in a first-order factor explained by a second-order factor after accounting for the uniqueness of the first-order factor; ω_{L1}, which quantifies the proportion of the total score explained by the second-order factor; and ω_{L2}, which measures the variance in first-order factors accounted for by the second-order factor. These estimates were obtained using the *semTools* package (Jorgensen et al., 2023). In the item response theory framework, the MRCMLM calculated the reliability for each latent factor,

defined as the ratio of the variance of the *EAP* to the variance of the plausible values (Adams, 2005). An EAP reliability of ≥ .8 is preferred.

The analysis of measurement invariance between sexes (with AS), samples (i.e., AS vs. MBSS) and time points (i.e., longitudinal measurement invariance; MBSS:12-, 18, and 24 months after bariatric surgery) for the second-order model with categorical indicators was performed using the theta-parameterization approach, facilitated by the *semTools* package (Jorgensen et al., 2023). This analysis involved a comparison of eight nested models with varying levels of constraints, following the methodology outlined by Millsap and Yun-Tein (Millsap & Yun-Tein, 2004) and further detailed in Sinval et al. (Sinval et al., 2022). To evaluate the nested models, two criteria were employed: the change in Comparative Fit Index (ΔCFI) with a threshold of ≤ −.010 (G. W. Cheung & Rensvold, 2002) and the change in chi-square ($\Delta\chi^2$) test (Satorra & Bentler, 2001). The ΔCFI criterion indicates that measurement invariance is maintained between two models if the ΔCFI is smaller than or equal to −.010. The $\Delta\chi^2$ criterion assesses invariance by accepting the null hypothesis (i.e., no significant difference between models) if the χ^2 difference is not statistically significant. Categories with few observations in at least one group can pose challenges. In cases where answer categories were missing in a group, the value of the preceding category was adjusted to match the missing category in the corresponding group, such procedure was made to enable the estimation of the multigroup CFA. (Rutkowski et al., 2019).

The structural model was fitted using the *lavaan* package (Rosseel, 2012) to provide validity evidence based on relations to other variables. An $\alpha = .05$ was maintained for all statistical tests conducted in the analyses.

Results

Sample characterization

The AS included 246 (72.1%) women and 95 (27.9%) men. The mean age was 23.21 (*SD* = 6.02). The majority of participants 285 (83.6%) were students, and 78 (22.9%) were attending the 5th year of university education. The mean current BMI was 22.910 (*SD*=4.40), the mean highest BMI was 24.468 (*SD*=4.98), and the mean lowest BMI was 20.747 (*SD*=3.614).

The MBSS included 262 (100%) women with a mean time since metabolic bariatric surgery of 15.748 (*SD*=4.137) months. The mean age was 44.775 (*SD*=9.519). The majority of participants 225

(85.9%) completed secondary education, and 183 (69.8%) were employed. The mean current BMI was 26.168 (*SD*=3.997), the mean highest BMI was 44.094 (*SD*=5.374), and the mean lowest BMI was 25.274 (*SD*=3.920).

Validity evidence based on internal structure

Dimensionality

The items' distributional properties are presented in Table 1 for the AS and MBSS samples. All items presented responses in all possible answer values (1–5) except for item 12 in the MBSS sample. No outliers were removed. Considering the univariate normality values, items 13 and 24 (AS), and 5, 13, 19, 20, and 24 (MBSS) presented severe violation of the univariate normality since presented $|ku| > 7$ or absolute $|sk| > 3$. The WLSMV estimator was used in subsequent analysis, as this estimator does not assume multivariate normality, being also more adequate to the ordinal nature of LOCES' answer scale.

The CFA to the original model revealed a non-acceptable fit to the data for the AS ($\chi^2_{(249)}$=1, 276.78; p<.001; *CFI*=0.88; *NFI*=0.87; *TLI*=0.86; *SRMR*=0.11; *RMSEA*=0.11; CI 90% (.10; .12); *P[RMSEA ≤ .05]* < .001). After inspecting the modification indices (i.e., MI > 11), three residuals' correlation paths were added: items 7 and 8's residuals (r=.54; p<.001), items 16 and 17's residuals (r=.51; p<.001) and a correlation path between items 22 and 13's residuals (r=.46; p < .001). The modified model fit to the AS data was marginally acceptable ($\chi^2_{(246)}$=1, 147.57; p<.001; *CFI*=0.89; *NFI*=0.87; *TLI*=0.88; *SRMR*=0.10; *RMSEA*=0.10; CI 90% (.10; .11); *P[RMSEA ≤ .05]* < .001). The CFA to the original model revealed a satisfactory fit to the data for the MBSS ($\chi^2_{(249)}$=610.28; p < .001; *CFI*=0.98; *NFI*=0.96; *TLI*=0.97; *SRMR*=0.05; *RMSEA*=0.08; CI 90% (.07; .08); *P[RMSEA ≤ .05]* < .001).

The LOCES-B presented did not present an adequate fit to the AS ($\chi^2_{(14)}$=162.11; p<.001; *CFI*=0.94; *NFI*=0.93; *TLI*=0.91; *SRMR*=0.10; *RMSEA*=0.18; CI 90% (.15; .20); *P[RMSEA ≤ .05]* < .001). After adding two correlations between the residuals of items 5 and 6 (r = .61; p<.001) and the residuals of items 5 and 20 (r = .43; p<.001) the fit was acceptable ($\chi^2_{(12)}$=60.44; p<.001; *CFI*=0.98; *NFI*=0.98; *TLI*=0.97; *SRMR*=0.05; *RMSEA*=0.11; CI 90% (.08; .14); *P[RMSEA ≤ .05]* < .001). The LOCES-B model fit to the MBSS data was satisfactory ($\chi^2_{(14)}$=54.86; p < .001; *CFI*=0.99; *NFI*=0.99; *TLI*=0.99; *SRMR*=0.03; *RMSEA*=0.11; CI 90% (.08; .14); *P[RMSEA ≤ .05]* < .001). The standardized factor loadings of the LOCES for the tested model are presented in Figure 1 for AS and MBSS samples.

Regarding the Rasch analysis, the LOCES item fit statistics (i.e., *Infit* and *Outfit*) revealed values within the acceptable range for all the items in the AS sample (except for Item 23). While for the MBSS sample, items 5, 10, 14, 16, 19, 20, 22 and 23 revealed values beyond the desired range of 0.6-1.4. For the AS sample, the Wrigth Map (Figure 2), showed that the items from the behavioral dimension are more sensitive to discriminate lower levels of the latent variable, while the items for the positive/euphoric dimension were more sensitive to higher levels of the latent continuum. Regarding the MBSS sample, the items from the behavioral dimension were the ones that were able to discriminate higher levels of the latent variable.

Table 6-1. Item's Distributional Properties.

Item	*M*	*SD*	*Min*	*Mdn*	*Max*	Histogram	*SEM*	*CV*	*Mode*	*sk*	*ku*	*Infit*	*Outfit*
						AS (*n* = 341)							
1	2.55	1.10	1	3	5		0.06	0.43	3	0.13	-0.94	0.93	0.94
2	2.39	1.07	1	2	5		0.06	0.45	2	0.32	-0.77	1.01	1.03
3	2.37	1.02	1	2	5		0.06	0.43	2	0.61	-0.17	0.94	0.94
4	2.75	1.07	1	3	5		0.06	0.39	3	0.04	-0.69	1.01	1.00
5	1.95	1.11	1	2	5		0.06	0.57	1	0.90	-0.33	0.94	0.89
6	2.50	1.16	1	2	5		0.06	0.47	2	0.22	-1.02	0.99	0.98
7	2.23	1.17	1	2	5		0.06	0.52	1	0.58	-0.69	1.04	1.02
8	1.58	0.98	1	1	5		0.05	0.62	1	1.69	1.92	1.06	1.09
9	2.29	1.10	1	2	5		0.06	0.48	1	0.44	-0.74	1.04	1.04
10	1.52	0.82	1	1	5		0.04	0.54	1	1.65	2.38	1.16	1.40
11	2.16	1.13	1	2	5		0.06	0.52	1	0.48	-0.96	0.96	0.95
12	1.66	0.95	1	1	5		0.05	0.57	1	1.30	0.69	0.98	0.94
13	1.33	0.78	1	1	5		0.04	0.59	1	2.73	7.41	1.42	1.23
14	1.78	1.04	1	1	5		0.06	0.58	1	1.19	0.43	0.78	0.75
15	1.44	0.83	1	1	5		0.04	0.58	1	2.04	3.80	0.74	0.59
16	1.65	0.98	1	1	5		0.05	0.59	1	1.55	1.72	0.86	0.76
17	1.98	1.07	1	2	5		0.06	0.54	1	0.82	-0.27	1.09	1.24
18	1.93	1.18	1	1	5		0.06	0.61	1	1.00	-0.16	1.08	1.13
19	1.54	0.93	1	1	5		0.05	0.60	1	1.88	3.12	0.88	0.82
20	1.38	0.83	1	1	5		0.05	0.60	1	2.50	6.03	0.79	0.58
21	2.47	1.14	1	2	5		0.06	0.46	2	0.33	-0.77	1.01	1.00
22	2.41	1.18	1	2	5		0.06	0.49	2	0.43	-0.88	1.31	1.34
23	1.46	0.90	1	1	5		0.05	0.62	1	2.15	4.16	1.26	1.61
24	1.28	0.68	1	1	5		0.04	0.53	1	3.06	10.79	0.86	0.62
Item	*M*	*SD*	*Min*	*Mdn*	*Max*	Histogram	*SEM*	*CV*	*Mode*	*sk*	*ku*	*Infit*	*Outfit*
						MBSS (*n* = 255)							
1	1.77	0.85	1	2	5		0.05	0.48	1	0.93	0.30	0.91	0.90
2	1.50	0.80	1	1	5		0.05	0.53	1	1.84	3.48	0.89	0.71
3	1.55	0.76	1	1	5		0.05	0.49	1	1.34	1.66	0.97	0.97
4	1.53	0.75	1	1	5		0.05	0.49	1	1.49	2.20	0.89	1.17
5	1.29	0.68	1	1	5		0.04	0.52	1	3.08	11.27	0.79	0.51
6	1.56	0.84	1	1	5		0.05	0.54	1	1.55	2.09	0.75	0.63
7	1.61	0.96	1	1	5		0.06	0.59	1	1.70	2.38	1.20	1.08
8	1.42	0.83	1	1	5		0.05	0.59	1	2.26	4.89	1.36	1.22
9	1.56	0.85	1	1	5		0.05	0.54	1	1.59	2.18	1.29	1.07
10	1.68	0.95	1	1	5		0.06	0.57	1	1.27	0.85	1.73	1.95
11	1.51	0.82	1	1	5		0.05	0.54	1	1.66	2.45	0.98	0.75
12	1.29	0.61	1	1	4		0.04	0.47	1	2.28	5.00	0.86	0.56
13	1.25	0.60	1	1	5		0.04	0.48	1	2.91	9.79	1.33	0.93
14	1.43	0.76	1	1	5		0.05	0.53	1	1.88	3.24	0.61	0.43
15	1.31	0.71	1	1	5		0.04	0.54	1	2.64	6.98	0.79	0.61
16	1.36	0.72	1	1	5		0.04	0.53	1	2.36	6.23	0.64	0.49
17	1.57	0.84	1	1	5		0.05	0.54	1	1.75	3.21	0.90	0.95
18	1.47	0.85	1	1	5		0.05	0.58	1	2.10	4.18	0.88	1.13
19	1.29	0.69	1	1	5		0.04	0.53	1	2.94	9.47	0.62	0.51
20	1.25	0.68	1	1	5		0.04	0.54	1	3.53	13.79	0.64	0.46
21	1.75	0.90	1	2	5		0.06	0.52	1	1.25	1.30	0.98	0.88
22	2.35	1.16	1	2	5		0.07	0.49	1	0.46	-0.74	1.57	1.55
23	1.43	0.81	1	1	5		0.05	0.57	1	2.15	4.40	1.14	1.31
24	1.30	0.70	1	1	5		0.04	0.54	1	2.91	9.27	0.86	0.74

Note: *M* – Mean; *SD* – Standard Deviation; *Min* – Minimum; *Max* – Maximum; *Mdn* – Median; *sk* – Skewness; *ku* – Kutosis; AS – Academic Sample; MBSS – Metabolic Bariatric Surgery Sample.

Figure 6-1 Measurement Model Diagram of LOCES (Standardized Estimates) for the Academic Sample and Metabolic Bariatric Surgery Sample.

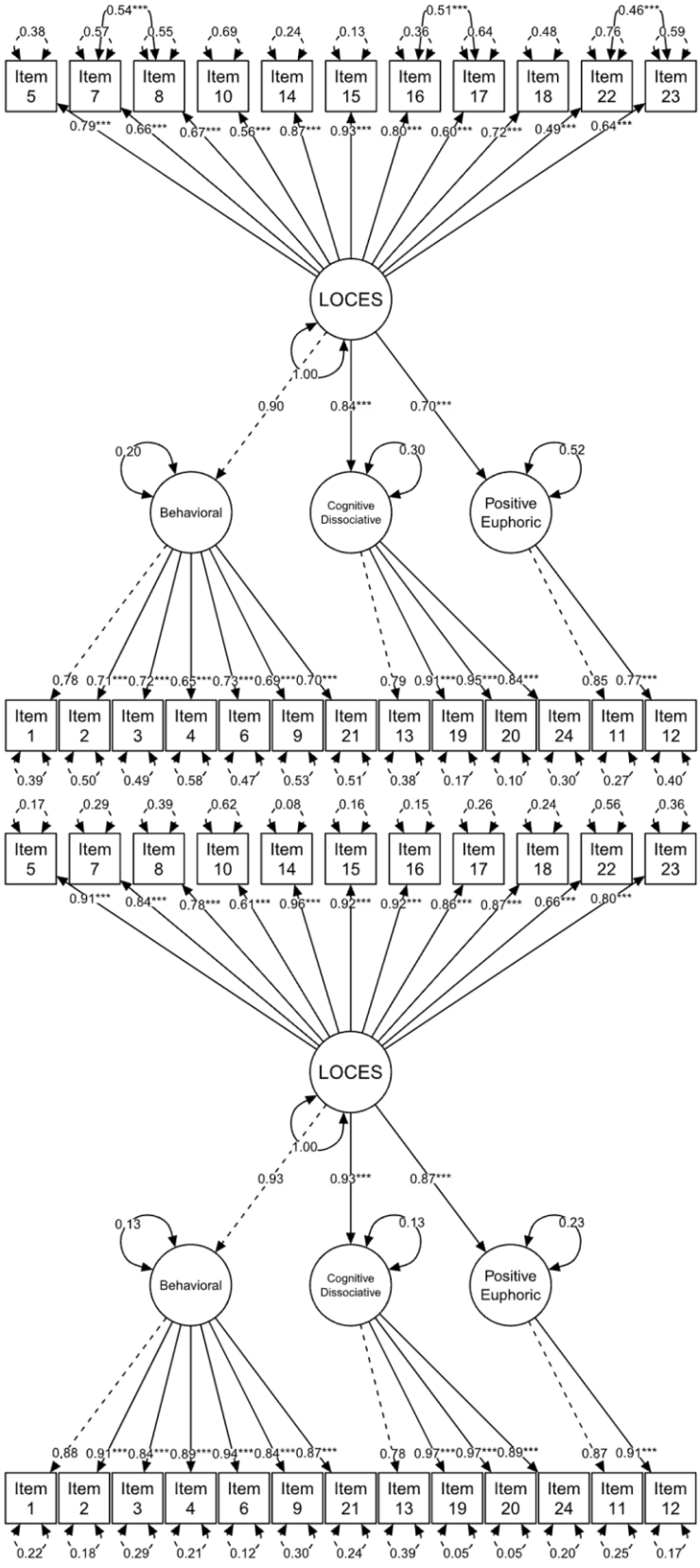
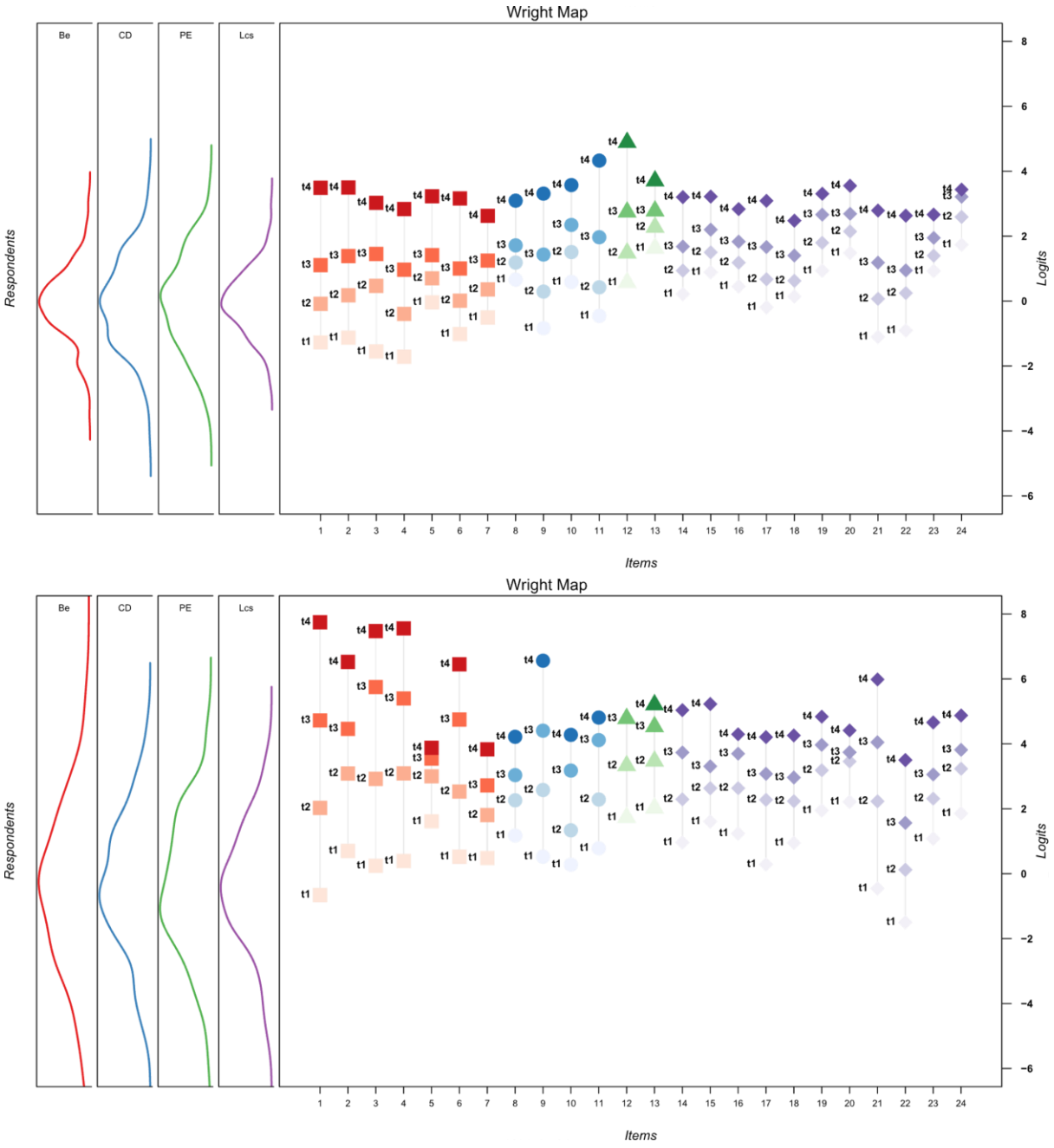


Figure 6-2 Wright Map.



