THE BARIATRIC INTERPROFESSIONAL PSYCHOSOCIAL ASSESSMENT OF SUITABILITY SCALE (BIPASS): PREDICTIVE VALIDITY FOR OUTCOMES 1 AND 2 YEARS FOLLOWING BARIATRIC SURGERY

by

Molly Atwood

Bachelor of Arts (Honours) in Psychology, Ryerson University, Toronto, 2012

Master of Arts in Psychology, Ryerson University, Toronto, 2015

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The Bariatric Interprofessional Psychosocial Assessment of Suitability Scale (BIPASS):

Predictive Validity for Outcomes 1 and 2 Years Following Bariatric Surgery

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Molly Atwood

Psychology

Ryerson University

Abstract

Bariatric surgery is the most effective intervention for severe obesity; however, many patients demonstrate insufficient and/or unsustained weight loss, and unsatisfactory psychosocial functioning in the longer-term. Although it is well established that attendance at postsurgical follow-up appointments is integral to sustained weight loss, nonadherence to follow-up is common. Consequently, presurgical psychosocial evaluations are conducted in order to identify patients at high risk of poor outcomes. Yet, no consensus has been established regarding a standardized protocol for the assessment of variables relevant to surgical outcomes, and bariatric programs vary widely in their interpretation of psychosocial risk. In addition, there is a paucity of research examining the predictive utility of psychosocial evaluations. The Bariatric Interprofessional Psychosocial Assessment of Suitability Scale (BIPASS™), a novel psychosocial evaluation tool, was developed to address these issues. The purpose of the present study was to contribute to the validation of the BIPASS tool via two aims: 1) by examining the psychometric properties of the BIPASS, and; 2) by examining the ability of the BIPASS tool to predict outcomes 1 and 2 years following bariatric surgery, including weight loss and weight regain, quality of life, psychiatric symptoms, and adherence to postsurgical follow-up appointments. The BIPASS was applied retrospectively to the charts of 200 consecutively referred patients of the Toronto Western Hospital Bariatric Surgery Program (TWH-BSP). Factor analysis of BIPASS items revealed a two-factor structure, reflecting “Mental Health” and “Patient Readiness” subscales. Internal consistency for the BIPASS Total and subscale scores ranged from poor to good, and inter-rater reliability was excellent. Higher BIPASS scores significantly predicted higher binge eating symptomatology, and lower physical and mental health-related quality of life at 1 year postsurgery. The BIPASS did not predict any outcome variables at 2 years postsurgery, or adherence to postsurgical follow-up appointments. Findings suggest that the BIPASS can be used to identify patients at increased risk of problematic eating and poor health-related quality of life early in the postsurgical course, thereby facilitating appropriate interventions.

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List of Abbreviations

%EWL: Percentage Excess Weight Loss

%TWL: Percentage Total Weight Loss

%WR: Percentage Weight Regain

AGB: Adjustable Gastric Banding

ASMBS: American Society for Metabolic and Bariatric Surgery

BED: Binge Eating Disorder

BIPASS: Bariatric Interprofessional Psychosocial Assessment of Suitability Scale

BMI: Body Mass Index

Kg: Kilograms

LOC: Loss of Control

RYGB: Roux-en-Y Gastric Bypass

SF-36: Medical Outcomes Study Short Form Health Survey

TWH-BSP: Toronto Western Hospital Bariatric Surgery Program

VSG: Vertical Sleeve Gastrectomy

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Introduction

Overview of Obesity: Prevalence, Classification, and Associated Consequences

Within the medical field, obesity is considered a chronic medical condition characterized by the accumulation of excess adipose tissue, to the extent that it might have detrimental effects on health. Rates of obesity have steadily increased worldwide over the past several decades (Ng et al., 2014). The most recent estimates of national prevalence indicate that approximately 35% of adults in the United States are obese (Ogden, Carroll, Kit & Flegal, 2014). Furthermore, approximately 18% of the adult population in Canada is obese, a number that is projected to continue rising over the next few years (Twells, Gregory, Reddigan, & Midodzi, 2014).

According to the National Institute for Health and Care Excellence (NICE, 2014) guidelines, Body Mass Index (BMI) determines weight categories. BMI is a standardized measure of weight, derived by dividing weight in kilograms by the square of height in meters (kg/m^2). In adults, "healthy weight" is defined as a BMI between 18.5 kg/m^2 and 24.9 kg/m^2. "Overweight" is defined as a BMI between 25 kg/m^2 and 29.9 kg/m^2, and "obese" as a BMI above 30 kg/m^2. Obesity is further subcategorized into class I (BMI between 30 kg/m^2 to 34.9 kg/m^2), class II (BMI between 35 kg/m^2 and 39.9 kg/m^2), and class III or "severe" obesity (BMI greater than 40 kg/m^2). Although the prevalence of class I and class II obesity in the United States has stabilized over the past decade, the prevalence rate of class III obesity continues to increase (Sturm & Hattori, 2013).

Individuals with severe obesity are at the highest health risk for a number of serious medical conditions, including cardiovascular disease, type II diabetes mellitus, several types of cancer, and obstructive sleep apnea, among others (Finer, 2010; Flegal, Graubard, Williamson & Gail, 2007; Kitahara et al., 2014). It is not surprising then, that individuals with severe obesity endorse poor health-related quality of life (Ul-Haq, Mackay, Fenwick & Pell, 2013). Moreover, the obesity-related health burden translates to increased healthcare utilization. Indeed, as obesity rates continue to climb, total annual healthcare expenditure spent addressing obesity-related illness increases, as do more indirect economic costs such as short- and long-term disability, absenteeism, and reductions in workforce productivity (Lehnert, Sonntag, Konnopka, Riedel-Heller, & König, 2013; Withrow & Alter, 2010). In a systematic review of 32 studies examining the relationship between obesity and direct economic costs, Withrow and Alter (2010) concluded that individuals with obesity accrued approximately 30% higher medical costs than their nonobese counterparts. In addition, a 2006 nationally representative survey in Canada concluded that approximately $4 billion in direct health care costs and $3 billion in indirect costs are accounted for by obesity (Janssen, 2013).

In addition to physical and economic consequences, individuals with severe obesity experience frequent discrimination, bias, and stigmatization due to pervasive weight-based societal stereotypes and prejudice (Puhl & Heuer, 2010). Indeed, weight-based discrimination rivals that based on gender or race (Bacon & Aphramor, 2011). Weight-based stigma occurs in multiple social domains, including the workplace, school, healthcare, and the public media (Puhl & Brownell, 2001; Puhl & Heuer, 2009). The experience of weight-based stigma has been associated with a range of negative psychological outcomes in individuals with obesity including depression (e.g., Friedman, Ashmore, & Applegate, 2008), low self-esteem (e.g., Carr & Friedman, 2005), body dissatisfaction (e.g., Wardle, Waller & Fox, 2002), and disordered eating (Haines, Neumark-Sztainer & Eisenber, 2006; Puhl & Moss-Racusin, 2007). It also contributes to lower levels of mental health-related quality of life than is reported by non-obese individuals (Hachem & Brennan, 2016).

Nonsurgical Treatment of Obesity

Given the increasing prevalence and associated costs of severe obesity, a substantial amount of research and public policy attention has been directed towards obesity prevention and intervention initiatives. The nonsurgical management of adult obesity includes behavioural lifestyle interventions, which emphasize the reduction of caloric intake, increase in physical activity, and management of food stimuli within an obesogenic environment through self-monitoring, stimulus control, problem solving, and activity scheduling (Fabricatore, 2007). Unfortunately, while behavioural lifestyle interventions typically result in modest weight loss (5 to 10% of body weight) by 6 months to 1 year, up to 80% of patients regain all or more of their pretreatment weight by 3 to 5 years posttreament (McTigue et al., 2003; Ozier, Kendrick, Leeper, Knol, Perko, & Burnham, 2008).

More recently, cognitive behavioural therapy (CBT) has been applied to the treatment and management of obesity. CBT for obesity includes comparable behavioural modification strategies to that of lifestyle interventions, and also incorporates cognitive therapy to challenge unhelpful thoughts related to eating, and shape and weight that are posited to interfere with sustained adherence to the behavioural regimen (Fabricatore, 2007). Comparable to research on strictly behavioural interventions, although many patients exhibit weight loss of between 5 to 10% of body weight after receiving CBT, weight regain within several years following cessation of treatment is the rule as opposed to the exception (e.g., Cooper et al., 2010). This occurs even when the prevention of weight regain is a specific target of the intervention.

Treatment of obesity with medication, such as orlistat or lorcaserin, is also frequently employed. However, several systematic reviews have concluded that the achievement of modest weight loss over the short-term is similarly succeeded by gradual weight regain following discontinuation of the medication (Arterburn & Noel, 2001; McTigue et al., 2003). These unsatisfactory results, in combination with the persistent rise in prevalence rate, have contributed to increasing interest in surgical interventions for the treatment of severe obesity (Santry, Gillen, & Lauderdale, 2005).

Surgical Treatment of Obesity

Bariatric (weight loss) surgery is the best available treatment for producing clinically significant and durable reductions in weight for individuals with severe obesity. At present, bariatric surgery is indicated for individuals with a BMI above 40 kg/m^2, or a BMI above 35 kg/m^2 in the presence of two or more obesity-related medical comorbidities, for whom nonsurgical interventions have not been effective (NICE, 2014).

Currently, the most commonly performed bariatric surgery procedures are Roux-en-Y gastric bypass (RYGB), vertical sleeve gastrectomy (VSG), and adjustable gastric banding (AGB; Angrisani, Santonicola, Iovino, Formisano, Buchwald, & Scopinaro, 2015). These procedures differ somewhat with respect to their mechanism of action. VSG and AGB are restrictive procedures that facilitate weight loss by reducing the size of the stomach, thereby limiting the amount of food patients can consume. More specifically, AGB involves placing an inflatable silicone band around the upper portion of the stomach to create a small stomach pouch, which limits and also slows the quantity of food that can be consumed in one sitting (Khwaja & Bonanomi, 2010). VSG involves the surgical removal of a large portion of the stomach along the greater curvature, resulting in a remaining “sleeve” or tube-like structure that is approximately 25% of the stomach’s initial size (Khwaja & Bonanomi, 2010; McGrice & Don Paul, 2015). Unlike AGB, VSG is irreversible. RYGB exerts both restrictive and malabsorptive effects, in that this procedure surgically reduces the size of the stomach to a 15-30 mL pouch, and also bypasses the remaining stomach and a portion of the small intestines (the duodenum and the proximal jejunum), thereby limiting the ability to intake food as well as absorb calories and nutrients (Khwaja & Bonanomi, 2010). Depending on the type of procedure, bariatric surgery can also produce metabolic changes in gut hormones that reduce hunger and increase satiety (e.g., ghrelin, GLP-1, peptin YY), as well as physiological changes that influence food preference and taste, which contributes to the efficacy of the procedure (Miras & le Roux, 2013).

Long-term outcomes. Numerous prospective studies have shown that bariatric surgery results in significant weight loss, with the nadir commonly achieved by 1 year postsurgery (Courcoulas et al., 2013). Although reporting of weight loss metrics varies across studies, weight loss is most commonly measured in one of the following two ways: *percentage total weight loss* (%TWL), calculated as total weight loss / presurgical weight x 100; or *percentage excess weight loss* (%EWL), calculated as total weight loss / excess weight loss × 100, where excess weight loss = total presurgical weight – ideal weight (i.e., the weight corresponding to a BMI of 25 kg/m^2). Common, albeit arbitrary, definitions of "successful" long-term weight loss following bariatric surgery are > 50% EWL and > 20% TWL (Corcelles et al., 2016; McGrice & Don Paul, 2015).

In the Swedish Obese Subjects (SOS) study, Sjöström and colleagues (2007) reported a mean total weight loss at 1-year postsurgery of 38.7% in patients who underwent RYGB and 26.9% in those who underwent AGB. Average total weight loss at 10 years postsurgery was 25% and 13% for RYGB and AGB, respectively (Sjöström et al., 2004). With respect to %EWL, one meta-analysis of 26 studies reported an average of 61.5% for RYGB and 42.6% for AGB at 1 year postsurgery, 69.7% and 50.3%, respectively, at 2 years postsurgery, and 71.2% and 55.2% at > 3 years (Garb, Welch, Zagarins, Kuhn, & Romanelli, 2009). In a recent systematic review of 16 studies, vertical sleeve gastrectomy was found to result in average excess weight loss of

59.3% at 5 or more years postsurgery (Diamantis, Apostolou, Alexandrou, Griniatsos, Felekouras, & Tsigris, 2014).

In addition to weight loss, bariatric surgery also results in improvements in obesity-related medical conditions. Both RYGB and VSG typically result in immediate, weight independent improvements in metabolic disorders. For example, diabetes remission rates as high as 80% have been reported in the short-term (Buchwald et al., 2009), which remain significant in the long-term (Sjöström et al., 2004). Even in patients who do not achieve remission, there is substantial improvement and a reduction in the use of oral hypoglycemic and insulin medications (Ikramuddin et al., 2013). Significant reductions in mortality due to cardiovascular disease and resolution or improvement of dyslipidemia, asthma, obstructive sleep apnea, and gastroesophageal reflux disease (GERD) have also been documented (Courcoulas et al., 2013; Higa, 2015; Sjöström et al., 2004).

Significant improvement in health-related quality of life is also reported following bariatric surgery, although scores generally remain lower than in the general population (Driscoll, Gregory, Fardy, & Twells, 2016; Nadaline et al., 2014; Raoof et al., 2015). A recent review concluded that quality of life demonstrates greatest improvement within the first year following surgery, which mirrors outcomes for weight loss and medical comorbidities (Hachem & Brennan, 2016). This finding suggests that changes in quality of life are at least partly attributable to weight loss and improvement in physical functioning, although concomitant improvement in self-esteem, body image, and reductions in depressive symptoms likely also contribute (de Zwaan et al., 2002; de Zwaan et al., 2011; Maddi, Fox, Khoshaba, Harvery, Lu, & Persico, 2001; Rand & Macgregor, 1991; Solow, Silberfarb, & Swift, 1974; Sutton & Raines, 2007; van Hout, Boekestein, Fortuin, Pelle, & van Heck, 2006; Waters, Pories, Swanson, Meelheim, Flickinger, & May, 1991). Several reviews have also noted that bariatric surgery produces greater positive effects on physical than on mental quality of life (Hachem & Brennan, 2016; Lindekilde et al., 2015; Magallares & Schomerus, 2014).

Although, overall, bariatric surgery is associated with a wide range of benefits, there is considerable variability in outcomes. Indeed, a sizeable proportion of patients – around 15 to 20% - fail to achieve 50% EWL (Maggard et al., 2005), and around 10% of patients fail to achieve 20% TWL (Corcelles et al., 2016). In addition, for many patients, weight regain is a pressing issue (Courcoulas et al., 2013; Shah, Simha, & Garg, 2006). In one prospective study following 300 bariatric patients for an average of 7 years after receiving RYGB, 37% of patients had experienced significant weight regain, defined as gain of ≥ 25% of total weight lost (Cooper, Simmons, Webb, Burns & Kushner, 2015). Weight regain appears to emerge early, with one study reporting that 30% of patients exhibited at least small amounts of weight regain between 1 and 2 years postsurgery (Rutledge, Groesz, & Savu, 2011). Another study showed that by 2 years postsurgery, approximately 25% of patients experience weight regain that is considerable compared to overall weight loss (Courcoulas et al., 2013). Importantly, these estimates are likely low as attrition following bariatric surgery is high (ranging up to as much as 70%, depending on the length of follow-up and surgical procedure; Sala, Haller, Laferrere, Homel, & McGinty, 2017; Toussi, Fujioka, & Coleman, 2009; Vidal et al., 2014), and nonadherence to follow-up care has been consistently linked to suboptimal weight loss outcomes (Gould, Beverstein, Reinhardt, & Garren, 2007; Harper, Madan, Ternovits, & Tichansky, 2007; Ramirez, Duffy, Robert, & Bell, 2008; Shen, Dugay, Rajaram, Carbrera, Siegl, & Ren, 2004).

Unfortunately, obesity-related medical comorbidities may recur or worsen as weight is regained (DiGiorgi et al., 2010; Sjöström et al., 2004). For instance, DiGiorgi and colleagues

(2010) reported that 24% of patients $\geq$ 3 years postsurgery experienced recurrence or worsening of type II diabetes; these patients were more likely to have either failed to lose substantial weight or regained a greater percentage of lost weight as compared to patients who did not exhibit recurrence or worsening of diabetes. Furthermore, improvements in quality of life may begin to deteriorate concomitant to weight regain, particularly in the domain of mental wellbeing (Karlsson, Taft, Ryden, Sjöström, & Sullivan, 2007). On the basis of these findings, it is apparent that positive outcomes are not guaranteed following bariatric surgery. Consequently, a growing effort has been made to identify factors that influence, or predict, negative outcomes.

Postsurgical adjustment. Far from being a passive cure for obesity, bariatric surgery is considered a tool that can aid patients in achieving significant weight loss and improved quality of life. In order to be successful in this pursuit, patients are required to make substantial, long-term behavioural and lifestyle changes, and cope effectively with unique physical, psychological, and social stressors.

Foremost amongst the required lifestyle changes are those related to eating patterns and behaviours, which are summarized in the postsurgical dietary guidelines. These guidelines are provided in order to reduce the likelihood of complications and to enable sustained weight loss (Parkes, 2006). For example, it is recommended that patients limit portion sizes and consume three small meals and two snacks per day, spaced no farther than 2 to 4 hours apart. Skipping or delaying meals or snacks can increase hunger and, consequently, overeating later in the day, and/or contribute to a failure to meet nutritional requirements (Parkes, 2006). It is also recommended that patients consume meals and snacks over a duration of 30 minutes, and chew food thoroughly (to the consistency of applesauce) in order to avoid food blockages at the entrance of the stomach. Liquids must be continually drunk throughout the day to prevent dehydration, although drinking is to be avoided for a period of time immediately before or after eating (Parkes, 2006). Patients are also faced with novel dietary restrictions, including a reduction in caffeine and alcohol intake, as physiological changes due to surgery result in the body metabolising these substances differently (Ertelt, Mitchell, Lancaster, Crosby, Steffen, & Marino, 2008). Intake of high energy density foods must also be significantly reduced in order to avoid “dumping syndrome” (i.e., intense discomfort accompanied by nausea, vomiting, diarrhea, weakness, dizziness, sweating, etc.; Heber, Greenway, Kaplan, Livingston, Salvador, & Still, 2010) and weight regain. Furthermore, for patients undergoing malabsorptive procedures such as RYGB, life long adherence to vitamin supplementation and daily protein requirements (between 60 to 120 grams per day) is necessary in order to mitigate the potential for developing nutritional deficiencies (Heber et al., 2010).

Increased and consistent physical activity also constitutes an important long-term strategy for weight maintenance, and is thus recommended for all patients following bariatric surgery (McGrice & Don Paul, 2015). In addition, adequate physical activity holds important implications for improved physical and mental health, including reducing the risk of cardiovascular disease, some types of cancer, and depression (Livhits et al., 2011). Unlike the dietary recommendations, there are no specific activity guidelines, which is partly attributable to variability in the physical capabilities of each individual patient.

In addition to lifestyle changes, bariatric patients must also cope with altered physiological sensations and experiences, such as the initial loss of hunger signals and changes in food preference and taste (Miras & le Roux, 2013), as well as a significant shift in body image that accompanies drastic weight loss. Although body image often improves following surgery (Song, Rubin, Thomas, Dudas, Marra, & Fernstrom, 2006), approximately 90% of bariatric patients develop excess skin (Kitzinger et al., 2012), which can contribute to continued negative evaluation of certain body parts, particularly the abdomen, breasts, and thighs (Conceição et al., 2013). In addition, excess skin can cause rashes, hygiene problems, and mobility issues (Baillot, Mampuya, Comeau, Meziat-Burdin, & Langlois, 2013). Medical problems associated with the surgery itself (particularly RYGB) are not uncommon, and include anastomotic leaks and bowel perforation, bowel obstruction, anastomotic stricture, alopecia, and hypoglycemia, among others (Neff, Olbers, & le Roux, 2013). Mental health difficulties and disordered eating behaviours can also (re)occur after surgery, making it more difficult to adhere to the dietary guidelines (Opozda, Chur-Hansen, & Wittert, 2016; Sheets et al., 2015). Lastly, many patients experience negative changes in the quality and dynamic of interpersonal and romantic relationships following surgery (Wadden & Sarwer, 2006).

Given the required changes and the plethora of potential challenges facing bariatric patients, positive postsurgical outcomes depend on patients' ability to successfully navigate and adjust to life postsurgery (Bagdade & Grothe, 2012). Indeed, difficulties adhering to dietary and physical activity guidelines and postsurgical follow-up appointments with members of the bariatric team, and a lack of adaptive skills to cope with stress and emotions, other than eating, have all been linked to suboptimal outcomes (Hsu, Sullivan, & Benotti, 1997; Livhits et al., 2011). As such, determining whether patients are ready and suitable for surgery is of critical importance.

Psychosocial Assessment of Bariatric Surgery Patients

In 1991, a National Institutes of Health (NIH) Consensus Development Conference Panel published guidelines for bariatric surgery, which included the recommendation that all patients undergo a comprehensive presurgical evaluation that includes assessment by various members of a multidisciplinary team with medical, surgical, mental health, and nutritional expertise (NIH conference, 1991). The American Society for Metabolic and Bariatric Surgery (ASMBS) similarly includes a presurgical psychosocial evaluation as part of their guidelines for bariatric surgery (Mechanick et al., 2013). The purpose of the presurgical evaluation process is to aid bariatric clinicians in determining patient readiness and suitability for surgery. This evaluation includes judgement of the patient's ability to effectively manage drastic and long-term lifestyle change, cope with the unexpected challenges that can arise following surgery, and make the necessary emotional, behavioural, and interpersonal adjustments (Ritz, 2006). Necessarily, the psychosocial evaluation also allows bariatric clinicians to determine whether there are any factors present that might hinder optimal postsurgical adjustment (Sogg & Mori, 2009; Mechanick et al., 2013). More specifically, information gathered during the evaluation process aids in identifying contraindications for surgery, as well as factors that may be amenable to intervention and, thus, warrant a delay as opposed to denial for surgery. For patients whose suitability and/or readiness for surgery are in question, the bariatric team is able to make appropriate recommendations (e.g., psychoeducation, psychotherapy, nutrition education, attendance at bariatric surgery support groups), which patients should complete before being reconsidered for surgery (Mechanick et al., 2013). Overall, the psychosocial evaluation aims to optimize positive patient outcomes following surgery, and to ensure that the benefits of pursuing surgery outweigh the potential risks.

Current Practices. Despite increasing recognition of the importance of presurgical evaluations, there are currently no standardized guidelines for the psychosocial assessment of bariatric candidates. Indeed, bariatric programs vary considerably in the methods and criteria they use to evaluate bariatric candidates, and little data exists on the best method of assessment.

The use of a clinical interview appears to be the most common component of the evaluation. For example, in a survey of 194 mental health professionals with an average of 4 years of experience conducting bariatric evaluations, most respondents (98.5%) reported using a clinical interview as part of the assessment process (Fabricatore, Crerand, Wadden, Sarwer, & Krasucki, 2006). Due to the use of the psychosocial evaluation as a tool for comprehensive treatment planning, and given the many psychosocial challenges bariatric patients face, the clinical interview goes beyond a traditional mental health assessment, which is typically limited to the assessment of psychopathology (Sogg, Lauretti, & West-Smith, 2016). This evaluation can include assessment of chaotic eating patterns, social support, and motivation, with a specific focus on how these factors might influence the patient's readiness for surgery, and psychosocial adjustment following surgery.

In another survey of 103 mental health professionals, only a minority of respondents (14.6%) reported using clinical interviews alone, while 74.8% reported additionally using between one and four symptom inventories (Walfish, Vance, & Fabricatore, 2007). Commonly used symptom inventories include those that assess for depressive symptoms (e.g., the Beck Depression Inventory), personality pathology (e.g., the Minnesota Multiphasic Personality Inventory, the Personality Assessment Inventory), eating pathology, and cognitive functioning (e.g., the Mini-Mental State Exam; Bauchowitz et al., 2005; Fabricatore et al., 2006; Walfish et al., 2007). However, there is no consistent assessment battery described in the literature.

Rates of, and reason for, denying or delaying surgery also vary. Fabricatore and colleagues (2006) reported that, on average, bariatric clinicians recommend surgery without reservation for approximately 70% of bariatric candidates, delaying surgery until specific issues are addressed or resolved for approximately 23% of candidates, and denying surgery for approximately 4% of candidates. Fourteen factors were cited by more than 10% of respondents as contraindications to surgery, although no one item was cited by more than 50% of the sample. Walfish et al. (2007) reported a slightly lower average rate of surgery denial or delay (14%) in their sample, although rates ranged from 0 to 60% across survey respondents. Again, reasons for denial or delay varied widely, from significant psychopathology (e.g., psychosis, severe depression, active substance use, eating disorders) to a lack of primary care physician support, and were inconsistently cited across respondents (Walfish et al., 2007).

Together, these findings suggest that the vast majority of bariatric programs require a presurgical psychosocial evaluation in order to determine patient suitability for surgery. However, the evaluation process has not been standardized, and programs vary widely in their interpretation of psychosocial suitability and risk. In addition, there is a paucity of research examining the predictive validity of psychosocial evaluations. As such, it is unclear whether current assessment practices provide meaningful information about which patients will experience poor postsurgical outcomes.

Psychosocial Domains of Assessment. Despite the wide variability across psychosocial evaluations, there are several key domains of assessment that are frequently described in the literature (see Table 1 for a summary). The rationale for the importance of assessing certain domains is based on available empirical support identifying presurgical risk factors that predict postsurgical outcomes, whereas others are based on current clinical practice guidelines and clinical expertise. These domains of assessment are relevant to the Bariatric Interprofessional Psychosocial Assessment of Suitability Scale (BIPASS), described later in this document.

General Psychopathology. One of the primary reasons why mental health professionals occupy a valued role in the presurgical evaluation of bariatric candidates is the high prevalence

Table 1

Psychosocial Domains of Assessment

General psychopathology (including stability and severity)
History of psychiatric illness
Eating disorders/behaviours
Substance use (including nicotine use)
Personality disorders
Weight history and knowledge of the process of weight gain
Motivation and expectations for bariatric surgery
Knowledge of surgery procedure, risks, and postsurgical behavioural regimen
Compliance and adherence with presurgical care
Availability and functioning of social support system
Socioeconomic factors (finances, employment, housing)
Emotion regulation and sense of coherence
Response bias and truthfulness
Cognitive functioning

of psychological disorders observed in this population. Indeed, individuals with severe obesity and those who present for surgical weight loss treatment report higher rates of psychopathology as compared to individuals in the community who are non-obese or obese (Malik, Mitchell, Engel, Crosby, & Wonderlich, 2014; Mitchell et al., 2012).

Specifically, many studies have reported high rates of current and lifetime mood and anxiety disorders. For instance, in a sample of 282 patients seeking bariatric surgery, Mauri et al. (2008) reported lifetime prevalence rates of 22% for mood disorders and 18.1% for anxiety disorders. Rates of mood and anxiety disorders at the time of assessment were 18% and 35%, respectively, with specific phobia (5%), major depressive disorder (4.6%), and panic disorder (4.6%) being most common. Kalarchian et al. (2007) reported a 66.3% lifetime prevalence of any psychiatric disorder in their sample of 288 bariatric candidates. Forty-five percent reported a lifetime prevalence of any mood disorder (15.5% met criteria for a current mood disorder), and 37.5% for any anxiety disorder (24% met current criteria). Similar rates were reported in the Longitudinal Assessment of Bariatric Surgery study (LABS-3; Mitchell et al., 2012), with 11.6% of bariatric candidates meeting criteria for a current mood disorder and 18.1 % for a current anxiety disorder, as determined via the Structured Clinical Interview for DSM-IV-TR (SCID-IV). The lifetime prevalence of mood and anxiety disorders was 44.2% and 31.7%, respectively. Research shows that depression tends to improve in the immediate postsurgical period (i.e., 1 year), although anxiety tends to remain stable (Dawes, et al., 2016; de Zwaan et al., 2011; Mitchell et al., 2014).

The majority of research examining the impact of presurgical psychological disorders on postsurgical outcomes has focused on depression. Although several studies have found that bariatric candidates with a diagnosis of depression at the time of assessment exhibit poorer postsurgical weight loss (Brunault et al., 2012; Livhits et al., 2012), the majority of studies have found no predictive relationship (Dawes et al., 2016; Dixon, Dixon, & O'Brien, 2003; Khan, Madan, Tichansky, & Coday, 2008; Marin, Perrone, & Eagon, 2006; Masheb, White, Toth, Burke-Martindale, Rothschild, & Grilo, 2007). However, there is evidence that while depression often improves in the short-term following surgery, patients tend to experience recurrence within 2 to 3 years (de Zwaan et al., 2011; Mitchell et al., 2014). Importantly, the presence of postsurgical depression predicts poorer weight loss and quality of life outcomes (de Zwaan et al., 2011; Dixon et al., 2003; Sanchez-Santos et al., 2006; White, Kalarchian, Levine, Masheb, Marcus, & Grilo, 2015).

In comparison to depression, the impact of anxiety disorders or symptoms on postsurgical outcomes has been studied less extensively. Research that has been conducted has generally found no relationship (Livhits et al., 2012), although there are exceptions (e.g., de Zwaan et al., 2011). Inconsistent findings might reflect the fact that various anxiety disorders likely impact postsurgical adjustment in different ways. For example, panic, agoraphobia, or social anxiety symptoms might prevent bariatric patients from attending follow-up appointments or social support group meetings, attendance at which is known to influence surgical outcomes (Lier, Biringer, Stubhaug, Erikson, & Tangen, 2011; McVay, Friedman, Applegate, & Portnier, 2013).

In addition to anxiety and depression, bariatric candidates also exhibit high rates of childhood trauma. For example, one study found significantly higher rates of childhood physical and sexual abuse in women with severe obesity presenting for bariatric surgery, as compared to women with mild to moderate obesity participating in a behavioural weight loss program (Wadden et al., 2006). In addition, elevated rates of physical and emotional neglect, as well as physical, sexual, and emotional abuse, have been reported in bariatric samples, as compared to community samples (Grilo, Masheb, Brody, Toth, Burke-Martindale, & Rothschild, 2005; Grilo, White, Masheb, Rothschild, & Burke-Martindale, 2006). Between 17% and 50% of bariatric candidates report a history of sexual abuse specifically (Buser, Dymek-Valentine, Hilburger, & Alverdy, 2004; Fujioka, Yan, Wang, & Li, 2008), compared to approximately 20 to 30% in the general population (Saunders & Adams, 2014).

Several studies have examined the relationship between childhood trauma and/or a history of posttraumatic stress disorder and postsurgical weight loss, and have not identified a significant association (Buser et al., 2004; Clark et al., 2007; Grilo et al., 2006). However, a remote history of trauma might exacerbate other mental health illness, including depression (Buser et al., 2004; Stiles et al., 2009), and make it more difficult to optimally adjust to the postsurgical lifestyle (Clark et al., 2007; Grilo et al., 2006; Larsen & Geenen, 2005). As such, although childhood trauma is not an absolute contraindication for bariatric surgery, it is often cited as an important domain of inquiry during the presurgical evaluation (Ratcliffe, 2016).

Most studies conducted to date have examined the relationship between the presence of psychiatric symptoms or diagnoses and postsurgical outcomes; however, there is some evidence that the severity of psychological problems, as opposed to simply their presence, is more important with respect to predicting outcomes (Herpertz, Kleimann, Wolf, Hebebrand, & Sent, 2004; Rutledge et al., 2011). Sogg et al. (2016) recommend that the psychosocial evaluation of general psychopathology focus on the severity of symptoms and the extent to which they are interfering with the individual's ability to function, as this will be pertinent to adherence to postsurgical guidelines and ability to engage in self-care. This includes an assessment of recent or lifetime history of hospitalizations, as this may reflect a greater degree of symptom severity, as well as a history of current and previous suicidal ideation and suicide attempts (Sogg et al., 2016). This latter point is particularly important, given the relatively high prevalence of self-reported suicide attempts in bariatric patients (e.g., 11.2% in Windover, Merrell, Ashton, & Heinber, 2010) and evidence for increased risk of suicide after bariatric surgery (Heneghan, Heinber, Windover, Rogula, & Schauer, 2012; Omalu et al., 2005). Gathering information related to the stability of psychological symptoms, and whether treatment has, or is expected to be, effective, is also of use to the bariatric clinician. In general, there is widespread agreement that active suicidality, recent suicide attempts, and uncontrolled or severe psychiatric illness should constitute contraindications for surgery, until adequately treated or controlled (Dziurowicz-Kozlowska, Wierzbicki, Lisik, Wasiak, & Kosieradzki, 2006; Sogg & Mori, 2009).

Eating disorders. While the vast majority of presurgical bariatric patients engage in poor eating habits (e.g., large portion sizes, high intake of food with poor nutritional value, skipping meals), a substantial proportion experience clinically significant eating disorders, particularly binge eating disorder (BED).

Binge Eating Disorder is characterized by recurrent binge eating episodes involving the consumption of an objectively large amount of food within a discrete (i.e., 2 hour) period of time, and a sense of loss of control (LOC) over eating. Binge eating episodes are also accompanied by at least three of five behavioural and emotional sequelae, including: eating more quickly than normal; eating large quantities of food when not physically hungry; eating until uncomfortably full; eating alone due to embarrassment about the quantity of food one consumes; and feeling disgusted, depressed, or guilty following a binge eating episode (APA, 2013). Dawes and colleagues (2016) reported that 17% of bariatric surgery candidates meet current criteria for BED. Estimates of lifetime prevalence for BED range from 13.1% to 27.1% (Kalarchian et al., 2007; Mitchell et al., 2012).

In addition to eating disorders, many bariatric patients exhibit problematic eating behaviours more broadly. For example, 20% to 60% of bariatric candidates report grazing, defined as the consumption of smaller amounts of food over extended periods of time and outside of planned meals and snacks, and 38% to 59% report the tendency to increase food intake in response to emotional distress and stressful situations, known as emotional eating (Opolski et al., 2015).

Diagnosed BED and the general presence of objective binge eating behaviour appear to decrease dramatically in the months immediately following bariatric surgery (Conceição, Utzinger, & Pisetsky, 2015; Devlin et al., 2018; Opozda et al., 2016). This is due, in part, to the fact that bariatric surgery alters the physiological capacity of the stomach, which limits the amount of food patients can eat. Further, consumption of either portions that are too large or foods that are high in fat or sugar can result in dumping syndrome in patients who have undergone RYGB. Thus, it is physically impossible or extremely uncomfortable, at least for a period of time following surgery, to consume objectively large quantities of food. However, there is evidence that while binge eating may initially exhibit a large reduction, this is followed by a subsequent re-emergence as early as 6 months to 2 years postsurgery, suggesting that patients are able to consume increasingly large amounts of food over time (Conceição et al., 2015; Opozda et al., 2016).

In addition, for many patients, although binge eating is not possible in the same way, LOC eating persists when eating smaller amounts of food (Meany, Conceição, & Mitchell, 2014). This is important given growing consensus that the clinical significance of binge eating is attributable more to the subjective experience of LOC, as opposed to the quantity of food one consumes (Vannucci et al., 2013). Indeed, bariatric patients who report LOC eating in the absence of consuming an objectively large amount of food experience comparable distress, eating disorder pathology, and psychosocial difficulties as patients who meet full diagnostic criteria for BED (Meany et al., 2014; White et al., 2010). There is also evidence that bariatric patients who report binge eating prior to surgery are at increased risk of grazing behaviours after surgery, which are more physically possible following restrictive surgeries. For example, Colles et al. (2008) found that between 6 and 12 months postsurgery, over 60% of AGB patients with preoperative BED reported recurrent grazing.

In general, the literature suggests that presurgical binge eating does not predict suboptimal weight loss or psychosocial outcomes up to 24 months following surgery (e.g., Hsu et al., 1997; Kalarchian et al., 2002; Malone & Alger-Mayer, 2004; Mitchell et al., 2001; White et al., 2006). However, multiple studies have shown that the presence of presurgical binge eating predicts disordered and other problematic eating behaviours later in the postsurgical course, including grazing and LOC eating (Colles et al., 2008; de Zwaan et al., 2010; Niego, Kofman, Weiss, & Geliebter, 2007; Sheets et al., 2015; Wadden et al., 2011; White, Kalarchian, Masheb, Marcus, & Grilo, 2010). Importantly, the persistence or (re)emergence of BED or objective binge eating behaviour (Meany et al., 2014; Kalarchian et al., 2002), LOC eating (Devlin et al., 2018; White et al., 2010), and grazing (Colles et al., 2008; Pizato, Botelho, Goncalves, Dutra, & de Carvalho, 2017; Saunders, 2004) after bariatric surgery are all linked with poorer weight loss and/or greater weight regain over time. The tendency to eat in response to negative emotions is also related to poorer postsurgical weight loss (Canetti, Berry, & Elizur, 2009).

Given overall findings regarding the relationship between presurgical disordered eating and postsurgical outcomes, existing guidelines do not identify eating disorders as an absolute contraindication for bariatric surgery (Gould et al., 2011; Greenberg, Sogg, & Perna, 2009;

Mechaniuck et al., 2009; Sauerland et al., 2005). However, as part of the presurgical psychosocial evaluation process, patients exhibiting these eating behaviours should be flagged as being at increased risk for the reemergence of disordered or problematic eating postsurgery, which has clearly been linked to poor postsurgical outcomes. It is worth noting that in addition to current eating pathology, establishing a lifetime history is important, given that individuals who develop postsurgical eating disorders are more likely to have a lifetime history of other eating disorders (Conceicao et al., 2013).

Personality Disorders. Reported prevalence rates of personality disorders among bariatric surgery candidates range from approximately 20% to 30% (Kalarchian et al., 2007; Mauri et al., 2008). The most commonly reported are borderline personality disorder, avoidant personality disorder, and obsessive-compulsive personality disorder.

In one systematic review of 14 studies that examined the relationship between personality disorders and postsurgical outcomes, approximately half found that personality pathology predicted poorer weight loss, while the remaining studies either found no relationship or suggested greater weight loss (Livhits et al., 2012). Expert clinical opinion would suggest that individuals with personality disorders characterized by mood lability and self-harming behaviours are more likely to encounter difficulties with postsurgical adjustment, and in forming relationships with the bariatric team (Ritz, 2006). As such, the assessment of personality disorders holds value with respect to formulating treatment recommendations that may be of benefit to both the patient and the bariatric team.

Substance Use. There are few research studies examining the lifetime or current prevalence of substance use disorders in bariatric populations. Kalarchian and colleagues (2007) reported a lifetime prevalence of 32.6%, which they noted was considerably higher than the national prevalence rate of 14.6%. Prevalence rates of current substance use disorders tend to be lower, in the range of 0.7% to 1.7%, with alcohol use disorder being most common (Kalarchian et al., 2007; Kalarchian et al., 2019; Pawlow et al., 2005). A recent systematic review of 40 studies found that presurgical substance use is a reliable predictor of postsurgical substance use (Li & Wu, 2016).

Substance use postsurgery may have detrimental effects on physical health outcomes, including increased risk of malnutrition and ulcers. Nicotine can also slow healing and increase risk of ulcers (Li & Wu, 2016). Thus, bariatric surgery practitioners, and published practice guidelines, are unanimous in the recommendation that active, problematic substance use or smoking at the time of assessment is a contraindication for surgery (Greenberg, Sogg & Perna, 2009; Le Mont et al., 2044; Mechaniuck et al., 2013). However, several studies have found that patients with a remote history of problematic substance use may actually achieve superior weight loss outcomes, given their history of successful and sustained behavioural change (Parikh, Johnson, & Ballem, 2016).

Weight History and Knowledge of the Process of Weight Gain. There is general consensus that establishing a timeline and trajectory of bariatric candidates' weight is beneficial, including details regarding periods of weight loss and weight (re)gain, and any notable life events that may have contributed to changes in weight and/or eating (Wadden & Sarwer, 2006). Knowledge of previous weight loss attempts serves to shed light on whether the patient has previously been successful in making and sustaining behavioural changes and, if not, what factors hindered their progress (Ratcliffe, 2016). Only a handful of studies have attempted to link previous weight loss attempts with weight loss outcomes following surgery. Both Deb and colleagues (2016) and Jantz, Larson, Mathiason, Kallies and Kothari (2009) found that mean weight loss attempts and mean weight loss achieved did not predict weight loss at 1 year postsurgery. However, Sethi and colleagues (2015) found that patients who had previously achieved ≥ 50 lbs. weight loss demonstrated greater %EWL at 2 years postsurgery.

Motivation and Expectations for Bariatric Surgery. Despite the many benefits associated with bariatric surgery, it is not without risk. Risk of mortality ranges from less than 1% to approximately 6% for high risk patient groups (e.g., those with BMI > 60 kg/m^2; Chang, Stoll, Song, Varela, Eagon, & Colditz, 2014; Cottam et al., 2006). The risk of serious complications is almost 20%, and approximately 7% of patients require revisional surgery (Chang et al., 2014). There is documented concern in the literature that some patients may value the benefit of weight loss associated with bariatric surgery to the extent that they disregard a high level of risk in order to achieve this outcome (Wee et al., 2013).

In addition, many bariatric candidates hold unrealistic expectations about weight loss following surgery (Bauchowitz et al., 2015; Kaly, Orellana, Torella, Takagishi, Saff-Koche, & Murr, 2008; Price, Gregory, & Twells, 2013). For example, in a sample of 114 bariatric candidates, patients' ideal weight loss was an average of 28 kg lower than what could reasonably be expected based on existing data. Discrepancies between ideal and expected weight loss were greater for women and Caucasians (Heinberg, Keating, & Simonelli, 2010). Data from another study reported that approximately 75% of patients disclosed that they would be disappointed with a sustained total weight loss of 20%, which is commensurate with available data of long-term outcomes (Wee et al., 2013).

There is a paucity of research examining the impact of unrealistic weight loss expectations on actual postsurgical weight loss, although in the nonsurgical literature evidence is mixed (Gorin, Marinilli Pinto, Tate, Raynor, Fava, & Wing, 2007; Finch, Linde, Jeffery, Rothman, King, & Levy, 2005; Linde, Jeffery, Finch, Ng, & Rothman, 2004; Durant, Joseph, Affuso, Dutton, Robertson, & Allison, 2013). Nevertheless, it is recommended that clinicians assess patient expectations during the psychosocial evaluation, as failure to achieve expected weight loss might be experienced as discouraging and contribute to a decline in motivation to adhere to postsurgical guidelines (LeMont, Moorehead, Parish, Reto, & Ritz, 2004). Most clinicians agree that patient education is necessary to more closely align expectations with postsurgical reality, in the interest of informed consent and in order to dissuade patients from agreeing to a high-risk procedure that they otherwise might not if expected weight loss was lower (Wadden & Sarwer, 2006; Wee et al., 2013).

Patient knowledge regarding the high likelihood of developing excess skin following drastic weight loss is also an important component of the presurgical evaluation. This is due to the fact that excess skin is associated with body dissatisfaction and interference with every day functioning following surgery (Sarwer, Fabricatore, Jones-Corneille, Allison, Faulconbridge, & Wadden, 2008; Sarwer, Wadden, Moore, Eisenberg, Raper, & Williams, 2010; Sockalingam, Micula-Gondek, Lundblad, Fertig, & Hawa, 2017; Song et al., 2006; Steffen, Sarwer, Thompson, Mueller, Baker, & Mitchell, 2012). As Sogg et al. (2016) aptly note, such conversation will be of particular relevance to patients with pre-existing body dissatisfaction or negative body image, who might have expectations that bariatric surgery will significantly reduce their distress.

With respect to motivations for surgery, overall, the majority of bariatric patients cite health concerns as their main reason for pursuing weight loss surgery (Libeton, Dixon, Laurie, & O’Brien, 2004; Munoz et al., 2007); however, a higher proportion of women than men endorse appearance as a significant motivating factor (Libeton et al., 2004). Patients’ motivations for pursuing surgery have not been consistently linked to surgical outcomes, yet some clinicians suggest that bariatric candidates who seek surgery for predominantly cosmetic reasons should not proceed with surgery before receiving the abovementioned education regarding common outcomes (i.e., excess skin and expected weight loss; Bagdade & Grothe, 2012).

Knowledge of Surgery Procedure, Risks, and Postsurgical Behavioural Regimen. Most professionals acknowledge the importance of assessing patients' understanding of bariatric surgery, including the risks associated with the procedure, and the ramifications of significant postsurgical lifestyle change (Ratcliffe, 2016). There is a documented tendency for some patients to overlook or minimize the risk of bariatric surgery, and the extent of the required lifestyle changes (Ratcliffe, 2016). Although there is no available research identifying a link between knowledge of bariatric surgery and patient outcomes, most clinicians agree that patients should be aware of the potential complications of surgery, as well as common pitfalls that are likely to compromise their progress postsurgery. It is also commonly suggested that patients provide evidence that they have sought out relevant information and have begun to consider how they might address or minimize potential risks (Ritz, 2006; Wadden & Sarwer, 2006).

Cognitive Functioning. An additional function served by inquiry into patients' understanding of surgery and its risks is to gauge cognitive functioning. Significant impairment in cognitive functioning might prevent an individual from fully comprehending the risks of surgery and, thus, their ability to provide informed consent, and also casts doubt on their ability to maintain the postsurgical regimen (LeMont et al., 2004). Deficits in attention, executive functioning, and verbal memory have been documented in a small proportion of bariatric candidates (16%; Spitznagel et al., 2013). These types of deficits predict nonadherence to medical regimens in other health populations (Ettenhofer et al., 2009; Feil et al., 2009), as well as less weight loss up to 3 years postsurgery (Spitznagel et al., 2013; Spitznagel et al., 2014). For these reasons, significant impairment of cognitive functioning is considered a contraindication for the procedure, particularly in individuals with insufficient long-term support to mitigate the additional burden of care resulting from surgery and necessary lifestyle modifications.

Compliance and Adherence with Presurgical Care. Evidence of a history of poor adherence to, or compliance with, various medical recommendations is concerning, given the complex, lifelong changes associated with bariatric surgery. Indeed, overwhelming evidence suggests that adherence to the dietary and physical activity recommendations made by bariatric team members, as well as compliance with attendance at follow-up visits, predict better weight loss following surgery (Gould et al., 2007; Harper et al., 2007; Poole et al., 2005; Ramirez et al., 2008; Sarwer et al., 2008; Shen et al., 2004). In contrast, nonattendance at follow-up appointments is linked to less weight loss, greater postsurgical complications, and higher rates of nutritional deficiencies and surgery related morbidity **(**Compher, Hanlon, Kang, Elkin, & Williams, 2012; Dixon et al., 2009; Lara, Baker, Larson, Mathiason, Lambert, & Kothari, 2005; Moroshko, Brennan, & O'Brien, 2011; Sivagnanam & Rhodes, 2010; Wheeler, Prettyman, Lenhard, & Tran, 2008).

Bariatric clinicians will typically discuss adherence to medication and diabetes management regimens, and use of continuous positive airway pressure (CPAP) therapy as a means to gauge patient adherence (Bagdade & Grothe, 2012). Attendance at presurgical appointments and compliance with presurgical nutrition assignments and dietary changes is also frequently monitored. Together, these behaviours are considered the best available estimate of the likelihood that patients will adhere to the postsurgical regimen, and the best behavioural indicator of motivation to undergo surgery (Bagdade & Grothe, 2012; Collazo-Clavell, Clark, McAlpine, & Jensen, 2006). Indeed, some research has shown that previous success with dieting attempts and motivation to change eating behaviour in the presurgical period predicts better postsurgical compliance with dietary recommendations (Bergh, Kvalem, Risstad, & Sniehotta, 2016).

Social Support. Living within an environment that encourages positive change is predictive of success in making changes (Stokols, 1992). In the nonsurgical obesity literature, a lack of support from close others increases patient difficulty in achieving weight loss and weight maintenance (Whale, Gillison, & Smith, 2014). In contrast, positive social support has been shown to predict greater weight loss for individuals participating in a behavioural weight loss program (LeMont et al., 2004). In addition, a recent review concluded that patient attendance at bariatric support group meetings was related to greater postsurgical weight loss (Livhits et al., 2011). Assessment of patients' availability and willingness to access quality support is therefore important to consider in the presurgical phase (Ratcliffe, 2016; Ritz, 2006).

Socioeconomic factors can also influence the patient's ability to adequately comply with postsurgical guidelines, and should therefore be included in the presurgical evaluation. These factors may include ability to afford vitamin supplements and high protein foods, and to take the recommended 3 to 4 weeks off from work to allow for optimal recovery from the operation (Wadden & Sarwer, 2006).

Emotion Regulation and Sense of Coherence. Many bariatric clinicians advocate for the assessment of current life stressors (e.g., job difficulty, marital or relationship distress), in order to gain a sense of the patient's psychological coping skills and ability to regulate distress. The postsurgical phase is challenging, and poor ability to manage stressful life events may negatively impact the patient's ability to adhere to recommended guidelines and other behaviours necessary to achieve success postsurgery (Ritz, 2006). In addition, difficulty with emotion regulation plays a significant role in psychopathology common in individuals with obesity and that may in and of themselves hinder postoperative adjustment, including depression, anxiety, and disordered and problematic eating (Cisler, Olatunji, Feldner, & Forsyth, 2010; Hoffman, Sawyer, Fang, & Asnaani, 2012; Kashdan & Breen, 2008; Kittel, Brauhardt, & Hilbert, 2015).

Response Bias and Truthfulness. There is evidence to suggest that some bariatric candidates desire to appear psychiatrically healthy during the evaluation process in order to ensure approval for surgery. Patients might modify or withhold certain information pertinent to the determination of suitability for surgery, as well as potential beneficial treatment recommendations (Mitchell et al., 2012). Evidence of withholding or modifying significant information pertinent to the safety and success of surgery (e.g., smoking, recent hospitalizations) is concerning and warrants surgical delay. Collateral information is sometimes sought from primary care physicians or other health professionals involved in the patient's care in order to detect deceptive behaviour (Sogg et al., 2016).

Limitations of the Literature

In summary, the above reviewed literature highlights that bariatric candidates have high rates of psychological disorders and symptoms, and might also report social and socioeconomic difficulties. Moreover, many patients do not exhibit behavioural motivation and/or readiness to undergo bariatric surgery. However, support for the impact of these psychosocial variables on outcomes following surgery is either nonexistent and, thus, the rationale for assessing these variables is based solely on expert clinical opinion, or findings have been mixed. Thus, it is clear that the lack of consensus regarding psychosocial evaluations is due, in part, to a general paucity of empirical research on, and a lack of consistently identified, presurgical predictors of postsurgical outcomes.

In addition to the general limitation of certain presurgical variables remaining unexplored in relation to postsurgical outcomes, several authors have implicated problems with the methodological approach of existing studies in explaining inconsistencies in findings. First, in general, the literature suffers from a lack of adequate follow-up. Suboptimal weight loss and/or weight regain are typically not apparent until after the first year postsurgery and, as such, length of follow up should exceed this threshold (Rutledge et al., 2011; Courcoulas et al., 2013). Second, the study of presurgical predictors of postsurgical outcomes has typically examined only one risk factor, despite the fact that several studies have provided evidence for the benefit of examining the impact of multiple risk factors together. For example, in their study of 60 adults who underwent RYGB or AGB, a significant relationship was found between presurgical psychiatric disorders and weight regain between 1 and 2 years postsurgery, but only for those patients with two or more diagnoses (Rutledge et al., 2011). These findings echo those from a previous study, wherein only patients with two or more psychiatric disorders demonstrated significantly lower weight loss over a median follow-up period of approximately 4 years (Kinzl, Schrattenecker, Traweger, Mattesich, Fiala, & Biebi, 2006). These results suggest that it is the overall burden or severity of mental health difficulties that predict weight outcomes, as opposed to the mere presence of a psychiatric disorder. Other authors agree that studies designed to examine combinations of multiple psychosocial constructs might provide a more sophisticated approach to the development of presurgical psychosocial evaluation guidelines, and identification of prognostic determinants of surgical outcome (Franks & Kaiser, 2008; Ritz, 2006; Sockalingam et al., 2011).

In order to address these limitations, there is a need for a validated clinical tool that will help to standardize and streamline the assessment of variables relevant to surgical outcomes, facilitate consistency in the identification of multiple hypothesized presurgical risk factors relevant to decisions regarding suitability for surgery, and aid in the continued examination of psychosocial predictors of outcomes following bariatric surgery.

Existing Psychosocial Evaluation Tools. To date, several assessment tools have been developed that attempt to achieve one or more of the above aims. One of the first tools developed was the Boston Interview for Gastric Bypass (BIBS; Sogg & Mori, 2009). The BIBS is a semi-structured assessment protocol, which helps to guide bariatric clinicians in gathering information pertinent to the presurgical evaluation, and reflects findings from the empirical and clinical bariatric literature. It assesses seven domains, including: 1) patient motivation and expectations for outcome; 2) diet, weight, and nutrition history; 3) social support; 4) psychiatric functioning; 5) eating disorders; 6) knowledge of surgery risks and postsurgical regimen; and 7) medical history. Regarding limitations of this tool, although the BIBS was developed to provide standardized parameters around gathering relevant information, it does not provide guidelines for determining sufficient risk to warrant surgical delay. In addition, the BIBS has not been subject to empirical validation.

The Revised Master Questionnaire (MQR; Corsica, Hood, Azarbad, & Ivan, 2012) is a 56-item, true/false self-report measure that was designed to assess the cognitive and behavioral difficulties related to management of weight. The MQR comprises 5 subscales, measuring: 1) an individual's belief that they can resist eating when presented with food-related cues (stimulus control); 2) an individual's belief in their ability to maintain self-efficacy and motivation for weight loss; 3) an individual's belief in their ability to remain hopeful regarding weight loss success (hopelessness); 4) an individual's belief in their ability to influence weight through behavioural changes, as opposed to attributing obesity to purely physiological factors (physical attribution); and 5) an individual's knowledge regarding caloric value of food, and energy expenditures (energy balance knowledge). The MRQ was originally developed for use in nonsurgical behavioral weight loss programs. It has since been validated in a bariatric population, demonstrating excellent internal consistency for the total score ($\alpha = .90$) and fair to acceptable internal consistency for subscale scores (α ranging from .63 to .76). The MQR has also demonstrated good convergent validity between specific subscales and relevant measures (e.g., BDI with motivation and hopelessness; BES with stimulus control). However, the main limitation of the MQR is its underassessment of constructs relevant to the psychosocial assessment of bariatric candidates, as well as the self-report format.

Finally, the Cleveland Clinical Behaviour Rating System (CCBRS; Heinberg, Ashton, & Windover, 2010) is a tool that was developed to assess a variety of domains relevant to the psychosocial assessment of bariatric patients. It includes nine domains of assessment, including: consent (cognitive impairment and understanding of risks/benefits of surgery), expectations regarding surgery outcomes, mental health, substance use (including nicotine use), eating behaviours/disorders, social support, coping/stressors, adherence, and overall impression. After patients proceed through a psychosocial assessment that collects information related to these domains, the CCBRS is scored according to a Likert scale where 5 = excellent (no reservation for surgery), 4 = good, 3 = fair, 2 = guarded (reservations about proceeding with surgery), and 1 = poor (inappropriate for surgery). Initial data suggests that the CCBRS demonstrates strong psychometric properties, including good internal consistency (Cronbach's $\alpha = .88$) and inter-rater reliability ($r = .82$; Heinberg, Ashton, & Windover, 2010). However, preliminary research also shows that the patients who received an "excellent/good/fair" rating on the CCBRS did not exhibit greater weight loss at 1 year postsurgery than patients with a "guarded" rating. The major limitation of the CCBRS is that the cutoff to determine surgical delay is not adequately described or empirically derived. In addition, as previously mentioned, psychosocial risk factors may become more relevant to surgical outcomes when examined in relation to weight changes after 1 year.