Reliability of the Scores

Internal Consistency. The reliability of the scores was assessed through internal consistency estimates (Table 2). The estimates ranged from satisfactory to good for the AS sample, and from good to excellent for the MBSS sample. In terms of the second-order reliability estimates — LOCES hierarchical latent variable — both samples presented good results (AS: ω_{L2}=.92; $\omega_{partial\ L1}$=.96; ω_{L1}=.92; MBSS: ω_{L2}=.97; $\omega_{partial\ L1}$=.97; ω_{L1}=.97). Regarding the LOCES-B, for the AS sample estimates ranged from

satisfactory to good (α=.89; ω=.80; *AVE*=.54), while for the MBSS sample excellent estimates were obtained (α=.96; ω=.93; *AVE*=.80).

Table 6-2. Internal Consistency Estimates.

	AS				MBSS			
	α	ω	*AVE*	*EAP*	α	ω	*AVE*	*EAP*
Behavioral	.87	.85	.50	.88	.96	.94	.78	.88
Positive/euphoric	.79	.73	.66	.79	.88	.79	.79	.85
Cognitive/Dissociative	.88	.88	.76	.71	.94	.91	.83	.79
LOCES	.90	.86	.51	.89	.96	.93	.70	.89

Test-Retest. Test-retest reliability was assessed by examining a structural equation modelling incorporating the LOCES latent variables for the MBSS sample at three assessment points (12, 18, and 24 months post-bariatric surgery). Results indicate that the measurement model presents a very good fit to the data ($\chi^2_{(2400)}$=2,698.10; p<.001; *CFI*=1.00; *NFI*=1.00; *TLI*=1.00; *SRMR*=0.06; *RMSEA*=0.03; CI 90% (.02; .03); *P[RMSEA≤.05]*>.999). The LOCES had satisfactory to good test-retest reliability between 12- to 18-months (r=.66; p<.001), 12- and 24-months (r=.50; p<.001), as well as 18- and 24-months (r=.47; p<.001).

Measurement Invariance

The analysis of the measurement invariance among sex (with AS) for LOCES and LOCES-B revealed uniqueness measurement invariance using the ΔCFI criterion, while using the $\Delta\chi^2$ criterion did not allow to hold factor loadings invariance (Table 3).

Measurement invariance analysis among samples (i.e., AS and MBSS) for LOCES and LOCES-B revealed scalar measurement invariance using the ΔCFI criterion, while using the $\Delta\chi^2$ criterion did not allow to hold thresholds invariance (Table 3).

Longitudinal measurement invariance (i.e., 12-, 18- and 24-months post-bariatric surgery) for LOCES and LOCES-B were tested using only participants from the MBSS. Results revealed (Table 3) that LOCES hold scalar invariance using the $\Delta\chi^2$ criterion. Using the same criterion, the LOCES-B held full uniqueness measurement invariance. Using the ΔCFI both LOCES and LOCES-B held full uniqueness measurement invariance. The ΔCFI criterion is preferred since it is less restrictive than the $\Delta\chi^2$ criterion.

Table 6-3. Measurement Invariance among AS and MBSS, and Longitudinal Measurement Invariance.

Model (invariance)	χ^2_{scaled}	df	$p(\Delta\chi^2)$	*CFI*	Δ*CFI*
Sex (AS: female and male)					
LOCES					
Configural	1,770.524	498	-	0.948	-
Thresholds	1,782.997	543	.580	0.950	0.001
Factor loadings	1,727.862	564	.003	0.953	0.003
Structural weights	1,706.394	566	.420	0.954	0.001
Intercepts (first-order)	1,648.328	590	.056	0.957	0.003
Latent Means	1,705.090	593	< .001	0.955	-0.002
Disturbances	1,645.821	596	> .999	0.957	0.003
Residuals	1,575.564	620	< .001	0.961	0.004
LOCES-B					
Configural	225.116	28	-	0.972	-
Thresholds	231.430	42	.838	0.973	0.001
Factor loadings	211.197	48	.034	0.977	0.004
Intercepts	192.539	54	.498	0.981	0.003
Latent Means	213.019	55	< .001	0.978	-0.003
Residuals	207.840	61	> .999	0.979	0.002
Samples (AS and MBSS)					
LOCES					
Configural	1,978.055	498	-	0.940	-
Thresholds	1,990.342	543	.006	0.941	0.001
Factor loadings	1,945.831	564	.111	0.944	0.003
Structural weights	1,921.422	566	.495	0.945	0.001
Intercepts (first-order)	2,130.683	590	< .001	0.938	-0.008
Latent Means	2,802.695	593	< .001	0.911	-0.027
Disturbances	2,129.153	596	> .999	0.938	0.027
Residuals	1,984.357	620	< .001	0.945	0.007
LOCES-B					
Configural	242.351	28	-	0.971	-
Thresholds	258.053	42	.009	0.970	0.000
Factor loadings	257.436	48	.023	0.971	0.001
Intercepts	323.198	54	< .001	0.963	-0.008
Latent Means	716.517	55	< .001	0.909	-0.054
Residuals	325.765	61	> .999	0.964	0.055
Longitudinal (MBSS sample: 12-, 18- and 24-months post-metabolic bariatric surgery)					
LOCES					
Configural	1,395.198	747	-	.990	-
Thresholds	1,407.722	837	.874	.991	.001
Factor loadings	1,370.043	879	.979	.992	.001
Structural weights	1,360.101	883	.579	.993	.000
Intercepts (first-order)	1,362.142	931	.623	.993	.001
Latent Means	1,402.049	937	< .001	.993	-.001
Disturbances	1,448.193	940	.001	.992	-.001
Residuals	1,436.193	988	< .001	.993	.001
LOCES-B					
Configural	94.098	42	-	0.997	-
Thresholds	107.717	70	.553	0.998	0.001
Factor loadings	101.606	82	.981	0.999	0.001
Intercepts	111.912	94	.397	0.999	0.000
Latent Means	124.815	96	.050	0.998	-0.001
Residuals	132.252	108	.956	0.999	0.000

Note: The χ^2_{scaled} column contains the robust test. The $p\Delta\chi^2$ column contains the robust difference test which is a function of two standard (not robust) statistics.

Validity Evidence Based on the Relations to Other Variables

Concurrent: Convergent Evidence

The validity evidence based on the relations to other variables was tested via the latent correlations (Table 4). The ED-15 (two factors: weight concern and eating concern), the FSCRS (three factors: inadequate self, hated self, and reassured self), the DERS, DASS (one factor: depression symptoms) and UPPS-NU (negative urgency) were used to assess the convergent evidence with LOCES and LOCES-B.

Using both samples together (i.e., AS and MBSS), two structural equation models were estimated using the mentioned measures, one used the LOCES, while the LOCES-B was used in another. The model with the LOCES presented an acceptable fit to the data ($\chi^2_{(4,146)}$=9,823.00; p<.001; *CFI*=0.90; *NFI*=0.85; *TLI*=0.90; *SRMR*=0.07; *RMSEA*=0.05; CI 90% (.05; .05); *P[RMSEA ≤ .05]* > .999). The model with LOCES-B presented an acceptable fit to the data ($\chi^2_{(2,738)}$=8,017.11; p<.001; *CFI*=0.90; *NFI*=0.85; *TLI*=0.89; *SRMR*=0.08; *RMSEA*=0.06; CI 90% (.06; .06); *P[RMSEA ≤ .05]* < .001).

The reliability of the scores in terms of internal consistency was satisfactory for all the convergent measures — ED-15 weight concern (ω = .93), ED-15 eating concern (ω=.72), FSCRS inadequate self (ω=.90), FSCRS hated self (ω=.86), FSCRS reassured self (ω=.91), DERS (ω=.93), DASS depression (ω=.94), and UPSS negative urgency (ω=.93).

Table 6-4. Latent Correlations between LOCES/LOCES-B and Related Measures.

	Latent Correlations											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	-	-	-	-	.60***	.62***	.46***	.49***	.68***	.47***	.85***	.71***
2	.60***	-	-	-	-	.49***	-.26***	.48***	-.46***	.43***	-.47***	.51***
3	.61***	-.46***	-	-	-	-	.43***	.78***	.54***	-.20***	.73***	-.51***
4	.50***	.54***	.85***	-	-	-	-	.62***	.58***	.38***	.70***	-.53***
5	.50***	.58***	-.47***	-.51***	-	-	-	-	.43***	.34***	.55***	-.39***
6	-.28***	.43***	.73***	-.53***	.50***	-	-	-	-	.39***	-.59***	.64***
7	.46***	.47***	.70***	-.39***	.50***	.62***	-	-	-	-	.68***	.61***
8	.51***	.43***	.55***	.64***	-.28***	.68***	.47***	-	-	-	-	.50***
9	.49***	-.20***	-.60***	.61***	.46***	-.46***	.43***	.40***	-	-	-	-
10	.78***	.38***	.68***	.50***	.51***	.54***	-.20***	.85***	.70***	-	-	-
11	.62***	.34***	.71***	.60***	.49***	.58***	.38***	-.47***	.55***	.68***	-	-
12	.68***	.40***	.51***	.61***	.78***	.43***	.34***	.73***	–.60***	.71***	.51***	-

Note: 1 – LOCES Behavioral; 2 – LOCES Cognitive/Dissociative; 3 – LOCES Positive/Euphoric; 4 – LOCES; 5 – ED-15 Weight Concern; 6 – ED-15 Eating Concern; 7 – FSCRS Inadequate self; 8 - FSCRS Hated self; 9 – FSCRS Reassured self; 10 – DERS Total; 11 – DASS Depression; 12 – UPPS – Negative Urgency; *** – p < .001. The upper triangle of latent correlations refers to the LOCES-B. The lower triangle of latent correlations refers to the LOCES.

Test-Criterion: Predictive

A full structural equation model was tested to investigate the predictive strength of the LOCES/LOCES-B scores regarding the BMI (i.e., criterion scores) obtained 6 months later. The latent regression analysis was conducted using the LOCES at 12 months after metabolic bariatric surgery and BMI assessed at 18 months after metabolic bariatric surgery. Only data from participants in the control group of the MBSS was used (n=94). The model presented a satisfactory fit to the data both for LOCES ($\chi^2_{(272)}$=366.38; p<.001; *CFI*=0.99; *NFI*=0.95; *TLI*=0.98; *SRMR*=0.07; *RMSEA*=0.06; CI 90% (.04; .08); *P[RMSEA ≤ .05]* = .136) and LOCES-B ($\chi^2_{(20)}$=34.22; p=.025; *CFI*=0.99; *NFI*=0.98; *TLI*=0.99; *SRMR*=0.06; *RMSEA*=0.09; CI 90% (.03; .14); *P[RMSEA ≤ .05]* = .112). Table 5 displays the regression coefficients for both models. The variance explained by the model was small for the BMI variable in the LOCES model (r^2 = .05) and in the LOCES-B model (r^2 = .04).

Discussion

This is the first study to investigate the psychometric properties of LOCES within Portuguese samples and among post-bariatric surgery patients. Supporting findings from previous studies (He et al., 2021; Latner et al., 2014; Sahlan et al., 2021; Stefano et al., 2016), the dimensionality of the original factor structure of LOCES and LOCES-B was confirmed for AS and MBSS. LOCES/LOCES-B models revealed a satisfactory fit to the MBSS. Regarding AS, after incorporating correlations among the residuals of specific item pairs, the model's fit was marginally acceptable for LOCES and acceptable for LOCES-B. This indicates that the original structure of both LOCES versions fit better with MBSS, with LOCES-B showing a better adjustment for AS. Internal consistency for both LOCES and LOCES-B was confirmed within both AS and MBSS, with higher estimate values for MBSS than AS, further suggesting a better adjustment for the MBSS. It is important to note that, unlike the full LOCES, which assesses a global score in addition to three dimensions (behavioral, cognitive/dissociative, and positive/euphoric) of the LOCE construct, the 7-item LOCES-B only offers a global score. Therefore, when selecting the most appropriate version, the full version may be essential for a comprehensive assessment of the different dimensions of LOCE, while the brief version may be useful for an expedited screening of LOCE.

Furthermore, this article extends prior work by assessing measurement invariance between sex (female versus male from the AS), samples (AS versus MBSS), and time (12-, 18- and 24-months post-bariatric surgery). Findings confirmed that LOCES/LOCES-B performed similarly for individuals across each of these groups. Therefore, scores can be reliably compared between sex, samples, and in repeated measures post-bariatric surgery. These results add to previous studies confirming LOCES

measurement invariance across disordered eating severity, and weight status (Sahlan et al., 2021; Vannucci & Ohannessian, 2018). This is crucial for longitudinal studies and intervention research, where comparing group scores over time is essential.

Lastly, LOCES/LOCES-B validity evidence based on the relation to other theoretically related variables was confirmed. While previous psychometric studies have explored the relationship between LOCES and measures of disordered eating psychopathology and depressive symptoms (He et al., 2021; Latner et al., 2014), the present study brings novelty by confirming significant correlations between LOCES/LOCES-B and measures of self-criticism, emotion regulation difficulties, and negative urgency. These results bring more evidence for research emphasizing the clinical significance of LOCE as an indicator of psychological impairment (Conceição et al., 2018; Paranjothy & Wade, 2024; Stevenson et al., 2019).

Along these lines, results also indicated that LOCES/LOCES-B scores at 12 months post-surgery within the MBSS can predict higher BMI at 18 months post-surgery, despite the model explaining only 4% of the variance. Initially after bariatric surgery, there is often a decrease in disordered eating behaviors due to the physical constraints imposed by the procedure. However, challenges with eating behavior typically emerge in the long term (usually after 24 months post-surgery), consequently affecting weight loss outcomes (Smith, Orcutt, Steffen, Crosby, Cao, Garcia, Mitchell, et al., 2019). Given that the average time post-surgery for patients in the MBSS was 15.748±4.137 months, it is understandable that the variance explained by the model is small. At this stage of the post-surgical process, patients likely have not yet achieved maximum weight loss, and eating behavior psychopathology may not be fully developed. Nevertheless, the significant finding that LOCES/LOCES-B scores at 12 months post-surgery predict higher BMI at 18 months post-surgery underscores the critical importance of early and continuous assessment of the subjective experience of LOCE. This emphasizes the need to go beyond solely focusing on specific eating behaviors or categorical diagnoses, as this subjective experience serves as a prognostic indicator for future poor weight loss outcomes.

Some limitations should be mentioned. Firstly, although the AS included participants of both sexes, the MBSS was exclusively composed of women. This limits the generalizability of the results and the study of measurement invariance among sexes within this sample. Secondly, while the MBSS data were collected longitudinally with multiple assessment moments, the AS data were collected cross-sectionally, which impeded the study of test-retest reliability and longitudinal measurement invariance within this sample. Moreover, several considerations regarding the generalizability of the data should be considered. The AS was collected in a university context and, therefore, cannot be considered

representative of the general Portuguese community population. Additionally, the MBSS might not represent a clinical population due to the average time post-surgery. Future studies should incorporate longitudinal, representative samples from the Portuguese population, encompassing both community settings and individuals with established eating disorders post-bariatric surgery. This approach is essential to validate the suitability of utilizing LOCES in both non-clinical and clinical environments, and to further substantiate the link between LOCE behaviors and weight outcomes.

Overall, findings suggest that both LOCES and LOCES-B are reliable and valid measures of LOCE in a Portuguese academic sample and in women post-metabolic bariatric surgery. Additionally, expands on the associations between LOCE and transdiagnostic constructs of eating disorders, underscoring the clinical significance of the LOCE construct. This study also emphasizes the predictive validity of these instruments concerning poor weight loss outcomes following bariatric surgery, highlighting the importance of early inclusion of LOCE measures in both assessment and intervention efforts to optimize surgical weight outcomes, although further research is needed.

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PART IV

Psychological Support in Sustaining Weight Loss After Metabolic Bariatric Surgery

Chapter 7

Psychological Interventions in Metabolic Bariatric Surgery: Timing and Strategies

Chapter 8

Maximizing Healthcare Efficiency: Exploring Alternative Healthcare Delivery Strategies

Chapter 9

A Stepped Care Intervention Program Using Social Media for Long-term Support After Metabolic Bariatric Surgery: An Effectiveness Study

Chapter 7

Psychological Interventions in Metabolic Bariatric Surgery: Timing and Strategies

Abstract

Metabolic bariatric surgery (MBS) is hailed as the premier treatment for obesity, offering significant weight loss and improved health outcomes. However, post-surgery weight management remains variable, with many patients facing challenges such as weight regain. This variability is influenced by individual behavioral factors, prompting the use of psychological interventions to promote lasting behavior change and weight maintenance.

This chapter provides a concise overview of psychological interventions in obesity and MBS, focusing on timing and strategies for optimizing long-term outcomes.

Keywords: psychological interventions, cognitive-behavioral therapy, third-generation therapies, metabolic bariatric surgery, weight loss maintenance.

Introduction

Metabolic bariatric surgery (MBS) is currently considered the most effective obesity treatment. Despite being associated with a wide range of health benefits, including substantial weight loss and reduction or resolution of various associated medical and psychological comorbidities, several studies have shown significant variability in weight trajectories post-surgery (Velapati et al., 2018). There is a considerable number of patients who fail to achieve the expected outcomes of this surgery or exhibit weight regain rates considered concerning (El Ansari & Elhag, 2021).

The spectrum of weight outcomes post-MBS is not solely a result of the surgical procedure employed or anatomical complications arising from these interventions. Individual behavioral variances play a pivotal role, impacting adherence to exercise recommendations, the prescribed dietary guidelines, and behavioral changes (El Ansari & Elhag, 2021; Masood et al., 2019; Sarwer, Allison, et al., 2019). Consequently, psychological interventions have emerged as valuable tools for promoting sustained behavior change and facilitating long-term weight management (Paul et al., 2017). Nonetheless, the challenge remains in optimizing the effectiveness of these interventions to ensure lasting weight loss maintenance.

This chapter seeks to provide a comprehensive exploration of the literature surrounding psychological interventions in the context of obesity and MBS. It aims to discuss optimal timing for intervention implementation and common intervention strategies utilized to enhance their impact on long-term weight management outcomes.

Timing Matters? Ideal Point for Intervention in MBS

Considering the current state of the art regarding the impact of the predictors of suboptimal weight outcomes or weight regain, psychosocial interventions have been increasingly recommended for the treatment of MBS patients (Van Zyl et al., 2020). Although still a relatively recent area of research, an examination of current literature reveals numerous empirical studies aimed at evaluating the impact of psychological interventions on eating behavior and/or associated psychopathology, psychological functioning, and lifestyle changes, all aimed at improving weight loss outcomes post-surgery (David et al., 2020).

However, in addition to the inconsistency of results concerning predictors of MBS suboptimal weight loss or weight regain, the literature also lacks conclusive findings regarding the optimal timing –

pre- or post-surgery – for implementing these psychosocial interventions. To date, only a limited number of studies have examined the receptivity of MBS patients based on the operative period.

One prospective study aimed to identify the treatment phase in which patients were most receptive to initiating, sustaining, and completing a behavioral intervention aimed at mitigating disordered eating behaviors. It showed that post-surgery patients were more likely to accept participation in the intervention, attend sessions, and complete follow-up compared to pre-surgery patients (Leahey et al., 2009). Authors argue that pre-operative patients tend to underestimate the beneficial effects of MBS on weight loss outcomes and eating behavior (Bauchowitz et al., 2007), which may lead to their lesser commitment to interventions. Moreover, since MBS entails significant changes for individuals, pre-surgery interventions may not address the needs felt by post-surgery patients, and they may not retain all the skills learned pre-surgery into the postoperative period (Conceição & Goldschmidt, 2019).

Nevertheless, candidates for MBS should advance with this procedure from an informed and conscious decision. Pre-surgical psychological intervention plays a crucial role in ensuring patients understand the requirements and potential challenges of the procedure. They need to be educated about the dietary changes they will need to adhere to, including the necessity for vitamin supplementation, food restrictions, and potential intolerances. Moreover, patients need to be aware of common post-surgery symptoms such as dumping syndrome or food plugging, as well as the potential changes in body image, including the effects of excess skin resulting from significant weight loss – which can impact self-esteem and intimate relationships (Conceição et al., 2020). By providing this information and reinforcing their role as active agents in the treatment process, pre-surgical psychological intervention aids in fostering greater awareness and helps patients form realistic expectations about the outcomes of their weight loss journey (Conceição & Goldschmidt, 2019).