Scale Development and Validation

The process of developing a rigorous scale involves several important steps, including item generation, scale construction, and scale evaluation (Boateng, Neilands, Frongillo, Melgar-Quinonez, & Young, 2018; Brown, 2006). Item development involves generating an initial set of questions or domains that will comprise the eventual scale. These items should reflect all facets of the construct one is endeavoring to measure, and are often derived by conducting a thorough review of the literature and a critique of existing measures of similar constructs (Boateng et al., 2018). Items can also be generated through survey of relevant group members (e.g., bariatric patients) using focus groups or individual interviews, after which the resulting data is subject to qualitative analysis and synthesis to create additional domain items. It is during the item generation step that the form, wording, and measurement of items are determined (Boateng et al., 2018). Once items are generated, they are then presented to a reference group of experts independent of those who generated the item pool, or to members of the target population, to obtain feedback and ensure content and face validity (Brown, 2006).

Subsequent steps in scale development involve administering the pool of items to a sample of the population in question and using data reduction techniques, such as inter-item and item-total correlations and Exploratory Factor Analysis, to determine which items in the larger pool need to be removed in order to create an internally consistent, final scale, as well as the number of latent factors that exist within the construct (Boateng et al., 2018). Finally, during the scale evaluation process, reliability analyses (e.g., Cronbach's alpha, test-retest, inter-rater) and tests of validity (e.g., convergent and discriminant validity, predictive validity, etc.) are conducted. A Confirmatory Factor Analysis is also conducted to ensure the construct and its latent factors (if relevant) are stable (Boateng et al., 2018; Brown, 2006).

The Bariatric Interprofessional Psychosocial Assessment of Suitability Scale

The Bariatric Interprofessional Psychosocial Assessment of Suitability Scale (BIPASS™; Sockalingham & Hawa, 2015©) was recently developed to improve upon the limitations of the existing bariatric psychosocial assessment tools. Items on the BIPASS were derived from existing clinical guidelines and expert decision-making processes, as well as the available scientific evidence identifying preoperative factors known to increase risk of poor outcomes following bariatric surgery. The development of the BIPASS began by identifying, through a comprehensive literature search, 26 factors relevant to the evaluation of bariatric candidates. These factors were sent for review to 25 experts in the field of bariatric surgery, from five countries (Canada, the United States, Italy, Sweden, and Singapore), in two rounds of feedback. Experts consisted of psychologists, psychiatrists, social workers, nurses, dieticians, and other physicians. Experts were asked to rate the importance of each factor in influencing bariatric surgery outcomes, from most to least significant. Five of the lowest ranking items were dropped following the first round of feedback and before items were resent for ranking. After the second round of feedback, the five lowest ranked items were again dropped. The BIPASS development team then reviewed the final 16 items and two similar items were amalgamated.

The final version of the BIPASS is comprised of 14 items falling within four broad assessment domains, which correspond to those previously reviewed in this paper: 1) patient readiness for surgery, which includes knowledge and understanding of the process of excess weight gain, understanding of bariatric surgery, risks, and lifestyle changes, willingness and motivation to prepare for surgery, and compliance with the presurgical program; 2) psychiatric illness, including history, stability, and severity of psychiatric issues, eating behaviour, substance use, and personality traits/disorders; 3) social support, including availability and functioning of social support, and finances, employment and housing; and 4) general features, including response bias, expectations for surgery, and emotion regulation. Four exclusion criteria are also included: current smoking; active, problematic substance use; severe or uncontrolled psychiatric illness, and; impaired cognitive functioning. The BIPASS provides a means to systematically derive one of three clinical decisions regarding patient suitability: 1) those who meet surgery exclusion criteria (designated RED); 2) those who are at elevated risk for negative outcomes and who might benefit from additional psychosocial intervention before proceeding with surgery (designated YELLOW), and 3) those who are currently suitable for surgery, with no significant reservations (designated GREEN). It is important to note that the BIPASS is not a questionnaire. It is a clinical tool that aids in standardizing the decision-making process regarding suitability for surgery by streamlining interprofessional discussion and increasing consistency in the identification of risk factors that warrant surgical delay.

Preliminary research using a small sample size has found that the BIPASS demonstrates high inter-rater reliability (intraclass correlation coefficient [ICC] of .84; Thiara et al., 2016). In addition, ROC analysis determined a BIPASS score of ≥ 16 as the optimal cutoff for a decision of YELLOW (sensitivity = 0.839; specificity = 0.783; Thiara et al., 2016), indicating that a score exceeding this cutoff is highly indicative of surgery being contraindicated for the patient at the present time. The internal consistency and factor structure of the BIPASS has not yet been explored.

Strengths of the BIPASS include the assessment of the full range of variables posited to be relevant to the assessment of suitability for surgery and, consequently, to surgical outcomes. The BIPASS also demonstrates good preliminary reliability. However, given that the BIPASS was just recently developed, it is not yet clear whether the tool holds utility in predicting postsurgical outcomes.

Summary

In summary, despite the benefits of bariatric surgery, a sizeable proportion of patients demonstrate suboptimal long-term outcomes, including insufficient and/or unsustained weight loss, and unsatisfactory psychosocial functioning. Furthermore, attendance at postsurgical follow-up appointments is integral to sustained weight loss, yet high rates of attrition have been documented in the literature. Consequently, psychosocial evaluations have become an integral component of presurgical bariatric care, with the aim of identifying patients at high risk of poor outcomes. However, no consensus has been established regarding a standardized protocol for the assessment of variables relevant to surgical outcomes. Further, there is little empirical data examining the predictive utility of psychosocial evaluations. Thus, a validated clinical tool is needed to facilitate consistency across evaluations and in the identification of risk factors, and to examine psychosocial predictors of postsurgical outcomes. The BIPASS, a novel psychosocial assessment tool, was developed to address these gaps in the literature.

The purpose of the present study is to contribute to the validation of the BIPASS tool, which will be accomplished via two aims. This research will: 1) examine the psychometric properties and optimal cutoff score of the BIPASS tool and; 2) examine the ability of the BIPASS to predict outcomes following bariatric surgery.

Study Aims and Hypotheses

Aim 1. The first aim of this study is to examine the psychometric properties and cutoff score of the BIPASS tool, and to describe how findings compare to the original master study by Thiara et al. (2016). This will be accomplished by examining the internal consistency and inter-rater reliability of the BIPASS and its subscales. In addition, the optimal cutoff score for the BIPASS tool (i.e., the highest sensitivity and specificity for categorization of YELLOW vs. GREEN) will be determined by examining how BIPASS scores compare to clinical team decisions regarding patient suitability for surgery.

Aim 2. The second aim of this study is to evaluate the predictive validity of the BIPASS related to outcomes 1 and 2 years after bariatric surgery, including weight, quality of life, psychiatric symptoms, and adherence to postsurgical follow-up. This aim will be accomplished by examining the ability of the BIPASS Total score to predict the abovementioned outcomes. In addition, the optimal cutoff score derived in aim 1 will be used to compare patients categorized as YELLOW with those categorized as GREEN on the same outcome variables. The use of the BIPASS tool to predict non-adherence to surgical follow-up and broader psychosocial functioning is a novel contribution of this study to the literature, given that these variables have not yet been examined in relation to a bariatric psychosocial evaluation tool. In addition, no studies to date have examined the predictive validity of a comprehensive psychosocial evaluation tool in relation to outcomes beyond 1 year postsurgery.

Specific to Aim 2, the following hypotheses are put forth:

Hypothesis 1. Given that suboptimal weight loss and/or weight regain typically do not become apparent until after 1 year postsurgery, and that erosions in the gains made in psychosocial functioning following surgery tend to coincide with weight regain, it is expected that BIPASS scores will not significantly predict weight loss, weight regain, quality of life, or psychiatric symptom outcomes at 1 year postsurgery.

Hypothesis 2. Similar to Hypothesis 1, it is expected that there will be no significant difference between psychosocial risk status groups (YELLOW vs. GREEN) on weight, quality of life, or psychiatric symptom outcome variables at 1 year postsurgery.

Hypothesis 3. At 2 years postsurgery, it is expected that higher BIPASS Total scores will predict:

a. Less weight loss and greater weight regain
b. Lower self-reported quality of life
c. Higher levels of self-reported depressive, anxiety, and binge eating symptoms
d. Nonadherence to postsurgical follow-up appointment attendance

Hypothesis 4. At 2 years postsurgery, it is expected that patients categorized as YELLOW on the basis of the BIPASS cutoff score, as compared to patients categorized as GREEN, will:

a. Exhibit less weight loss and greater weight regain
b. Exhibit lower self-reported quality of life
c. Exhibit higher self-reported levels of depressive, anxiety, and binge eating symptoms
d. Be significantly more likely to be classified as non-adherent to postsurgical follow-up appointment attendance

Exploratory Hypotheses. Several hypotheses will be investigated on an exploratory basis.

Hypothesis 5. The relative predictive validity of scores for each BIPASS subscale will be examined in relation to weight, quality of life, psychiatric symptom, and adherence outcomes. Given that previous research has found that overall burden of mental health difficulties is a strong predictor of weight loss, it is anticipated that the Psychiatric Illness subscale will predict weight outcomes. In addition, the existing literature has shown that presurgical psychiatric illness is a strong predictor of postoperative psychiatric illness; thus, it is anticipated that the Psychiatric Illness subscale will also significantly predict binge eating, depressive, and anxiety symptoms. However, the remainder of the subscales included in the BIPASS tool have yet to be examined in composite in relationship to surgical outcomes or adherence and, thus, will be investigated on an exploratory basis.

Method

Participants

Participants were 200 patients of the Toronto Western Hospital Bariatric Surgery Program (TWH-BSP). Consistent with established guidelines for bariatric surgery, patients were between the ages of 18 and 65 years, with a presurgical BMI $\geq$ 40 kg/m^2, or $\geq$ 35 kg/m^2 with one or more comorbid obesity-related medical conditions (NICE, 2014). Patients who were consecutively referred to the TWH-BSP between January 2013 and September 2013, and who underwent bariatric surgery, were included in the study. Given that one of the aims of the present study was to examine the predictive utility of the BIPASS with respect to surgical outcomes, patients who were approved but did not complete surgery, or who were deemed inappropriate for surgery by the clinical team (i.e., designated RED) were not scored using the BIPASS. All patients of the TWH-BSP are assessed for suitability for RYGB; a VSG is offered only if surgically indicated (e.g., in the case of significant bowel disease, previous upper abdominal surgery resulting in substantial scarring), and in the minority of cases.

Eligible patients must have completed at least four of five presurgery assessments (including dietician, nursing, psychology/psychiatry, and social work, described below) in order to complete the scoring for the BIPASS tool, and a clinical team decision regarding patient suitability for surgery must have been made in order to compare this with the clinical decision of the BIPASS. Patients who did not consent to research during the assessment process were excluded from participation.

The year 2013 was selected as the recruitment period in order to account for: time to complete the psychosocial evaluation process, which typically takes several months; a clinical team decision of delay for surgery (i.e., YELLOW) for a subset of patients, for which the delay ranges from 3 months to 1 year; wait-time of up to approximately 5 months to book an operating room once approved for surgery, and; a 2 year follow-up period. Together, the maximum timeframe for completion of the psychosocial assessment process, scheduling and completion of surgery, and the 2 year follow up period is approximately 4 years. Thus, a recruitment period of 2013 ensured a maximum amount of complete data for outcomes at 2 years postsurgery.

The Research Ethics Boards for Ryerson University and the University Health Network granted approval for this study.

Power Analysis. Power analyses were conducted to determine the necessary sample size to adequately assess the predictive validity of the BIPASS with respect to continuous outcomes at the longest (i.e., 2 year) follow-up time point. Because no study has examined the predictive validity of a psychosocial evaluation tool in relation to outcomes at 2 years postsurgery, *a priori* power analyses were based on a medium effect size, which was deemed sufficient to predict enough variance in the outcome variables to be clinically meaningful.

Power was calculated using the most comprehensive models to be tested. For models with a continuous predictor, the most comprehensive was a multiple regression analysis with four predictors (each subscale of the BIPASS) and three covariates (sex, age, presurgical BMI). Using a medium effect size (Cohen's $d = 0.05$), an error probability of $\alpha = .05$, and power of .80, the total required sample size was estimated at $N = 85$ (using G*Power 3.1 software). For models with a dichotomous predictor, the most comprehensive was an Analysis of Covariance (ANCOVA) with two groups (GREEN vs. YELLOW) and three covariates (sex, age, presurgical BMI). Again using a medium effect size ($d = 0.05$), an error probability of $\alpha = .05$, and power of .80, the total required sample size was estimated at $N = 90$ (using G*Power 3.1 software).

In the bariatric literature, incomplete data and/or attrition between surgery and 2 year follow-up ranges from approximately 30% to 70% (e.g., Sala et al., 2017; Toussi et al., 2009; Vidal et al., 2014). In order to balance project feasibility and a conservative estimate of attrition, a 50% attrition rate was deemed an adequate estimate for the present study. Thus, a sample size of 200 was ultimately chosen in order to retain data for at least 100 patients at 2 years postsurgery, which is in excess of the minimum sample size needed to achieve adequate power.

Study Setting

The TWH-BSP is a Bariatric Center of Excellence accredited by the American College of Surgeons, and is one of two bariatric assessment centers in a six-hospital University of Toronto Bariatric Surgery Collaborative. Bariatric candidates are directed to the TWH-BSP based on their postal code, after being referred by a physician to a province-wide centralized referral center administered by the Ontario Bariatric Network. Patients undergo assessment and education at the TWH-BSP before being assigned for surgery at one of three affiliated hospitals: TWH, Toronto East General Hospital, or St. Michael's Hospital. All patients who undergo surgery return to the TWH-BSP for postsurgical follow-up appointments.

Assessment and Determination of Suitability for Surgery. The TWH-BSP comprises a comprehensive, multidisciplinary team of physicians (surgeons and psychiatrists), psychologists, dieticians, social workers, and nurse practitioners. These professionals work collaboratively in an integrated care model to determine patient suitability and readiness for bariatric surgery at the time of initial assessment.

Once a referral is received, bariatric candidates are scheduled to attend an orientation session where they are provided with information regarding the structure of the program, the bariatric procedures performed, including potential risks and benefits, and what can be expected both pre and postsurgically with respect to diet and weight loss outcomes**.** Patients also complete a psychosocial self-report questionnaire package. Bariatric candidates then proceed through the psychosocial evaluation process, which consists of a series of assessments conducted by a nurse practitioner, social worker, psychologist or psychiatrist, and dietician. They also attend a mandatory nutrition class. Additional appointments with specialists are scheduled as needed, based on the patients' presenting concerns and comorbidities.

Each of the abovementioned clinicians conduct an independent assessment, and evaluate patient suitability for surgery based on current clinical practice guidelines as they pertain to their particular scope of practice. A psychologist or psychiatrist conducts a psychodiagnostic assessment of current and past psychological disorders including eating disorders, mood disorders, anxiety disorders, psychotic disorders, obsessive-compulsive disorder, posttraumatic stress disorder, and substance use disorders using a semi-structured clinical interview (i.e., the M.I.N.I International Neuropsychiatric Interview version 6.00; Sheehan et al., 1998). A social worker collects demographic information including occupation, financial resources and stability, and living situation, and enquires about patient motivations and outcome expectations for surgery, and patient attributions regarding weight gain. The social worker also conducts a risk assessment and queries past hospitalizations due to mental health difficulties, enquires about psychiatric treatment history, and assesses the availability and functioning of the patient's social support system. During the dietician assessment, food intake and eating patterns, food preferences and intolerances, and meal prepping behaviours (i.e., grocery shopping habits, cooking skills) are assessed. A lifetime weight history, including previous weight loss attempts, is obtained, and the patient's motivation to engage in and sustain lifestyle changes is queried. Patients also attend a nutrition class, where they learn about general nutrition concepts, postsurgery dietary guidelines, postsurgery diet progression, and nutrition complications and strategies for mitigating risk. Patients are required to complete a nutrition assignment, which is used to gauge retention of knowledge from the nutrition class. Lastly, a nurse practitioner also obtains a weight history and assesses patient knowledge of the bariatric procedure, including risks and weight loss outcomes. They also conduct a thorough medical workup (e.g., current cardiovascular health, endocrine and gastrointestinal functioning). It is during these assessments that information relevant to scoring of the BIPASS is collected.

Each week, patients who have completed the assessment process (with the exception of meeting with the bariatric surgeon) are discussed at interprofessional rounds. At this meeting, clinicians raise particular concerns about client suitability based on the findings of their assessment. A colour code system comparable to that used for scoring the BIPASS (i.e., RED, YELLOW, GREEN) is used to communicate risk among team members. The entire team will then review the patient chart and reach consensus regarding suitability for surgery through discussion: for patients who do not meet exclusionary criteria for surgery (designated RED; see below in measures section for a description), a delay (designated YELLOW) might be recommended until the patient is able to complete recommendations delivered by the team. During the delay, the patient will continue to meet with members of the team for periodic reassessment. Once cleared for surgery from a psychosocial perspective, patients proceed through a final assessment conducted by a bariatric surgeon. Although this process is comprehensive and capitalizes on the collective expertise of the interprofessional bariatric team, the process is not necessarily efficient, standardized, or consistent in identifying risk factors warranting surgery delay, and often includes assessment of additional variables that may not be relevant to the determination of patient suitability for bariatric surgery (Thiara et al., 2016).

Follow-up. The TWH-BSP follows bariatric patients for a total of 5 years postsurgery. This includes appointments at 1, 3, 6, and 12 months, and annually thereafter. There is also an optional 18 month appointment. The 1-month visit includes a group education session, as well as an individual consultation appointment with a nurse practitioner and dietician. At all subsequent appointments, patients meet with a nurse practitioner, dietician, and either a social worker or psychologist. Patients who have been identified as 'high risk' (e.g., of worsening or recurring mental illness, suicidal ideation, substance use) during the presurgical assessment process will also meet with a program psychiatrist within the first year after surgery. Patients complete a psychosocial questionnaire package and are weighed at each follow-up appointment. It is worth noting that the collection of follow-up data for research purposes was only implemented within the past several years. As such, there are insufficient data collected as of yet to examine outcomes 3 years and beyond. A visual depiction of the surgical process relevant to the present study, from the psychosocial evaluation through to 2 year follow-up, is shown in Figure 1.

Predictive Measures

The Bariatric Interprofessional Psychosocial Assessment of Suitability Scale (BIPASS^{TM}; Sockalingam & Hawa, 2015©). As previously described, the BIPASS is a comprehensive assessment tool designed to standardize the presurgical psychosocial evaluation process. The BIPASS is comprised of 14 items, falling within four broad assessment domains: 1) patient readiness for surgery; 2) psychiatric illness; 3) social support; and 4) general features, including response bias, expectations for surgery, and emotion regulation. Each item on the BIPASS is rated on a 4-point Likert scale ranging from excellent, fair, borderline, and poor, which aids in capturing variability in severity. Each rating for each item includes descriptors to guide scoring. As with the items themselves, descriptors were developed with input from experts

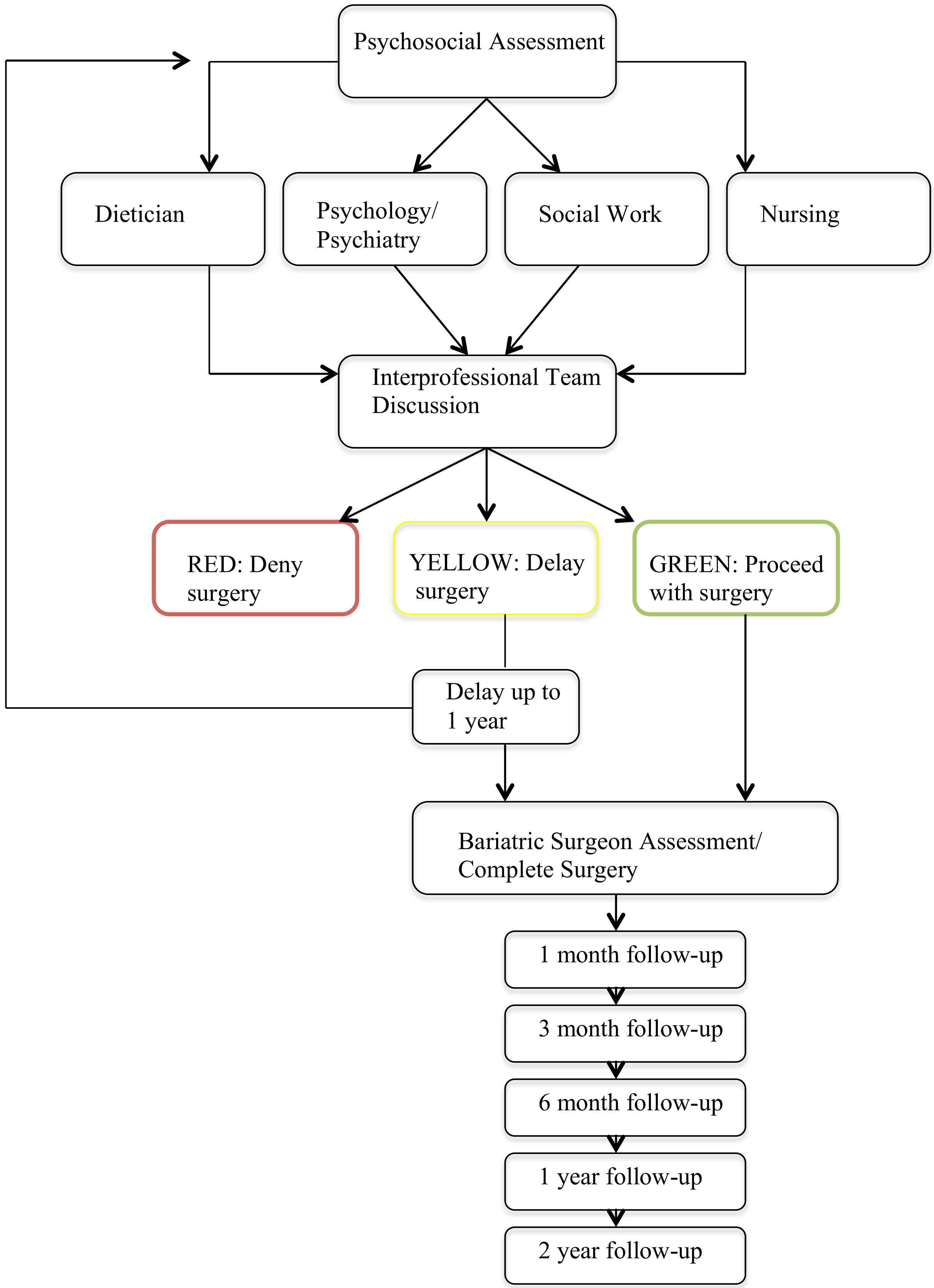

Figure 1. Surgical process at the TWH-BSP

in the field of bariatric surgery. Three of the BIPASS items have a maximum score of 3 (i.e., excellent = 0, fair = 1, borderline = 2, and poor = 3), whereas 11 of the items have a maximum score of 6 (excellent = 0, fair = 2, borderline = 4, poor = 6). This variation in scoring reflects the weighting of individual items during the expert rating process (i.e., items weighted higher have a higher maximum score). The total maximum score for the BIPASS is 75. The BIPASS also includes four items capturing contraindications for surgery, including active smoking or substance use, cognitive impairment, and severe uncontrolled psychiatric illness, that are not included in scoring, but warrant denial of surgery regardless of the presence or absence of additional psychosocial risk factors.

The BIPASS provides a means to systematically derive one of three clinical decisions regarding patient suitability: 1) those who meet surgery exclusion criteria (RED); 2) those who are at risk for negative outcomes and who might benefit from additional psychosocial intervention before proceeding with surgery (YELLOW), and 3) those who are currently suitable for surgery, with no significant reservations (GREEN). As previously described, preliminary research has shown that the BIPASS demonstrates high inter-rater reliability (ICC = .84; Thiara et al., 2016).

Demographics. Demographic information, including sex, age, marital status, education, and income was collected from all patients during the initial assessment process, and was used in this study for descriptive purposes.

Outcome Measures

Weight Outcomes. Participants' height and weight measurements were collected by a nurse practitioner at their initial presurgery assessment and at each follow-up appointment. Body weight was measured with patients in stocking feet, to the nearest 0.1 kg, using a bariatric wheelchair digital scale. Height was measured to the nearest 0.1 cm using a stadiometer, fixed to the wall. Body mass index was calculated as weight (kg) / height^2 (m), and used to provide descriptive information about the study sample.

In the bariatric surgery literature there is large variability in the reporting of weight loss metrics. Weight loss has been reported as the absolute number of pounds or kilograms lost, the number of BMI points lost, percentage total weight loss (%TWL), and percentage excess weight loss (%EWL; Hatoum & Kaplan, 2013). Currently, there is no consensus as to the best weight metric to report, although %TWL has the advantage of being the least associated with presurgical BMI (Hatoum & Kaplan, 2013). An executive summary of the ASMBS outcome reporting standards recommends presenting results using both %TWL (measured in kilograms or BMI units) and %EWL to facilitate comparisons across studies (Brethauer et al., 2015). For the present study, %TWL for 1 and 2 years postsurgery was calculated as follows: [(presurgery weight – postsurgery weight) / presurgery weight] x 100. Percentage EWL was calculated as: [(presurgery weight – postsurgery weight) / (presurgery weight – ideal weight)] x 100 (with ideal weight defined by the weight corresponding to a BMI of 25 kg/m^2; Brethauer et al., 2015).

There is also no consistent definition of weight regain used in the bariatric literature. Although the most commonly used definition is an increase in weight of $\geq$ 10 kg from weight loss nadir, this definition does little to communicate the clinical significance of weight regain, and limits comparability across individuals and studies (Lauti, Kularatna, Hill, & MacCormick, 2016). As such, it has been argued that defining weight regain by percentage of total weight lost is more clinically meaningful and useful (Lauti et al., 2016). Percentage weight regain was therefore calculated as the percentage of weight regained from the lowest weight achieved following surgery: [(current weight − nadir weight) / (presurgical weight − nadir weight)] x 100.

Quality of Life. Quality of life was measured via the Medical Outcomes Study Short Form Health Survey Version 2.0 (SF-36; Ware & Sherbourne, 1992). The SF-36 is a widely used self-report questionnaire that assesses health-related quality of life. It assesses both the physical and mental components of health, and is comprised of eight subscales: four subscales comprise the physical health domain (physical functioning, bodily pain, general health, and role limitations due to physical health problems), and four subscales comprise the mental health domain (vitality, social functioning, general mental health, and role limitations due to emotional problems). Items within each subscale are summed. Summed scores are then transformed onto a scale from 0 to 100, with higher scores indicating better health related quality of life. The SF-36 yields a physical component summary (PCS) score and a mental component summary (MCS) score, derived by summing respective subscale scores. The SF-36 demonstrates excellent reliability (e.g., Cronbach's $\alpha > .8$ for each subscale; Stewart, Hays, & Ware, 1998). As evidence of concurrent validity, the SF-36 has been shown to significantly correlate with medical and psychiatric symptoms (McHorney, Ware, & Raczek, 1993). In the current study, Cronbach's α ranged from .83 to .97 for each subscale at the presurgery time point.