In turn, the post-operative phase poses numerous challenges and demands for patients. Initially, after surgery, patients face physical constraints that restrict their tolerance to specific foods and limit food intake. However, as time passes, these dietary restrictions gradually diminish, permitting a wider variety of foods and larger portions in the diet. This transition requires individuals to exert additional effort in adhering to the prescribed dietary plan. During this period, cravings for calorie-dense foods, grazing habits, or a sense of loss of control over eating may reemerge, potentially influencing weight outcomes negatively (Conceição et al., 2015). Additionally, studies have shown that patients navigating obesogenic environments often struggle to obtain social support for maintaining their new healthy lifestyle habits (Ogle et al., 2016). Additionally, while symptoms of depression and anxiety typically

decrease from the pre- to the postoperative period, they seem to worsen in the long-term post-operation, potentially introducing new challenges during this phase of treatment (Mitchell et al., 2014).

Throughout this chapter, we will provide an overview of some of the key studies in the field of psychological interventions in MBS. Given the inconsistency of results, as well as the diversity of designs and research methodologies employed by various studies, establishing comparisons between the available literature becomes challenging. Therefore, in this chapter, studies implemented pre- and post-surgery will be presented separately to facilitate understanding and analysis.

Psychological Interventions Pre-MBS

Psychosocial interventions in MBS have aimed to promote and facilitate the behavioral changes required post-treatment and optimizing outcomes in the postoperative period. In the short term, the effectiveness of these interventions offered to pre-surgery patients appears to be well-established in current literature, although there is no consensus regarding the maintenance of these positive results in the long term.

For instance, when examining whether participation in a pre-operative group counselling program led to enhanced weight loss outcomes or adherence to treatment guidelines for patients undergoing MBS, findings revealed that involvement in support groups did not significantly improve adherence to post-surgery treatment and lifestyle changes (Lier et al., 2012). Similarly, other researchers compared the efficacy of a medically supervised weight control program before MBS with a control group receiving standard individualized care only. This weight control program comprised an initial medical evaluation and five monthly group sessions led by nutritionists, focusing on education and strategies for diet, physical activity, and behavioral modification to facilitate weight loss. Results demonstrated that the intervention provided did not yield any additional benefits pre- and post-surgery compared to the control group in terms of behavioral and weight loss outcomes (Parikh et al., 2012). Additionally, a randomized controlled trial randomly assigned 75 candidates for MBS with severe obesity to a control condition – only with usual pre-surgery care – and an intervention condition with 6 weekly in-person sessions of 30-45 minutes where participants received personalized behavioral and cognitive instructions to increase home-based physical activity. Results demonstrated that patients in the intervention group significantly increased their level of moderate to vigorous physical activity compared to the control group, also improving their quality of life. However, despite the importance of these results, the authors did not assess whether the short-term preoperative benefits persisted in the postoperative period (Bond,

Thomas, et al., 2015; Bond, Vithiananthan, et al., 2015). Similarly, a randomized controlled trial compared a control group that only received usual medical consultations, with an intervention group undergoing a behavioral lifestyle change intervention over six months. The intervention consisted of eight weekly in-person sessions, followed by 16 weeks of in-person and telephone sessions offered before MBS. Three monthly phone contacts were also included post-surgery. Pre-surgery, participants in the intervention group significantly lost more weight compared to participants in the control group (Kalarchian et al., 2013). However, two years after surgery, the behavioral intervention did not lead to improvements in the participants' weight trajectories (Kalarchian et al., 2016).

In addition to interventions focused on behavioral change to improve lifestyles, including components of diet and physical activity, several studies have also directed their attention towards designing interventions aimed at identifying and treating disordered eating behaviors. However, the long-term efficacy results of these pre-surgical interventions also appear inconclusive. One study sought to evaluate whether the impact of a pre-surgery CBT intervention exceeded the impact of conventional hospital treatment in terms of improving disordered eating behaviors, affective and mood symptoms, and weight outcomes one year after surgery. The control group received only education and nutritional support as conventionally offered to bariatric patients, while the treatment group received a total of 10 pre-surgery CBT sessions focused on recognizing the main triggers of disordered eating behaviors and improving self-monitoring and self-control of these behaviors (Gade et al., 2014). Although the results of assessments conducted pre-surgery showed that the CBT intervention exceeded usual hospital care, when analyzed after 1 year of MBS, the CBT group did not show any additional improvement compared to the control group in terms of disordered eating behaviors, affective symptoms, and body weight. This led to the conclusion that although this CBT intervention resulted in early improvements in eating behavior and affective symptoms, the difficulty in maintaining these improvements in the long term persists (Gade et al., 2014). Recently, authors sought to evaluate the effects of this same intervention after 4 years of follow-up. Although the results also did not demonstrate any clinically significant effect on eating behavior, depressive symptoms, and body weight, they found that patients with more depressive symptoms were more likely to experience long-term weight regain, being that the implemented CBT intervention was associated with lower body weight during this period. However, to the best of our knowledge, this was the first randomized controlled trial to evaluate the effects of a long-term (> 2 years) CBT intervention. Thus, these data should be interpreted with caution, and additional studies are needed to confirm the results achieved (Hjelmesæth et al., 2019).

As previously mentioned, the adoption of novel intervention methods has drawn interest from both researchers and clinicians in the field aiming to enhance healthcare accessibility. A study sought to evaluate the viability of employing a smartphone application to prepare patients for MBS. Results, based on participant satisfaction scores, indicated that the application was positively received. It seamlessly integrated into their daily routines, assisting them in preparation and engagement with the therapeutic process, while also fostering a stronger sense of connection to the medical care team (Mundi et al., 2015).

Recently, in a randomized controlled pilot study, researchers discovered that a brief CBT intervention, administered in six telephone sessions to MBS patients before surgery, effectively improved disordered eating psychopathology and psychosocial functioning. However, this study did not incorporate weight variables, preventing an investigation into whether this phone-delivered CBT intervention had a positive impact on weight outcomes. Moreover, the data provided only offer preliminary findings, emphasizing the necessity for further research to validate their conclusions (Cassin et al., 2016).

Post-MBS Psychological Interventions

While the literature thus far may present discouraging results regarding the impact of pre-surgical psychological interventions, recent studies have been demonstrating the effectiveness of psychological interventions implemented in the post-surgical period in promoting better weight loss outcomes and behavioral changes (Conceição & Goldschmidt, 2019; David et al., 2020).

One study illustrated that a structured dietary intervention initiated one year after gastric bypass surgery facilitated weight loss and reduced calorie intake, proving to be a promising strategy for habit and lifestyle modification (Kalarchian, Marcus, Courcoulas, Lutz, et al., 2016). Likewise, a program aimed at instigating habit and lifestyle changes among post-surgery bariatric patients exhibited encouraging outcomes in sustaining long-term weight loss (up to 3 years post-surgery), surpassing the results observed with standard treatment approaches. In this study, although both groups exhibited similar weight outcomes during the first nine months after surgery, the intervention group's weight outcomes improved as the follow-up period progressed. The authors suggest that the initial effects of the surgery, which restrict opportunities for exhibiting disordered eating behaviors due to the reduced gastric capacity of patients, may account for these observations. However, as food tolerance increases

over time, the intervention appears to have become crucial in fostering positive outcomes by encouraging healthy dietary habits, eating behavior, and physical activity (Papalazarou et al., 2010).

The utilization of modern technologies in post-surgery interventions for MBS patients has emerged as a focal point in recent academic and clinical discussions. A study named "*Bariatric Surgery and Education (BaSE)*" was conducted to assess the efficacy of a group psychoeducational intervention administered through video conferencing over one year for individuals who underwent MBS. This investigation was conducted as a multicenter randomized controlled trial (Wild et al., 2015) et al., 2015). Results indicated that post-surgery, this psychoeducational program showed sustained effects on self-efficacy and severity of depressive symptoms but not on weight loss. However, long-term data suggest that improvement in self-efficacy levels may lead to better weight loss maintenance (Bray et al., 2017). Additionally, Portuguese researchers sought to investigate the use of mobile applications as an intervention tool. The designed program includes a self-help CBT manual and psychoeducation about bariatric surgery, a monitoring system with automatic feedback tailored to patients, and scheduled chat sessions with psychologists specialized in eating behavior. This intervention program aims to train relevant skills for the postoperative period, promote better adherence to necessary behavioral adjustments, as well as healthier habits and lifestyles, and early detection of risky behaviors. Although the effectiveness results of this study have not been published to date, it is expected that the aforementioned factors will lead to improvements in weight loss and/or maintenance, as well as in the associated psychopathology in this population (Conceição et al., 2016).

Cognitive-Behavioral Therapy in Obesity Treatment

The psychological intervention aimed at promoting and facilitating the behavioral changes required during the post-operative period assumes particular importance in this phase of treatment. The strategies used in these interventions may be based on different branches of psychology. However, regardless of the therapeutic approach used, the primary objectives should focus on promoting an active lifestyle, as well as a regular and healthy eating pattern. Despite employing various therapeutic approaches, the prevailing focus in current literature is on studies dedicated to seeking scientific evidence for CBT strategies. Adapted to the treatment of obesity, this therapeutic approach is based on the premise that not only behavioral changes regarding diet and physical activity are necessary but also changing dysfunctional thoughts that maintain those behaviors. This theory assumes that by modifying how individuals evaluate and interpret certain situations (thought component), we can change how they

feel about a particular situation (feeling component), and thus influence the actions they take as a result (behavior component). Table 1 summarizes the main objectives of these therapeutic approaches, as well as some of the cognitive-behavioral strategies described most frequently in current literature.

Table 7-1. Description of Cognitive-Behavioral Therapy Objectives and Strategies for Obesity Treatment.

Education and motivation
▪ Promotion of intrinsic motivation: weight loss as a goal to improve overall health and quality of life; Psychoeducation on obesity and bariatric surgery; Education on individual responsibility in the process of weight loss and maintenance.
Self-monitoring skills
▪ Recording events and their contextual details (e.g., a daily record of food intake with time, quantity, and contextual details); Records should be made promptly after each event; Records may pertain to food consumption, physical activity, or weight.
Stimulus control
▪ Stimulus control involves identifying stimuli that promote or hinder the development of adaptive behaviors, facilitating favorable stimuli, and eliminating unfavorable ones. These stimuli can pertain to eating behaviors, physical exercise, among others.
Goals and expectations
▪ Definition of success; Establishing realistic, specific, and quantifiable goals in different areas of life throughout the weight loss process; Defining the respective steps/stages necessary to achieve them.
Self-regulated behavior
▪ Development of adaptive emotional regulation strategies and impulse control skills; Behaviors should be managed based on the goals intended to be achieved and not based on internal expectations such as thoughts, emotions, or impulses.
Problem solving and stress management
▪ Identification of obstacles to behavioral change and exploration of various alternatives to solve or facilitate the problem.
Active lifestyle and physical exercise
▪ Promotion of an active lifestyle; Reduction of engagement in sedentary behaviors; Facilitation of involvement in structured physical activity; Education about the importance of physical activity; Identification of barriers to regular exercise practice.

Healthy eating
▪ Education on strategies to maintain a suitable and regular dietary pattern; Facilitation of healthy food choices; Promotion of compliance with nutritional recommendations.
Disordered eating behaviors
▪ Identification of disordered and persistent eating behaviors (e.g., emotional eating, binge eating, LOC eating, grazing); Identification of cues, cognitions, and emotions associated with disordered behaviors; Management of cognitions and alternative adaptive behaviors in risky situations; Education on common eating issues after bariatric surgery (dumping, plugging).
Thoughts, emotions, and food
▪ Psychoeducation on the relationship between thoughts, emotions, and eating; learning to cope with mood swings after MBS; Cognitive restructuring and cognitive debate: identifying maladaptive thought distortions for behavioral change and promoting more functional alternatives thought.
Body image
▪ Promotion of a better relationship with body image and self-esteem; Establishment of a personal evaluation system not based on weight; Development of self-concept by expanding the personal evaluation system; Development of self-care.
Social support and interpersonal relationships
▪ Identification of the social support network for different types of needed support (emotional, instrumental, informational); Learning interpersonal conflict management techniques.
Relapse prevention
▪ Facilitation of ongoing follow-up; Anticipation of problematic situations and establishment of a relapse plan; Establishment of strategies to maintain the achieved results.

Third-generation Therapies in the Obesity Treatment

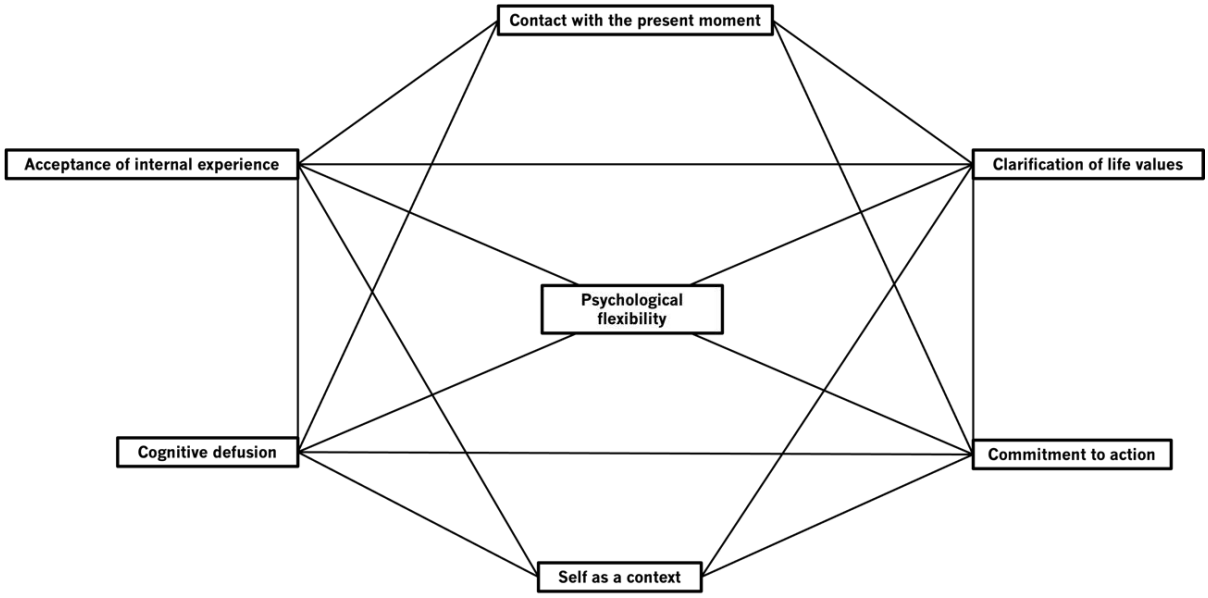
As previously described, there is a strong trend in current literature focused on studying the effectiveness of CBT interventions for the treatment of obesity and MBS patients (Paul et al., 2017). Despite these approaches showing positive results, their effectiveness is still limited, with long-term outcome maintenance being one of the main challenges. Most participants fail to maintain long-term behavioral changes in diet and physical exercise, reverting to old habits associated with obesity such as decreased energy expenditure, increased food disinhibition, and excessive consumption (Noria et al., 2023).

In this context, recent research has underscored the significance of alternative psychological approaches to complement traditional interventions in obesity management. Among these new methodologies, the third wave of cognitive-behavioral therapies comprises a range of therapeutic strategies with demonstrated efficacy in treating obesity. These include Acceptance and Commitment Therapy (ACT) (Weineland et al., 2012), Dialectical Behavior Therapy (Ben-Porath et al., 2020; Braden et al., 2020), Mindfulness-Based Cognitive Therapy (Wnuk et al., 2018), and Compassion-Focused Therapy (Gilbert, 2009).

Like classical CBT, all these therapeutic approaches aim for behavioral change, rooted in the premise that thoughts exert a strong influence on emotions and consequent behaviors. However, this new wave of therapies introduces novel strategies that enable individuals to navigate discomfort more flexibly. They concentrate on cultivating psychological flexibility, under the assumption that repetitive behaviors in response to specific experiences render individuals psychologically inflexible, thereby perpetuating the problem. Thus, the primary objective of these therapies is to alter individuals' relationships with their internal experiences, fostering an attitude of openness, flexibility, acceptance, and non-judgment towards these experiences.

According to these approaches, the concept of psychological flexibility is defined by considering six interconnected processes or factors that underlie the main therapeutic strategies. Each of these principles (illustrated in Figure 1) is regarded as a positive psychological skill – that should be cultivated – rather than merely a method to prevent psychopathology (Finger et al., 2020; Hayes, 2016; Hayes et al., 2006, 2012).

Figure 7-1. Components of the psychological flexibility model.



The **acceptance of internal experiences** offers an alternative to avoiding them, leading individuals to recognize the ineffectiveness of attempting to control or suppress negative internal experiences. Such attempts often have a counterproductive effect, intensifying the internal experiences further. Therefore, this assumption seeks to promote in the individual a willingness to actively and consciously engage in events previously suppressed or avoided, learning to observe and accept them. The metaphor of quicksand is one of the commonly used exercises where, by alluding to the practical example of quicksand – in which the more energetic the attempts to escape, the more trapped one becomes – a comparison is made to real situations experienced by the individual (e.g., panic attack situations where emotional responses to anxiety exacerbate the panic attack, while opposite reactions, such as observing the sensations experienced, help to control it).

Cognitive defusion, on the other hand, entails the need to disengage from internal experiences since they are merely mental products. The goal is to abandon attempts to modify or eliminate thoughts, learning instead to observe them from a distance without the need to react automatically to them. By countering the tendency for fusion between the individual and their thoughts, it is expected that internal experiences will have less influence on behavior. A frequently used strategy in developing this psychological capacity is the repetitive naming of thoughts aloud until they lose their meaning, or the naming of cognitive processes (e.g., "I am having thoughts that I am not capable," instead of "I am not capable").

One of the characteristics of psychological inflexibility is also reflected in the rigidity of attention. In a continuous effort to avoid problems, individuals often become fixated on cognitive representations of both the past and the future. Instead of experiencing the present moment, they are typically preoccupied with past situations or imagining problems that have not yet arisen. In this sense, the process of **contact with the present moment** aims to counteract this tendency. Through flexible attention, individuals can increase their contact with the present moment and regulate their focus on the here and now. Mindfulness exercises are the most common strategies for promoting the competence of present attention.

Furthermore, the premise of "**Self as Context**" aims to address the locus of perspective in human experiences, where the Self functions merely as context and not as the content of experiences. This assumption posits that the individual is not their thoughts, and their identity is not defined by how they feel or think. To work on this skill, the metaphor of a chessboard is often used, where the individual is likened to the board itself, and their thoughts and feelings are compared to the game pieces. Just as the outcome of the game does not affect the board, the conflict between internal experiences does not need to compromise the individual.

Regarding the **clarification of life values**, this assumption posits that life values represent valued life directions, to which a person attributes importance and towards which they direct their actions. Thus, this factor aims for individuals to clarify their life directions across different dimensions (e.g., "a valued life is one where I can enjoy leisure time with my family"). It's important to note that life values are not about listing "life goals." Life values represent an orientation for living moment to moment, rather than a definitive achievement. A commonly used strategy is organizing personally significant events along a timeline that represents one's life journey.

In this same vein, patterns of inaction, persistent avoidance, or even impulsivity represent barriers to developing a meaningful life since they are not guided by values. Thus, the last enumerated factor – **commitment to action** – seeks to enhance the development of more committed action patterns, moment by moment, through the establishment of concrete goals linked to the already defined values. The techniques used to promote commitment involve traditional behavioral methods.

In a general sense, when adapted to the treatment of obesity, these therapeutic methodologies aim to help the patient develop a set of adaptive skills so that they can deal with excess weight and obesity in a less self-critical manner. This involves fostering a more tolerant, conscious, positive, flexible, and committed relationship with food, body image, or other areas of difficulty.