Anxiety Symptoms. Anxiety symptoms were measured via the Generalized Anxiety Disorder 7-item scale (GAD-7; Spitzer, Kroenke, Williams, & Lowe, 2006). The GAD-7 was originally developed to diagnose generalized anxiety disorder, but it has also proved to be an adequate screening instrument for panic disorder, social anxiety disorder, and post-traumatic stress disorder (Spitzer et al., 2006). Respondents are asked to rate the frequency with which they have experienced anxiety symptoms over the previous 2 weeks on a scale ranging from 0 to 3. Scores on the GAD-7 range from 0 to 21. Mild, moderate, and severe levels of anxiety symptoms correspond to cutoff scores of 5, 10, and 15, respectively. The GAD-7 has been shown to have excellent internal consistency (α = 0.92) and test-retest reliability (ICC = 0.83; Spitzer et al., 2006). In the present sample, Cronbach's alpha was .9 measured at the presurgery time point.

Depressive Symptoms. Depressive symptoms were measured via the Patient Health Questionnaire (PHQ-9; Spitzer et al., 1999). The PHQ-9 consists of 9 self-report items that were designed to correspond to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) diagnostic criteria for major depressive disorder. It asks respondents to rate the frequency with which they have experienced depressive symptoms over the previous 2 weeks on a scale ranging from 0 (not at all) to 3 (nearly every day). Scores on the PHQ-9 can range from 0 to 27, and mild, moderate, moderately severe, and severe levels of depressive symptoms correspond to cutoff scores of 5, 10, 15, and 20 respectively. Internal consistency and test-retest reliability of the PHQ-9 is good (α = 0.89, ICC = 0.85; Kroenke, Spitzer, & Williams, 2001). Cronbach's alpha in the present study was .87 at presurgery.

Binge Eating Symptomatology. Binge eating symptomatology was measured via the Binge Eating Scale (BES; Gormally, Black, Daston, & Rardin, 1982). The BES is a16-item self-report measure of cognitions, emotions, and behavioural symptoms associated with binge eating. It was designed specifically for use with individuals with obesity. Each item is comprised of 3 or 4 response options and individuals are asked to indicate the response that best describes how they feel about their eating behaviour. Scores on the BES range from 0 to 46, with moderate levels of binge eating corresponding to a threshold score of 18 and severe levels of binge eating corresponding to a threshold score of 27. The BES has demonstrated good internal consistency in a clinical population of individuals who binge eat (α = .85; Gormally et al., 1982). The BES also has good test-retest reliability (r = .87; Timmerman, 1999), and is an adequate screening measure for BED in individuals with obesity seeking bariatric surgery (Grupski et al., 2013). In the present study, Cronbach's alpha was .88 at presurgery.

Adherence to Postsurgical Follow-up. In order to examine whether BIPASS scores predict nonadherence in the postsurgical period, patients were categorized as adherent or non adherent. A minimum of five follow-up appointments is scheduled during the first 2 years of the postsurgical phase: 1, 3, 6, 12, and 24 months postsurgery. There is also an optional 18 month appointment. Consistent with prior research, nonadherence to postsurgical follow-up was defined as missing > 50% of regular and/or additionally scheduled appointments (e.g., Moroshko et al., 2012).

Procedure

The primary investigator reviewed patient charts and used the BIPASS tool to score patient suitability for bariatric surgery. The primary investigator was trained in scoring by one of the developers of the BIPASS (S. S.), as well as a TWH-BSP research assistant with more than 1 year of experience using this tool. Both the primary investigator and the trained research assistant independently scored a total of 20 patient charts in order to calculate inter-rater reliability for the BIPASS. Only the primary investigator scored the remainder of patient charts.

Information relevant to scoring of the BIPASS is collected during a series of individual assessments conducted by members of the multidisciplinary bariatric team (dietician, social worker, nurse practitioner, and psychologist or psychiatrist). Copies of the resulting assessment reports for each of these clinicians were obtained from patients' electronic charts. Given that patients with identified psychosocial risk factors often receive recommendations for short-term intervention, many attend multiple assessment appointments before being approved for surgery.

In order to accurately capture initial psychosocial risk, the BIPASS was used to score information collected from the initial assessment appointments only.

Patients completed the self-report measures of quality of life, binge eating symptomatology, and depressive and anxiety symptoms following the orientation class and prior to attending their first individual assessment, and at 1 and 2 year follow-up appointments. Height and weight were measured by a nurse practitioner during the initial nursing assessment, and again at each follow-up appointment; this information was obtained from individual patient charts. Documentation of attendance at all follow-up appointments was collected from the electronic patient record.

The primary investigator was blinded to the TWH-BSP clinical team decision regarding patient suitability for surgery, as well as weight, quality of life, psychiatric symptoms, and adherence outcomes prior to scoring patient charts using the BIPASS. This was accomplished by having a second research assistant copy all patient assessment reports and physically obscure any documented information related to the team decision. Self-report data and weight and attendance outcomes were kept in a separate database from the assessment reports; they were not accessed for the purposes of data collection until scoring of patient charts using the BIPASS was complete.

Data Analysis Plan

Statistical Analyses. All statistical analyses were conducted using SPSS software version 25.

Aim 1. Internal consistency of the BIPASS Total and subscale scores was examined using Cronbach's alpha. Inter-rater reliability was calculated using the Interaclass Correlation Coefficient, computed between the two independent raters for the BIPASS Total score and each subscale score. To obtain the optimal cutoff score for categorization of YELLOW (vs. GREEN), the clinical team's outcome decision was compared with the BIPASS Total score of the primary investigator for each patient using Receiver Operating Characteristic (ROC) analysis. The accuracy of the BIPASS cutoff point was determined by examining the sensitivity and specificity of varying thresholds, and area under the curve (AUC).

Aim 2. Bivariate correlations were calculated between dependent variables and potential covariates, including surgery type, age, and sex. Variables that significantly correlated with any outcome variables were included as covariates in subsequent analyses.

Hypothesis 1. Hypothesis 1 was examined via a series of hierarchical multiple regression analyses with BIPASS Total score and relevant covariates entered as the predictor variables and weight loss (%TWL, %EWL, %WR), quality of life, depression, anxiety, and binge eating severity scores at 1 year postsurgery entered as dependent variables. The Holm-Bonferroni correction for multiple comparisons was applied to adjust p values and control for familywise error. This method sequentially ranks a family of p values from smallest to largest and compares each to an adjusted p value based on the formula *α/n – rank number of p value by degree of significance + 1*, where $\alpha = .05$ and n = the number of statistical tests. The Holm-Bonferroni method can adequately control for Type I error, with the benefit of being less conservative than the Bonferroni method and, thus, also adequately controlling for Type II error (Abdi, 2010).

Hypothesis 2. Group differences, controlling for relevant covariates, at 1 year postsurgery were examined via between-group ANCOVAs with psychosocial risk status (YELLOW vs. GREEN) as the between subjects factor, and %TWL, %EWL, %WR, quality of life, depression, anxiety, and binge eating severity at 1 year postsurgery entered as the dependent variables. The

Holm-Bonferroni correction for multiple comparisons was applied. Between-group effect sizes were calculated using Cohen's *d*.

Hypothesis 3. Hypothesis 3 was examined via a series of hierarchical multiple regression analyses with BIPASS Total score and relevant covariates entered as the predictor variables and weight loss (%TWL, %EWL, %WR), quality of life, depression, anxiety, and binge eating severity scores at 2 years postsurgery entered as dependent variables. The Holm-Bonferroni correction for multiple comparisons was applied.

To determine if BIPASS Total score predicts adherence to postsurgical follow-up, data were analyzed using a binary logistic regression analysis. BIPASS Total score and covariates were entered as the predictor variables, and adherence vs. nonadherence entered as the dependent variable.

Hypothesis 4. Hypothesis 4 was examined using between-group ANCOVAs, with psychosocial risk status entered as the between-subjects factor and %TWL, %EWL, %WR, quality of life, depression, anxiety, or binge eating severity scores at 2 years postsurgery as the dependent variables. The Holm-Bonferroni correction for multiple comparisons was applied. Between-group effect sizes were calculated using Cohen's *d*.

To determine whether patients categorized as YELLOW vs. GREEN were more likely to be nonadherent to postsurgical follow-up, data were analyzed using a hierarchical binary logistic regression. Psychosocial risk status and relevant covariates were entered as the predictor variables, and adherence vs. nonadherence entered as the dependent variable.

Exploratory Hypothesis. A series of hierarchical multiple regression analyses were conducted to investigate the ability of BIPASS subscales to predict each dependent variable at both 1 and 2 years posturgery. The Holm-Bonferroni correction for multiple comparisons was again applied.

Results

Descriptive Statistics

Demographics and baseline clinical characteristics are presented in Table 2. Approximately 80% of the sample was female. At presurgical assessment, the mean patient BMI was 49.5 kg/m^2 (*SD* = 9.46; range = 33.92[1] to 88.65 kg/m^2). The mean age of patients was 44.63 years (*SD* = 10.47; range = 18 to 67 years[2]). The majority of patients were white (66%), married (46%), and working full time (63%). Almost half had completed college or a trade certificate (44.7%), and average household income was high (*M* = $81,000.13; *SD* = $63,862.13; range = $1,300 to $600,000). Ninety percent of patients underwent RYGB; 10% underwent VSG.

Of the 200 patients, 53.8% reported symptoms that met diagnostic criteria for a current or lifetime psychiatric illness. The mean number of psychiatric comorbidities was .94 (*SD* = .08). Of those patients who were diagnosed with a current psychiatric illness, mood disorders (7.0%) and eating disorders (7.0%) were most common, followed by anxiety disorders (6.5%), trauma or stressor-related disorders (2.5%), ADHD (1.5%), and substance use disorders (0.5%). With respect to lifetime psychiatric illness (excluding current diagnoses), the most common was a mood disorder diagnosis (29.5%), followed by substance use disorders (14.5%), eating disorders (11.5%), trauma or stressor-related disorders (9.5%), and anxiety disorders (4.5%).

Aim 1: Psychometric Properties of the BIPASS

Data Screening and Preliminary Analyses. Prior to conducting analyses relevant to aim 1, BIPASS items were screened for violations of univariate normality. *Substance Use*, *Personality Traits and Disorders*, and *Response Bias and Truthfulness* items had values above

[1]In order to be eligible for bariatric surgery, the OBN requires that patients have a BMI > 40 kg/m^2, or > 35 kg/m^2 in the presence of 2 or more obesity-related medical comorbidities, at the time of referral. In some instances, BMI has dropped below the cutoff by the time of assessment. One patient had a BMI of 33.92 at the time of assessment.
[2]Similarly, in rare instances, patients are below the age cutoff of 65 at the time of referral and exceed this cutoff by the time of assessment. Three patients were approved for surgery at the ages of 66, 66, and 67 years, respectively.

Table 2

Participant Demographics and Baseline Clinical Characteristics (N = 200)

Variable	*M (SD)* or *n* (%)
Sex	
Male	37 (18.5)
Female	163 (81.5)
Age (years)	44.63 (10.47)
BMI (kg/^{2})	49.5 (9.5)
Income ($)	81000.13 (63862.13)
Ethnicity	
White	132 (66)
Black	24 (12)
Latin American	20 (10)
East/South East Asian	9 (4.5)
Arab/West/South Asian	9 (4.5)
Aboriginal	4 (2)
Biracial	1 (.5)
Relationship Status	
Married	92 (46)
Single	57 (28.5)
Divorced/Separated	27 (13.5)
Common-law	22 (11)
Widowed	2 (1)

Employment Status	
Full time	126 (63)
Part time	15 (7.5)
Student	10 (5)
Disability	10 (5)
Social Assistance	16 (8)
Homemaker	7 (3.5)
Unemployed	9 (4.5)
Retired	7 (3.5)
Education	
Less than high school	13 (6.5)
High school diploma	63 (31.7)
College degree/trade certificate	89 (44.7)
Undergraduate degree	22 (11.1)
Master's Degree	8 (4.0)
Professional degree	3 (1.5)
Current Psychiatric Disorder	
Any mood disorder	14 (7)
Any anxiety disorder	13 (6.5)
Any eating disorder	14 (7)
Any substance use disorder	1 (.5)
Any trauma and stress-related disorder	5 (2.5)
ADHD [a]	3 (1.5)

Lifetime Psychiatric Disorder	
Any mood disorder	59 (29.5)
Any anxiety disorder	9 (4.5)
Any eating disorder	23 (11.5)
Any substance use disorder	29 (14.5)
Any trauma and stress-related disorder	19 (9.5)

Note. Diagnoses were made according to DSM-IV-TR; however, PTSD and adjustment disorder are grouped here according to DSM-5 Trauma and Stressor-Related Disorders.

[a] ADHD prevalence includes current and lifetime diagnoses

the recommended cutoff for both skewness and kurtosis (of $\pm$ 2 and 7, respectively; Curan, West, & Finch, 1997). A visual inspection of the histograms revealed positive skew and platykurtosis, with scores clustered around the low end of the scale for each item. Applying logarithm transformation corrected the distribution for the *Substance Use* item to within normal limits; however, no transformation was successful in correcting the distribution for *Personality Traits and Disorders* or *Response Bias and Truthfulness* items. Consequently, all analyses were performed using nontransformed data.

The data were also screened for the presence of outliers. Approximately 12% of cases (n = 23) had univariate outliers, defined as a z score > 3.29, on one or more of five BIPASS variables: *Knowledge and Understanding of Excess Weight Gain; Finances, Employment, and Housing; Substance Use; Personality Traits and Disorders*; and *Response Bias and Truthfulness*. Outliers were replaced with the next highest value (Tabachnick & Fidell, 2007), which corrected outliers for the majority of items. However, this process resulted in a further increase in the kurtosis values for *Personality Traits and Disorders* and *Response Bias and Truthfulness*. Removing outliers similarly increased platykurtosis. As such, outliers were not modified for those items.

BIPASS Total scores ranged from 0 to 37, with a mean of 12.4 (*SD* = 7.55). Internal consistency for the BIPASS Total score was adequate (α = .65. Cronbach's α was .29 for the Patient Readiness Level subscale, .41 for the Social Support System subscale, .64 for the Psychiatric Illness subscale, and -.1 for the General Assessment Features subscale. Given the poor internal consistency of the BIPASS subscale scores, a decision was made to conduct an exploratory factor analysis and a confirmatory factor analysis in order to examine the relationship among the 14 BIPASS items, and to identify and restructure underlying factors.

Exploratory Factor Analysis. Prior to conducting the EFA, multivariate outliers were detected using mahalanobis distance values. Only one mahalanobis distance value was above the critical $\chi^2(14) = 36.12$, $p = .001$. This case was removed from the dataset. The factorability of the BIPASS was also examined. The presence of multicollinearity was assessed by conducting a multiple regression analysis with the 14 BIPASS items entered as predictor variables, and examining the tolerance and variance inflation factor (VIF) values. It is suggested that tolerance values < .1 and VIF values > 10 indicate multicollinearity (Fields, 2009). Multicollinearity was not detected in the data; thus, the assumption of collinearity was deemed to be satisfied.

A visual scan of the inter-item correlation matrix revealed that less than half of the BIPASS items yielded a correlation above .3 with any other item (Tabachnick & Fidell, 2007). The *Expectations for Bariatric Surgery* item did not significantly correlate with any items or the BIPASS Total score and was consequently removed. Given the small number of items comprising the BIPASS and the theoretical importance of each variable to the assessment of suitability for surgery, the remainder of the items with low inter-item correlations were retained at this stage. Despite small correlations between several items, the correlation matrix was significantly different from an identity matrix according to Bartlett's test of sphericity ($\chi^2[78] = 405.53$, $p < .001$). The overall Kaiser-Meyer-Olkin's statistic was .69, which is above the recommended criterion of .60 for good factorability (Tabachnick & Fidell, 2007). Taken together, the data appeared suitable for EFA.

Principal Axis Factoring (PAF) was chosen for extraction, as this method is robust to violations of normality (Fabrigar et al., 1999). PAF with direct oblimin rotation, an orthogonal rotation, was used in an initial run to estimate the likely number of factors from eigenvalues > 1 (Kaiser, 1958) and a visual inspection of the scree plot. The initial model had five eignevalues greater than one and explained 39% of the total variance. However, Zwick and Velicer (1986) caution that eigenvalues almost always overestimate the number of factors to retain. Indeed, the scree plot indicated that a more parsimonious model might be warranted, with apparent breaks between two and five factors. Consequently, several additional PAF runs were planned, specifying two, three, and four factors to determine the best conceptual and statistical fit of the data. The criterion for item deletion was item loadings below .32 (Tabachnick & Fidell, 2007). It was also required that at least three items loaded onto a factor in order for that factor to be retained, given that factors comprised of two items or less are considered unstable, and that items within a potential factor had minimal cross-loadings with other factors (Tabachnick & Fidell, 2007; Yong & Pearce, 2013).

For each of the iterations specifying three, four, and five factors, at least one factor had an insufficient number of items load above .32, and several items cross-loading onto more than one factor. The two-factor solution resulted in five items loading above .32 onto each factor and no cross-loadings; however, three items (*Knowledge and Understanding of Excess Weight Gain, Substance Use*, and *Response Bias and Truthfulness*) did not load onto any factor. These items were removed and the two-factor solution was re-run; all remaining variables loaded onto a factor above .32. In sum, the two-factor solution was ultimately chosen since: 1) it resulted in factors with more than three items loading onto them and no cross-loadings, and 2) interpretations for the other models were conceptually ambiguous given the small number of primary item loadings on additional factors. The factor pattern matrix is presented in Table 3.

PAF was then repeated using varimax (orthogonal) rotation, which yielded comparable results. Given that the resulting factors were moderately correlated (r = .3), final results are reported using direct oblimin rotation. Communalities are presented in Table 4. The final two-

Table 3

Pattern Matrix for Principal Axis Factoring with Direct Oblimin Rotation of the BIPASS

Item	Factor 1 "Mental Health"	Factor 2 "Patient Readiness"
2. Understanding of Surgery	-0.17	**.329**
3. Willingness, Motivation, and Lifestyle Modification	-0.37	**.422**
4. Compliance and Adherence	.036	**.461**
5. Social Support System	.002	**.518**
6. Finances, Employment, and Housing	.056	**.525**
7. Psychiatric Stability	**.582**	.226
8. Eating Behaviour	**.460**	-.002
9. History of Psychiatric Illness	**.925**	-.115
11. Personality Traits and Disorders	**.379**	.043
12. Coherence and Emotion Regulation	**.605**	-.062

Note: Factor loadings > .32 are in bold.

Table 4

BIPASS Communalities After Extraction Using Principal Axis Factoring.

Items	Communalities
BIPASS 2	.105
BIPASS 3	.170
BIPASS 4	.224
BIPASS 5	.269
BIPASS 6	.297
BIPASS 7	.470
BIPASS 8	.211
BIPASS 9	.852
BIPASS 11	.155
BIPASS 12	.347

factor solution accounted for 31% of the variance. Most values in the residual correlation matrix were near zero, further supporting the two-factor structure. In addition, the reproduced correlation matrix showed that 33% of residuals were above .05, which is less than the suggested cutoff of 50%, indicating that the model was an adequate fit of the data (Field, 2009). The first factor explained 21.93% of the variance (Eigenvalue = 2.09) and appears to reflect "Mental Health." The second factor, which accounted for 9.06% of the variance (Eigenvalue = 1.31), appears to reflect "Patient Readiness" for surgery. For both subscales, as with the Total score, higher scores indicate greater psychosocial risk (i.e., *poorer* mental health and readiness for surgery).

Confirmatory Factor Analysis. Confirmatory Factor Analysis (CFA) is a multivariate technique that assesses whether covariations among variables load onto one or more latent factors (Arbuckle, 2009). CFA is used to verify the number of underlying dimensions of a scale, and the pattern of item-factor relationships (Brown, 2015). A CFA was conducted in order to confirm the two-factor structure of the BIPASS derived from the EFA. A higher-order model was tested, in order to account for the correlation between Patient Readiness and Mental Health factors (Shek & Yu, 2014). CFA was performed using Analysis of Moment Structured (AMOS) for SPSS software version 24.

Four metrics were utilized to evaluate the goodness of fit of the model. First, the absolute fit of the model to the data was measured via the normed chi-square, which is the ratio of chi-square to degrees of freedom (χ^2/df). Dividing chi-square by the model's degrees of freedom reduces sensitivity of the model to sample size. A ratio of less than 2 is indicative of good model fit (Kline, 2005). Second, the root mean square error of approximation (RMSEA) was used to measure the discrepancy between the model and the population covariance matrix. An RMSEA value of less than .06 is considered to be indication of a good model fit; less than .08 is considered to be a reasonable fit (Hu & Bentler, 1999). The 90% confidence intervals should not cross zero. The comparative fit index (CFI) was used to measure relative fit, which is a measure of the discrepancy between the hypothesized model and the data, adjusting for sample size. A CFI value greater than .95 is indicative of good model fit and .9 is considered acceptable model fit (Hu & Bentler, 1999). Finally, the standardized root mean square residual (SRMR) was used to measure the overall difference between predicted and observed correlations in the model. An SRMR value of less than .1 is considered to indicate good model fit (Kline, 2005).

Results of the CFA, including the standardized beta coefficients for each item, are presented in Figure 2. Each path from observed to latent variable was statistically significant, indicating that no further BIPASS items should be removed. The normed chi-square value indicated good absolute model fit, χ^2/df = 1.79. The RMSEA indicted a reasonable model fit (RMSEA = .06, CI = .03 - .08), and the 90% confidence intervals did not cross zero. The CFI indicated acceptable model fit (CFI = .91), but the SRMR was just above the acceptable cutoff for good model fit (SRMR = .11). Taken together, the absolute and relative fit indicators demonstrate acceptable fit of the data to the proposed model (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999).

Modification indices were examined to determine whether model fit could be improved (as determined by a change in chi square) if covariances between error terms were allowed to freely estimate (Kline, 2005). The largest modification index was for covariances between e2 (*Willingness, Motivation, and Lifestyle Modification*) and e4 (*Social Support*), yet it was below the commonly recommended cutoff of 15 (Kline, 2005). Inserting the covariance into the model

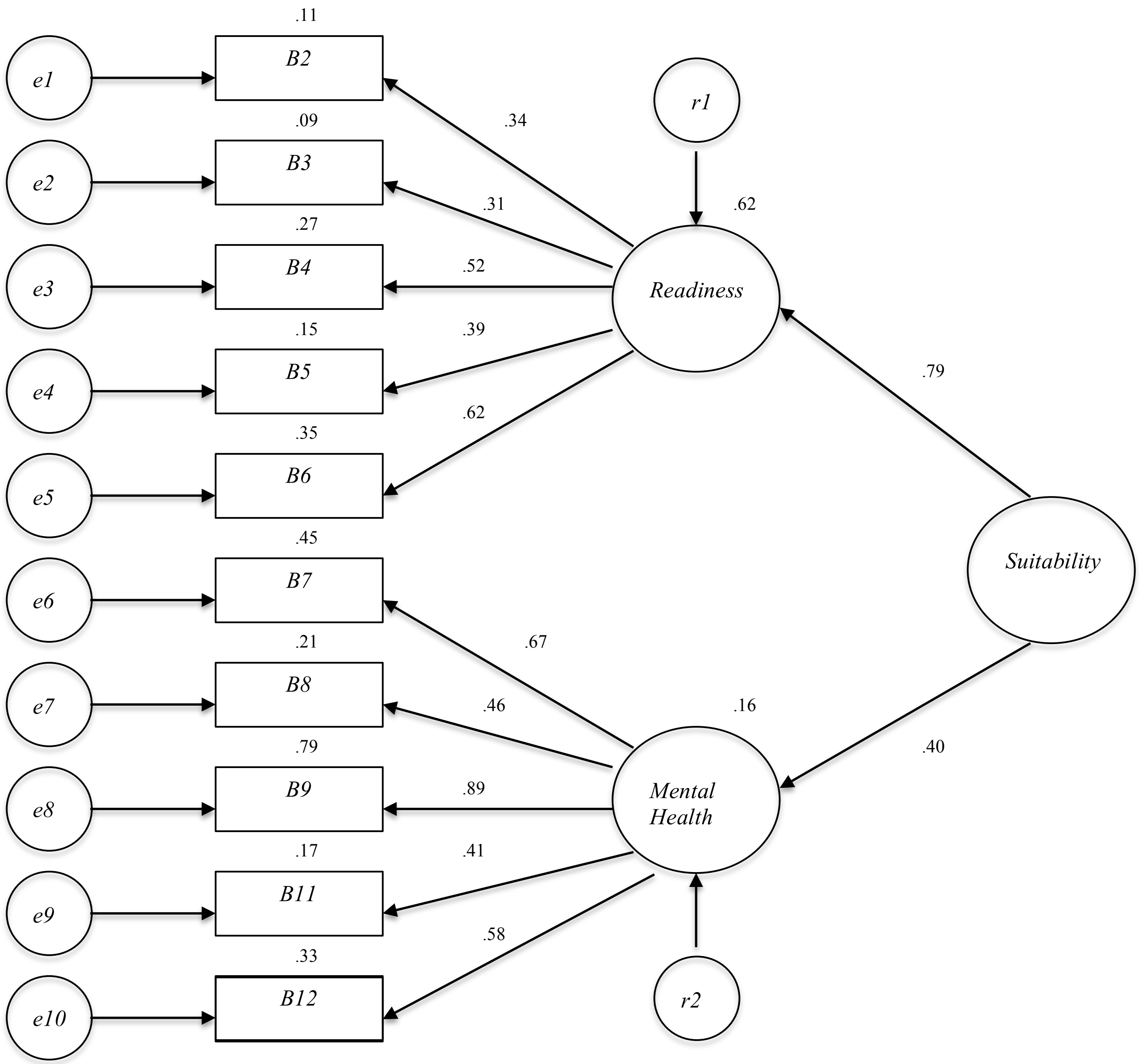

Figure 2. Two-Factor confirmatory analysis of the BIPASS.

resulted in minimal improvement in model parameters. Consequently, the original model solution without freely estimated covariances was retained.

Reliability and Validity. Total scores for the 10-item BIPASS tool ranged from 0 to 34, with a mean of 10.4 (*SD* = .49). Internal consistency was calculated for the BIPASS Total score and newly derived subscale scores. Cronbach's α for the BIPASS Total was acceptable (α = .69). Internal consistency was also acceptable for the Mental Health subscale (α = .73). The reliability of the Patient Readiness subscale was low (α = .55). Inter-rater reliability was very high for the Total score (ICC = .98), and the Mental Health (ICC = .97) and Readiness subscales (ICC = .99).

ROC Analysis. Sixty-eight percent of the total sample (*n* = 136) was categorized as GREEN by the bariatric interprofessional team; 32% (*n* = 64) was categorized as YELLOW. A ROC analysis was conducted to determine the cutoff score for the BIPASS that optimally differentiated between designations of YELLOW and GREEN as determined by bariatric clinician consensus. An ROC curve provides an estimate of how accurately a model classifies a designation by plotting sensitivity (i.e., true positive rate) against 1 minus specificity (i.e., false positive rate) for each potential cutoff score. The AUC represents the overall accuracy of the model to differentiate between designations, with a higher AUC indicating higher accuracy. Youden's index combines specificity and sensitivity to determine the optimal cutoff score to use.