Conclusion

Despite being relatively recent, the current literature on psychological interventions in MBS already encompasses a wide variety of studies that have sought to implement different theoretical approaches at different intervention stages, using various delivery formats. In summary, in conjunction with MBS surgery, psychological interventions for behavioral change appear to result in more sustained weight loss and maintenance over time. Regarding effectiveness in behavior change and improvement of health habits, current evidence is more robust regarding the impact of post-surgical interventions compared to pre-surgical interventions (Van Zyl et al., 2020). However, these conclusions should be interpreted with caution.

Future research should seek to deepen our understanding of the optimal phase to initiate these follow-up programs and how to integrate surgical and behavioral interventions in the treatment of obesity.

The optimization of implemented interventions seems to involve the application of psychoeducational strategies in the preoperative phase, providing information about MBS and the changes required after this surgical procedure, and then advancing to more intensive strategies in the postoperative phase. At this stage, it is essential that interventions aimed at behavioral change cover topics not only related to diet and physical exercise but also concerning body image, social support, interpersonal relationships, emotions, and thoughts.

Different therapeutic methodologies have been used, with cognitive-behavioral approaches being the ones with the most evidence in the current literature. However, the third wave of cognitive-behavioral therapies, which has received more attention in recent years, has emerged as a strong complement to the classical therapies typically used.

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Chapter 8

Maximizing Healthcare Efficiency: Exploring Alternative Healthcare Delivery Strategies

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Abstract

Current literature has supported the importance of postoperative cognitive-behavioral interventions to prevent weight-regain, promote adherence to post-surgical recommendations, and changes in lifestyle, behavioral, and psychosocial factors. However, in an environment with limited healthcare resources to deal with the rising bariatric population, alternative time-efficient and cost-effective interventions are needed. Such interventions should consider the heterogeneity of the metabolic bariatric surgery population and the difficulties in the accessibility of specialized treatment centers. With the dramatic growth in web technologies, online platforms represent a powerful and cost-effective alternative tool to deliver validated interventions, attempting to narrow the gap between clinical support services and patients. Given the marked variability in individual outcomes, recent research also suggested the need for personalized approaches. Stepped-care approaches are clinically relevant allowing an efficient allocation of resources, starting with minimal, low-intensity, cost-effective strategies for all patients and successively adding components of increasing intensity if needed.

This chapter aims to summarise the main studies in the field of psychological interventions for MBS patients, exploring the advances in new online therapeutic and management strategies, and personalized medicine including stepped care approaches.

Keywords: alternative healthcare strategies, bariatric surgery, weight regain, prevention.

Introduction

Obesity has become a global epidemic (Sarwer et al., 2020), and MBS stands out as the most successful intervention for severe obesity, leading to substantial weight loss and improvements in related health conditions (Angrisani et al., 2024). Nonetheless, a notable portion of patients face suboptimal outcomes or present significant weight regain, resulting in considerable economic burdens. This underscores the necessity for continuous weight management post-surgery.

Through this chapter, the main studies in the field of psychological interventions for promoting weight loss maintenance and preventing weight regain after MBS will be discussed. Firstly, we will discuss major risk factors for suboptimal weight loss outcomes. Increase our knowledge on this field is critical in guiding recommendations for specific psychological care programs and is warranted to inform the development of stepped-care models of psychosocial intervention for MBS populations. Considering the limited healthcare resources to deal with the globally rising number of bariatric patients, alternative time-efficient and cost-effective interventions are needed. Thus, we will explore the advances in new therapeutic approaches to optimize bariatric interventions' outcomes, as well as innovative delivery strategies such as mobile and online (eHealth) programs that allow overcoming the barriers imposed by face-to-face interventions. Lastly, personalized, and stepped-care approaches will also be scrutinized. This novel intervention format allows an efficient allocation of resources, starting with minimal, low-intensity, cost-effective strategies for all patients and successively adding components of increasing intensity if needed. Given the marked variability in individual outcomes, this intervention also represents powerful and cost-effective alternatives to deliver validated interventions.

Behavioral Weight Management Interventions Strategies

The importance of psychosocial factors, both as a precipitating factor and a perpetuating of poor weight loss outcomes after bariatric interventions is well established (Sarwer, Allison, et al., 2019). Therefore, mounting evidence on the field supports that sustained weight loss in patients following MBS requires comprehensive, regular, and supportive management by multidisciplinary teams. These intervention programs should equip individuals with the necessary coping and cognitive skills to make them less vulnerable to disordered eating behaviors. The study of behavioral interventions for preventing or reversing postoperative weight regain after MBS is only in its infancy. Overall, existing evidence is stronger for the impact of psychosocial interventions on eating behaviors (e.g., emotional eating,

grazing, and binge eating) and psychological distress (e.g., depressive and anxiety symptoms, quality of life). However, studies suggesting the impact of psychosocial interventions on dietary behaviors (e.g., dietary intake), and lifestyle behaviors (e.g., physical activity) are mixed (David et al., 2020).

Cognitive-Behavioral Therapy Interventions

Most centers offer psychosocial interventions through support group sessions, which allow for addressing a higher number of patients consuming fewer resources. There is some evidence suggesting that attending support groups post-surgery can positively affect short- and long-term weight outcomes after MBS (Andreu et al., 2020). In this line, CBT has largely been recommended by many studies as the treatment of choice for improving outcomes after MBS (Cheroutre et al., 2020; Paul et al., 2017). Studies have demonstrated that even brief CBT programs could help in the reduction of binge eating and maintenance of weight loss after surgery (Kalarchian & Marcus, 2003). Psychoeducation, goal setting, problem-solving, self-care, physical activity promotion, and cognitive restructuring were intervention techniques commonly implemented across these interventions and likely contributed to improvements in psychological functioning and weight outcomes.

A pilot study investigated a 6-week behavioral group intervention developed to treat bariatric patients experiencing weight regain. This intervention targeted dietary non-adherence, management of clinically relevant stressors, and reduction of grazing/binge eating episodes, and alcohol use using a combination of CBT and dialectical behavior therapy techniques. Results suggested that patients who completed this brief intervention experience modest weight loss, improved their mood slightly, and decreased their grazing and binge eating behaviors (Himes et al., 2015). Similarly, other authors examine the impact of an eight-week CBT closed psychotherapy group. The CBT intervention implemented focuses on specific themes such as stress and coping, emotional eating, changing negative thinking, body image, and self-esteem. Results suggested that participants in the CBT group presented significant improvements in psychological distress, perceived difficulties in their lives, and weight-related adjustments that were maintained throughout a 3-month follow-up period (Beaulac & Sandre, 2015). Furthermore, a recently published review of the literature analyzed the contribution of CBT interventions in the context of MBS and found a beneficial effect of CBT in reducing risk factors for weight regain after surgery. CBT produced significant improvements in patients' eating behavior, comorbid psychological conditions (e.g., depressive and anxiety symptoms), and body weight ((Cheroutre et al., 2020).

Acceptance and Commitment Therapy Interventions

Besides CBT, several studies have investigated the efficacy of other contemporary treatment methods for preventing weight regain after bariatric surgery. Acceptance and commitment therapy (ACT) interventions are a newer generation behavioral approach that may prove to promise specifically in post-MBS patients, as it provides a unique way of teaching self-regulation skills (Bradley et al., 2016; Weineland et al., 2012). The ACT rational defines experiential avoidance as an unwillingness to remain in contact with negative private events (for example, negative thoughts, emotions, or physical sensations). Engaging in avoidance behaviors (namely eating or drinking) results in the short-term relief of those negative emotions. Thus, ACT targets the promotion of psychological flexibility around negative private events (Finger et al., 2020; Hayes, 2016). What differentiates ACT from CBT intervention is that, while CBT strategies strive to change negative thoughts and feelings, ACT focus on the acceptance of those private events. There is a growing body of research proving the impact of ACT on weight regain prevention after MBS. A randomized controlled trial showed that MBS patients with access to an ACT-based program (including face-to-face sessions and support via an Internet application) significantly improved on eating disordered behaviors, body dissatisfaction, quality of life, and acceptance of weight-related thoughts and feelings, compared to participants in the treatment as usual condition (Weineland et al., 2012).

Mindfulness-based Interventions

Mindfulness-based interventions are also alternative healthcare delivery strategies for preventing weight regain after bariatric surgery which has been objected to growing attention in recent years. The conceptual foundation of mindfulness is bringing one's complete attention to the present experience on a moment-to-moment basis (Kabat-Zinn, 2001). In line with the perspective of acceptance of negative experiences, mindfulness is practised with an attitude of acceptance without judgment or interpretation of thoughts, feelings, and sensations (Kristeller & Wolever, 2011). There is an increased body of research evidence for mindful intervention applied to eating behavior (Carrière et al., 2018; Yu et al., 2020), and several studies with MBS populations are emerging. A recent pilot study tested the effects of eight weekly 2-hour group sessions of mindfulness-based eating awareness training (MB-EAT) as a treatment for weight maintenance and psychological symptoms post-MBS. Results showed improvements in depression levels, emotional regulation, binge eating, and emotional eating. These findings suggested that MB-EAT is feasible for addressing disordered eating behaviors and related

psychological factors that can interfere with successful weight loss maintenance (Wnuk et al., 2018). Similarly, a randomized controlled pilot trial showed that a 10-week mindfulness-based intervention designed to control weight after MBS surgery is highly acceptable to bariatric patients (1–5 years post-surgery) and may be effective for reducing emotional eating. Nevertheless, results fail to prove its impact on weight loss in the short term (Chacko et al., 2016). Also, a combination of CBT techniques and mindfulness-based practices proves to be effective for improving binge eating symptoms, depressive symptomatology, emotion regulation skills, and increased motivation to change disordered eating behavior in post-MBS patients (Leahey et al., 2008).

Altogether, these findings underline the positive impact of alternative intervention strategies to promote weight loss maintenance and prevent weight regain after bariatric surgery. Yet, caution is needed in the interpretation and conclusions of these findings. Most of the studies explored small sample sizes and did not provide follow-up data beyond 1 year following surgery. Additionally, fewer studies analyzed the impact of interventions on weight loss outcomes. Indeed, most of them assess the effectiveness of psychosocial interventions on risk factors for poor weight loss outcomes. Going forward, further investigations with large sample sizes, extended longitudinally, and evaluating impacts on weight outcomes are needed to confirm the sustained beneficial effects of these alternative healthcare intervention programs for MBS populations.

Alternative Treatment Applications

With global increases in the prevalence of overweight and obesity, the number of patients submitted to MBS has been growing worldwide which, consequently, increases the need for long-term monitoring. Unfortunately, healthcare resources are limited and do not keep pace with this advance. Face-to-face interventions have shown to be efficient but can be problematic if we consider practical barriers such as limited mobility and accessibility of specialized bariatric surgery centers in some countries or rural areas. A significant number of patients continue to demonstrate unmet needs and a lack of holistic and consistent support. These difficulties may be mainly due to time restrictions, geographic limitations, or financial burdens. Therefore, developing alternative treatment applications with the potential to improve the cost-effectiveness and portability of psychosocial interventions is crucial.

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Telephone-based Interventions

Conducting interventions remotely may help to overcome these barriers, allowing for greater access to care and improved outcomes. In this line, mobile and internet-based (eHealth) applications of behavioral interventions are being examined. Preliminary results comparing the efficacy of a pre-operative telephone-based CBT intervention versus standard care suggested that the telephone-based CBT program is a promising brief intervention for improving eating psychopathology and depression in MBS candidates (Cassin et al., 2016). One pilot study also provided preliminary results about the feasibility and efficacy of a telephone-based CBT intervention to improve eating pathology and psychosocial functioning in 6-months post-MBS patients. Participants received six weekly sessions of telephone-based CBT that include an introduction to the cognitive-behavioral model of obesity, food records and scheduling of meals, scheduling pleasurable activities, managing difficult eating scenarios, problem-solving strategies to reduce vulnerability, and challenging negative thoughts. With a retention rate of 73.7% post-intervention, preliminary results suggested that post-surgery telephone-based CBT is feasible and can improve post-surgery symptoms of psychopathology (Sockalingam et al., 2017).

More recently, another pilot study suggested that a weekly (six sessions) telephone-based CBT delivery 1-year after MBS may improve binge-eating, emotional eating, and depression/anxiety symptoms in women (Sockalingam et al., 2019). Also, recent qualitative research suggested that bariatric surgery patients were generally highly satisfied with telephone-based CBT, noticed a variety of positive changes following this intervention program, and preferred this modality of delivery versus in-person therapy (Santiago et al., 2021). Despite all these positive indicators, the findings represent only preliminary results assessed immediately following treatment delivery. For this reason, it is uncertain whether the improvements were maintained in the long term and whether they translated into better weight loss outcomes. Further randomized controlled trials are warranted to confirm the continued impact of telephone-based interventions for this population.

Internet-based Interventions

As the world is experiencing exponential technological growth, people are becoming increasingly comfortable with eHealth strategies and several internet-based weight loss programs have been tested in individuals with overweight and obesity. One study analyzed weight-loss outcomes achieved when physicians refer overweight/obese patients to an automated 3-month internet-based behavioral weight-loss program. This intervention included 12 weekly multimedia behavioral lessons, a website for

submitting self-monitoring data, and weekly automated feedback provided to the participants on their progress to date. Participants on the internet-based behavioral program lost more weight at the end of the 3-month program compared to participants randomly assigned to an internet newsletter control condition. Moreover, participants maintained this weight loss in full at 6-months (Thomas et al., 2015).

Similar findings were also found with MBS populations. Bradley et al. (2017) developed a pilot study to test a 10-modules remote acceptance-based behavioral intervention for postoperative weight regain. Results supported the feasibility and acceptability of this intervention – retention rate of 70% among those who started the program and high satisfaction among study completers. Furthermore, weight regain was reversed throughout the intervention and maintained at 3-months follow-up. This intervention program also showed a positive impact on eating-related psychopathology (Bradley et al., 2017).

Additionally, in a randomized controlled trial, investigators are currently evaluating the efficacy of APOLO-Bari – an internet-based CBT program for longitudinal support of bariatric surgery patients that includes additional guidance, a monitoring system, clinical support, and a psychoeducational program to bariatric patients during the postoperative period. Results are not yet available but will add important information to the still limited body of evidence about the impact of postoperative interventions delivered remotely (Conceição et al., 2016).

Smartphone Applications-based Interventions

With the increased growth in technologies, along with the rising popularity of smartphones, there have been massive advancements in the development of mobile phone technologies. The number of smartphone applications available to download is, nowadays, huge. Healthcare interventions have accompanied this development and there is currently a vast variety of interventions for health promotion delivery by smartphone applications. Similarly, the utilization of smartphone interventions to obesity and MBS patients is not something new. Studies proved the feasibility of a smartphone application in the education and engagement of patients before MBS. Participants' satisfaction scores suggested that this application was well-received and induced positive behavior changes and weight loss (Mundi et al., 2015). In this line, Zhang et al. (2015) also demonstrated the potential feasibility of having an online and smartphone cognitive behavioral portal to serve the psychological needs of MBS patients (Zhang et al., 2015). However, more clinical research of smartphone applications aimed at postoperative intervention to prevent weight regain is still needed.

Facebook-based Interventions

As new technologies advance, patients are also turning to online modalities to access information about their health, and bariatric surgery patients are no exception. A study analyzed the pattern of internet use by 103 patients after MBS and found that 51.5% of patients accessed the internet in search of information about health and bariatric surgery. Facebook was the most used site for pursuit this type of information and online support groups have recently gained increased attention from bariatric surgery patients (Martins et al., 2015). However, little was known about the actual content of these interaction groups. A recent study conducting a content analysis of MBS patients support groups and pages on Facebook suggested that these online tools are commonly used to receive support, celebrate physical and emotional accomplishments after the intervention, provide anecdotal accounts of the "bariatric lifestyle," and comment on challenges with mental health and experiences of weight bias (Koball et al., 2017a). Results also showed that in a sample of 103 postoperative MBS patients, 84% (n=86) of patients joined or follow Facebook support groups (Martins et al., 2015).

Nevertheless, despite the increased interest in these platforms, there are some concerns about their use. Not all the groups were properly managed by specialized professionals in the field which is not guaranteed that the information presented is medically accurate or helpful. Corroborating this, a recent study assessed the perceived value for MBS patients of a Facebook social support group. This private Facebook group sought to engage in a discussion of experiences with peers, access information, and receive answers to questions directly from the healthcare providers responsible for overseeing the group's activity. Results showed that members check the group page more than once per day which further highlights its impact on patients' lives. The same authors also highpoint that Facebook groups work best when an experienced healthcare professional monitors the group's activity to screen for inappropriate posts, ensure that reliable information is being exchanged, and provide answers to questions not appropriately addressed by the group (Athanasiadis et al., 2020). It was noteworthy that the findings available currently represent only preliminary results and further investigations are needed to determine more broadly the extent to which this kind of support impacts weight loss outcomes after MBS. Nevertheless, this information offers relevant recommendations to the field for future research on Facebook and online social network interventions. Using these tools to deliver validated interventions incorporating CBT, ABT, or mindfulness-based strategies may be interesting but to date, no study has investigated this possibility.

Stepped care Approaches

Given the marked variability in individual outcomes after MBS, authors have recently suggested the need for personalized approaches. Stepped-care approaches are clinically relevant allowing an efficient allocation of treatment resources, starting with minimal, low-intensity, cost-effective strategies for all patients and successively adding components of increasing intensity for those patients who need them most (Kalarchian & Marcus, 2018). These typologies of intervention use a predetermined algorithm to select individuals who do not respond correctly to treatment after a predefined period and offer them a stepped care intervention in varying intensity. Past research has investigated these approaches in adults with binge eating disorders suggesting the potential utility of this intervention model (Grilo et al., 2020).

The applicability of stepped-care approaches to individuals with obesity has also been previously tested. Participants with a sedentary lifestyle and with obesity were randomly assigned to a standard and stepped care behavioral weight loss program, respectively. When patients in the stepped care behavioral weight loss program fail to achieve weight loss goals, it results in additional counseling based on problem-solving therapy. Results demonstrated that participants in the stepped care group lost significantly more weight and body fat, reported greater physical activity and greater improvements in diet, and were more likely to achieve their within-treatment weight loss goals than participants in the standard group (Carels et al., 2005).

Another study investigated whether a stepped care weight loss intervention compared with a standard behavioral weight loss intervention would result in greater weight loss outcomes in a sample of 363 adults with overweight and obesity. The standard behavioral weight loss program resulted in greater mean weight loss than the stepped care program over 18 months. However, this novel stepped care model resulted in clinically meaningful weight loss that cost less to implement (Jakicic et al., 2012). Surprisingly, to the best of our knowledge, adaptive clinical trials to establish the effectiveness of stepped care approaches and inform the development of treatment algorithms are highly recommended but inexistent in bariatric surgery populations (Conceição & Goldschmidt, 2019).

Conclusion

Behavioral interventions in MBS patients are crucial - identifying and intervening on specific disordered eating patterns and promoting healthy lifestyle behaviors are necessary to sustain or enhance long-term surgical outcomes. With the number of bariatric procedures performed increasing worldwide (Welbourn et al., 2019), it is crucial to develop and test new interventions with the view of increasing dissemination across MBS patients in cost-effective ways. CBT, ABT, and mindfulness-based intervention have shown promising results on weight regain prevention. With the advances in web technologies over the past decades, researchers and clinicians are looking to the internet as a feasible tool to deliver validated behavioral weight loss programs. These tools have several advantages compared with the traditional onsite treatment programs and represent a way to help resolve some of the major difficulties of health care services. Delivery validated intervention remotely allows narrow the gap between clinical support services and patients. MBS patients can have access to the intervention as they like, at any time and in any location with an internet connection, which eliminates the costs and participation burden associated with hospital visits. Despite these advantages, some concerns with eHealth should be noteworthy. Many patients are not keen on new technologies and social media or do not have routine access to the internet and cannot benefit from these types of interventions. Additionally, the unintended effect of health interventions delivery by the internet is also significant due to the potential for reinforcing problems that the intervention was designed to help – such as sedentarism and isolation. Moreover, despite remote interventions help to mitigate poor treatment retention in MBS populations, results showed that retention rates are still not optimal. Altogether, this information suggests that notwithstanding the use of internet-based interventions represents a part of the solution for the assessment and monitoring of MBS patients, more work is needed to find ways to outline the aforementioned issues.

Given the limited resources available to deal with the growing number of MBS and the marked variability found in treatment response, there is also a pressing need for the development of more complex and personalized models of intervention that focus attention on unresponsive patients. Stepped care approaches are models of intervention clinically relevant and cost-effective. Traditional stepped care treatment programs propose starting with minimal intervention delivery to all patients and move to more intensive or specialized treatments only if patients non respond to the previous treatment step. Despite experts on the field consistently highlight the need for stepped care models, research on the field is quite limited. Past studies confirm the feasibility of these interventions models for supporting

weight loss in patients suffering from overweight or obesity. Nonetheless, to the best of our knowledge, no study analyzed the impact of such approaches on weight loss outcomes after MBS interventions. There is an imperative need for rigorous clinical trials with large sample sizes, investigating how to design personalized health care approaches for weight management after MBS. Future research should consider the marked heterogeneity of the bariatric population and optimal timing to deliver validated intervention. Additionally, it is also crucial to incorporate the increased variability of delivery formats offered by technology advancements.

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Chapter 9

A Stepped Care Intervention Program Using Social Media for Long-term Support After Metabolic Bariatric Surgery: An Effectiveness Study

Abstract

Introduction: APOLO_Bari Stepped-care Intervention is designed to optimize weight loss and prevent weight regain after bariatric intervention. It includes two different steps 1) 18 months low-intensity intervention (delivered by Facebook®), and 2) 12 months high-intensity cognitive-behavioral-therapy program (delivered online and with phone calls). This study outlines the protocol intervention and its outcomes within the 18 months of intervention.

Methods: Intention-to-treat two-arm randomized-controlled-trial design. A total of 499 bariatric surgery patients were selected. After two screening processes, 228 participants were included in the study: IG – 124 (54%) received the intervention in addition to treatment as usual, and CG – 105 (46%) received treatment as usual only. Of these, 182 (IG = 98 (54%), CG = 84 (46%)) completed the 6-month midterm assessment. The assessment included self-reported measures of eating behavior, depressive symptoms, negative urgency, emotional regulation, and self-criticism.

Results: GEE analysis revealed a significant time-by-group interaction effect on %WL and measures of repetitive eating, compulsive grazing, loos of control loss of control eating, eating-related psychopathology, emotional eating, and psychological variables indicating a different evolution between groups across time. While the CG exhibits a trajectory of decreasing %WL and increasing psychopathology of eating behavior over time, the IG demonstrates trajectories in the opposite direction.

Discussion: This intervention produced improvements in weight loss maintenance, disordered eating, and psychological variables crucial for weight loss maintenance post-bariatric surgery. This highlights the potential of personalized approaches, adaptable to individual needs and timings, for sustaining long-term patient engagement in treatment.

Keywords: Bariatric-surgery, stepped-care approaches, Facebook®-based interventions, eating behaviour, weight-regain prevention.

Introduction

Metabolic Bariatric Surgery (MBS) remain the most effective and durable treatment for patients with severe obesity (Di Lorenzo et al., 2020; Rubino et al., 2016). Despite resulting in significant weight loss and improvements in obesity-related comorbidities (Arterburn et al., 2020), a subset of patients fails to achieve weight loss targets or experience substantial weight regain (Kalarchian et al., 2019).

Examination of postoperative factors associated with weight loss suggested that the greatest challenge for these patients may stem from the difficulty of embracing or maintaining required lifestyle changes and psychological disorders (El Ansari & Elhag, 2021). Studies suggest that the predictive value of problematic eating behaviours (PEBs) such as uncontrolled eating, binge-eating, or grazing, plays an important role in postoperative weight loss, with particular significance around 12-24 months after surgery (Allison et al., 2023; Conceição, Mitchell, Pinto-Bastos, et al., 2017; Conceição, Pinto-Bastos, et al., 2014; Conceição & Goldschmidt, 2019; Hilbert et al., 2022).

Considerable efforts have been put into understanding the mechanisms underlying the onset of PEBs postoperatively. Empirical investigations have suggested the prognostic effect of depressive symptomatology on weight outcomes following MBS (Freire et al., 2020). However, research in different populations has explored other psychological dimensions associated with PEBs that have been poorly investigated in the MBS population. Specifically, the inability to establish an encouraging and supportive relationship with oneself in setbacks or failure situations (Matos et al., 2023), difficulties with emotion regulation (Baldofski et al., 2016), and a tendency for using impulsive coping strategies in response to negative affect (Conceição et al., 2018; Sarwer et al., 2019) are associated with the occurrence of PEBs in community samples, individuals with obesity, or individuals submitted to MBS. Thus, the early detection of these dimensions that put patients at risk, and the implementation of tailored interventions emerge as key strategies for preventing weight recovery (Conceição & Goldschmidt, 2019; Paul et al., 2020).

A systematic review examined published literature on the impact of pre- and post-operative psychological interventions in weight loss outcomes following MBS. The findings suggested that post-operative cognitive-behavioural therapy (CBT) interventions, which focus on improving eating and lifestyle behaviors as well as psychological symptoms, show promise for improving short-term weight loss outcomes. However, the effects may not be durable, highlighting the need for long-term follow-up to maintain changes (David et al., 2020).

Additionally, a growing body of research underscore the importance of incorporating Acceptance and Commitment Therapy (ACT) techniques within this population. ACT aims to promote psychological flexibility in the face of negative private events (Finger et al., 2020). A randomized controlled trial demonstrated that MBS patients with access to an ACT-based program showed significant improvements on eating disordered behaviors, body dissatisfaction, quality of life, and acceptance of weight-related thoughts and feelings compared to participants in the control condition (Weineland et al., 2012).

Authors suggest that the optimal time to initiate psychosocial treatment is in the postoperative period before the onset of PEBs and significant weight regain (Conceição & Goldschmidt, 2019). Furthermore, in an environment with limited healthcare resources to deal with the rising MBS population, alternative time-efficient, and cost-effective interventions are needed. Such interventions should consider the heterogeneity of the population, and the difficulties in the accessibility of specialized treatment centers, particularly in areas with poor medical infrastructures, allowing a rational use of health system resources (McCarthy & Hart, 2011). Recently, the SARS-CoV-2 pandemic has also highlighted the need to develop online platforms that offer long-distance support and monitoring for patients who do not require a hospital visit.

With the dramatic growth in web technologies, online social networks represent a powerful and cost-effective alternative tool to deliver long-distance interventions, attempting to narrow the gap between clinical support services and patients. Although people are using social media to seek social support and health information (Athanasiadis et al., 2020, 2022), not all the content is medically accurate or helpful (Koball et al., 2017b). Facebook® seems to be the preferred platform (80,6%) for bariatric patients to seek health information (Martins et al., 2015; Scarano Pereira et al., 2022). Besides the high level of user retention and engagement (Maher et al., 2014), this platform is highly accessible, allowing for easier dissemination, provision of long-term intervention, reduced stigma, and costs for users and health services (Griffiths et al., 2006). Prior investigations have explored the effects of online interventions on MBS outcomes (Wright et al., 2021). However, to the best of our knowledge, no study has investigated the effectiveness of psychological interventions delivered through Facebook on weight outcomes after bariatric surgery.

Given the marked variability in individual outcomes, recent research suggested the need for personalized approaches (Conceição & Goldschmidt, 2019). Stepped-care approaches are clinically relevant allowing an efficient allocation of resources, starting with minimal, low-intensity, cost-effective strategies for all patients and successively adding components of increasing intensity if needed

(Kalarchian & Marcus, 2018). Notwithstanding, randomized clinical trials to establish the effectiveness of stepped-care approaches are highly recommended but inexistent in MBS populations (Conceição & Goldschmidt, 2019; Wright et al., 2021).

To narrow these gaps, our team developed the APOLO-Bari-Stepped-care intervention. This psychological support program was designed to support MBS patients in the long term after surgery to optimize weight loss and prevent postoperative weight regain. Thus, the aim of the present study is twofold: (1) to describe the study protocol for the randomized controlled effectiveness trial of APOLO-Bari Stepped-care intervention, and (2) to present the outcomes of the 18 months of intervention.

Methods

APOLO-Bari Stepped-care: The Intervention Program

The APOLO-Bari intervention was initially designed as an internet-based program to enhance MBS outcomes by providing long-term clinical support during the postoperative period and consistently monitoring key patient features related to long-term success. This program is intended to complement treatment as usual (TAU). The original intervention, described in detail by Conceição et al. (2016), consisted of three main components: (1) the APOLO-Bari self-help manual; (2) a feedback monitoring system with immediate feedback, and (3) scheduled interactive chat sessions with a trained psychologist in the field. The APOLO-Bari self-help manual is a supporting 12-chapter manual CBT-based with educational information on relevant topics to optimize long-term outcomes. Each chapter addresses topics related to weight regain prevention and is divided into four sub-topics supported by a set of tasks associated with each topic. For the APOLO_Bari_Stepped-care approach, this component was adapted to follow recent recommendations in the literature, incorporating not only the previously designed CBT strategies but also ACT-based strategies. Detailed information about the self-help manual chapters used is presented as supplementary material (Appendix i). The adaptation of the remaining components will be detailed below.

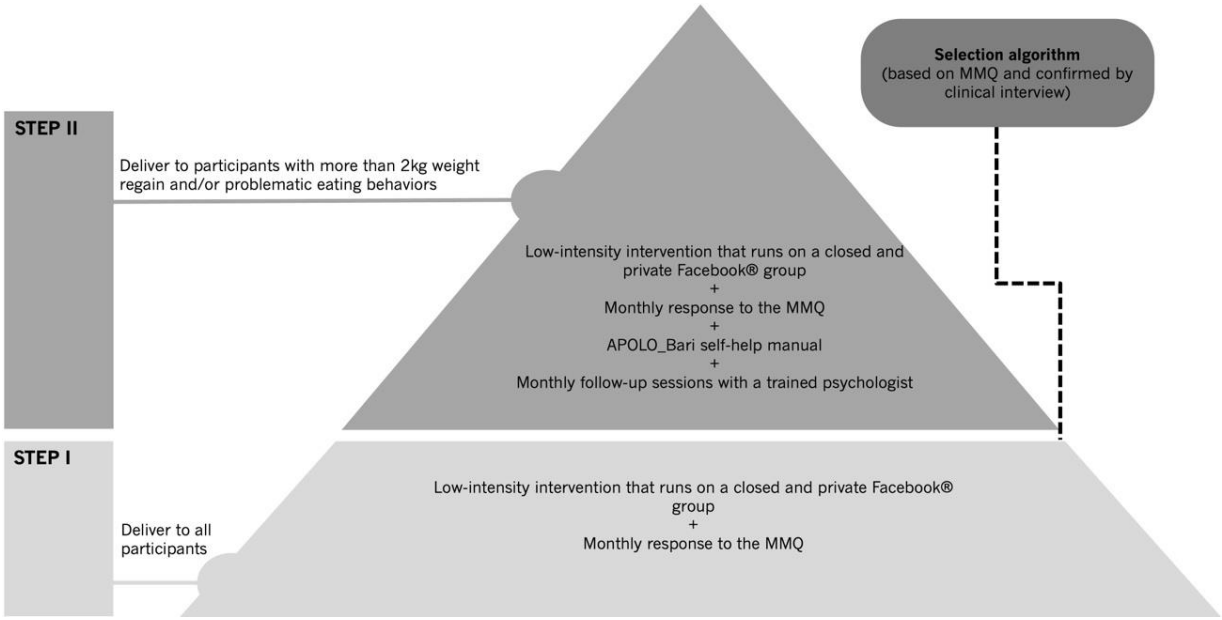
Based on the most recent international recommendations for support of MBS patients (Conceição & Goldschmidt, 2019; Kalarchian & Marcus, 2018), and considering the advances in the intervention delivery tools, our research team adapted the original APOLO_Bari protocol to a Stepped-care intervention format delivered remotely to participants through Facebook® platform and phone

calls. The APOLO_Bari_Stepped-care intervention includes two different steps from low- (Step I) to high-intensity (Step II) intervention and runs for 18 months total.

Step I – consists of a closed and private Facebook® group delivered to all participants. A new subtopic and related activities are posted every week in three publications (every Sunday, Wednesday, and Friday). The content for publication on Facebook® was composed of short texts/images and was created based on the adapted APOLO-Bari self-help manual. Patients are encouraged to participate by viewing the publications, commenting on the pictures, and posting their content. At the end of each month, participants are invited to complete the Monthly Monitoring Questionnaire (MMQ), an online questionnaire that allows them to regularly input information regarding their weight, key problematic eating behaviors (PEBs) (e.g., skipping meals, grazing, loss of control eating, and binge eating), psychological impairment, and physical exercise habits. The responses are reviewed, and a feedback message is sent to each participant via Facebook chat. A selection algorithm (detailed below) based on the degree of PEBs or weight regain selected patients at risk of weight regain to step up to the next level of intervention.

Step II – This level of intervention is offered only for patients at risk of weight regain and includes two components: (1) the adapted APOLO-Bari 12-chapter self-help manual. Participants in this step receive a new topic (chapter) each month via private chat on Facebook® and are instructed to read one of the four subtopics per week; and (2) individual interactive phone sessions with a psychologist (30 min) at the end of each month. This session runs via phone call during which a trained psychologist guides the participant through the content of the previous chapter. This phone session allows discussing difficulties and receiving personalized recommendations.

Figure 9-1. APOLO-Bari Stepped-care program – flowchart.



Note: The presence of weight regain and risk eating behavior was confirmed by a researcher during a semi-structure clinical interview carried out via phone call.

APOLO-Bari Stepped-care: The Selection Algorithm

The selection algorithm is based on MMQ – included as supplementary material (Appendix ii). Patients reporting at least one PEB and/or presenting more than 2kg weight regain on the MMQ since the beginning of the intervention are contacted by a research member and invited for a phone session. During this phone session, the researcher runs a semi-structured clinical interview to confirm the presence of PEBs and/or weight regain in the previous month (Conceição, Mitchell, et al., 2014; Fairbun & Beglin, 2008). If PEBs are not confirmed and/or weight regain is explained by other conditions not related to PEBs (e.g., an increase in lean body mass through physical exercise), participants remain in Step I and receive a reinforcing feedback message via Facebook® private chat. If PEBs and/or weight regain are confirmed, participants receive orientation information to move to Step II by phone call. All diagnoses resulting from the clinical interview are discussed by the research team to reach a consensus on whether to move the participant to the next step.

Procedure

The effectiveness study of the APOLO-Bari-Stepped-care intervention used an intention-to-treat two-arm randomized controlled trial design: (1) the intervention group (IG) with access to the APOLO-Bari-Stepped-care program in addition to TAU, and (2) a control group (CG) receiving only TAU. In the hospital involved in the study, the TAU offered to patients during the first year post-surgery includes up to two annual consultations with each specialist of the multidisciplinary team (psychologist, endocrinologist, nutritionist, and surgeon) for up to three years of follow-up, at which point the multidisciplinary monitoring ends. The main outcomes for the efficacy of the intervention were body mass index (BMI), weight loss, and the scores on the psychological measures.

Participants from both the IG and CG completed a set of self-report questionnaires at the beginning of intervention (T_b), at the first midterm assessment 6 months after the beginning of intervention (T_{m1}), at the second intermediate assessment 12 months after the beginning of intervention (T_{m2}), at the end of treatment after 18-months of intervention (T_{eot}), and at 6 months follow-up (T_{fu}).

The primary outcome measure was weight loss assessed at all the assessment moments using the following formula: Percentage of weight loss ($\%WL_{baseline}$): (Current weight at surgery – Current weight at the assessment moment)/Current weight at surgery) x100. Secondary outcome measures included scores on eating-related psychopathology and psychological variables through the several assessment moments, engagement during the intervention, and satisfaction with the intervention assessed at the end of treatment.

The study was first introduced as a program to support patients undergoing MBS in the long-term aiming to monitor relevant variables and investigate patients' perceptions of the utility of the intervention. Participants were blinded regarding the study condition they were assigned to. To avoid the bias of knowing the group to which the participants were assigned (IG or CG), it was explained that the program is delivered in different modalities with different intensities that aimed to monitor key-risk behaviors after surgery. The procedures were explained, and all participants signed an informed consent form after participation acceptance. Participants were informed about the possibility of withdrawing from the study at any time. Those who agreed to participate were randomized to the IG or CG through a computer system on a 1:1 basis. After finishing the study, CG participants are offered the option of receiving the APOLO_Bari-Stepped-care intervention. Participants did not receive any other form of compensation.

Participants from both the IG and CG completed a set of self-report questionnaires at the beginning of intervention (T_b), at the first midterm assessment 6 months after the beginning of intervention (T_{m1}), at the second intermediate assessment 12 months after the beginning of intervention (T_{m2}), at the end of treatment after 18-months of intervention (T_{eot}), and at 6 months follow-up (T_{fu}).

All the self-report measures were completed online via Google forms®. Participants were asked for two contact phone numbers and email addresses. To maximize participant retention, a reminder message/email was sent when a questionnaire was available. Participants were given one week to respond. If no response was received after this period, the research team initiated up to four contact attempts, spaced 24 hours apart, as a reminder.

All the plans to guarantee the security of the data collected were implemented – all participants were identified using a code so that no identifying information was used and only the research team involved in the study had access to the data. The study was approved by the ethical committees from the hospital center and the university ethical review board involved in the study. The randomized controlled trial protocol was registered in the platform ClinicalTrials.gov under de reference: NCT05946187. The Consolidated Standards of Reporting Trials (CONSORT) reporting guideline was used when writing this paper (Schulz et al., 2010).

Recruitment and Participants

Participants were recruited from the University Hospital Center of São João within the "Centro de Responsabilidade Integada de Obesidade" (CRIO) group in two times (December 2021 and June 2022).

Criteria for inclusion included: woman aged between 18-65 years; underwent Roux-en-Y Gastric Bypass or Gastric Sleeve between 12 and 24 months ago; have a Facebook® account and regular Internet access. Exclusion criteria included: taking weight-loss medications; acute psychiatric or medical problems; pregnancy or lactation, and illiteracy.

During the recruitment period, we used the appointment list of one of the psychiatrists of the CRIO group to access participants coming in for the 12-month appointment after MBS. Based on the information available in medical records (sex, age, date of bariatric surgery), a first screening was carried out according to the inclusion/exclusion criteria. All eligible MBS patients resulting from this screening process were contacted by phone by a researcher. The study was presented during this phone

call and the remaining inclusion/exclusion criteria were confirmed. Patients accepting participation in the study were then randomized to IG and CG and received all the orientations necessary.

Analysis of power using the G-Power program for F-test with repeated measures, considering a 0.5 effect size, alpha of 0.05, statistical power of 0.8, and 30% dropout rate (based on preliminary studies of our team) suggest that a minimum of 144 participants should be recruited and randomized to one of two groups (IG and CG, n=72).

Measures

Sociodemographic and Clinical/Anthropometric Questionnaire (SCAQ) – self-report questionnaire that assesses relevant demographic and clinical information (type of surgery, pre-surgery weight, lowest and highest weight before and after surgery). The following equation was used to calculate the Weight Regain at baseline and WRbaseline: (Current weight at baseline assessment – Nadir weight at baseline assessment).

Repetitive Eating Questionnaire – Rep(eat)-Q (Conceição, Mitchell, Machado, et al., 2017a) – 12-items self-report measure that assesses feelings, behaviours, and cognitions related to grazing through two subscales: repetitive eating (α = .96) and compulsive grazing (α = .95).