The ROC curve was specified to use nonparametric assumptions, in order to ensure that the analysis was robust to distributional nonormality. The ROC curve significantly differentiated between designations of YELLOW and GREEN as determined by clinician consensus (AUC = .89, SE = 0.22, $p < .001$; 95% CI 0.85 to 0.94). A score of 10.92 on the BIPASS maximized both sensitivity (.88) and specificity (.75) for predicting clinician consensus regarding suitability for surgery (see Figure 3). A cutoff score of ≥ 11 was retained and used for between-group analyses

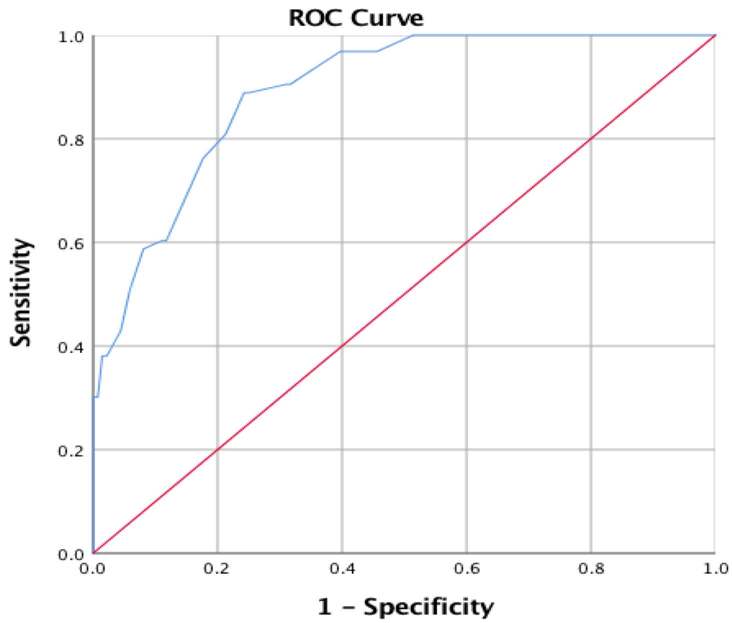

Figure 3. Receiver operating characteristic (ROC) curve predicting presurgical psychosocial risk status based on clinician consensus regarding suitability for surgery.

in aim 2, and can be interpreted as patient scores exceeding this threshold being highly suggestive of significant psychosocial risk for poor outcomes following bariatric surgery.

Aim 2: Predictive Validity for Outcomes at 1 and 2 Years Postsurgery

Data Screening. The variables used in analyses in aim 2 were screened for univariate outliers (i.e., z scores > 3.29) and violations of the assumptions of normality. The newly created BIPASS Total and Patient Readiness and Mental Health subscale variables all adhered to distributional normality and there were no univariate outliers. Several of the dependent variables contained univariate outliers, including weight regain (three outliers identified), anxiety symptoms at 1 year (one outlier identified) and 2 years (one outlier identified) postsurgery, physical health-related quality of life at 1 year postsurgery (two outliers identified), and both physical and mental health-related quality of life at 2 years postsurgery (one outlier identified for each). Replacing outliers with the next highest score (or lowest score for quality of life variables) corrected any problematic skewness and kurtosis values to within an acceptable range (Tabachnick & Fidell, 2007). Examinations of analysis-specific multivariate outliers and assumptions were undertaken prior to completing each statistical analysis and are described in detail below.

Descriptive Characteristics of Postsurgery Sample. Mean BMI of the sample no longer fell within the severe (Grade III) obesity range at 1 or 2 years postsurgery (see Table 5). However, mean BMI did remain within the Grade I to Grade II obesity range. In this sample, mean weight regain was minimal, ranging from 0 to 51.54% by 2 years postsurgery. Percentage weight regain could not be examined as an outcome variable at 1 year postsurgery, as insufficient weight had been regained on average at that time point.

Table 5

Means and Standard Deviations for Weight and Self-report Measures Pre- and Postsurgery

Measures	Baseline		1 Year		2 Years	
	M	*SD*	*M*	*SD*	*M*	*SD*
BMI	49.49	9.46	35.46	7.45	34.6	8.17
EWL	-	-	63.81	18.243	66.25	23.16
TWL	-	-	30.66	8.78	31.34	10.6
WR	-	-	-	-	5.54	9.8
BES	16.85	9.02	5.63	5.96	6.59	6.2
PHQ-9	10.49	6.38	2.65	3.54	3.34	3.91
GAD-7	6.12	5.38	1.23	1.99	2.14	3.63
SF-36 PCS	33.58	11.12	49.42	10.33	52.08	8.6
SF-36 MCS	46.76	11.4	55.23	8.68	53.95	8.83

Note. BES = binge eating scale; BMI = body mass index; EWL = % excess weight loss; GAD-7 = generalized anxiety disorder 7-item scale; PHQ-9 = patient health questionnaire 9-item; SF-36 MCS = 36-item short form health survey mental component summary; SF-36 PCS = physical component summary; TWL = % total weight loss; WR = % weight regain

There was improvement on all psychiatric symptom measures from baseline to 1 year postsurgery, and a slight worsening of symptoms from 1 to 2 years. Mean scores on the PHQ-9, GAD-7, and BES were within the normal range at both 1 and 2 years postsurgery. Physical health-related quality of life improved at 1 year postsurgery and continued to improve up to 2 years, whereas mean mental health-related quality of life scores improved at 1 year postsurgery and declined slightly thereafter.

Missing Data. One hundred percent of the outcome variables contained missing data, and 186 patients (92.5%) had some missing data. At 1 year postsurgery, the percentage of missing values for each outcome variable ranged from 33.8% (%EWL, %TWL) to 75.6% (BES). At 2 years postsurgery, the percentage of missing values for outcome variables ranged from 50.7% (%EWL, %TWL, weight regain) to 79.6% (SF-36). Forty-five (22.5%) participants were lost to follow-up (i.e., did not attend or return for subsequent appointments) at 1 year postsurgery, and this increased to 101 (50.5%) by 2 years. This means that some patients who attended an appointment at 2 years postsurgery failed to complete self-report measures. Given that missing data at this rate can result in reduction of power beyond that accounted for in the *a priori* power analysis, imputation of missing values using multiple imputation (MI) was considered.

In order to determine whether the data were suitable for imputation, the mechanism behind missingness was first examined via Little's MCAR (missing completely at random) test (Little, 1998). Little's method compares the observed mean for each pattern of missing data for a missing variable with the expected population mean for that variable, and produces a chi-square value. If data are MCAR, the mean for each pattern of missing data should be comparable to the mean for that variable computed for the entire dataset. If the data deviate (i.e., if there are differences between missing and nonmissing cases), then the chi-square test will be significant and the data can be deemed as not MCAR. Little's test was nonsignificant for almost all variables at 1 year and 2 years postsurgery (all *p*s > .05). The exception was depressive symptoms at 2 years postsurgery, which indicated that data for this variable was *not* missing completely at random, $\chi^2(8) = 19.12$, $p = .014$. Unlike MCAR, there is no way to reliably determine whether data are missing at random (MAR; where missingness can be accounted for by observed variables in the dataset) versus missing not at random (MNAR; where values of the missing variable are related to the reason they are missing). Therefore, when MCAR has been ruled out, both MAR and MNAR must be considered as possible missing data mechanisms (McKnight, McKnight, Sidani, & Figueredo, 2007). When data are MNAR, MI can produce biased parameter estimates (McKnight et al., 2007). Thus, it was concluded that the majority of variables were suitable for MI, with the exception of the PHQ-9 at 2 years postsurgery.

Next, differences in characteristics of patients with and without missing data at each time point (i.e., 1 or 2 years postsurgery), and at both time points were examined on the following baseline clinical and demographic variables: age, income, sex, education, ethnicity, employment status, marital status, presence of psychiatric diagnosis, BMI, and BES, PHQ-9, GAD-7, SF-36 PCS, and SF-36 MCS scores. When significant differences in participant characteristics are apparent, results from complete case analysis (CCA) may be biased, in addition to being underpowered, because the remaining participants are no longer representative of the entire population (Lee, Roberts, Doyle, Anderson & Carlin, 2016). If there are observed variables related to missingness, MI has the potential to reduce bias, as it allows for the inclusion of all participants in analyses (Lee et al., 2016).

New dummy coded variables were created to indicate whether the patient had missing data or present data at each time point, or at both time points. There was a significant difference between those with and without missing weight data at 1 year postsurgery on presurgical BMI (t[197] = 2.53, p = .012), and for those with and without missing self-report data at 1 year postsugrery on baseline GAD-7 (t[186] = -2.39, p = .017), and SF-36 MCS scores (t[109] = 3.02, p = .003). There was also a significant difference between those with and without missing weight data at 2 years postsurgery on age (t[197] = 2.65, p = .009), and between those with and without missing self-report data at 2 years on baseline GAD-7 scores (t[194] = -2.09, p = .037). Lastly, there was a significant difference between those with and without missing weight data at both 1 and 2 years postsurgery on age (t[197] = 4.59, p < .001), and between those with and without missing self-report data at both time points on baseline PHQ-9 (t[193] = -2.39, p = .018), GAD-7 (t[194] = -2.72, p = .007), and SF-36 MCS (t[114] = 2.98, p = .003) scores. Based on these findings, it was concluded that there would likely be benefit to proceeding with MI.

Multiple imputation uses regression models to replace missing values with random values based on the underlying distributions in the observed dataset (McKnight et al., 2007). This process is repeated over several iterations, resulting in multiple complete datasets. Analyses are performed separately on each complete dataset using standard procedures and are then pooled to produce a final result using Rubin’s (1987) combination rules (McKnight et al., 2007). When data are MCAR or MAR and the model used to estimate missing values is appropriately constructed, MI produces valid inferences (Biering, Hjollund, & Frydenber, 2015). Indeed, a noted strength of this approach is that the standard error of the MI estimated values incorporates variability from each of the imputed datasets, as well as the variability in estimates between the datasets. In contrast, other common methods of missing data handling such as single imputation (e.g., imputation with the mean, last observation carried forward) artificially decrease variances and, thus, underestimate standard errors, and produce biased parameter estimates and errors in significance testing (McKnight et al., 2007).

The specification of an appropriate imputation model involves determining which variables should be included in the model. In addition to including variables that are part of the planned analysis, the imputation model should also include auxiliary variables. Auxiliary variables are variables in the dataset that are correlated with the missing variable in the model and/or are believed to be associated with missingness. Auxiliary variables are included in the model in order to increase the plausibility of the MAR assumption and to improve the quality of imputed values. That is, auxiliary variable values are used to predict the missing values. Indeed, the inclusion of auxiliary variables enhances information recovery and improves estimation of the missing data values, and they are particularly important when there is a high proportion of missing data (Lee et al., 2016). Thus, for each analysis, imputation models were based on the independent and dependent variables, covariates, and additional variables measured at previous or concurrent time points that significantly correlated with the variables of interest that had missing values (i.e., the auxiliary variables). Because the majority of data were missing at the scale level (i.e., responses for an entire questionnaire are missing) and not the item level, total scores and subscale scores were imputed for self-report measures (Graham, 2012). Imputation models were run with a linear regression mechanism and specifying 20 imputations: a larger number of imputations, in excess of the recommended five to ten, is necessary with greater amounts of missing data (McKnight et al., 2007). Results for aim 2 are reported using both complete case analysis (CCA) and MI; the analyses predicting depressive symptoms at 2 years postsurgery are presented with CCA only. Complete cases are those that answered the entirety of a questionnaire; cases with values missing at the item level were not included in CCA.

Hypothesis 1: Predicting Outcomes at 1 Year Postsurgery From BIPASS Total Score. Hierarchical multiple regression analyses were performed to investigate the ability of the BIPASS Total score to predict levels of each dependent variable. Previous research has identified age, sex, and surgery type as variables potentially associated with postsurgical outcomes (e.g. Contreras, Santander, Court, & Bravo, 2013; Manning et al., 2014). Consequently, prior to conducting the regression analyses, Pearson's product-moment and point-biserial correlations were calculated between those variables and weight, quality of life, and psychiatric symptom outcomes. Sex and age were significantly correlated with several outcomes, whereas surgery type was not correlated with any outcome variable. As a result, age and sex were included as covariates in subsequent analyses. Previous research has also identified presurgical BMI as one of the strongest predictors of postsurgical weight when calculated as %EWL (Hatoum & Kaplan, 2013). Indeed, presurgical BMI was significantly correlated with %EWL but not %TWL or %WR; therefore, this variable was also entered as a covariate in the analysis predicting %EWL. Thus, for each analysis, relevant covariates were entered as predictors in the first step of the model. BIPASS Total score was entered into the second step of the model.

There were no correlations between predictor variables above 0.8 and, for all variables in each model, the tolerance values were > 0.10 and the variance inflation factor (VIF) values were < 10.0, which excluded the presence of multicollinearity (Myers, 1990). In addition, Durbin-Watson statistics ranged from 1.76 to 2.43. Values less than 1 or above 3 suggest that the assumption of independent errors has been violated (Field, 2009); thus, it was concluded that this assumption was satisfied. A visual inspection of scatterplots and histograms of the residuals showed that the assumptions of linearity, homogeneity of variances, and normally distributed errors were also met for the majority of analyses, with the exception of BIPASS Total score predicting anxiety symptoms, which suggested a slight positive skew.

To test whether the hierarchical linear regression models fit the observed data well or were influenced by a small number of cases, the data for each analysis were screened for outliers and influential cases. No cases had a standardized residual value > 3.29. One case in the analysis predicting %EWL, one case in the analysis predicting binge eating symptomatology, two cases in the analysis predicting depressive symptoms, two cases in the analysis predicting anxiety symptoms, and three and four cases in the analyses predicting physical and mental health-related quality of life, respectively, had leverage values above the expected value for that model (Field, 2009). Visual inspection of these cases did not reveal an obvious error in data input. Regression analyses were re-run without these cases, which did not alter the results. As such, it was concluded that these outliers did not bias the models. No cases had a Cook's value > 1 or a standardized DFBeta value greater than 2, suggesting that there were no influential cases affecting the models (Field, 2009).

Regression results for weight outcomes are presented in Table 6. Using CCA, the model predicting %EWL at 1 year postsurgery from BIPASS Total score and controlling for age, sex, and presurgical BMI, was statistically significant at step 1 ($F[3, 120] = 8.84$, $p < .001$). In step 2, the addition of the BIPASS Total score did not significantly add to the prediction of %EWL, although the model remained significant when compared to a Holm-Bonferroni adjusted critical value of $< .007$ ($\Delta R^2 = 0.000$, $p = .845$; $F[4, 119] = 6.59$; $p < .001$), and accounted for 15.4% of the variance. Only presurgical BMI ($\beta = -0.37$, $p < .001$; 95% CI = -1.06 to -0.38) accounted for a significant amount of unique variance, such that higher presurgical BMI predicted lower %EWL at 1 year postsurgery. Results were comparable when using MI, with the model

Table 6

Hierarchical Regression Analyses Predicting Weight Outcomes at 1 Year Postsurgery From BIPASS Total Score

%EWL	CCA					MI				
Predictor Variable	*B*	*SE B*	*β*	*F*	*p*	*B*	*SE B*	*β*	*F*	*p*
Step 1										
Age	-0.18	0.15	-0.10			-0.18	0.17	-0.20		
Sex	-5.49	4.30	-0.12			-5.81	5.29	-0.10		
Presurgical BMI	-0.72	0.17	-0.37***			-0.7	0.14	-0.24***		
				8.84	.000				8.49	.002
Step 2										
Age	-0.17	0.15	-0.09			-0.18	0.17	-0.17		
Sex	-5.87	4.34	-0.11			-5.72	5.36	-0.11		
Presurgical BMI	-0.72	0.17	-0.37***			-0.70	0.14	-0.25***		
BIPASS Total	0.04	0.21	0.01			0.04	0.21	0.05		
				6.59	.000				6.45	.004
%TWL										
Step 1										
Age	-0.11	0.07	-0.12			-0.12	0.07	-0.15		
Sex	-3.25	2.07	-0.13			-2.99	2.08	-0.13		

				2.59	.079				4.98	.036
Step 2										
Age	-0.10	0.07	-0.12			-0.12	0.07	-0.14		
Sex	-3.10	2.09	-0.12			-2.90	2.11	-0.12		
BIPASS Total	0.06	0.10	0.05			0.04	0.09	0.03		
				1.83	.145				3.36	.058

Note. %EWL = percentage excess weight loss; %TWL = percentage total weight loss; BMI = body mass index; CCA = complete case analysis; MI = multiple imputation

* $p < .05$, ** $p < .01$, *** $p < .001$

significant at step 1 (F(3, 195] = 8.84; p = .002) and step 2 (F[4, 194] = 6.45; p = .004), and presurgical BMI (β = -0.25, p < .001; 95% CI = -0.99 to -0.41) accounting for a significant amount of unique variance.

The overall model predicting %TWL at 1 year postsurgery was nonsignificant for CCA (F[3, 129] = 1.83, p = .145), and MI (F[3, 195] = 3.36, p = .058).

Regression results for psychiatric symptoms and quality of life outcomes are presented in Table 7. In the CCA predicting binge eating symptomatology, the first step of the model was not significant (F[2, 46] = 0.47, p = .623). In step 2, with the addition of the BIPASS Total score, the overall model remained nonsignificant when compared to an adjusted critical value of < .01 (ΔR^2 = 0.15, p = .005; F[3, 45] = 3.26; p = .03). However, when compared to the covariate only model, the change in F was significant (ΔF(1, 45) = 8.66, p = .005). An inspection of the beta values revealed that BIPASS Total score accounted for a significant amount of unique variance in this variable (β = 0.40, p = .005; 95% CI = 0.11 to 0.63), such that higher BIPASS scores predicted greater binge eating symptomatology at 1 year postsurgery. Using MI, the overall model in step 2 was statistically significant (F[3, 195] = 14.77; p = .001), with BIPASS Total score accounting for a significant amount of unique variance (β = 0.33, p = .013; 95% CI = 0.08 to 0.63).

Using CCA, in the model predicting mental health-related quality of life from BIPASS Total score and controlling for age and sex, the first step was not significant (F[2, 49] = 3.21, p = .049). In step 2, the addition of BIPASS Total score significantly added to the prediction of mental health-related quality of life when compared against a Holm-Bonferroni corrected critical value of < .008 (ΔR^2 = .13, p = .006; F[3, 48] = 5.20; p = .003); the model accounted for 19.8%

Table 7

Hierarchical Regression Analyses Predicting Psychiatric Symptom and Quality of Life Outcomes at 1 Year Postsurgery From BIPASS Total Score

BES										
	CCA					MI				
Predictor Variable	*B*	*SE B*	*β*	*F*	*p*	*B*	*SE B*	β	*F*	*p*
Step 1										
Age	-0.07	0.08	-0.14			-0.01	0.10	-0.10		
Sex	0.84	2.49	0.05			1.54	2.57	0.11		
				0.47	.623				4.15	.239
Step 2										
Age	-0.03	0.07	-0.05			-0.01	0.10	-0.10		
Sex	-0.16	2.33	-0.01			-0.84	2.52	-0.09		
BIPASS Total	0.37	0.12	0.40**			0.35	0.13	0.33*		
				3.26	.03				14.77	.001

PHQ-9										
Step 1										
Age	-0.07	0.04	-0.23			-0.05	0.04	-0.17		
Sex	-0.9	1.26	-0.09			-0.85	1.02	-0.11		
				2.03	.14				6.09	.072
Step 2										
Age	-0.06	0.04	-0.18			-0.05	0.4	-0.33		

Sex	-1.06	1.23	-0.10			-0.66	0.99	-0.09		
BIPASS Total	0.13	0.07	0.24			0.09	0.05	0.19		
				2.62	.059				7.8	.028
GAD-7										
Step 1										
Age	-0.05	0.02	-0.27*			-0.03	0.02	-0.20		
Sex	-0.25	0.74	-0.04			-0.115	0.56	-0.07		
				2.52	.089				6.73	.126
Step 2										
Age	-0.05	0.02	-0.26*			-0.03	0.02	-0.20		
Sex	-0.28	0.75	-0.04			-0.09	0.56	-0.07		
BIPASS Total	0.01	0.04	0.04			0.01	0.03	0.09		
				1.69	.178				5.49	.114
SF-36 PCS										
Step 1										
Age	-0.23	0.13	-0.23			-0.05	0.10	-0.05		
Sex	3.19	3.73	0.11			3.29	2.50	0.10		
				1.733	.187				1.674	.26
Step 2										
Age	-0.25	0.13	-0.25			-0.05	0.10	-0.06		
Sex	4.33	3.65	0.16			2.60	2.45	0.08		
BIPASS Total	-0.52	0.25	-0.28*			-0.35	0.15	0.19*		

				2.68	.057				4.02	.042
SF-36 MCS										
Step 1										
Age	0.28	0.11	0.33*			0.23	0.13	0.25		
Sex	0.54	3.05	0.02			2.19	2.85	0.09		
				3.21	.049				10.61	.049
Step 2										
Age	0.26	0.10	0.31*			0.22	0.13	0.24		
Sex	1.78	2.88	0.07			1.43	2.68	0.07		
BIPASS Total	-0.57	0.20	-0.36**			-0.38	0.21	-0.27		
				5.20	.003				14.81	.001

Note. BES = binge eating scale; CCA = complete case analysis; GAD-7 = generalized anxiety disorder 7-item scale; MI = multiple imputation; PHQ-9 = patient health questionnaire 9-item; SF-36 MCS = 36-item short form health survey mental component summary; SF-36 PCS = physical component summary

* $p < .05$, ** $p < .01$, *** $p < .001$

of the variance. BIPASS Total score (β = -0.36, p = .006; 95% CI = -0.97 to -0.17) and age (β = 0.31, p = .017; 95% CI = 0.04 to 0.47) each accounted for a significant amount of unique variance, such that higher BIPASS Total score and younger age predicted lower mental health-related quality of life. In the MI analysis, the overall model was significant at step 2 (F[3, 195] = 14.81; p = 0.001); however, age and BIPASS Total no longer accounted for a significant amount of unique variance.

The overall models were nonsignificant for the following hierarchical regression analyses predicting psychiatric symptom outcomes: depressive symptoms for CCA, $F(3, 57) = 2.63$, p = .059, and MI, $F(3, 195) = 7.8$, p = .028; anxiety symptoms for CCA, $F(3, 56) = 1.69$, p = .178, and MI, $F(3, 195) = 5.49$, p = .114; and physical health-related quality of life for CCA, $F(3, 48) = 2.68$, p = .057, and MI, $F(3, 194) = 4.02$, p = .042.

Hypothesis 2: Between-group Differences on Outcomes at 1-Year Postsurgery. According to the BIPASS cutoff score of $\geq$ 11for high psychosocial risk, 54.8% (n = 109) of patients were categorized as GREEN, and 45.2% (n = 90) were categorized as YELLOW. A series of ANCOVAs were performed on weight, quality of life, and psychiatric symptom outcomes at 1 year postsurgery to evaluate differences between patients designated YELLOW vs. GREEN.

Prior to running the ANCOVA's, assumptions were tested. Preliminary ANOVAs revealed that neither age (F[1, 197] = 0.02, p = .879) nor presurgical BMI (F[1, 197] = 0.45, p = .502) was found to significantly differ between the two groups. A chi-square analysis also revealed no difference in the proportion of males and females between the two groups ($\chi^2(1)$ = 1.86, p = .172). Thus, independence of the independent variable and covariates was assumed, and the covariates were included in the subsequent models. In addition, the covariates were not significantly correlated with one another (ps < .05), indicating that they were not redundant and that multicollinearity was not an issue.

Levene's test was significant for several analyses, including the models testing group differences in binge eating symptomatology ($p < .001$), depressive symptoms ($p = .047$), anxiety symptoms ($p = .048$), mental health-related quality of life ($p < .001$), and physical health-related quality of life ($p = .002$). Variance ratios concurred with the results of Levene's test; therefore, it was concluded that the assumption of homogeneity of variances was violated for these models (Field, 2009; Tabachnick & Fidell, 2001). Consequently, these analyses were performed using bootstrapping, a robust test that produces accurate models in the presence of this violated assumption (Field, 2009). Bootstrap analyses were sampled 1000 times and results are reported with bias corrected confidence intervals (BCCI).

To test the assumption of homogeneity of regression slopes, each model was run including the interaction term between each covariate and grouping variable (i.e., YELLOW vs. GREEN). The interaction terms for the majority of the analyses were nonsignificant (all ps < .05), with the exception of the analyses predicting physical health-related quality of life. Here, the interaction between group status and sex was significant ($p = .03$), indicating that the relationship between sex and physical health-related quality of life was different between patients with high versus low presurgical psychosocial risk. Consequently, this outcome was examined using a moderated multiple regression analysis, in order to include the interaction effect between group and sex in the model (Leppink, 2018). This was accomplished using Hayes' PROCESS macro version 3.0 for SPSS (Hayes, 2018). Given that PROCESS cannot be run on multiple datasets, multiple imputation was not used for this analysis. The Holm-Bonferroni method was applied to all analyses to control for familywise error.

Using CCA, after adjusting for age and sex, there was a significant difference between groups with respect to binge eating symptomatology when compared against a Holm-Boferroni adjusted critical value of < .007 ($F[1,45] = 10.48$, $p = .002$, $d = 0.96$). Patients designated YELLOW had significantly higher BES scores (*EMM* = 9.23, *SE* = 1.36, BCCI = 5.6 to 12.56) at 1 year postsurgery than patients designated GREEN (*EMM* = 3.71, *SE* = 0.98, BCCI = 2.53 to 5.08). For the MI analysis, there was also a significant difference between groups ($F[1,195] = 34.19$, $p = .005$), with patients designated YELLOW demonstrating higher BES scores (*EMM* = 10.21, *SE* = 1.34) than those designated GREEN (*EMM* = 6.14, *SE* = 0.99).

Using CCA, the difference between groups with respect to mental health-related quality of life approached significance, when compared to a Holm-Bonferroni adjusted critical value of < .008 ($F[1,48] = 7.32$, $p = .009$, $d = 0.78$). Patients designated YELLOW demonstrated marginally lower SF-36 MCS scores (*M* = 51.18, *SE* = 1.85, BCCI = 44.59 to 56.50) at 1 year postsurgery than patients designated GREEN (*M* = 57.38, *SE* = 1.85, BCCI = 55.91 to 58.60). The difference between groups was significant when using MI ($F[1,195] = 20.89$, $p = .002$).

ANCOVAs were nonsignificant for the following outcomes: %EWL for CCA, $F(1, 120) = 0.19$, $p = .66$, and MI, $F(1, 194) = 1.15$, $p = .50$; %TWL for CCA, $F(1, 129) = 0.73$, $p = .39$, and MI, $F(1, 195) = 1.58$, $p = .333$; depressive symptoms for CCA, $F(1, 57) = 3.23$, $p = .077$, and MI, $F(1, 195) = 7.77$, $p = .123$; and anxiety symptoms for CCA, $F(1, 56) = 0.57$, $p = .45$, and MI, $F(1, 195) = 4.75$, $p = .198$ (see Table 8).

For the CCA moderated regression predicting physical health-related quality of life, the overall model was marginally significant when compared against a Holm-Bonferroni corrected critical value of < .01, $F(4, 47) = 3.52$, $p = .013$, and accounted for 23.1% of the variance. Psychosocial risk status ($\beta = -0.93$, $p = .004$, 95% CI = -15.55 to -3.13), age ($\beta = -0.35$, $p = .012$,

Table 8

Between-group Differences in Outcomes at 1-Year Postsurgery, Controlling for Age, Sex, and Presurgical BMI

Variable	GREEN *EMM (SE)*	YELLOW *EMM (SE)*	*F*	*p*	*d*
%EWL					
CCA	63.18 (2.08)	64.53 (2.22)	0.19	.66	0.09
MI	65.03 (1.98)	66.03 (2.99)	1.15	.5	
%TWL					
CCA	30.05 (1.03)	31.36 (1.11)	0.73	.393	0.15
MI	29.63 (1.02)	31.02 (1.15)	1.58	.333	
BES					
CCA	3.71 (0.98)	9.23 (1.36)	10.48	.002**	0.96
MI	6.14 (0.99)	10.21 (1.34)	34.19	.005**	
PHQ-9					
CCA	2.03 (0.56)	3.68 (0.72)	3.23	.077	0.47
MI	3.52 (0.53)	4.65 (0.69)	7.77	.123	
GAD-7					
CCA	1.07 (0.32)	1.48 (0.41)	0.57	.45	0.2
MI	1.77 (0.28)	2.27 (0.40)	4.75	.198	
SF-36 MCS					
CCA	57.38 (1.34)	51.18 (1.85)	7.32	.009**	0.78

MI	56.00 (1.38)	50.29 (1.56)	20.89	.002**

Note. %EWL = percentage excess weight loss; %TWL = percentage total weight loss; BES = binge eating scale; CCA = complete case analysis; EMM = estimated marginal mean; GAD-7 = generalized anxiety disorder 7-item scale; GREEN = low psychosocial risk; MI = multiple imputation; PHQ-9 = patient health questionnaire 9-item; SF-36 MCS = 36-item short form health survey mental component summary; YELLOW = high psychosocial risk

* $p < .05$, ** $p < .01$, *** $p < .001$

95% CI = -0.62 to -0.07), and the interaction between psychosocial risk status and sex (β = 17.28, *p* = .031, 95% CI = 1.57 to 32.99) emerged as significant predictors of unique variance.

These results suggest that a designation of high psychosocial risk (i.e., YELLOW) and older age are associated with lower physical health-related quality of life. A plot of physical health-related quality of life scores by sex and group status revealed that for individuals with high psychosocial risk, females (*M* = 42.76) demonstrated lower physical health-related quality of life than males (*M* = 57.44). For individuals with low psychosocial risk (i.e., GREEN), males (*M* = 49.50) and females (*M* = 52.11) exhibited similar levels of physical health-related quality of life. Results are presented in Table 9.

Hypothesis 3: Predicting Outcomes at 2 Years Postsurgery From BIPASS Total.

Weight and psychiatric symptoms. A series of hierarchical multiple regression analyses were conducted to evaluate whether BIPASS Total score predicts weight outcomes and psychiatric symptoms at 2 years posturgery. Age and sex were again entered in each multiple regression analysis as a first step in the model. Presurgical BMI was also included as a covariate in the first step of the model predicting %EWL. BIPASS Total score was entered in the second step of the model.

For each model, tolerance values fell above 0.1 and VIF values did not exceed 10, indicating no issue with multicollinearity for any of the analyses. Durbin-Watson statistics ranged from 1.80 to 2.45, indicating that the assumption of independent errors was also satisfied. Scotterplots and histograms of the residuals showed that the assumptions of linearity, homogeneity of variances, and normally distributed errors were met for the majority of analyses. Exceptions were the two analyses predicting weight regain and anxiety symptoms from BIPASS

Table 9

Moderated Regression Analysis Predicting Physical Health-Related Quality of Life at 1 Year Postsurgery

Predictor Variable	*B*	*SE B*	*t*
Age	-0.35	0.13	-2.59*
Sex	-2.60	4.31	-0.60
Sex*Psychosocial risk	17.28	0.13	-2.59*
Psychosocial risk	-9.34	3.08	-3.02**

$F(4,47) = 3.528$, $p = .013$

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Total score, which suggested that error values were slightly positively skewed and heteroskedastic.

One case in the analysis predicting anxiety symptoms from BIPASS Total score had a standardized residual value > 3.29. In addition, one case in the analysis predicting %EWL and one case in the analysis predicting %TWL had leverage values above the expected value for that model. Visual inspection of these cases did not reveal an obvious error in data input. Regression analyses were re-run without these cases, which did not alter the results. As such, it was concluded that the models were not biased by these cases. No cases had a Cook's value > 1 or a standardized DFBeta value greater than 2.

Regression results are presented in Table 10. The Holm-Bonferroni method was applied to adjust the alpha level in order to control familywise error. Using CCA, the model predicting %EWL from BIPASS Total score and controlling for age, sex, and presurgical BMI, was significant at step 1, ($F[3, 95] = 6.37$, $p = .001$). In step 2, the addition of BIPASS Total score did not significantly add to the prediction of this variable ($\Delta R^2 = .007$, $p = .367$), although the model remained significant when compared against a corrected critical value of < .006 ($F[4, 94] = 4.97$; $p = .001$). The model accounted for 14% of the variance in %EWL. Presurgical BMI ($\beta = -0.32$; $p = .001$) and age ($\beta = -0.23$; $p = .016$) each accounted for a significant amount of unique variance, with higher BMI and older age being associated with less EWL at 2 years postsurgery. Using MI, both step 1 ($F[4, 194] = 6.48$, $p = .002$) and step 2 of the model were significant. Age ($\beta = -0.17$; $p = .038$) and presurgical BMI ($\beta = -0.25$; $p = .012$) accounted for significant unique variance.

Table 10

Hierarchical Regression Analyses Predicting Weight Outcomes at 2 Years Postsurgery From BIPASS Total Score

%EWL	CCA					MI				
Predictor Variable	*B*	*SE B*	*β*	*F*	*p*	*B*	*SE B*	*β*	*F*	*p*
Step 1										
Age	-0.51	0.21	-0.26*			-0.38	0.18*	-0.17		
Sex	-6.01	5.49	-0.10			-6.51	4.97	-0.10		
Presurgical BMI	-0.76	0.22	-0.32**			-0.61	0.23**	-0.24		
				6.37	.001				8.33	.001
Step 2										
Age	-0.52	0.21	-0.23*			-0.39	0.18	-0.17*		
Sex	-6.24	5.51	-0.10			-6.84	4.97	-0.11		
Presurgical BMI	-0.77	0.22	-0.32**			-0.61	0.27**	-0.25*		
BIPASS Total	-0.27	0.30	-0.08			-0.16	0.26	-0.05		
				4.97	.001				6.48	.002

%TWL										
Step 1										
Age	-0.21	0.10	-0.20*			-0.14	0.09	-0.14		

Sex	-3.17	2.60	-0.12			-3.50	2.07	-0.13		
				2.84	.063				4.63	.038
Step 2										
Age	-0.21	0.10	-0.20*			-0.15	0.09	-0.15		
Sex	-3.28	2.61	-0.12			-3.68	2.07	-0.13		
BIPASS Total	-0.09	0.14	-0.06			-0.09	0.12	0.06		
				2.03	.115				3.46	.053
%WR										
Step 1										
Age	0.07	0.09	0.08			-0.01	0.07	0.04		
Sex	3.64	2.44	0.15			2.41	2.06	0.10		
				1.41	.249				1.87	.301
Step 2										
Age	0.08	0.09	0.09			-0.00	0.07	0.04		
Sex	3.96	2.40	0.16			2.83	2.06	0.11		
BIPASS Total	0.28	0.13	0.20*			0.21	0.12	0.16		
				2.42	.069				3.05	.105

Note. %EWL = percentage excess weight loss; %TWL = percentage total weight loss; %WR = percentage weight regain; BMI = body mass index; CCA = complete case analysis; MI = multiple imputation

* $p < .05$, ** $p < .01$, *** $p < .001$

The overall models were nonsignificant for %TWL for CCA ($F[3, 96] = 2.03$, $p = .115$) and MI ($F[3, 195] = 3.46$, $p = .053$), and for %WR for CCA ($F[3, 95] = 2.44$, $p = .069$) and MI ($F[3, 195] = 3.05$, $p = .105$).

The overall models were nonsignificant for all hierarchical regression analyses predicting psychiatric symptom and quality of life outcomes at 2 years postsurgery from BIPASS Total score: binge eating symptomatology for CCA, $F(3, 38) = 0.06$, $p = .98$, and MI, $F(3, 195) = 3.06$, $p = .064$; depressive symptoms for CCA, $F(3, 45) = 1.06$, $p = .374$, and MI, $F(3, 195) = 6.15$, $p = .028$; anxiety symptoms for CCA, $F(3, 45) = 0.79$, $p = .501$, and MI, $F(3, 195) = 6.14$, $p = .028$; physical health-related quality of life for CCA, $F(3, 37) = 0.33$, $p = .802$, and MI, $F(3, 195) = 6.70$, $p = .067$; and mental health-related quality of life for CCA, $F(3, 37) = 1.37$, $p = .265$, and MI, $F(3, 195) = 8.0$, $p = .024$ (see Table 11).

Adherence to postsurgical follow-up. According to the predetermined definition of adherence (i.e., missing > 50% of postsurgical appointments), 23.6% ($n = 47$) of patients were classified as nonadherent. To determine if the BIPASS Total score predicted adherence to postsurgical follow-up, data were analyzed using a binary logistic regression. In this analysis, adherence to postsurgical follow-up (0 = adherent; 1 = nonadherent) was entered as the outcome variable. Past research has identified an association between age, employment status, and adherence to postsurgical follow-up appointments (e.g., Larjani et al., 2016; Vidal et al., 2014). Consequently, prior to conducting the logistic regression, the association between these variables was examined, in order to determine whether either warranted inclusion as a covariate in the analysis. A dummy variable was created for employment status where 0 = full or part time employment, including as a student or homemaker, and 1 = unemployed or retired. As expected,

Table 11

Hierarchical Regression Analyses Predicting Psychiatric Symptom and Quality of life Outcomes at 2 Years Postsurgery From BIPASS Total Score

BES										
	CCA					MI				
Predictor Variable	*B*	*SE B*	*β*	*F*	*p*	*B*	*SE B*	*β*	*F*	*p*
Step 1										
Age	0.02	0.09	0.04			-0.08	0.08	-0.13		
Sex	0.76	2.39	0.05			-0.14	2.17	-0.07		
				0.09	.913				3.57	.163
Step 2										
Age	0.02	0.10	0.04			-0.08	0.08	-0.13		
Sex	0.75	2.42	0.05			-0.03	2.11	-0.07		
BIPASS Total	0.01	0.14	0.01			0.09	0.12	0.11		
				0.06	.980				3.06	.064
PHQ-9[a]										
Step 1										
Age	-0.05	0.05	-0.15							
Sex	-1.57	1.43	-0.15							
				1.23	.301					
Step 2										
Age	-0.07	0.05	-0.19							
Sex	-1.56	1.44	-0.15							

BIPASS Total	-0.07	0.08	-0.13							
				1.06	.374					
GAD-7										
Step 1										
Age	-0.06	0.05	-0.19			-0.08	0.05	-0.23		
Sex	-0.99	1.40	-0.10			-0.18	1.12	-0.07		
				1.17	.317				8.23	.081
Step 2										
Age	-0.07	0.05	-0.20			-0.08	0.05	-0.23		
Sex	-0.97	1.41	-0.10			-0.13	1.11	-0.07		
BIPASS Total	-0.02	0.07	-0.04			-0.23	0.64	-0.08		
				0.79	.501				6.14	.028
SF-36 PCS										
Step 1										
Age	-0.05	0.13	-0.07			-0.09	0.14	-0.12		
Sex	2.19	3.30	0.10			4.85	3.92	0.16		
				0.30	.737				7.00	.123
Step 2										
Age	-0.08	0.13	-0.10			-0.09	0.14	-0.12		
Sex	2.23	3.33	0.10			4.54	3.91	0.16		
BIPASS Total	-0.12	0.19	-0.10			-0.15	0.21	-0.12		
				0.33	.802				6.70	.067
SF-36 MCS										

Step 1										
Age	0.19	0.13	0.23			0.16	0.19	0.13		
Sex	-0.19	3.32	-0.01			3.57	5.22	0.13		
				1.12	.335				6.61	.105
Step 2										
Age	0.25	0.13	0.30			0.16	0.19	0.13		
Sex	-0.28	3.29	-0.01			3.01	4.97	0.12		
BIPASS Total	0.26	0.19	0.22			0.28	0.39	0.18		
				1.37	.265				8.00	.024

Note. BES = binge eating scale; CCA = complete case analysis; GAD-7 = generalized anxiety disorder 7-item scale; MI = multiple imputation; PHQ-9 = patient health questionnaire 9-item; SF-36 MCS = 36-item short form health survey mental component summary; SF-36 PCS = physical component summary

* $p < .05$, ** $p < .01$, *** $p < .001$

[a] Multiple imputation was not performed for PHQ-9 because Little's MCAR (Little, 1998) test was significant for that variable

biserial correlation revealed a statistically significant association between age and adherence, r_b = -0.27, $p < .001$. In addition, a chi square analysis revealed a statistically significant association between employment status and adherence, $\chi^2(1) = 5.58$, $p = .018$. Thus, when predicting adherence to follow-up appointments, a hierarchical logistic regression analysis was performed with employment status and age entered as covariates in the first block, and BIPASS Total score entered as the predictor variable in the second block.

Prior to conducting the logistic regression analysis, assumptions regarding multicollinearity and linearity of the logit were explored. The assumption of linearity was examined by running the logistic regression with the interaction between each continuous predictor and its log transformation entered as predictors of nonadherence. Results revealed that the interactions between age and BIPASS Total score and their respective natural logarithms were not statistically significant (ps > .05), suggesting that the assumption of linearity of the logit was met (Hosmer & Lemeshow, 1989). Multicollinearity between the predictor variables was assessed by running a linear regression with the same predictors and outcome variables, and examining the tolerance and VIF statistics. Tolerance values ranged from 0.83 to 0.96 and VIF values ranged from 1.04 to 1.21, indicating that this assumption was satisfied.

The data were also screened for outliers and influential cases that could affect the regression model. Two cases had standardized residuals above 3.29, suggesting possible outliers. In addition, three cases had leverage values above those expected for the model. Results of the logistic regression model did not change with and without the outliers and influential cases present, suggesting the model was not biased by these cases. No cases had a Cook's value > 1 or a standardized DFBeta value greater than 2.

Results of the hierarchical logistic regression are displayed in Table 12. In step 1 of the analysis, age and employment status significantly predicted nonadherence to postsurgical follow-up appointments [model $\chi^2(2) = 20.06$, $p < .001$; $R^2 = .096$ (Cox & Snell), 0.14 (Nagelkerke)]. The Hosmer and Lemeshow Test was nonsignificant ($p = .185$), indicating that the model was a good fit to the data. Overall, results of step 1 revealed that a one-unit increase in age is associated with a 6.1% decrease in the probability of nonadherence to follow-up appointments, when controlling for employment status. In addition, the model showed that the odds of a patient who is unemployed being nonadherent to follow-up are 3.1 times higher than those of a patient who is employed, when controlling for age. When BIPASS total score was added to the model in step 2, the model remained significant [model $\chi^2(3) = 20.60$, $p < .001$; $R^2 = .09$ (Cox & Snell), 0.14 (Nagelkerke)]. However, only age significantly increased the odds of nonadherence to follow-up. More specifically, a one-unit increase in age is associated with a 6.3% decrease in the probability of nonadherence to follow-up, when controlling for employment status and BIPASS Total score.

Hypothesis 4: Between-group Differences on Outcomes at 2 Years Postsurgery.

Weight and psychiatric symptoms. A series of ANCOVAs were performed to evaluate differences between patients designated YELLOW vs. GREEN on weight, quality of life, and psychiatric symptom outcomes at 2 year postsurgery. Covariates included age and sex, as well as presurgical BMI for the analysis with %EWL entered as the dependent variable.

Levene's test was not statistically significant for any analysis (ps $< .05$), indicating that the assumption of homogeneity of variances was not violated. To test the assumption of homogeneity of regression slopes, each model was run including the interaction term between each covariate and the grouping variable of psychosocial risk status. The interaction terms for

Table 12

Logistic Regression Analysis Predicting Adherence to Postsurgical Follow-Up as a Function of Age, Employment, and BIPASS Total Score

					95% Confidence Interval	
Predictor Variable	*B*	*SE B*	Wald	Odds Ratio	Lower	Upper
Step 1[a]						
Age	-0.06	0.01	12.51	0.93***	0.90	0.97
Employment	1.12	0.56	3.87	3.06*	1.00	9.34
Step 2[b]						
Age	-0.06	0.01	12.89	0.93***	0.90	0.97
Employment	0.98	0.59	2.74	2.68	0.83	8.62
BIPASS Total	-0.02	0.02	0.53	0.98	0.92	1.03

[a] Model $\chi^2(2) = 20.065$, $p < .001$

[b] Model $\chi^2(3) = 20.601$, $p < .001$

* $p < .05$, ** $p < .01$, *** p , .001

most of the analyses were nonsignificant (*p*s < .05), with the exception of the analysis predicting %EWL, and the analysis predicting mental health-related quality of life. With respect to the former analysis, the interaction between group and presurgical BMI was significant ($p = .001$), indicating that the relationship between presurgical BMI and %EWL differed for patients with high versus low psychosocial risk. For the latter analysis, the interaction term between group and age was statistically significant ($p = .034$), indicating that the relationship between age and mental health-related quality of life differed according to the group to which the patient was designated. Thus, these outcomes were examined using moderated multiple regression analyses, in order to include the interaction effects between group and either presurgical BMI or age (Leppink, 2018). This was accomplished using Hayes' PROCESS macro for SPSS (Hayes, 2018). The Holm-Bonferroni method was used to adjust all *p* values to account for familywise error.

ANCOVAs, when controlling for age and sex, were not statistically significant for any weight or psychiatric symptom outcomes at 2 years postsurgery, including: %TWL for CCA, $F(1, 96) = 0.02$, $p = .879$, and MI, $F(1, 195) = 0.4$, $p = .653$; weight regain for CCA, $F(1, 95) = 2.18$, $p = .143$, and MI, $F(1, 195) = 6.29$, $p = .053$; binge eating symptomatology for CCA, $F(1, 38) = 0.08$, $p = .771$, and MI, $F(1, 195) = 5.91$, $p = .225$; depressive symptoms for CCA, $F(1, 45) = 1.99$, $p = .164$, and MI, $F(1, 195) = 4.86$, $p = .28$; anxiety symptoms for CCA, $F(1, 45) = 0.23$, $p = .63$, and MI, $F(1, 195) = 1.48$, $p = .418$; and physical health-related quality of life for CCA, $F(1, 37) = 0.3$, $p = .583$, and MI, $F(1, 195) = 4.44$, $p = .176$ (see Table 13).

Using CCA, for the moderated regression analysis predicting %EWL, the overall model was significant when compared to a corrected critical value of < .007, $F(5, 93) = 4.5$, $p = .001$.

Table 13

Between-group Differences in Outcomes at 2 Years Postsurgery, Controlling for Age and Sex

Variable	GREEN *EMM (SE)*	YELLOW *EMM (SE)*	*F*	*p*	*d*
%TWL					
CCA	31.21 (1.35)	31.53 (1.66)	0.02	.879	0.00
MI	31.19 (1.24)	31.29 (1.28)	0.40	.653	
%WR					
CCA	4.35 (1.27)	7.3 (1.54)	2.18	.143	0.3
MI	6.45 (1.04)	9.47 (1.34)	6.29	.053	
BES					
CCA	6.34 (1.30)	6.96 (1.58)	0.08	.771	0.08
MI	8.66 (1.26)	10.35 (1.28)	5.91	.225	
PHQ-9					
CCA	4.05 (0.74)	2.41 (0.86)	1.99	.164	0.41
MI	5.9 (0.73)	5.02 (0.81)	4.86	.28	
GAD-7					
CCA	2.37 (0.70)	1.84 (0.82)	0.63	.630	0.14
MI	3.55 (0.55)	3.76 (6.40)	1.48	.418	
SF-36 PCS					
CCA	52.18 (1.80)	56.47 (2.15)	2.25	.142	0.49
MI	50.55 (1.98)	48.05 (1.75)	4.44	.176	

Note. %TWL = percentage total weight loss; %WR = percentage weight regain; BES = binge eating scale; CCA = complete case analysis; EMM = estimated marginal mean; GAD-7 = generalized anxiety disorder 7-item scale; GREEN = low psychosocial risk; MI = multiple imputation; PHQ-9 = patient health questionnaire 9-item; SF-36 PCS = 36-item short form health survey physical component summary; YELLOW = high psychosocial risk

Only presurgical BMI (β = -1.07, $p < .001$) and age (β = -0.49, $p = .024$) emerged as significant predictors of this outcome variable.

Lastly, using CCA, the overall model for the moderated regression analysis predicting mental health-related quality of life was not significant, $F(4, 36) = 2.52$, $p = .057$ (see Tables 14 and 15).

Adherence to postsurgical follow-up. To determine whether patients categorized as YELLOW vs. GREEN were more likely to be nonadherent to postsurgical follow-up, data were analyzed using a hierarchical binary logistic regression. Employment status and age were entered as covariates in the first block, and psychosocial risk status was entered as the categorical predictor variable in the second block.

Tolerance values ranged from 0.87 to 0.97 and VIF values ranged from 1.03 to 1.14, indicating the assumption regarding multicollinearity was satisfied. Results revealed that the interaction between the continuous predictor age and its natural logarithm was not statistically significant ($p > .05$), suggesting that the assumption of linearity of the logit was met. Two cases had standardized residuals above 3.29, suggesting possible outliers. In addition, four cases had leverage values above those expected for the model. Results of the logistic regression model did not change with and without the outliers and influential cases present, suggesting the model was not biased by these cases. No cases had a Cook's value > 1 or a standardized DFBeta value greater than 2.

Results of the hierarchical logistic regression are displayed in Table 16. The test of the full model, with age, employment, and psychosocial risk status as predictors, was significant [$\chi^2(3) = 20.22$, $p < .001$; $R^2 =$ 0.09 (Cox & Snell), 0.14 (Nagelkerke)]. The Hosmer and

Table 14

Moderated Regression Analysis Predicting %EWL at 2 Years Postsurgery

Predictor Variable	*B*	*SE B*	*t*
Age	-0.49	0.21	-2.28*
Sex	-4.51	5.53	-0.81
Presurgical BMI	-1.07	0.28	-3.75***
Presurgical BMI*Psychosocial risk	0.83	0.46	1.78
Psychosocial risk	-0.03	4.40	-0.00

$F(5,93) = 4.504$, $p = .001$

Note. BMI = body mass index

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 15

Moderated Regression Analysis Predicting Mental Health-Related Quality of Life at 2 Years Postsurgery

Predictor Variable	*B*	*SE B*	*t*
Age	0.59	0.20	2.98**
Sex	-0.25	3.11	-0.08
Age*Psychosocial risk	-0.57	0.25	-2.24*
Psychosocial risk	4.33	2.70	1.60

$F(4,36) = 2.525$, $p = .057$

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 16

Logistic Regression Predicting Adherence to Postsurgical Follow-up as a Function of Age, Employment, and Psychosocial Risk Status

					95% Confidence Interval	
Predictor Variable	*B*	*SE B*	Wald	Odds Ratio	Lower	Upper
Step 1[a]						
Age	-0.06	0.01	12.51	0.93***	0.90	0.97
Employment	1.12	0.56	3.87	3.06*	1.00	9.34
Step 2[b]						
Age	-0.06	0.01	12.16	0.93***	0.90	0.97
Employment	1.17	0.58	4.02	3.23*	1.02	10.20
Psychosocial risk	-0.14	0.36	0.15	0.86	0.42	1.77

[a] Model $\chi^2(2) = 20.065$, $p < .001$

[b] Model $\chi^2(3) = 20.222$, $p < .001$

* $p < .05$, ** $p < .01$, *** p , .00

Lemeshow Test was nonsignificant ($\chi^2(8) = 11.99$, $p = .151$), indicating that the model was a good fit to the data. Only age and employment significantly increased the odds of nonadherence to follow-up. More specifically, in this analysis, a one-unit increase in age was associated with a 6.1% decrease in the probability of nonadherence to follow-up, when controlling for employment status and psychosocial risk status. In addition, the odds of a patient who is unemployed being nonadherent to follow-up are 3.9 times higher than a patient who is employed, when controlling for psychosocial risk status and age.

Exploratory Analyses

Hypothesis 5: Predicting Outcomes at 1 and 2 Years Postsurgery From Mental Health and Patient Readiness Subscale Scores. Herarchical multiple regression analyses were conducted to investigate the ability of BIPASS Mental Health and Patient Readiness subscales to predict each outcome variable at both 1 and 2 years postsurgery. Age and sex were again entered in each multiple regression analysis as a first step in the model. Presurgical BMI was also included as a covariate in the model predicting %EWL. The Mental Health and Patient Readiness subscales were entered simultaneously in the second step of the model.

1 year outcomes. Tolerance values all fell above 0.1 and VIF values did not exceed 10, indicating no issue with multicollinearity for any of the analyses. Durbin-Watson statistics ranged between 1.77 to 2.44, indicating that the assumption of independent errors was also satisfied. Scatterplots and histograms of the residuals showed that the assumptions of linearity, homogeneity of variance, and normally distributed errors were met for the majority of analyses, with the exception of BIPASS scores predicting depressive and anxiety symptoms, which suggested a slight positive skew.

One case for the analysis predicting depressive symptoms, one case for the analysis predicting anxiety symptoms, and one case for the analysis predicting mental health-related quality of life from Mental Health and Patient Readiness subscales had a standardized residual value > 3.29. Each analysis also had several cases with leverage values above the expected value for their respective models. Analyses were re-run without the outlier, and the model fit was substantially improved for the analysis predicting depressive symptoms. Consequently, results are presented without the outlier included. Results did not substantially differ with or without the outlier for the remainder of the analyses. No cases had Cook's values above 1 or a standardized DFBeta value greater than 2.

Regression results are presented in Table 17. The Holm-Bonferroni method was used to adjust the alpha level in order to control familywise error. In the regression analysis predicting %EWL, the first step of the model was significant, $F(3, 120) = 8.48$, $p < .001$. In step 2, the addition of BIPASS subscale scores did not significantly add to the prediction of this variable ($\Delta R^2 = .005$, $p = .686$), although the model remained significant when compared to an adjusted critical value of < .007 ($F[5, 118] = 5.4$; $p < 0.001$), accounting for 15.2% of the variance. Only presurgical BMI ($\beta = -0.36$; $p < .001$) accounted for a significant amount of unique variance in %EWL. For the analysis using MI, step 1 of the model was statistically significant ($F[3, 195] = 12.6$, $p < .001$). Step 2 of the model remained significant ($F[5, 193] = 8.21$, $p < .001$), with presurgical BMI predicting a significant amount of unique variance ($\beta = -0.33$; $p < .001$).