Eating Disorder_15 – ED_15 (Tatham et al., 2015) – 15-items self-report measure that evaluates eating disorder psychopathology with two subscales: weight concern (α =.62) and eating concern (α = .93). Only the 10 items that constitute the total score and subscale were used.

Three Factor Eating Questionnaire_ R21 – TFEQ_R21 (Stunkard & Messick, 1985) – 19-items self-report measure that assesses three types of disordered eating behaviours namely: uncontrolled eating, cognitive restriction, and emotional eating. For this study, only the emotional eating (α = .95) and cognitive restraint (α = .64) subscales were used.

The Loss of Control Over Eating Scale – LOCES (Latner et al., 2014) – 24-items self-report measure that assesses the degree of loss of control over eating. Cronbach's α was .96 for the total score.

Depression Anxiety Stress Scales – DASS (Lovibond & Lovibond, 1995) – 21-items self-report measure that evaluates three dimensions: anxiety, depression, and stress. For this study, only the depression scale (7-items) was used (α = .91).

UPPS Impulsivity Scale – UPPS_NU (Whiteside et al., 2005) – 12-items self-report measure that assesses four distinct personality pathways to impulsive behaviour. For this study, only the negative urgency scale was used which measures an individual's tendency to surrender to strong impulses, particularly under situations of negative emotions. Cronbach's α was .93.

Difficulties in Emotion Regulation Scale – DERS (Gratz & Roemer, 2004) – 18-items self-report measure that assesses clinically relevant difficulties in emotion regulation. Cronbach's α was .93 for the total score.

Forms of Self-Criticizing and Reassuring Scale – FSCRS (Gilbert et al., 2004) – 22-items self-report measure that examines how critical or how supportive people are when things go wrong for them. It generates three subscales: inadequate-self (α = .90), hated-self (α = .81), and reassure-self (α = .91).

Satisfaction questionnaire (SQ) – 21-items self-report measure developed for this study to addresses the utility and feasibility of the program from the patient's perspective (data not analysis in the present dissertation).

Table 1 presents a summary of the self-report measures for each assessment time.

Table 9-1. Timeline of self-report measures used in the randomized controlled trial.

	Baseline (T_b)	6-month midterm assessment (T_{m1})	12-month midterm assessment (T_{m2})	18-month end of treatment (T_{eot})	6-month follow-up assessment (T_{fu6})	Monthly
SCAQ	x	-	-	-	-	-
Repe(eat)-Q	x	x	x	x	x	-
ED-15	x	x	x	x	x	-
TFEQ_R21	x	x	x	x	x	-
LOCES	x	x	x	x	x	-
DASS	x	x	x	x	x	-
UPPS_NU	x	x	x	x	x	-
DERS	x	x	x	x	x	-
FSCRS	x	x	x	x	x	-
SQ	-	-	-	IG	-	-
MMQ	CG	CG	CG	CG	CG	IG

Note: x – available for both intervention and control group; IG – Intervention group; CG – Control Group.

Statistical analysis

For the present study, only the data from the baseline, 6- and 12-month midterm, and 18-month end-of-treatment assessments were used. Cronbach's α was calculated for subscales or total score, as applicable. Participant characteristics were summarized using descriptive statistics including means, standard deviations (SD), frequencies, and proportions. Mann–Whitney (U) tests, Chi-square tests (χ^2), and t-tests for independent samples were used (according to the decision on the normality of the data) to analyze differences between IG and CG on baseline assessment. Generalized Estimating Equations (GEE) models with Gamma with log link distribution, maximum likelihood estimate method, and 95% confidence interval level were generated for each outcome variable (Percentage of Weight Loss (%WL) and scores in self-report measures) with main effects of time (baseline assessment, midterm assessment), group (IG, CG), and time-by-group interaction. When a covariate was included in the GEE model, the covariable main effects were also described. Non-normally distributed outcomes were (x +1) transformed when needed. For results reporting, estimated means and standard errors (SEs) from GEE were back transformed to their original units. Were considered statistically significant $p<0.05$ values. The IBM® SPSS® Statistics 24 was used for data analysis.

Results

Characterization of the sample

MBS patients in the list provided for contact were n = 499. After the first screening, n = 142 patients were excluded: n = 25 (17%) were men, n = 44 (31%) did not meet the age criteria and n = 73 (51%) were not within the follow-up range stipulated as inclusion criteria, resulting in n = 357 patients randomized to the two groups: IG = 195 (55%); CG = 162 (45%). Out of these n = 357 patients, n = 41 (IG = 26 (63%); CG = 15 (37%)) were not possible to contact, n = 27(IG = 19 (70%); CG = 8 (30%)) accepted participation but did not complete the instructions to join the private group/complete the baseline assessment, n = 11 (IG = 7 (64%); CG = 4 (36%)) rejected participation, and n = 50 (IG = 19 (38%); CG = 31 (62%)) did not meet the inclusion criteria – which resulted in a total of n = 228 (IG = 124 (54%); CG = 104 (46%)) participants included in the study.

Of the n = 228 participants, n = 172 (IG = 89 (52%), CG = 83 (48%)) completed the 6-month midterm assessment, n = 139 (IG = 68(50%), CG = 70(50%)) completed the 12-month midterm assessment, and n = 128 (IG = 69(54%), CG = 59(46%) completed the 18-month final assessment. Figure 2 presents a flowchart representing the recruitment process.

Figure 9-2. Flowchart representing the recruitment process.

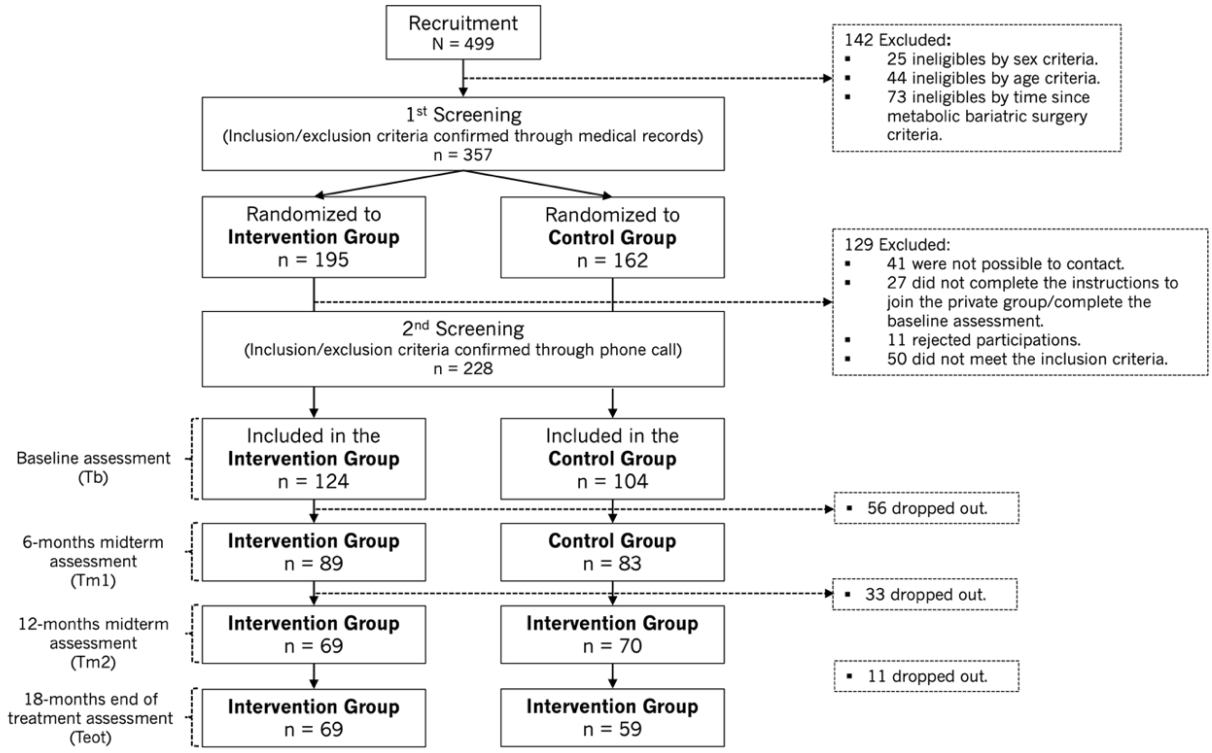


Table 1 presents participants' sociodemographic and anthropometric baseline characteristics. No statistically significant differences were found between groups regarding sociodemographic and anthropometric variables at baseline assessment, except for age, time since MBS and employment situation. Participants in the CG presented a mean age of 3 years higher than participants in the IG and a mean time since MBS 1.86 months higher than the IG. The proportion of patients employed in the IG is 20% higher than in the CG.

Table 9-2. Demographic and anthropometric characteristics of participants at baseline assessment.

	Intervention Group (IG) No. (%); Mean (S.D.)	Control Group (CG) No. (%); Mean (S.D.)	Statistical teste value
Age (years)	43.43(9.03) (Min. = 22; Max. = 64)	46.52(10.31) (Min. = 23; Max. = 64)	-2.41, $p = .008$
Marital Status			
Single	21 (16.9%)	18 (17.3%)	
Married/live with partner	87 (70.2%)	68 (65.4%)	0.99, $p = .80$
Divorced/separated	13 (10.5%)	14 (13.5%)	
Widowed	3 (2.4%)	4 (3.8%)	
Educational level			
High school (9–12 years)	110 (88.7%)	85 (81.7%)	
Graduated level	11 (8.9%)	15 (14.4%)	2.23, $p = .33$
Post-graduated level	3 (2.4%)	4 (3.8%)	
Employment situation			
Employed	97 (78.2%)	61 (58.7%)	
Unemployed	16 (12.9%)	21 (20.2%)	10.93, $p = .01$
Domestic	6 (4.8%)	13 (12.5%)	
Retired	5 (4.0%)	9 (8.7%)	
Type of Surgery			
Gastric Sleeve	19 (15.3%)	21 (20.2%)	0.93, $p = .34$
Gastric Bypass	105 (84.7%)	83 (79.8%)	
PRIM-REOP			
Primary	114 (91.9%)	98 (94.2%)	0.46, $p = .50$
Reoperative	10 (8.1%)	6 (5.8%)	
Time since MBS (months)	14.80 (2.51) (Min. = 12; Max. = 24)	16.66 (2.94) (Min. = 12; Max. = 24)	4045.50, $p < .001$
%WL	39.81 (6.85) (Min. = 23.15; Max. = 62.93)	38.64 (8.19) (Min. = 19.31; Max. = 63.64)	5795.50, $p = .19$
WR	0.55 (1.20) (Min. = 0.00; Max. = 7.00)	1.70 (2.93) (Min. = 19.31; Max. = 63.64)	5884.50, $p = .17$

Note: Mean – Estimated mean; S.D. – Standard deviation; Min – Minimum; Max – Maximum; %WL – Percentage of weight loss at baseline assessment; WR – Weight regain at baseline assessment.

Out of the 124 participants initially included in the intervention, 132 (98%) stayed as members in the Facebook® private group during the 18- month of intervention.

Comparison between groups from baseline to end of treatment assessment

Percentage of weight loss

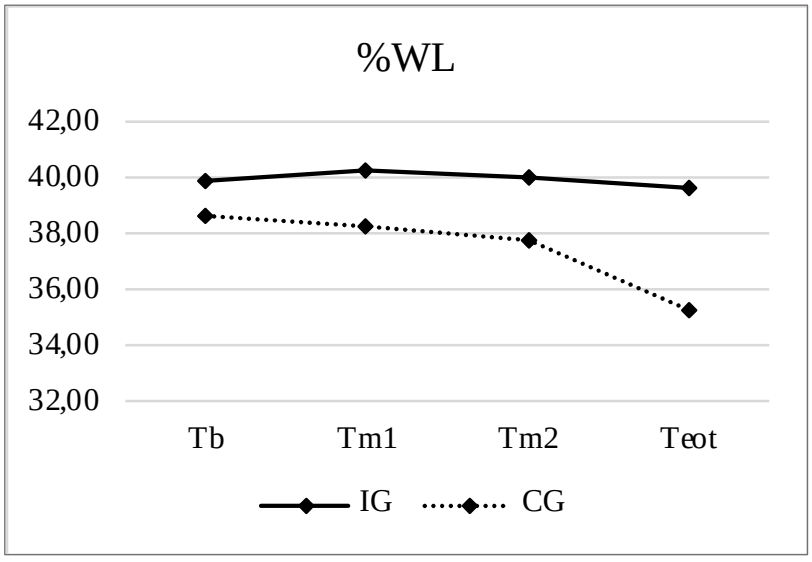
Considering the %WL, a statistically significant time-by-group interaction effect and a main effect of group and time were found (Table 2). IG increase in %WL between Tb and Tm1, followed by a slight decrease over the following assessment moments. In turn, the CG depicted a statistically significant decrease in %WL over time. At the end of treatment, there is a statistically significant difference in the %WL between groups (Figure 3, Table 3).

Table 9-3. Parameters of the generalized estimating equations analysis for %WL.

	β (95%CI)	SE	Wald χ^2	*p*
Time	0.09 (0.04 to 0.14)	0.03	11.46	<.001
Group	0.15 (0.07 to 0.22)	0.04	13.51	<.001
Time x Group	-0.09 (-0.15 to -0.24)	0.03	7.24	.01
Time Since MBS[a]	0.01 (0.004 to 0.03)	0.01	7.49	.01

Note: %WL – Percentage Weight Loss.

Figure 9-3. Comparison between groups on %WL.



Eating-related psychopathology variables

A significant time-by-group interaction effect, as well as main effects of time and group, were found for repetitive eating (Rep(eat)-Q), compulsive grazing (Rep(eat)-Q), loss of control eating (LOCES),

weight and shape concern (ED-15), and emotional eating (TFEQ) (Table 4). These results indicate distinct patterns of change over time for each group concerning these variables.

Specifically, while the CG showed an upward trend in scores over time for repetitive eating, compulsive grazing, loss of control eating, and emotional eating, the IG demonstrated a decline. Consequently, there were significant differences in score values between the groups at Tm2 and Teot (Figure 4; Table 3).

Regarding weight concern scores, both groups initially showed a decrease from Tb to Tm1. However, their paths diverged afterwards, as the Intervention Group (IG) continued to decrease while the Control Group (CG) experienced an increase. By the end of treatment, the groups exhibited statistically significant differences in their results (Figure 4; Table 3).

Concerning eating concern scores, only a time-by-group interaction effect was observed. Although both groups decreased until Tm2, IG showed a higher decrease, with groups presenting statistically significantly different scores at this assessment point (Figure 4; Table 3).

No significant time-by-group interaction effect or main effect of time and group was found for cognitive restraint. Both groups decreased over time (Figure 4; Table 3).

Psychological variables

A significant time-by-group interaction effect was observed for all psychological variables assessed (Table 4). Overall, the IG demonstrated greater improvements compared to the CG in the psychological variables under study. As such, the groups exhibited significantly different values at Teot in terms of emotional regulation difficulties, self-criticism (reassured- and hated-self), depression symptoms, and negative urgency (Figure 5; Table 3).

Table 9-4. Mean values and mean differences between groups on the different assessment moments.

	Intervention Group (IG)				Control Group (CG)				Dif_{Tb} (n=127) Mean (S.D.)	*p*	Dif_{Tm1} (n=172) Mean (S.D.)	*p*	Dif_{Tm2} (n=139) Mean (S.D.)	*p*	Dif_{Test} (n=128) Mean (S.D.)	*p*
	T_b	T_{m1}	T_{m2}	T_{est}	T_b	T_{m1}	T_{m2}	T_{est}								
%WL	39.81 (0.61)	40.28 (0.82)	40.03 (0.92)	39.64 (0.94)	38.64 (0.80)	38.21 (0.93)	37.76 (1.02)	35.28 (1.10)	1.17 (1.01)	.24	2.07 (1.25)	.10	2.27 (1.37)	.05	4.37 (1.44)	.002
Eating-related psychopathology variables																
Rep(eat)-Q_RE	0.88 (0.10)	0.65 (0.1)	0.38 (0.8)	0.23 (0.7)	0.78 (0.09)	0.93 (0.13)	1.00 (0.12)	1.24 (0.22)	0.10 (0.13)	.44	-0.28 (0.16)	.09	-0.62 (0.15)	<.001	-1.01 (0.23)	<.001
Rep(eat)-Q_CE	1.05 (0.11)	0.71 (0.11)	0.42 (0.09)	0.49 (0.11)	0.88 (0.12)	0.96 (0.14)	1.04 (0.13)	1.29 (0.23)	0.16 (0.16)	.31	-0.26 (0.17)	.14	-0.63 (0.16)	<.001	-0.80 (0.25)	.001
LOCES_TS	1.53 (0.06)	1.34 (0.05)	1.20 (0.05)	1.15 (0.04)	1.46 (0.05)	1.44 (0.06)	1.49 (0.07)	1.51 (0.10)	0.08 (0.08)	.31	-0.10 (0.08)	.21	-0.30 (0.09)	<.001	-0.36 (0.11)	.001
ED_15_WCS	1.28 (0.13)	0.89 (0.13)	0.81 (0.15)	0.63 (0.14)	1.37 (0.15)	0.94 (0.15)	1.08 (0.15)	1.26 (0.20)	-0.09 (0.20)	.65	-0.05 (0.20)	.80	-0.26 (0.21)	.21	-0.63 (0.25)	.01
ED_15_ECS	2.16 (0.12)	1.59 (0.15)	1.21 (0.17)	1.28 (0.15)	2.00 (0.13)	1.80 (0.13)	1.72 (0.18)	1.73 (0.17)	0.16 (0.18)	.37	-0.22 (0.20)	.28	-0.50 (0.24)	.04	-0.45 (0.23)	.05
TFEQ-R21_EE	1.88 (0.08)	1.73 (0.08)	1.49 (0.08)	1.45 (0.08)	1.68 (0.07)	1.78 (0.08)	1.83 (0.09)	1.91 (0.14)	0.19 (0.11)	.07	-0.05 (0.11)	.67	-0.35 (0.12)	.003	-0.46 (0.16)	.004
TFEQ-R21_CR	2.93 (0.05)	2.90 (0.05)	2.85 (0.07)	2.73 (0.05)	2.85 (0.06)	2.76 (0.06)	2.58 (0.07)	2.64 (0.06)	0.08 (0.08)	.33	0.14 (0.08)	.07	0.27 (0.10)	.01	0.09 (0.08)	.25
Psychological variables																
DERS_TS	30.59 (1.08)	26.46 (1.24)	25.20 (1.28)	24.35 (1.47)	31.05 (1.30)	28.46 (1.18)	29.63 (1.34)	32.68 (2.07)	-0.45 (1.69)	.79	-2.00 (1.71)	.24	-4.43 (1.84)	.02	-8.33 (2.54)	.001
FSCRS_RS	18.93 (0.71)	20.07 (0.86)	20.68 (0.89)	24.54 (0.80)	18.73 (0.71)	18.69 (0.72)	17.14 (0.76)	20.15 (0.99)	0.20 (1.00)	.85	1.38 (1.11)	.22	3.54 (1.17)	.002	4.38 (1.27)	<.001
FSCRS_IS	10.27 (0.70)	7.69 (0.78)	6.01 (0.90)	7.22 (1.07)	9.63 (0.74)	8.00 (0.68)	9.86 (0.71)	10.00 (1.38)	0.63 (1.02)	.54	-.31 (1.04)	.76	-3.84 (1.15)	<.001	-2.78 (1.75)	.11
FSCRS_HS	2.07 (0.30)	1.51 (0.29)	1.26 (0.35)	1.74 (0.34)	2.16 (0.29)	1.73 (0.31)	2.04 (0.38)	3.34 (0.68)	-0.09 (0.42)	.83	-0.23 (0.43)	.59	-0.78 (0.52)	.13	-1.60 (0.76)	.04
DASS_DS	2.89 (0.34)	2.94 (0.47)	2.39 (0.43)	2.64 (0.53)	3.79 (0.44)	3.34 (0.43)	5.34 (0.65)	4.36 (0.71)	-0.90 (0.56)	.11	-0.39 (0.64)	.54	-2.95 (0.78)	<.001	-1.72 (0.88)	.05
UPPS_NU	2.29 (0.06)	2.17 (0.08)	1.99 (0.08)	1.76 (0.09)	2.26 (0.06)	2.25 (0.06)	2.25 (0.06)	2.19 (0.11)	0.03 (0.09)	.76	-0.10 (0.10)	.319	-0.26 (0.10)	.09	-0.43 (0.14)	.003

Note: %WL – Percentage Weight Loss; Rep(eat)-Q_RE – Repetitive eating scale; Rep(eat)-Q_CE – Compulsive eating scale; LOCES_TS – LOCES total score; ED_15_WCS – Weight Concern Scale; ED_15_ECS – Eating Concern Scale TFEQ-R21_EE – Emotional Eating Scale; TFEQ-R21_CR – Cognitive Restraint Scale; DERS_TS – Difficulties in Emotion Regulation Scale total score; FSCRS_RS – Reassured-self scale; FSCRS_IS – Inadequate-self scale; FSCRS_HS – Hated-self scale; DASS – Depression Scale; UPPS_NU – Negative Urgency Scale, Dif_{Tb} – Difference between groups on baseline assessment; Dif_{Tm1} – Difference between groups on 6-month midterm assessment; Dif_{Tm2} – Difference between groups on 12-month midterm assessment; Dif_{Test} – Difference between groups on 18-month end of treatment assessment

Figure 9-4. Comparison between groups on eating-related psychopathology variables.