In the regression analysis predicting mental health-related quality of life, the first step of the model was not statistically significant ($F[2, 49] = 3.21$, $p = .049$). The addition of the BIPASS subscales significantly added to the prediction of mental health-related quality of life when compared to a Holm-Bonferroni adjusted critical value < .008 ($\Delta R^2 = .13$, $p = .019$; F[4,

Table 17

Hierarchical Regression Analyses Predicting Outcomes at 1 Year Postsurgery From BIPASS Subscales

%EWL	CCA					MI				
Predictor Variable	B	SE B	β	*F*	*p*	B	SE B	β	*F*	*p*
Step 1										
Age	-0.18	0.15	-0.10			-0.17	0.14	-0.09		
Sex	-5.94	4.30	-0.12			-6.89	3.87	-0.14		
Presurgical BMI	-0.72	0.17	-0.37***			-0.68	0.14	-0.35***		
				8.84	.000				12.60	.000
Step 2										
Age	-0.16	0.15	-0.09			-0.16	0.14	-0.09		
Sex	-5.82	4.34	-0.11			-6.61	3.91	-0.14		
Presurgical BMI	-0.70	0.17	-0.36***			-0.66	0.14	-0.33***		
Readiness	-0.22	0.38	-0.05			-0.2	0.38	-0.05		
Mental Health	0.23	0.31	0.06			0.19	0.29	0.05		
				5.40	.000				8.21	.000
%TWL										
Step 1										
Age	-0.11	0.07	-0.12			-0.10	0.07	-0.12		
Sex	-3.25	2.07	-0.13			-3.19	2.48	-0.14		
				2.59	.079				4.74	.056

Step 2										
Age	-0.10	0.07	-0.12			-0.10	0.07	-0.12		
Sex	-3.02	2.10	-0.12			-2.98	2.49	-0.13		
Readiness	-0.02	0.19	-0.01			0.11	0.16	-0.02		
Mental Health	0.12	0.15	0.07			0.01	0.17	0.07		
				1.44	.222				2.73	.107
BES										
Step 1										
Age	-0.07	0.08	-0.14			-0.00	0.10	-0.11		
Sex	0.84	2.49	0.05			0.15	2.21	0.01		
				0.47	.623				3.34	.235
Step 2										
Age	-0.02	0.07	-0.05			-0.00	0.10	-0.11		
Sex	-.033	2.35	-0.02			0.59	2.13	0.09		
Readiness	0.56	0.24	0.31*			0.37	0.19	0.21		
Mental Health	0.30	0.15	0.26			0.20	0.15	0.14		
				2.66	.045				7.48	.008
PHQ-9										
Step 1										
Age	-0.10	0.03	-0.32*			-0.04	0.03	-0.13		
Sex	-.061	1.12	-0.06			-0.72	0.99	-0.09		
				3.74	.03				3.88	.136
Step 2										

Age	-0.08	0.03	-0.27*			-0.04	0.03	-0.13		
Sex	-0.83	1.08	-0.09			-0.58	0.96	-0.08		
Readiness	0.25	0.11	0.26*			0.19	0.12	0.21		
Mental Health	0.09	0.07	0.14			0.05	0.07	0.08		
				3.70	.01				6.36	.01
GAD-7										
Step 1										
Age	-0.05	0.02	-0.27*			-0.03	0.02	-0.21		
Sex	-0.25	0.74	-0.04			0.17	0.52	-0.07		
				2.52	.089				6.50	.095
Step 2										
Age	-0.05	0.02	-0.27*			-0.03	0.02	-0.21		
Sex	-0.29	0.75	-0.05			0.16	0.51	-0.06		
Readiness	0.04	0.07	0.07			0.00	0.05	0.06		
Mental Health	0.00	0.05	-0.00			-0.00	0.03	0.05		
				1.31	.277				3.89	.118
SF-36 PCS										
Step 1										
Age	-0.23	0.13	-0.23			-0.01	0.16	-0.09		
Sex	3.19	3.73	0.11			8.68	3.64	0.26*		
				1.73	.187				9.61	.007
Step 2										
Age	-0.25	0.13	-0.25			-0.03	0.16	-0.09		

Sex	4.33	3.69	0.16			7.69	3.54	0.23*		
Readiness	-0.59	0.41	-0.19			-0.07	0.36	-0.03		
Mental Health	-0.50	0.31	-0.21			-0.54	0.27	-0.20*		
				2.01	.109				8.16	.001
SF-36 MCS										
Step 1										
Age	0.28	0.11	0.33*			0.24	0.11	0.42*		
Sex	0.54	3.05	0.02			1.92	3.24	0.12		
				3.21	.049				12.35	.02
Step 2										
Age	0.26	0.10	0.31*			0.24	0.11	0.28*		
Sex	1.83	2.9	0.08			1.52	3.25	0.11		
Readiness	-0.75	0.33	-0.29*			-0.61	0.25	-0.24*		
Mental Health	-0.47	0.24	-0.24			-0.16	0.25	-0.11		
				3.99	.007				14.06	.000

Note. %EWL = percentage excess weight loss; %TWL = percentage total weight loss; BMI = body mass index; BES = binge eating scale; CCA = complete case analysis; GAD-7 = generalized anxiety disorder 7-item scale; MI = multiple imputation; PHQ-9 = patient health questionnaire 9-item; SF-36 MCS = 36-item short form health survey mental component summary; SF-36 PCS = physical component summary

* $p < .05$, ** $p < .01$, *** $p < .001$

47] = 3.99, p = .007). The Patient Readiness (β = -0.29; p = .026) subscale accounted for a significant amount of unique variance, whereas the Mental Health (β = -0.24; p = .059) subscale did not. Thus, higher Patient Readiness scores (i.e., higher psychosocial risk on this subscale and, thus, poorer readiness for surgery) predict lower mental health-related quality of life at 1 year postsurgery. Step 1 of the MI model was not statistically significant when compared to an adjusted p value of .008 (F[2, 196] = 12.35, p = .02). With the addition of the BIPASS subscales, step 2 of the model was statistically significant (F[4, 194] = 14.06, p < .001). Both age (β = 0.28; p = .036) and Patient Readiness (β = -0.24; p = .018) predicted unique variance.

It is worth noting that although the analysis predicting depressive symptoms was not ssignificant when the one outlier was included in the model (F[2, 56] = 2.38, p = .062), the analysis was significant when the outlier was removed and the p value was compared to an adjusted critical value of < .01, F(4, 55) = 3.7, p = .01. Both age (β = -0.27; p - .027) and the Patient Readiness subscale (β = 0.26; p = .032) predicted a significant amount of unique variance, such that older age and higher Patient Readiness scores were associated with higher PHQ-9 scores at 1 year postsurgery. Using MI, step 2 of the model was significant (F[4, 194] = 6.36, p = .01); however, neither age nor Patient Readiness predicted unique variance.

For CCA, the overall model predicting physical health-related quality of life was not significant at step 1 (F[2, 49] = 1.73, p = .187) or step 2 (F[4, 47] = 2.0, p = .109). However, using MI, step 1 (F[2, 196] = 9.61, p = .007) and step 2 of the model were significant, (F[4, 194] = 8.16, p = .007), when compared to an adjusted critical value of < .01. Sex (β = 0.23; p = .028) and Mental Health (β = -0.2; p = .04) predicted a significant amount of unique variance.

Similarly, the overall CCA model predicting binge eating symptomatology was not significant at step 1 (F[2, 46] = 0.47, p = .623) or step 2 (F[4, 44] = 2.66, p = .045), when compared to an adjusted p value of < .012. For the analysis using MI, however, step 2 (F[4, 194] = 7.48, p = .008) of the model was statistically significant. No predictor variable accounted for a significant amount of unique variance.

The overall models were nonsignificant for the following hierarchical regression analyses: %TWL for CCA, $F(4, 128) = 1.44$, $p = .222$, and MI, $F(4, 194) = 2.73$, $p = .107$; and anxiety symptoms for CCA, $F(4, 55) = 1.31$, $p = .277$, and MI, $F(4, 194) = 3.89$, $p = .118$.

2 year outcomes. Tolerance values all fell above 0.1 and VIF values did not exceed 10, indicating no issue with multicollinearity for any of the analyses. Durbin-Watson statistics ranged between 1.79 to 2.46, indicating that the assumption of independent errors was also satisfied. Scatterplots and histograms of the residuals showed that the assumptions of linearity, homogeneity of variances, and normally distributed errors were met for the majority of analyses, with the exception of BIPASS scores predicting weight regain, which suggested a slight positive skew.

One case for the analysis predicting weight regain, one case for the analysis predicting anxiety symptoms, and one case for the analysis predicting physical health-related quality of life at 2 years postsurgery had a standardized residual value > 3.29. In addition, analyses predicting %EWL, %TWL, and weight regain each had several cases (three, six, and four, respectively) with Leverage values above the expected value for their respective model. Analyses were re-run without the outliers, and the model fit was sizeably improved and the parameter estimates changed for the analysis predicting mental health-related quality of life. Consequently, results for this variable are presented without the outlier included. Results did not substantially differ with or without outliers for the remainder of the analyses. No cases had Cook's values above 1 or a standardized DFBeta value greater than 2.

Regression results are presented in Table 18. The Holm-Bonferroni method was applied in order to correct for familywise error. Using CCA, the analysis predicting %EWL was statistically significant at the first step, $F(3,95) = 6.37$, $p < .001$. In step 2, the addition of BIPASS subscale scores did not significantly add to the prediction of this variable ($\Delta R^2 = .008$, $p = .64$), although the model remained significant ($F[5,93] = 3.95$; $p = .003$), accounting for 13.1% of the variance. Again, only presurgical BMI ($\beta = -0.33$; $p < .001$) accounted for a significant amount of unique variance in %EWL. For the analysis using MI, step 1 of the model was statistically significant ($F[3, 195] = 7.35$, $p = .001$). Step 2 of the model remained significant ($F[5, 193] = 5.11$, $p < .001$), with presurgical BMI predicting a significant amount of unique variance ($\beta = -0.23$; $p = .015$).

Using CCA, the overall model predicting physical health-related quality of life was not significant at step 1 ($F[2, 38] = 0.3$, $p = .737$) or step 2 ($F[4, 36] = 0.27$, $p = .895$). Using MI, step 1 of the model was not significant ($F[2, 196] = 8.84$, $p = .05$). However, step 2 was significant when compared to an adjusted critical value of < .008 ($F[4, 194] = 2.29$, $p = .005$), No predictor variable accounted for a significant amount of unique variance in this variable.

The overall models were not statistically significant for the remainder of the hierarchical regression analyses, including: %TWL for CCA, $F(4, 95) = 1.63$, $p = .172$, and MI, $F(4, 194) = 2.78$, $p = .103$; weight regain for CCA, $F(4, 94) = 1.86$, $p = .127$, and MI, $F(4, 194) = 2.77$, $p = .096$; binge eating symptomatology, $F(4, 37) = 0.05$, $p = .994$, and MI, $F(4, 194) = 2.87$, $p = .145$; depressive symptoms for CCA, $F(4, 44) = 0.98$, $p = .427$; anxiety symptoms for CCA, $F(4, 44) = 0.66$, $p = .621$, and MI, $F(4, 194) = 3.92$, $p = .06$; and mental health-related quality of life for CCA, $F(4, 36) = 1.04$, $p = .40$, and MI, $F(4, 194) = 7.5$, $p = .103$.

Table 18

Hierarchical Regression Analyses Predicting Outcomes at 2 Years Postsurgery From BIPASS Subscales

%EWL	CCA					MI				
Predictor Variable	*B*	*SE B*	*β*	*F*	*p*	*B*	*SE B*	*β*	*F*	*p*
Step 1										
Age	-0.51	0.21	-0.22*			-0.31	0.18	-0.14		
Sex	-6.01	5.49	-0.10			-5.70	4.88	-0.09		
Presurgical BMI	-0.76	0.22	-0.32***			-0.60	0.22	-0.25**		
				6.37	.001				7.35	.001
Step 2										
Age	-0.51	0.22	-0.22*			-0.28	0.18	-0.13		
Sex	-6.11	5.55	-0.10			-5.72	4.81	-0.09		
Presurgical BMI	-0.76	0.23	-0.32***			-0.57	0.23	-0.23*		
Readiness	-0.42	0.60	-0.07			-0.80	0.53	-0.13		
Mental Health	-0.17	0.47	-0.03			0.11	0.39	-0.03		
				3.95	.003				5.11	.000
%TWL										
Step 1										
Age	-0.21	0.10	-0.20*			-0.16	0.08	-0.16		
Sex	-3.17	2.60	-0.12			-2.99	2.48	-0.11		
				2.84	.063				4.74	.045

Step 2										
Age	-0.23	0.10	-0.22*			-0.16	0.09	-0.16		
Sex	-3.47	2.63	-0.13			-3.13	2.51	-0.11		
Readiness	0.72	0.28	0.02			-1.07	0.23	0.04		
Mental Health	-0.21	0.22	-0.10			-0.07	0.19	-0.04		
				1.63	.172				2.78	.103
%WR										
Step 1										
Age	0.07	0.09	0.08			-0.01	0.09	-0.06		
Sex	3.64	2.44	0.15			2.50	1.99	0.10		
				1.41	.249				1.89	.232
Step 2										
Age	0.09	0.09	0.10			-0.00	0.09	-0.06		
Sex	4.07	2.43	0.16			2.99	2.03	0.12		
Readiness	0.20	0.26	0.07			0.17	0.23	0.07		
Mental Health	0.34	0.21	0.17			0.25	0.17	0.13		
				1.84	.127				2.77	.096
BES										
Step 1										
Age	0.02	0.09	0.04			-0.07	0.09	0.14		
Sex	0.76	2.39	0.05			-0.52	2.13	0.07		
				0.09	.913				3.58	.149
Step 2										

Age	0.03	0.10	0.03			-0.07	0.09	-0.14		
Sex	0.78	2.46	0.05			-0.44	2.12	-0.06		
Readiness	0.04	0.23	0.03			0.03	0.20	0.07		
Mental Health	-0.03	0.27	-0.02			0.05	0.21	0.09		
				0.05	.994				2.87	.145
PHQ-9[a]										
Step 1										
Age	-0.05	0.05	-0.15							
Sex	-1.57	1.43	-0.15							
				1.23	.301					
Step 2										
Age	-0.06	0.05	-0.17							
Sex	-1.56	1.44	-0.15							
Readiness	-0.15	0.12	-0.18							
Mental Health	0.01	0.13	0.02							
				0.98	.427					
GAD-7										
Step 1										
Age	-0.06	0.05	-0.19			-0.07	0.05	-0.19		
Sex	-0.99	1.40	-0.10			-0.26	1.16	-0.07		
				1.17	.317				6.33	.071
Step 2										
Age	-0.06	0.56	-0.19			-0.07	0.05	-0.19		

Sex	-1.02	1.42	-0.10			-0.19	1.10	-0.07		
Readiness	-0.07	0.12	-0.09			-0.00	0.08	-0.03		
Mental Health	0.03	0.12	0.04			0.04	0.09	0.08		
				0.66	.621				3.92	.06
SF-36 PCS										
Step 1										
Age	-0.05	0.13	-0.07			-0.13	0.13	-0.14		
Sex	2.19	3.30	0.10			5.68	3.63	0.20		
				0.30	.737				8.84	.05
Step 2										
Age	-0.09	0.14	-0.11			-0.14	0.14	-0.16		
Sex	2.25	3.37	0.11			5.02	3.61	0.20		
Readiness	-0.04	0.31	-0.02			0.03	0.33	0.07		
Mental Health	-0.21	0.34	-0.11			-0.36	0.32	-0.18		
				0.27	.895				7.29	.005
SF-36 MCS										
Step 1										
Age	0.20	0.09	0.29*			0.22	0.20	0.21		
Sex	-0.16	2.56	-0.01			-0.86	4.22	-0.10		
				2.31	.109				8.77	.118
Step 2										
Age	0.19	0.09	0.28*			0.23	0.20	0.22		
Sex	0.91	2.46	0.04			-0.32	4.17	-0.09		

Readiness	-0.70	0.27	-0.33*			0.16	0.33	0.08		
Mental Health	-0.27	0.21	-0.16			0.28	0.40	0.14		
				3.20	.021				7.50	.103

Note. %EWL = percentage excess weight loss; %TWL = percentage total weight loss; %WR = percentage weight regain; BMI = body mass index; BES = binge eating scale; CCA = complete case analysis; GAD-7 = generalized anxiety disorder 7-item scale; MI = multiple imputation; PHQ-9 = patient health questionnaire 9-item; SF-36 MCS = 36-item short form health survey mental component summary; SF-36 PCS = physical component summary

* $p < .05$, ** $p < .01$, *** $p < .001$

[a] Multiple imputation was not performed for PHQ-9 because Little's MCAR (Little, 1998) test was significant

Adherence to postsurgical follow-up. To determine if BIPASS subscale scores predicted adherence to postsurgical follow-up, data were analyzed using a hierarchical logistic regression. Adherence to postsurgical follow-up was entered as the outcome variable. Employment status and age were entered as covariates in the first block, and Patient Readiness and Mental Health subscale scores were entered as the predictor variables in the second block.

Prior to conducting the logistic regression analysis, assumptions regarding multicollinearity and linearity of the logit were explored, and results revealed that they were met. The data were also screened for outliers and influential cases that could affect the regression model. One had standardized residuals above 3.29, suggesting a possible outlier. In addition, two cases had leverage values above those expected for the model. Results of the logistic regression model did not change with and without the outliers and influential cases present, suggesting the model was not biased by these cases. No cases had a Cook's value > 1 or a standardized DFBeta value greater than 2.

Results of the hierarchical logistic regression are displayed in Table 19. In step 2 of the model, when Patient Readiness and Mental Health subscale scores were added, the model was significant [model $\chi^2(3) = 22.36$, $p < .001$; $R^2 =$ .1 (Cox & Snell), .16 (Nagelkerke)]. However, only age significantly increased the odds of nonadherence to follow-up. More specifically, a one-unit increase in age is associated with a 6.6% decrease in the probability of nonadherence to follow-up, when controlling for employment status and Patient Readiness and Mental Health subscale scores.

Table 19

Logistic Regression Analysis Predicting Adherence to Postsurgical Follow-Up as a Function of Age, Employment, and BIPASS Subscales

					95% Confidence Interval	
Predictor Variable	*B*	*SE B*	Wald	Odds Ratio	Lower	Upper
Step 1[a]						
Age	-0.06	0.01	12.51	0.93***	0.90	0.97
Employment	1.12	0.56	3.87	3.06*	1.00	9.34
Step 2[b]						
Age	-0.06	0.01	13.77	0.93***	0.90	0.96
Employment	-1.04	0.60	3.00	0.35	0.10	1.14
Readiness	0.03	0.04	0.47	1.03	0.94	1.13
Mental Health	-0.05	0.04	2.03	0.94	0.87	1.02

[a] Model $\chi^2(2) = 20.06$, $p < .001$

[b] Model $\chi^2(4) = 22.36$, $p < .001$

* $p < .05$, ** $p < .01$, *** p , .001

Discussion

The purpose of the present study was to contribute to the validation of the BIPASS, a novel presurgical psychosocial assessment tool, by: 1) examining the psychometric properties of the BIPASS, and; 2) examining the ability of the BIPASS to predict weight, quality of life, psychiatric symptom, and adherence outcomes 1 and 2 years following bariatric surgery. Overall, results provided minimal support for study hypotheses. Higher BIPASS scores significantly predicted higher binge eating symptomatology and lower health-related quality of life at 1 year postsurgery, but did not predict any outcomes at 2 years postsurgery. In addition, the BIPASS did not predict adherence to postsurgical follow-up appointments. The psychometric properties of the BIPASS tool will be addressed, followed by a discussion of the findings for study hypotheses, study strengths and limitations, clinical implications, and future research directions.

Aim 1: Psychometric Properties of the BIPASS

Factor Analysis. Examination of Cronbach's alpha for the original BIPASS tool revealed poor internal consistency for the majority of subscales (Patient Readiness, Social Support System, and General Features). The development of the BIPASS tool relied on a comprehensive literature search, as well as input from experts in the field, to inform the conceptualization of the construct of suitability for surgery. This led to the creation of an initial item pool that best reflected all aspects of that construct. This process provided substantive validity for the BIPASS (Simms, 2008). However, items were subsequently selected or removed, and subscales were created, based on expert consensus, as opposed to empirical analysis. As a consequence, some subscales contained insufficient items (Social Support System) and others were grouped together based not on theoretical grounds, but by virtue of being ill fitting for the remainder of the subscales (General Assessment Features). This likely contributed to poor initial internal consistency estimates. Thus, an exploratory factor analysis (EFA) was conducted in order to investigate the relationship among BIPASS items, and to identify and restructure underlying factors.

The final version of the BIPASS tool consists of 10 items, and the EFA supported the subdivision of these items into two subscales, “Patient Readiness” and “Mental Health”. Both subscales contained items that loaded on to their respective factor above the predetermined threshold with no cross loadings, indicating that the subscales were non-overlapping. The CFA conducted with the 10 BIPASS items revealed that the two-factor, higher-order model was an adequate fit to the data. Together, these findings show that it is possible to model the theoretical construct of suitability for surgery, which appears to consist of two first-order latent factors - Mental Health and Patient Readiness - as indicated by 10 observed variables. However, several items on the Patient Readiness subscale demonstrated low communalities and factor loadings across both the EFA and CFA, and total variance explained by the two subscales in the EFA was low.

Indeed, when the original BIPASS items were subjected to factor analysis, several were dropped because they did not correlate significantly with any other items or the BIPASS Total score (*Expectations for Bariatric Surgery*), or because they did not load onto any factor above the predetermined cutoff (*Knowledge and Understanding of Excess Weight Gain, Substance Use*, and *Response Bias and Truthfulness*). This finding might indicate that these items are not a good conceptual fit with the other BIPASS items. Yet, given that education about bariatric surgery outcomes includes familiarity with realistic weight loss expectations and the likelihood of developing significant excess skin, it was surprising that *Expectations for Bariatric Surgery* did not correlate with *Understanding of Surgery*. That is, if the *Understanding of Surgery* item was scored highly, expectations about weight loss and body image would presumably also be scored highly. However, expectations are only one component of bariatric education. Patients might demonstrate understanding of the lifestyle changes following surgery, but for those who are emotionally invested in substantial (and perhaps unrealistic) weight loss and improvement in the appearance of their body, they might not be ready to internalize realistic outcome statistics.

Another potential explanation for the low inter-item correlations and factor loadings, for items that were both removed and retained, is that scores on several BIPASS items clustered towards the lower end of the scoring scale. For example, the *Response Bias and Truthfulness* item exhibited an extreme floor effect, likely because patient dishonesty is a relatively rare occurrence. In addition, given that the study sample included only those patients who received surgery, relatively few reported drinking above the minimum recommended amount per week (corresponding to the lowest score on the BIPASS), therefore restricting the range in *Substance Use* scores. It is likely that patients with higher scores on this item would have been designated RED and not approved for surgery. Relatedly, although the *Personality Traits and Disorders* item was retained in the final scale, personality pathology is not routinely assessed within the TWH-BSP and, thus, this item was also subject to a floor effect. If this item is included in future versions of the BIPASS it will be important to consistently assess for the presence of personality disorder diagnoses or traits using a personality scale or semi-structured interview, and to determine whether such assessment improves variability in scores.

Restricted variability in scores for several additional items likely reflects specific ways in which information relevant to the BIPASS is gathered at the TWH-BSP, as well as the wording of BIPASS scoring descriptors. For example, the descriptors for borderline and fair ratings for the *Knowledge and Understanding of the Process of Excess Weight Gain* item, which also clustered around the lower end of the scoring scale, both include a judgment regarding patient knowledge**.** What differentiates the two is whether the lack of knowledge persists after the patient is provided with education and resources by the bariatric team. Typically, information pertinent to this item is gauged and documented during the nursing assessment, and the standardized assessment protocol for nursing prompts them to do so. Unless nursing deems a patient's knowledge to be significantly and atypically low, it is not likely to be reevaluated by additional team members in subsequent assessment appointments. In addition, because this study was designed to capture initial psychosocial risk, if knowledge and understanding of weight gain was reevaluated by nursing at a later, additional appointment, that information would not be captured in the present data. Together, these issues increased the likelihood that limited patient knowledge would be scored lower (i.e., fair), rather than higher (i.e., borderline), even if poor knowledge persisted despite patient education from the team.

In addition, some items contain complex and/or ambiguous descriptors for scoring, which might have contributed to increased measurement error variance (Viswanathan, 2005). For example, wording for the *Willingness, Motivation, and Lifestyle Modification* item encourages the rater to consider the extent to which the patient is involved with the presurgical process, the extent to which they have made significant and sustained changes to their lifestyle in preparation for surgery, whether they are compliant with team recommendations, and to make a judgment regarding the extent to which patients might be minimizing the risks of surgery. Several aspects of these descriptors are unclear, including the way in which "involvement" with the presurgical process and "significant and sustained changes" to lifestyle are operationalized. Furthermore, consideration of multiple components of motivation and willingness within a single item might contribute to inconsistency in scoring across patients.

Finally, the BIPASS was designed to capture the full spectrum of psychosocial risk, and this is reflected in the scoring descriptors for each item. However, patients on the severe end of the spectrum are likely to be designated RED and, thus, denied surgery, in some cases before the assessment process is even completed. Thus, the BIPASS is measuring a degree of psychosocial risk that is not necessarily relevant to the population been researched. More specifically, in the current study, the BIPASS factor structure was explored in a sample of patients who had eventually been approved for, and completed, surgery. This likely also contributed to restricted variability in scores across BIPASS items. Indeed, in a study of a similar tool (the CCBRS) conducted by Heinberg and colleagues (2010), internal consistency was high at $\alpha = .88$. It is possible that that finding was due to the fact that their sample included patients who were eventually denied surgery due to high psychosocial risk. In the future, the factor structure of the BIPASS will need to be explored in a sample that is more representative of the bariatric population as a whole, which includes patients who are assessed for suitability for surgery and who are designated RED as a consequence of substantially high psychosocial risk.

Internal Consistency. Internal consistency for the newly derived BIPASS Total and Mental Health subscale were within the acceptable range. Internal consistency for the Patient Readiness subscale remained poor after factor analysis.

In addition to the above-noted issues regarding restricted variability in item scores, and high error variance possibly due to ambiguous and complex item descriptors, several additional issues relevant to poor internal consistency warrant mention. First, it is important to note that Cronbach's alpha, the measure of internal consistency used in the present study, is a function of the number of test items, as well as the average correlation between those items. If test items are not correlated highly with one another, the alpha value is decreased. When the test length is shorter, the alpha value further decreases (Tavokol & Dennick, 2011). The Patient Readiness subscale contained only five items, which, in combination with the low inter-item correlations, would result in a poorer internal consistency value.

In addition, during the item selection process for the BIPASS, multiple items were removed based on expert clinical feedback regarding their degree of importance to suitability for surgery. Perhaps subjecting the initial item pool to EFA would have resulted in a more internally consistent scale that accounted for more of the variance in the suitability for surgery construct. This is, being over inclusive with redundant items from the start might have allowed for the retention of items that were most highly correlated, as opposed to those that best demonstrated face validity. Indeed, one approach to increasing scale reliability is to identify additional items that exhibit inter-item correlations close to the average for the scale (Simms, 2008). Including items with the highest inter-item correlation in general can increase redundancy and narrowness of the scale; however, the average inter-item correlation approach can increase internal consistency while maintaining balance between breadth and narrowness (Simms, 2008).

Inter-rater Reliability. Inter-rater reliability of the BIPASS Total and Mental Health and Patient Readiness subscale scores between the two raters was examined using intraclass correlation coefficient (ICC). These data showed excellent reliability for both total and subscale scores, indicating that two separate raters produce highly consistent estimates of psychosocial risk. Indeed, ICC for the BIPASS Total score (.98) was higher than that found by Thiara and colleagues (ICC = .84; 2016). This speaks to the objectivity of the BIPASS, and provides support for one of the primary purposes of the tool, which is to facilitate consistency in the identification of presurgical psychosocial risk. Indeed, a noted strength of the BIPASS tool is its ability to standardize the psychosocial assessment process for bariatric surgery, and provide a more reliable estimate of risk.

Cutoff Score. An ROC analysis was conducted in order to determine the optimal cutoff value of the BIPASS tool to indicate high psychosocial risk. The accuracy of the test to discriminate the clinical team's decision of YELLOW versus GREEN was evaluated using the Area Under the Curve (AUC). An AUC of 1 indicates a perfect test, whereas an AUC value of .5 indicates no discriminative value. Generally, an AUC $\leq$ .75 is considered not clinically useful (Fan, Upadhye, & Wroseter, 2006). In the present study, the optimal cutoff score was approximately 11, and corresponded to an AUC of .89. This is well above the standard for clinical utility. A cutoff score of 11 is lower than that reported by Thiara and colleagues (2016); however, this difference reflects the reduced average total score of the BIPASS after dropping several items during the EFA.

The empirically derived cutoff score obtained through the ROC analysis will provide bariatric clinicians with a tangible threshold above which a higher, problematic level of psychosocial risk can be assumed. Thus, an additional strength of the BIPASS tool is its ability to stratify presurgical bariatric patients by psychosocial risk, which will allow clinicians to quickly communicate level of risk. It will also provide a means to further explore the predictive validity of high risk with respect to postsurgical outcomes.