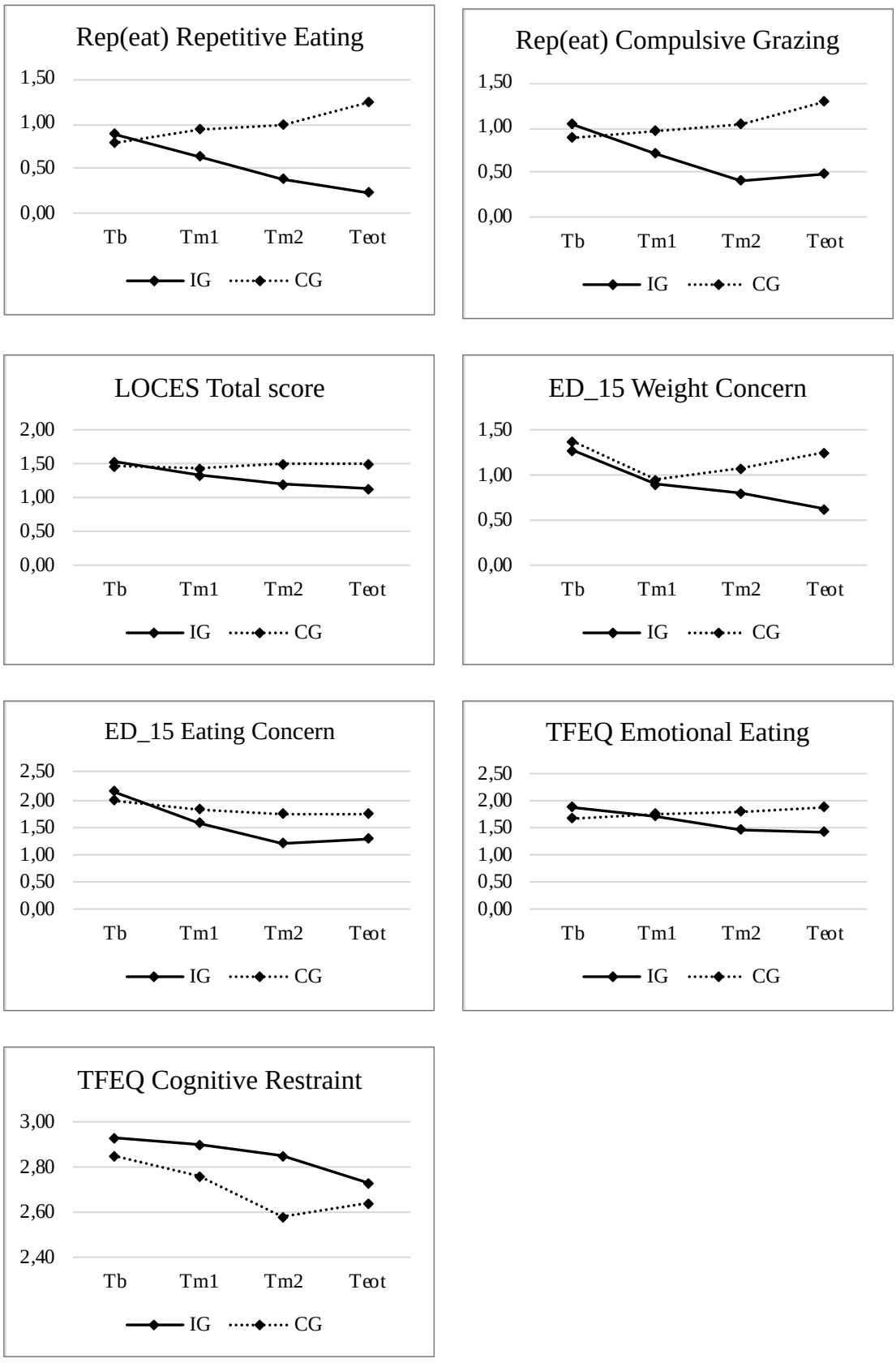
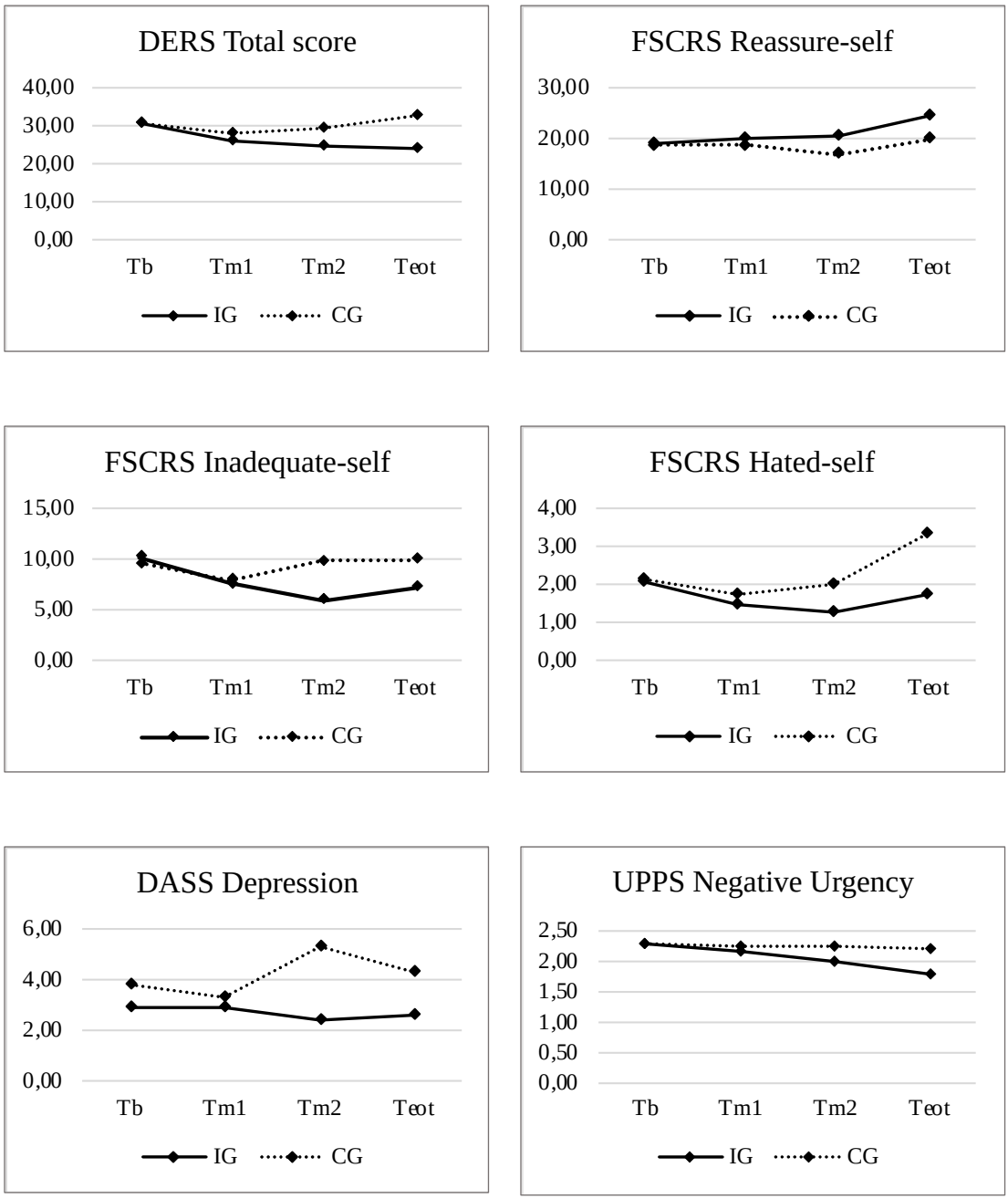


Table 9-5. Parameters of the generalized estimating equations analysis for eating-related variables.

	β (95%CI)	SE	Wald χ^2	*p*
Rep(eat)-Q Repetitive Eating Subscale				
Time	-0.23 (-0.41 to -0.06)	0.09	6.65	.01
Group	-0.60 (-0.81 to -0.37)	0.11	27.49	<.001
Time x Group	0.66 (0.42 to 0.89)	0.12	30.85	<.001
Time Since MBS[a]	.004 (-0.02 to 0.03)	0.01	0.11	.74
Rep(eat)-Q Compulsive Eating Subscale				
Time	-0.20 (-0.36 to -0.03)	0.08	5.62	.02
Group	-0.41 (-0.65 to -0.17)	0.12	11.44	<.001
Time x Group	0.51 (0.28 to 0.74)	0.12	19.02	<.001
Time Since MBS[a]	0.01 (-0.02 to 0.03)	0.01	0.50	.48
LOCES Total Score				
Time	-0.04 (-0.15 to 0.08)	0.06	0.46	.50
Group	-0.27 (-0.42 to – 0.11)	0.08	11.55	<.001
Time x Group	0.32 (0.18 to 0.47)	0.08	18.23	<.001
Time Since MBS[a]	0.002 (-0.02 to 0.02)	0.01	0.08	.78
ED_15_Weight Concern Subscale				
Time	0.05 (-0.14 to 0.23)	0.09	0.25	.62
Group	-0.32 (-0.58 to -0.07)	0.13	6.33	.01
Time x Group	0.29 (0.04 to 0.54)	0.13	5.03	.03
Time Since MBS[a]	.003 (-0.02 to 0.03)	0.02	0.05	.83
ED_15_Eating Concern Subscale				
Time	0.09 (-0.03 to 0.20)	0.06	2.24	.14
Group	-0.14 (-0.33 to 0.04)	.10	2.24	.13
Time x Group	0.24 (0.07 to 0.42)	0.09	7.54	.006
Time Since MBS[a]	0.02 (0.01 to 0.04)	0.01	6.05	.01
TFEQ Emotional Eating Subscale				
Time	-0.13 (-0.25 to -0.002)	0.06	3.99	.05
Group	-0.26 (-0.43 to –0.08)	0.09	8.39	.004
Time x Group	0.38 (0.21 to 0.55)	0.09	19.50	<.001
Time Since MBS[a]	0.01 (-0.01 to 0.03)	0.01	0.60	.44
TFEQ Cognitive Restraint Subscale				
Time	0.08 (0.02 to 0.13)	0.03	7.40	.01
Group	0.03 (-0.02 to 0.09)	0.03	1.30	.26
Time x Group	-0.01 (-0.08 to 0.06)	0.04	0.03	.86
Time Since MBS[a]	.000 (-0.01 to 0.01)	0.004	0.008	.93
Time Since MBS[a]	0.02 (0.01 to 0.04)	0.01	6.05	.01
DERS_Total Score				
Time	-0.05 (-0.17 to 0.07)	0.06	0.68	.41
Group	-0.29 (-0.46 to 0.12)	0.09	10.77	.001
Time x Group	0.28 (0.12 to 0.44)	0.08	11.64	<.001
Time Since MBS[a]	0.004 (-0.13 to 0.21)	0.01	0.24	.62
FSCRS_Reassure-self Subscale				
Time	-0.07 (-0.18 to 0.04)	0.05	1.68	.20
Group	0.29 (0.07 to 0.30)	0.06	10.47	.001
Time x Group	-0.18 (-0.31 to -0.05)	0.07	7.49	.01
Time Since MBS[a]	.00 (-0.02 to 0.01)	0.01	0.002	.97
FSCRS Inadequate-self Subscale				
Time	-0.03 (-0.25 to 0.19)	0.11	0.07	.80
Group	-0.25 (-0.60 to 0.11)	0.18	1.88	.17
Time x Group	0.34 (0.02 to 0.67)	0.16	4.40	.04
Time Since MBS[a]	0.22 (-0.10 to 0.05)	0.02	1.76	.18
FSCRS Hated-self Subscale				
Time	-0.31 (-0.59 to 0.03)	0.14	4.62	.03
Group	-0.43 (-0.81 to -0.04)	0.20	4.71	.03
Time x Group	0.43 (0.07 to 0.79)	0.18	5.38	.02
Time Since MBS[a]	0.15 (-0.03 to 0.06)	0.02	0.44	.51
DASS_Depression scale				
Time	0.12 (-0.37 to 0.14)	0.13	0.74	0.39
Group	-0.38 (-0.77 to 0.003)	0.20	3.79	.05
Time x Group	0.18 (-0.21 to 0.57)	0.20	0.81	0.37
Time Since MBS[a]	0.002 (0.04 to 0.04)	0.02	0.01	.94
UPPS_NU				
Time	0.04 (-0.06 to 0.13)	0.05	0.55	.46
Group	-0.21 (-0.35 to -0.07)	0.07	8.71	.003
Time x Group	0.23 (0.93 to 0.36)	0.07	11.01	<.001
Time Since MBS[a]	0.002 (-0.01 to 0.02)	0.01	0.11	.74

Figure 9-5. Comparison between groups on psychological variables.



Discussion

The present study aimed to describe the APOLO-Bari Stepped-care intervention study protocol and present the results of the 18-month intervention. This is the first randomized controlled trial to test a stepped-care internet-based psychological program using a social media network (Facebook®). The APOLO-Bari program aims to monitor and support BMS patients in the long term and optimize weight outcomes following surgery. It does so by preventing the onset of problematic eating behaviors and psychological impairment which are known to be consistently associated with poor outcomes, thereby facilitating the maintenance or transition toward healthier lifestyle habits.

Findings from the 18-month program, provide evidence for the effectiveness of the APOLO_Bari Stepped-care program as a supplementary intervention to the treatment as usual, in optimizing outcomes after MBS among a sample of Portuguese women.

Findings from a comprehensive prospective cohort study involving 1406 individuals who underwent RYGB revealed that the median time to reach nadir weight (the lowest post-surgery weight) was 2 years after surgery, with the most substantial weight regain occurring during the first year after reaching nadir weight (King et al., 2018). Consequently, it's reasonable to anticipate a decrease in the percentage of weight loss (%WL) for participants in this study, considering the post-operative phase they are in. Despite that, the fact that the intervention group (IG) displayed a more favorable trajectory compared to the control group (CG) signifies promising results regarding the effectiveness of this intervention.

Furthermore, the intervention resulted in an improvement in grazing, loss of control eating, emotional eating, and eating-related psychopathology scores within the IG, in contrast with the increase of these scores observed in the CG. During the immediate postoperative period, the procedure's intrinsic physical constraints naturally limit the consumption of large amounts of food. However, as time progresses, these constraints gradually diminish, fostering the emergence of PEBS and, ultimately, reduced weight loss outcomes after MBS (Allison et al., 2023; Conceição, Mitchell, Pinto-Bastos, et al., 2017). Therefore, early intervention aiming to prevent the development of these PEBs is crucial for the optimization of MBS treatment. The results found in our study hold practice significance for both clinical practice and research in the field as they underscore the potential of the APOLO_Bari_Stepped-care program to effectively prevent disordered eating following MBS, which may, in turn, enhance long-term weight loss and mitigate weight regain.

Additionally, the intervention also showed positive outcomes concerning psychological variables such as depression, difficulties in emotional regulation, self-criticism, and negative urgency. These variables have been described in the literature as mechanisms underlying the onset of PEBs (Baldofski et al., 2016; Conceição, Teixeira, et al., 2018; Freire et al., 2020; Sarwer, Allison, et al., 2019), which consequently may preclude MBS success.

Finally, it is worth highlighting that 98% of participants in the IG maintained their membership within the Facebook® private throughout the initial 18-month period, with continued access to the content disseminated during this time. Given the suboptimal adherence rates observed in follow-up consultations among MBS patients (Larjani et al., 2016), the high acceptability and retention rate of patients in this online intervention presents a promising development. Nonetheless, longitudinal investigations are still important analyzing not only the retention rate on the Facebook® private groups but also the participant's engagement with the intervention provided, investigating its potential associations with PEBs, psychological impairment and weight-related outcomes.

Even with these encouraging results, our findings should be interpreted in the light of their limitations. Firstly, although participants were recruited from a public reference hospital in the north of Portugal, which increases representativeness, concerns must be considered regarding the generalizability of the outcomes, particularly due to the exclusive inclusion of women in the study sample. Secondly, even though the potential for response bias due to the use of self-report measures on BMI and psychological variables should be considered, some precautions were implemented in this study. Past research has suggested that MBS patients tend to provide more accurate reports of their weight compared to the general population, possibly due to heightened attentiveness to weight changes after surgery (Christian et al., 2013). The self-report measures selected in this protocol were validated and have been widely used in bariatric populations. Furthermore, all diagnoses and decisions to switch participants to the next intervention level were previously confirmed by clinical interviews and discussed by the research team. Furthermore, to mitigate the potential impact of social desirability on responses, participants were assured that their answers would be treated with anonymity and confidentiality. Lastly, it's crucial to include in future studies an analysis of follow-up assessment data to ascertain the long-term sustainability of these positive outcomes shown by the IG. Moreover, it is imperative to include in future analyzes other variables that may predict different patterns of change in the group intervention. Furthermore, assessing participants' satisfaction with the intervention would offer valuable insights into their specific needs, shed light on dropout rates, and facilitate the refinement of these programs.

In conclusion, the findings indicate that the APOLO_Bari_Stepped-care intervention holds promise for clinical practice and future research, offering a new cost-effective and innovative intervention tool. The demand for long-term supportive and effective care for an increasing number of patients worldwide continues to outpace the evolution of available healthcare resources. This underscores the need to enhance and refine evidence-based psychological programs that must be tailored to the variability of patients' needs and follow the advances in intervention delivery strategies, highlighting the valuable addition of this randomized controlled trial.

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PART V

Conclusion

Summary and Integrative Discussion of Main Results

Obesity has increased significantly over the years, leading to a rise in the number of individuals undergoing MBS (WOF. World Obesity Federation, 2023). While this treatment often results in substantial weight loss and improvements in medical and psychological comorbidities associated with obesity (Cadena-Obando et al., 2020; Jirapinyo et al., 2019), long-term weight regain remains a challenging issue for researchers and clinicians in the field (Cadena-Obando et al., 2020; Geerts et al., 2021) who work with limited resources to meet the growing demand for support.

This dissertation aimed to address these challenges by expanding our knowledge about three main existing gaps: (1) contributing to a better understanding of constructs associated with suboptimal weight outcomes after MBS (Part II), (2) investigate the suitability of tools for assessing loss of control over eating in patients post-MBS (Part III), and (3) expanding our knowledge on the field of alternative psychological interventions tools to prevent weight regain after MBS (Part IV).

Recent studies in the field of eating behavior have highlighted the importance of assessing the construct of loss of control eating (LOCE), arguing that it is a major indicator of disordered eating-related and general psychopathology (Conceição et al., 2018a). This perspective becomes even more evident in individuals undergoing MBS, where surgical procedures limit the intake of large quantities of food, while feelings of LOCE and associated psychopathology persist through the consumption of smaller amounts of food (Goldschmidt et al., 2016). However, literature in this area still requires further investigation and the development of appropriate assessment and diagnostic tools.

Following this line of research, Chapter 1 (Part II) compared OBE, SBE, Compulsive Grazing, and Non-compulsive Grazing episodes and demonstrated that grazing exhibits levels of eating-related psychopathology, psychological distress, and negative urgency similar to those reported in binge-eating episodes. Thus, this study confirmed that psychopathology persists beyond the quantity of food consumed. Furthermore, it highlighted that evaluating these problematic eating behaviors dichotomously – as present or absent – may overlook subsyndromal variations of disordered behaviors that could also impact weight loss outcomes (Conceição et al., 2014; Conceição & Goldschmidt, 2019). It is imperative to conceptualize these problematic eating behaviors along a continuum of psychopathology to ensure a more effective assessment of patients. Furthermore, it is essential to consider the development of these eating behaviors, including both subtypes of grazing, when planning interventions aimed at preventing weight regain after MBS.

When designing these interventions, it is essential to understand which variables may trigger feelings of being unable to stop eating or control how much is eaten. Thus, Chapter 2 (Part II) demonstrated that discomfort with excessive skin, coupled with body image shame, led to increased eating-related psychopathology. This, in turn, was associated with higher levels of negative urgency, triggering episodes of uncontrolled eating in MBS patients. These findings highlight several variables to consider when intervening with this specific population.

In addition to expanding our knowledge about the underlying mechanisms of problematic eating behaviors in the post-MBS period, it is also important to increase our understanding of the suitability of assessment and diagnostic tools for this specific population. Chapter 3 (Part III) suggested that some of the five DSM-5 indicators may require adaptation for post-MBS patients. This study also suggests that the more indicators of LOCE a patient endorses, the higher their scores for eating-disordered psychopathology among post-MBS patients. This implies that with a greater number of LOCE indicators present, patients may be more likely to exhibit psychopathology indicative of an eating disorder diagnosis. Therefore, it is recommended that professionals exercise caution when utilizing these indicators to assess and identify LOCE episodes among post-surgery patients, with particular attention given to patients endorsing a significant number of indicators.

Finally, in Chapter 4 (Part III), confirmatory factor analysis of the originally proposed version of LOCES and its brief version (LOCES-B) confirm its structure for a Portuguese academic sample and among women undergoing MBS. Additionally, LOCES and LOCES-B demonstrated measurement invariance across sex, sample types (academic vs. bariatric), and different time points throughout the post-MBS process (12-, 18- and 24-months post-surgery). Moreover, this study expands on the associations between LOCE and transdiagnostic constructs of eating disorders, underscoring the clinical significance of the LOCE construct. It also emphasizes the predictive validity of these instruments concerning poor weight loss outcomes following MBS, highlighting the importance of early inclusion of LOCE measures in both assessment and intervention efforts to optimize surgical weight outcomes.

Considering these significant findings emphasizing crucial factors to consider when assessing and monitoring patients undergoing MBS, part IV of this dissertation aimed to address a pressing need for psychological intervention within this population.

A comprehensive analysis of the literature (Chapter 5) suggested the superior effectiveness of interventions post-MBS compared to those preoperatively in fostering behavioral changes that prevent poor weight outcomes. Additionally, literature suggested that psychological interventions should include classical Cognitive-Behavioral strategies alongside new alternative approaches, such as Acceptance and

Commitment Therapy (Chapter 5) for a more efficient treatment. Moreover, new technologies emerge as valuable alternative tools for delivering psychological interventions in the realm of promoting healthy habits among individuals with obesity or those who have undergone MBS (Chapter 6). These innovative approaches allow for resource optimization by reaching a larger number of patients with fewer resources, frequently monitoring participants, enhancing proximity to clinicians, and overcoming barriers such as difficulties in accessing treatment in remote areas (Conceição & Goldschmidt, 2019). Furthermore, in line with resource optimization, literature highlighted the promising value of stepped-care intervention models, which aim to escalate the intensity of interventions according to participants' needs, thus offering more personalized treatment models tailored to users' needs (Kalarchian & Marcus, 2018).

Grounded on all the knowledge acquired, the APOLO-Bari stepped-care intervention program is presented (Chapter 7). This comprehensive program spans 18 months and is conducted via private Facebook® groups, targeting MBS patients between 12- and 24-months post-surgery, and aiming to optimize MBS outcomes and prevent weight regain. The intervention consists of two steps with differing levels of intensity. In Step I, participants gain access to a private Facebook group where essential information on key aspects to prevent weight regain is shared weekly. Through a monthly selection process, individuals at risk of weight regain are identified and transitioned to Step II. Here, they receive additional resources, including a monthly self-help manual and personalized sessions with a specialized psychologist to address any challenges encountered while implementing the manual's tasks. This heightened level of support extends over 12 months.

In the randomized controlled study outlined in Chapter7, the effectiveness of this intervention is assessed. A control group receiving standard hospital treatment is compared with a group receiving the APOLO-Bari stepped-care intervention in addition to the standard treatment. The study evaluates various outcomes, including weight loss percentage, eating behavior psychopathology, and psychological variables, demonstrating the program's efficacy in the intervention group on the variables assessed.

This study introduces a novel psychological stepped-care longitudinal intervention protocol, pioneering in its aim to mitigate suboptimal weight loss outcomes post-MBS interventions. To the best of our knowledge, this is the first randomized controlled trial validating the high acceptability and effectiveness of such approach. The APOLO-Bari stepped-care intervention emerges as an accessible, cost-effective, and easily implemented social media-based intervention to reduce the significant burden of weight regain in MBS settings.

Lessons Learned and Implications for Practice

Broadly, this dissertation holds significant implications for research and clinical practice and represents a potential future contribution to preventive efforts through initiatives promoting healthy lifestyles and psychological well-being. Therefore, some highlights are synthesized.

Highlight 1: Patients after MBS have specific characteristics that need to be understood to ensure effective assessment and intervention.

MBS is a surgical procedure that induces significant changes in individuals both physically and psychologically (Alsaqaaby et al., 2024). The anatomical alterations produced by the surgery impose several physiological constraints on eating behavior. As a result, constructs, measures, and diagnostic categories originally developed for non-bariatric eating disorder patients may not adequately address the clinical presentation of problematic eating behaviors among post-MBS patients (Conceição et al., 2015). Many of the assessment and diagnostic measures for psychological constructs were used without a prior study of their applicability to the bariatric population. The insufficient understanding of eating behavior and the absence of diagnostic schemes and assessment tools specifically designed for the bariatric population significantly hinder the evaluation of problematic eating patterns, appropriate referrals for care, and the creation of tailored interventions.

In addition to the challenges related to eating behavior, individuals who undergo MBS also experience aesthetic alterations resulting from rapid and massive weight loss, significantly impacting various aspects of their lives. Excess skin is one of these changes that impact body image, often causing dissatisfaction and embarrassment (Kitzinger et al., 2012), and is frequently associated with a reduced health-related quality of life (Biörserud et al., 2013). As demonstrated in this dissertation, the discomfort experienced due to excess skin, coupled with body image shame, leads to more eating-related psychopathology, which, associated with a higher tendency to act impulsively, can trigger uncontrolled eating. Given the proven association between eating behavior and weight outcomes, all these factors can ultimately impact weight loss results (Miller-matero et al., 2018) and should be considered in intervention models for weight regain prevention.

In light of these, the findings of the present dissertation underscore the importance of recognizing MBS patients as a group with unique characteristics and specific challenges. Consequently, they require tailored evaluations for early detection and intervention of risk factors. The research findings

from this dissertation should be incorporated into clinical management strategies to ensure optimal patient outcomes.

Highlight 2: Psychological support is essential for weight regain prevention after MBS.

Undeniably, although genetics and biology play a central role in the manifestation of obesity, the social environment and human behavior also serve as crucial components in the development of this chronic and recurrent medical condition (Safaei et al., 2021). Consequently, psychologists have specialized knowledge in understanding human behavior and promoting the behavioral changes necessary to equip individuals with the skills necessary to promote good psychosocial adjustment and improvement.

Overall, this thesis reinforces the pivotal role of psychological support in weight regain prevention after MBS and reaffirms the necessity of frequent, and long-term monitoring to optimize the positive outcomes of this surgery. It is also essential that clinical approaches consider individual variability in weight loss trajectories and the limitations of public health resources in managing the increasing bariatric patient population. Consequently, there is a need for healthcare services to focus on cost-effective resource allocation and to identify the optimal timing and target groups for additional treatment.

Highlight 3: Social media can be a useful tool for delivering validated interventions to complement standard treatment.

In Portugal, the availability of public hospitals providing MBS interventions remains limited, predominantly clustered in major urban centers. Consequently, the geographical distance from these urban hubs may pose a barrier to patient's adherence to the necessary multidisciplinary and long-term treatment.

The results of this dissertation offer valuable insights into the potential of remote interventions, specifically using the Facebook® platform, for long-term patient support, allowing for personalized strategies and optimal resource allocation.

In addition to boasting a high level of user retention and engagement (Maher et al., 2014), Facebook® offers higher accessibility and flexibility. This platform not only allows access to content publishing tools but also enables the establishment of direct communication channels with users

through chat tools. Thus, it serves as an effective way for bridging the gap between professionals and patients, disseminating health information, reducing stigma and providing interventions in long-term. Furthermore, Facebook® allows to connect with patients where they are, thus, more fully integrating into their busy lives (Waring et al., 2018). This also contributes to cost reduction for both users and health services. Beyond these benefits, Facebook enhances standard treatment methods and enables the monitoring of patient progress, along with the collection of dynamic health-related data. This capability not only aids in tracking changes in weight over time but also facilitates deeper investigation into the underlying mechanisms behind these fluctuations.

The practical implications of this dissertation pave the way for new avenues of research that intersect with various health domains. For example, still in the field of MBS, a study demonstrated that patients are using Facebook® to get nutritional-related information, with half of the posts analyzed containing inaccurate content (Koball et al., 2018). The findings of this dissertation open new doors for future studies to explore the impact of social media platforms in disseminating validated information across other multidisciplinary areas such as endocrinology, nutrition, and physical exercise. Additionally, future research should investigate the adaptation of these intervention strategies to diverse contexts, expanding their relevance and efficacy beyond MBS to include areas like cancer, smoking cessation, and diabetes management. Such efforts would enhance our understanding of effective online psychological interventions across various health fields.

Highlight 4: Could integrating social media platforms into health intervention strategies inadvertently promote more addictive and sedentary behaviors?

This question is critical as we increasingly rely on digital tools for health interventions. Online platforms offer accessible and efficient ways to disseminate information and provide support (Bradley et al., 2017). In the case of Facebook®, this social network represents a frequently used and easily accessible tool with high user retention levels (Maher et al., 2014). Studies have shown that engagement with interventions via Facebook® is significantly and positively associated with weight loss (Hales et al., 2014), similar to in-person interventions (Mitchell et al., 2020). Consequently, research and clinicians worked to adapt healthcare interventions to include the features of this platform that most enhance participant satisfaction and engagement, aiming to promote better outcomes.

On the other hand, findings on the use of this social network suggest habitual and excessive use. Individuals often turn to this platform to pass the time when bored, procrastinate from other activities,

or escape feelings of loneliness and negative emotions (Ryan et al., 2014). This presents a potential paradox when weighing the risks and benefits of integrating such platforms into health interventions: are we promoting healthy behaviors, or are we, conversely, encouraging more sedentary lifestyles and maladaptive strategies like isolation?

The study presented in this dissertation (Chapter 7) found improvements within the group that accessed the intervention through Facebook in weight loss outcomes, eating-related psychopathology, and psychological variables such as difficulties with emotion regulation, self-criticism and negative urgency. This indicates that, for this specific population, Facebook® can be used as a vehicle to offer psychological interventions aimed at improving these aspects.

The advantages of the current dissertation extend beyond proposing an effective intervention model. It highlights the critical role of integrating social network tools for increasing communication between health care services and patients. Future research should explore the impact of incorporating educational advertising within social networks, focusing on validated and reliable content that promotes healthy habits. The rationale for using this tool should not be viewed as an attempt to increase social media usage, but rather as a strategy to leverage that time to provide validated and necessary information, thereby promoting adherence to healthier behaviors.

Limitations and Suggestions for Future Research

The empirical studies conducted within the framework of this dissertation encompass certain limitations that warrant consideration.

Most of the empirical studies presented in Part II were cross-sectional. This limits the discussion to associations between variables and does not allow for the establishment of causality. Longitudinal studies are essential to comprehend the trajectory of eating behaviors from the pre-surgical phase to the post-surgical phase and their evolution throughout the various stages of this period. Additionally, longitudinal studies can investigate their potential role as mediation or moderation variables in the process of weight loss maintenance.

Furthermore, the bariatric samples were collected in public clinical environments, which compromises the generalizability of the results. In Portugal, according to "*Portaria n.º 1454/2009, de 29 de dezembro do Diário da República*," which regulates the Obesity Surgical Treatment Program in the national health system, patient monitoring after MBS must include, free of charge, two consultations with each of the mandatory specialists (surgeon, psychologist, nutritionist, and endocrinologist) during

the first year of treatment. This is followed by one or two consultations with each specialist in the subsequent years until completing three years of follow-up and concluding the monitoring process. However, in the private sector, this support is paid for by the client, and the number of consultations may vary according to the client's needs. Therefore, it is important to consider the potential differences in the monitoring provided by multidisciplinary teams in public and private settings, which can globally influence the outcomes of this surgery. Specialized multidisciplinary care is crucial for achieving optimal long-term results after MBS (Cambi et al., 2021; Ogden et al., 2019). Consequently, the possibility of more frequent follow-up could impact the timely detection and treatment of medical, nutritional, or psychological complications, thereby influencing outcomes. Additionally, there is a need for further studies to assess whether motivation and compliance with treatment differ between the public and private sectors, and subsequently, how these differences may impact the outcomes.

Additionally, most studies included in this dissertation consisted solely of female participants, which further hinders the generalizability of results to both sexes. The decision to exclude men was guided by various considerations. Firstly, obesity is more prevalent in women than in men across most countries (Cooper et al., 2021), resulting in a higher likelihood for women to undergo MBS (Kochkodan et al., 2018). This sex imbalance in the field of MBS has led to men being underrepresented in research studies, thereby limiting the ability to achieve sufficient statistical power for robust comparisons between the sexes. Despite limited research, existing literature suggests that men are less likely to join weight loss programs (Tsai et al., 2016), and demonstrated lower adherence rates to follow-up support provided by multidisciplinary teams after MBS than women (Auge et al., 2022; Barka et al., 2021). Moreover, studies examining sex differences in populations with overweight and obesity have highlighted variations in eating behavior and related psychopathology between women and men. Women are more likely to exhibit PEBs such as grazing, LOC eating, emotional eating, and nocturnal eating, and are also more prone to experiencing body image dissatisfaction and overvaluation of weight/shape concerns compared to men (Saules & Herb, 2019). Furthermore, it is essential to acknowledge that various aspects addressed during the APOLO-Bari stepped care intervention may be perceived differently by men and women, potentially introducing bias into our study outcomes. For instance, men and women often encounter distinct barriers to engaging in physical activity. Similarly, the effects of common post-surgical changes, such as hair loss or excess skin due to significant weight loss, may be interpreted differently, necessitating tailored approaches for each sex. Additionally, the coexistence of both men and women within the same private Facebook group could potentially hinder participant involvement due to concerns regarding social desirability. Considering these factors, while it is imperative for future

research to address the underrepresentation of men in study samples, we must recognize that the relatively limited number of male patients undergoing MBS may not provide sufficient statistical power to analyze sex differences within our study groups. Therefore, opting to exclude male patients could help mitigate sample bias.

Furthermore, it is crucial to consider the dropout rates observed in the randomized controlled study. Attendance at assessment time points decreased similarly over time for both groups. This dropout occurred despite the implementation of strategies aimed at maximizing participant retention. Interestingly, 98% of participants in the intervention group remaining in the private Facebook groups till the end of treatment. Future studies should delve into which variables may be associated with this dropout phenomenon.

In this context, it's imperative to consider the impact of weight stigma. Research indicates that individuals who undergo MBS frequently experience self-stigmatization, manifesting as both experienced and internalized weight bias that is worsened by the stigma surrounding such procedures (Garcia et al., 2023; Hansen & Dye, 2018). Weight stigma and weight bias internalization in MBS patients contribute to feelings of social isolation, avoidance of healthcare, worse dietary adherence, PEBs, and diminished motivation for physical activity (Himmelstein et al., 2022; Raves et al., 2016). Qualitative findings suggest that patients who have undergone MBS may not recognize these interconnected factors. Instead, they often attribute issues such as PEBs, failure to adhere to strict dietary guidelines, and subsequent weight regain to personal shortcomings, reinforcing internalized weight bias or self-stigmatization related to body weight (Raves et al., 2016). Taking this information into account, it is crucial to consider that participants who did not respond to assessment requests may be those facing greater difficulties in terms of eating behavior, psychological state, and/or weight loss maintenance. Due to self-blame for these difficulties, patients might distance themselves from health professionals.

Therefore, it would be essential to further explore the impact on outcomes, of adherence to assessments, online sessions with the psychologist, and participation in private groups through viewing posts, giving likes, or making comments. Beyond that, it is important that, based on the data collected in this randomized controlled trial, future studies quantitatively and qualitatively analyze participants' perceptions of the utility and feasibility of the intervention program. For example, research about its optimal length, intensity and content suitability is necessary. Additionally, it would be noteworthy to conduct dismantling studies to determine which intervention component participants found most adequate, attractive, and helpful.

In this regard, it is important to highlight that one of the main challenges in demonstrating the effectiveness of interventions carried out on social media is the speed of research. The relatively slow pace of conducting large randomized clinical trials with rigorous study designs makes it difficult to keep up with the rapid pace of technological innovation in the market. This rapid innovation frequently changes the algorithms of engagement that determine which platforms are most used and how content should be adapted to achieve maximum visibility which creates challenges for patients, researchers, and clinicians. Recently, other social media platforms besides Facebook, such as Instagram, TikTok, YouTube, Pinterest, Snapchat or Twitter have emerged and rapidly gained popularity (Waring et al., 2018). Therefore, it is important for research to keep pace with these advancements, seeking to explore how these new tools can be utilized as vehicles for delivering psychological interventions or promoting greater adherence to interventions.

Also, it would be interesting to assess whether participation in this supplementary program influenced participants' adherence to the standard multidisciplinary treatment offered by the hospital involved in the study.

Another limitation in the research on the use of new technological tools is the lack of studies on the cost of implementing social media-delivered interventions. Data on cost-effectiveness can significantly influence decision-making regarding the provision of treatments or preventive interventions and the willingness to pay for these programs, especially in an era of limited healthcare budgets. Future studies should include cost-effectiveness analyses to determine the economic viability of widespread implementation (Waring et al., 2018). This will inform the next generation of interventions and ultimately how such approaches could be integrated into healthcare and reimbursement systems.

Finally, it is important to consider that the APOLO-Bari stepped-care intervention was designed as a low-intensity program to optimize surgical outcomes and prevent weight regain, aiming to act preventively during the critical timeframe for the development of behaviors predictive of poorer results. Future studies should assess the impact of these online methodologies as higher-intensity intervention tools in individuals already presenting with established psychopathology.

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