Aim 2: Predictive Validity of the BIPASS

Sample Characteristics. According to commonly cited definitions, on average, the current sample demonstrated "successful" weight loss of greater than > 50% EWL and > 20% TWL at both follow-up time points (Corcelles et al., 2016; McGrice & Don Paul, 2015). Mean %EWL of 66.25 and %TWL of 30.66 in this study at 2 years postsurgery were both consistent with findings from previous research (Garb et al., 2009; Sjöström et al., 2007). Weight regain by

2 years postsurgery was evident in a somewhat smaller percentage of patients than has previously been cited in the bariatric literature (Courcoulas et al., 2013; Rutledge et al., 2011). Indeed, 20.5% of the entire sample exhibited any weight regain by 2 years postsurgery, with only 4% (*n* = 8) experiencing weight regain ≥ 25%. Ruteledge and colleagues (2011) found that approximately 30% of their sample experienced at least some weight regain by 2 years postsurgery. In a more recent study, mean percentage weight regain was 23.4% by 1 year postsurgery, with 36.9% of patients exhibiting weight regain ≥ 25% (Cooper et al., 2015).

Both domains of quality of life increased more than 5 points from baseline to 1 and 2 years postsurgery, reflecting clinically important improvement (Norman, Sloan & Wyrwich, 2003). Indeed, both scores were within the normative range for the Canadian population postsurgery (Hopman et al., 2000). However, consistent with previous research, physical health-related quality of life improved to a greater extent than did mental health-related quality of life (Driscoll et al., 2016; Lindekilde et al., 2015). Furthermore, physical health-related quality of life continued to show improvement from 1 to 2 years postsurgery, whereas improvement in mental health-related quality of life peaked at 1 year and deteriorated slightly thereafter, although this was not clinically significant (Karlsson, Sjöström, & Sullivan, 1998). A deterioration in mental health-related quality of life around 1 year postsurgery is not uncommon, and may reflect the onset of difficulties with adherence to guidelines after the initial "honeymoon" phase of significant and rapid weight loss within the first year, as well as the development of body image issues associated with excess skin. With respect to psychiatric symptoms, at baseline average scores for patients in this study fell within the mild, moderate, and normative to mild range for anxiety, depressive, and binge eating symptomatology, respectively. Postsurgery, average anxiety and binge eating scores were within the normative range, whereas depressive symptoms fell within the mild range. Overall, scores on self-report measures were comparable to other studies of bariatric surgery patients (e.g., Hilgendorf et al., 2018; Sockalingam et al., 2017).

It is well documented in the literature that patients with higher rates of attendance at postoperative follow-up appointments demonstrate better weight loss and maintenance (Compher et al., 2012; Gould et al., 2007; Kim, Madan & Fenton-Lee, 2014; Sivagnanam & Rhodes, 2010). Yet, high rates of nonadherence to postoperative follow-up care are a common problem as early at 1 year postsurgery (Nguyen et al., 2009; Shauer et al., 2012; Wheeler et al., 2008). In the present study, 23.6% of patients were classified as nonadherent by two years postsurgery, which is lower than rates previously cited using a similar population and definition of nonadherence (38%; Larjani et al., 2016). This finding could be attributable to recent patient care initiatives implemented within the TWH-BSP aimed at increasing attendance at follow-up appointments (described in further detail below; Santiago et al., 2019). Overall, while nonadherence in the current study was on the lower end of what has been reported in the literature (Moroshka et al., 2011; Sala et al., 2017; Toussi et al., 2009; Vidal et al., 2014), rates remain concernedly high.

Prediction of Outcomes at 1 Year Postsurgery. Hypothesis 1 stated that the BIPASS tool would not predict outcomes at 1 year postsurgery. Findings provided partial support for this hypothesis. Specifically, the BIPASS tool did not predict %EWL, %TWL, or anxiety symptoms at 1 year postsurgery. The former findings are in line with the notion that insufficient weight loss is typically not apparent until after the first year postsurgery and, as such, psychosocial risk factors do not play a substantial role in influencing weight at that time point. Indeed, in one previous study, the association between overall psychosocial risk (as determined via the CCBRS tool) and weight loss at 1 year was not statistically significant (Heinberg, Ashton, & Windover, 2010).

Contrary to Hypothesis 1, BIPASS Total score predicted binge eating symptomatology at 1 year postsurgery. Thus, patients with higher overall psychosocial risk appear to have greater subsequent difficulty with problematic eating. The analysis examining BIPASS subscale scores as a predictor of binge eating symptomatology at 1 year postsurgery was not significant when using CCA. Results were significant when using MI; however, neither subscale emerged as a significant predictor of unique variance. Given that the CCA analysis was significant according to an unadjusted critical value ($p = .045$), and that the use of MI increased power for that analysis, it is reasonable to accept the results of the MI analysis. Together, these findings suggest that it is the total BIPASS scale, as opposed to one particular subscale, that predicts binge eating symptomatology. Although not anticipated, this is an important finding, given that there is strong evidence to suggest that the presence of binge eating behaviours after bariatric surgery is linked with poorer weight loss and/or greater weight regain, as well as increased psychosocial difficulties (Meany et al., 2014; White et al., 2010). In addition, while presurgical binge eating behaviour has been shown to predict the persistence/re-emergence of postsurgical problematic eating behaviours (including grazing and loss of control eating), new occurrences of problematic eating are also not uncommon following surgery (e.g., White et al., 2010). The BIPASS tool might provide a means of identifying patients at increased risk of the persistence, reemergence, and *new* development of problematic eating early on in the postsurgical course.

Also contrary to study hypotheses, higher BIPASS Total score predicted poorer mental health-related quality of life at 1 year postsurgery. When exploring the relative contribution of Mental Health and Patient Readiness subscales to this outcome variable, higher Patient Readiness scores (i.e., *higher* psychosocial risk on Patient Readiness items and, thus, poorer readiness) emerged as a significant predictor. Higher Patient Readiness scores also predicted higher depressive symptoms at one year postsurgery using CCA, although this result was no longer significant when using MI. The Patient Readiness subscale includes items that capture patient willingness and motivation to prepare for surgery, including demonstrating knowledge of the procedure and typical outcomes, and making the necessary lifestyle modifications to be successful following surgery. In addition, Patient Readiness includes information about the patient's social support network, including the extent of support and overall functioning of the support system, as well as the stability of employment, finances, and housing. It makes intuitive sense that patients with increased risk in these areas will experience poorer mental health-related quality of life early on postsurgery. More specifically, for those patients who do not properly self-educate or prepare for the bariatric procedure, disappointment about the rate or extent of weight loss, difficulty adhering to postsurgical guidelines, and/or unanticipated complications and excess skin, could all contribute to mental health concerns that impact on quality of life and functioning. In addition, there might not be a means for patients to reduce the negative psychological impact of these challenges without adequate support and socioeconomic stability. Indeed, although social support has most commonly been explored in relation to weight loss outcomes following bariatric surgery (LeMont, et al., 2004; Whale et al., 2014), the association between social support and better mental health and quality of life has been demonstrated in previous studies of several different medical populations (e.g., Bucholz et al., 2014; Eom et al., 2012). These findings are important contributions to the literature and, if replicated, might provide a consistent means of identifying patients at risk of poorer mental health-related quality of life postsurgery.

In contrast to the above finding, the Mental Health subscale was not found to predict psychiatric symptoms or mental health-related quality of life 1 year postsurgery. This was surprising, given that psychiatric symptoms *prior* to surgery have been shown to predict psychiatric symptoms *following* surgery (e.g., de Zwaan et al., 2011; White et al., 2010). One potential explanation for this result is that mental health-related quality of life is influenced more by third variables introduced as a consequence of surgery, than by presurgical mental health status. For example, one in five bariatric patients cite body image as a primary motivation for seeking surgery, and the development of excess skin after significant weight loss is common (Ivezaj & Grilo, 2018). Furthermore, many patients hold unrealistic expectations about surgery outcomes, including the amount of weight loss they will achieve. It is possible that increased distress about body image concerns and unmet expectations have a negative impact on mental health-related quality of life, although this requires examination in future research.

Higher Mental Health subscale scores were significantly predictive of lower physical health-related quality of life at 1 year postsurgery, although only in the analysis using MI. It is well documented that there is an association between poor mental health and chronic health conditions, including obesity, that significantly impact on quality of life (Luppino, 2010). It is possible that poor presurgical mental health directly contributes to difficulty engaging in health-related behaviours, leading to a greater physical burden of disease and, thus, poorer health-related quality of life after surgery.

In addition to BIPASS Total score and subscale scores, high versus low psychosocial risk was examined as a categorical predictor of outcomes 1 year following surgery. The proportion of patients categorized as high psychosocial risk (i.e., YELLOW) by clinician consensus (32%) and by BIPASS cutoff score (45%) was higher than has previously been reported in the literature. For example, in a retrospective chart review of 389 bariatric surgery candidates, Heinberg, Ashton, and Windover, (2010) gave 25% a "guarded" rating using the CCBRS, indicating that they required intervention before being cleared for surgery. This difference in percentage of patients with high psychosocial risk between programs might reflect the fact that the TWH-BSP has access to publicly funded resources both within the program and in the Greater Toronto Area, and thus errs on the side of recommending intervention in order to optimize suitability for surgery.

Results of this study showed that patients designated YELLOW had significantly higher binge eating symptomatology at 1 year than did patients designated GREEN. Although the difference between groups with respect to mental health-related quality of life was not statistically significant when compared to an adjusted critical value, the corresponding effect size was in the medium range (Cohen's d = 0.77). The between-group difference in mean scores was greater than five points, further supporting the notion that the difference was clinically significant. This suggests that with enough power, a significant finding may have been established. Indeed, for the analysis using MI, the difference was statistically significant at the adjusted critical value. Lastly, there was a trend towards significance with respect to the association between higher psychosocial risk and lower physical health-related quality of life, with women in the YELLOW group demonstrating the lowest average scores on this outcome measure. Upon closer inspection of the eight domains of the SF-36, all eight were lower for the YELLOW groups as compared to the GREEN, with the largest observed difference for Role Physical (M = 72.91 and M = 95.38), Social Functioning (M = 79.16 and M = 96.62), and Vitality (M = 56.84 and M = 72.56). Indeed, the difference between groups on these subscales is quite large, and clinically significant. Though contrary to Hypothesis 2, the ability to predict patients at risk of exhibiting binge eating symptomatology or poor quality of life based on risk status is an important finding related to the predictive validity of the BIPASS tool, as it will guide early postsurgical monitoring and intervention for these issues, thereby potentially improving patient outcomes.

Prediction of Outcomes at 2 Years Postsurgery. Hypothesis 3 and 4 were not supported by the results of this study. Neither BIPASS Total score nor subscale scores predicted weight outcomes at 2 years postsurgery. In addition, there were no significant differences between patients designated YELLOW versus GREEN with respect to %EWL, %TWL, or %WR. Although these findings are not consistent with study hypotheses, they are not in conflict with the broader literature, which has been unable to identify reliable presurgical predictors of postsurgical weight outcomes. More recent research has focused on factors present early in the postsurgical period that contribute to less weight loss or subsequent weight regain over time, including problematic eating patterns and noncompliance with dietary guidelines, as well as poor mental health (Karmali, Brar, Shi, Sharma, de Gara, & Birch, 2013; Odom et al., 2010). In addition, some studies have investigated the contribution of surgical and metabolic factors to weight recidivism. For example, higher levels of plasma ghrelin and dilation of the gastric stoma have both been linked to weight regain in several studies (Karmali et al., 2013). In addition, reductions in resting energy expenditure and metabolic adaptation might also play a role (e.g., Chu et al., 2019). The relative contribution of anatomical or metabolic factors and psychosocial factors (either pre or post surgery) to weight outcomes is in need of further examination.

Relatedly, it can be argued that the existing bariatric literature suffers from a narrow view of success (i.e., weight outcomes). The ultimate purpose of bariatric surgery is not to help patients achieve a particular aesthetic, but to help improve health and longevity. Severe obesity (i.e., BMI > 40 kg/m^2) does confer increased risk of morbidity and mortality. However, there is also a growing body of literature, which shows that physical fitness predicts morbidity and mortality independent of BMI, and that improved cardiovascular fitness can mitigate the health risks associated with obesity (Barry, Baruth, Beets, Durstine, Liu, & Blair, 2014). In addition, engaging in healthy habits, such as increasing vegetable consumption and physical activity, and reducing smoking and alcohol consumption, is associated with a decrease in mortality regardless of BMI (Matheson, King, & Everett, 2012). Stated another way, it is possible for individuals with obesity to improve their health by engaging in health behaviours, regardless of weight loss. Additionally, a lower BMI may have little impact on the experience of the individual living with obesity if this lower BMI does not contribute to greater quality of life. It is worth mentioning that generic measures of quality of life, such as the SF-36, do not capture aspects of quality of life specific to individuals with obesity, including the impact of weight-based stigma, poor body image, and adjustment to new eating patterns. For this reason, weight-specific measures might be more sensitive to changes in quality of life following weight loss (de Vries et al., 2018; Kolotkin, Crosby, Kosloski, & Williams, 2001). Nevertheless, future research should place additional emphasis on determining patients' success with engaging in physical activity and adhering to postsurgical dietary guidelines, and on presurgical psychosocial factors that predict difficulty with engaging in these behaviours, as opposed to focusing predominantly on weight.

BIPASS Total and Mental Health and Patient Readiness subscale scores also did not predict the majority of psychiatric symptom or quality of life outcomes at 2 years, and no difference between high and low psychosocial risk groups was found. The exception was the MI model predicting physical health-related quality of life at 2 years from age, sex, and BIPASS subscale scores. The model was significant; however, neither BIPASS subscale emerged as a unique predictor.

Interestingly, visual inspection of the mean scores reveals that binge eating symptomatology, depressive symptoms, and mental health-related quality of life improved for patients categorized as YELLOW between 1 and 2 years postsurgery. In contrast, patients categorized as GREEN demonstrated a worsening of symptoms and quality of life over the same period of time. There are several potential explanations for these trends, which likely contributed to the lack of significant differences between groups. First, it is possible that recommendations and/or interventions by the multidisciplinary team during the pre and/or postsurgical period for patients deemed to have higher psychosocial risk are effective in improving their trajectory. That is, when patients are identified as experiencing difficulties at 1 year postsurgery, and adhere to recommendations to address those difficulties, their symptoms improve by the subsequent follow-up. In contrast, if patients in the GREEN group did not exhibit difficulties at 1 year, they may not have received extra resources or recommendations from the team and, consequently, experienced subsequent erosion in gains made by 2 years. Indeed, a slight worsening of symptoms after the initial year is typical of bariatric populations. An alternative explanation is that patients who experience more difficulty with problematic eating or depressive symptoms early postsurgery are less likely to return for follow-up appointments, thus biasing results at later time points. Indeed, the mean scores based on MI data, in general, suggest no improvement within the YELLOW group from 1 to 2 years on the aforementioned self-report measures.

Adherence to postsurgical follow-up. In the present study, an increase in patient age was associated with a decrease in the probability of nonadherence to postsurgical follow-up. In addition, the odds of being nonadherent were higher for unemployed as compared to employed patients. The BIPASS did not add to the prediction of nonadherence. These findings are in line with prior research exploring presurgical predictors of nonadherence, with younger age (Bellows, Gauthier & Webber, 2014; Larjani et al., 2016; Vidal et al., 2014), unemployment (Larjani et al., 2016), and greater travel distance to bariatric centres (Bellows et al., 2014; Vidal et al., 2014), which was not assessed in the present study, emerging as factors most frequently associated with nonadherence. Responder analyses were also conducted to provide more detailed information about the characteristics of patients missing data at each or both follow-up time points. In general, those with missing data tended to be younger, and have higher anxiety and poorer mental health-related quality of life. Given these differences, it is surprising that the Mental Health subscale of the BIPASS did not predict nonadherence to postsurgical follow-up. This might be due to the fact that nonadherence was defined as missing > 50% of appointments, which could include those scheduled earlier on postsurgery (i.e., at 1, 3 and 6 months). Thus, nonadherent patients could have data present at both 1 and 2 years postsurgery. Perhaps patients who do not adhere to follow-up early on, but who return later in the postsurgical course are quantitatively different from those who become nonadherent over time. This is an area for further exploration.

The poor rate of postsurgical follow-up is a general weakness of the bariatric literature (Vidal et al., 2014). Retention of 80% of the original sample is often cited as the minimum standard for longitudinal research (Abshire, Dinglas, Cajita, Eakin, Needham, & Himmelfarb, 2017), and many bariatric studies fail to achieve this benchmark. The extent of attrition likely biases perception of the effectiveness of bariatric surgery, especially given that weight regain is associated with nonattendance at follow-up appointments. For example, one study followed a bariatric cohort for 8 years postsurgery and reported a treatment “failure” (i.e., < 25% EWL) rate of 42% in those who returned for follow-up appointments. After implementing intensive strategies to contact patients lost to follow-up, they reported a failure rate of 60% in that subsample of patients (te Riele, Boerma, Wiezer, Borel Rinkes, & van Ramshorst, 2010). Additional research has found a significant correlation between % EWL and attendance at follow-up appointments (Ramirez et al., 2008), as well as greater % EWL at 3 to 4 years postsurgery in those who attended a greater number of postsurgical follow-up appointments (Gould et al., 2007). Yet, despite a clear link between follow-up attendance and weight outcomes, it is difficult to determine the direction of causality. That is, one cannot definitively rule out the possibility that less weight loss/greater weight regain occurs as a consequence of nonadherence (and, thus, lack of support from the bariatric team), as opposed to being a contributing factor to motivation behind nonadherence to follow-up. Regardless of reason, this issue highlights the importance of maximizing retention, in order to ensure realistic conclusions regarding the effectiveness of bariatric surgery are drawn.

Strengths and limitations

Missing Data. Several limitations warrant consideration when interpreting the results of this study. First, although *a priori* analyses were conducted in order to ensure that the study was adequately powered, there were more missing data for self-report measures than anticipated at both 1 and 2 year follow-up. This issue might have limited statistical power to find significant effects for outcomes measured via self-report. Furthermore, given the differences in baseline characteristics between those with and without missing data at each follow-up time point, CCA analyses might have also been biased and of limited generalizability to the postsurgical bariatric population. Indeed, CCA ignores individuals who do not complete follow-up, which relies on the assumption that these individuals do not differ in a systematic (i.e., non-random) way from those who did complete follow up. If differences do exist, this can degrade the internal and external validity of results, as well as replicability of findings, given that parameter estimates are not likely to be reproduced (McKnight et al., 2007). For these reasons, analyses were also conducted using multiple imputation to account for missing data. Multiple imputation is considered to yield less biased findings than either CCA or single imputation strategies, such as last observation carried forward (LOCF; McKnight et al., 2007). This is because MI appropriately accounts for the uncertainty in the missing data by deriving multiple predictions of the missing values in an iterative process. In contrast, LOCF replaces missing data with the last recorded data point for each participant, thus making the assumption that the last observation reflects the individual's true score at the most current time point (McKnight et al., 2007).

There is some question in the literature regarding the appropriateness of multiple imputation with very large amounts of missing data (e.g., > 50%; Lee et al., 2016). Indeed, maximum amounts of missing data with which MI can reasonably be used are often cited; however, amounts vary and reflect "rules of thumb" as opposed to being empirically derived (Jakobsen, Gluud, Wetterslev, & Winkel, 2017; Lee et al., 2016). As McKnight and colleagues (2007) note, when there are substantial missing data on auxiliary variables used to estimate parameters for missing data, bias can indeed be introduced into MI models. However, of the available options (i.e., reporting only CCA), MI is the most reasonable, as it allows for estimation of the error attributable to imputation (McKnight et al., 2007). It is important to note that many of the auxiliary variables included in the imputation models were measured at baseline and contained no missing data, which increases confidence in the results obtained from analyses using MI.

Retrospective Study Design. Another limitation of this study is the retrospective nature of its design. The primary investigator applied the BIPASS tool to historical data contained within patient charts, as opposed to collecting information in real time. Consequently, this limited the ability to ask questions and gather additional information relevant to certain BIPASS items, such as those assessing response bias and personality traits, which might have reduced the floor effect for those items. Furthermore, the retrospective nature of this study made it impossible to measure potential confounds. For example, given that the BIPASS tool was applied only to the initial assessment appointments, this research study did not identify or control for the effects of any subsequent interventions. For all patients, the domains assessed by the BIPASS are almost always points for intervention presurgery. For patients designated YELLOW and delayed for surgery, specific feedback is given by the bariatric team regarding areas to improve upon and patients must demonstrate compliance before they can be deemed suitable to receive surgery. It is also standard practice for patients to receive feedback on postsurgical eating patterns by the team dieticians, and it is not uncommon for patients experiencing difficulty with mental health or problematic eating to receive treatment either within the bariatric program or in the community. Thus, it is important to acknowledge that the lack of predictive utility of the BIPASS tool with respect to certain postsurgical outcomes might be attributable to the effects of various interventions, as opposed to the irrelevance of the BIPASS domains to those outcomes. Nevertheless, this study is an important first step in identifying avenues for further exploration using a prospective research design, and controlling for the abovementioned confounds.

Generalizability. Overall, characteristics of the sample at baseline were comparable to previously published studies (e.g., Driscoll et al., 2016; Garb et al., 2009; Hilgendorf et al., 2018; Sjöström et al., 2007; Sockalingam et al., 2017). The exception was current and lifetime estimates of psychiatric disorders, which tend to be higher in the bariatric literature than what was found in this study (Kalarchian et al., 2007; Mitchell et al., 2012). This finding is likely due to the fact that the present study selected patients who had completed surgery: those with greater psychiatric difficulties might have been designated RED using the BIPASS tool, or been lost to follow-up prior to undergoing surgery. Indeed, a few studies have found that patients who do not complete the presurgical evaluation process and proceed through to surgery have greater psychological risk than those who do (Benediktsdottir, Halldorsson, Bragadottir, Gudmundsson, & Ramel, 2016; Merrell, Ashton, Windover, & Heinberg, 2012; Sockalingam et al., 2013).

Despite consistency between most sample characteristics and what is reported in the broader literature, results of this study are based on a sample of patients from one bariatric program with substantial pre and postsurgical resources, and operating within a publicly funded system in an urban area. Indeed, the TWH-BSP is considered a Bariatric Center of Excellence, part of a six-hospital University of Toronto Bariatric Surgery Collaborative, which provides assessment and treatment by multiple health care professionals as part of surgical care. As such, results might not be fully generalizable to bariatric programs with fewer resources available to patients, or that are part of a multipayer healthcare system where access to additional support is decided by insurance companies, as opposed to the clinical judgment of the bariatric team based on patient needs.

In addition, the study sample was relatively homogenous. The prevalence of severe obesity is roughly equal in males and females; however, around 80% all of bariatric patients are female (Santry et. al., 2005), a finding that was consistent in the present sample. It has been suggested that this difference in sex distribution is influenced, in part, by motivations for seeking bariatric surgery. For example, males report medical conditions and health concerns as their primary reason for seeking surgery, whereas females report appearance as their primary motivation (Libeton, 2004). Females also report greater body image concerns and psychological disorders than males (Kochkodan, Telem & Ghaferi, 2018). Additionally, ethnic minorities and individuals of low socioeconomic status are underrepresented in bariatric samples, including the present one, even though these groups experience the highest rates of obesity and obesity-related medical comorbidities (Flegal, Carroll, Kit, & Ogden, 2012; Ogden et al., 2014). Further, some studies have shown poorer weight loss outcomes for these groups (e.g., Bayham, Bellanger, Hargroder, Johnson, & Greenway, 2012; Elli et al., 2016). Increasing diversity in bariatric samples would improve generalizability of findings to the broader obesity population, and encourage the identification of additional differences in motivation for, and outcomes following, surgery, which could inform patient education and intervention efforts.

This research also benefits from a number of strengths, including the prediction of postsurgical outcomes beyond 1 year. Although 2 years is still considered short-term follow-up, given the changes that occur for patients after they plateau around 1 year, follow-up beyond that time point is beneficial (Rutledge et al., 2011; Courcoulas et al., 2013). In addition, the use of psychometrically sound self-report measures and the examination of objective weight outcomes using several different definitions are also noted strengths. Furthermore, this is the first study of a bariatric psychosocial assessment tool that examined multiple aspects of its psychometric properties, including factor structure. Finally, the fact that the primary investigator scoring patient charts using the BIPASS tool was blinded to both the team decision regarding presurgical psychosocial risk status and outcomes postsurgery limited bias during the scoring process, which increases validity of the results.

Clinical Implications

The motivation behind developing the BIPASS tool was to enhance the consistent identification of psychosocial risk factors for poor outcomes following bariatric surgery that are amenable to treatment, with the ultimate goal of improving long-term health and quality of life for patients. In this study, the BIPASS demonstrated excellent inter-rater reliability, indicating that this tool does hold promise for standardizing the presurgical psychosocial assessment process. In addition, the cutoff score derived from this study will allow clinicians to quickly communicate level of risk and provide a means to further explore the predictive validity of the tool. It is important to note that while the present study contributed to the validation of the BIPASS tool, there are several recommendations for further exploration of its reliability and validity that should be undertaken before firm conclusions can be drawn that will inform patient care (see Future Directions below). Therefore, the discussion of clinical implications should be interpreted as hypotheses for further exploration.

Although many of the study hypotheses were not supported, and findings are in need of replication, results can still be used to explore clinical decision-making and treatment planning for bariatric surgery patients. Indeed, the current research suggests that patients with higher presurgical psychosocial risk are more likely to experience problematic eating and poorer health-related quality of life early in the postsurgical course. These data suggest that these issues can be anticipated, in part, during the presurgical evaluation, and potentially reduced through education and intervention. Specifically, this knowledge might allow clinicians to manage patient expectations about the benefits of surgery, and to impress upon certain at-risk individuals the importance of attending follow-up appointments, and of engaging in team recommendations and interventions in order to improve outcomes.

For example, it will be important to provide patients with high psychosocial risk access to effective treatments for problematic eating. Cognitive Behavioural Therapy (CBT) has the greatest empirical support for reducing problematic eating in bariatric patients, although the literature is still nascent (Kalarchian & Marcus, 2015). CBT techniques, as applied to bariatric patients, typically focus on restructuring unhelpful thoughts and behaviors that perpetuate the cycle of problematic eating patterns, as well as teaching alternative coping skills, so that food is not used as a strategy to regulate emotions (Whiteside, Chen, Neighbors, Hunter, Lo, & Larimer, 2007). Specific cognitive and behavioural skills might include preparing and eating meals and snacks at regular time intervals, scheduling pleasurable activities as alternatives to eating, planning for difficult eating situations, and reducing susceptibility to emotional overeating through problem solving and by challenging unhelpful thinking (e.g., Abiles et al., 2013; Cassin et al., 2013; Gade, Hjelmesæth, Rosenvinge, & Friborg, 2014; Leahey, Crowther, & Irwin, 2008; Lier et al., 2012). Several studies have demonstrated that CBT delivered either pre or postsurgery has positive effects on eating pathology and adherence to dietary guidelines in bariatric patients, as well as on depressive symptoms (Beaulac & Sandre, 2015; Cassin et al., 2013; Gade et al., 2014; Leahey et al., 2008; Papalazarou et al., 2009). However, CBT is not routinely offered in all bariatric programs, and patients who do receive CBT are typically not targeted for treatment because they are experiencing problematic eating behaviours. Thus, the BIPASS could be used to identify patients at increased risk of experiencing difficulty with eating postsurgery and who are likely to benefit from CBT, thereby improving the efficient and appropriate allocation of resources. Given the distress associated with binge eating symptomatology, examining whether the BIPASS is a consistent predictor of this outcome in subsequent studies, and whether allocating additional resources to at-risk patients improves their outcomes, is a worthwhile endeavour. In addition, the benefits of using the BIPASS to identify and treat high-risk patients should be measured relative to the time and cost associated with using the BIPASS.

The present study also emphasizes the importance of addressing Patient Readiness factors in the presurgical evaluation period, as well as devoting bariatric program resources to this component of presurgical care. Which specific Patient Readiness factors should be addressed is dependent on the individual patient, but recommendations and/or interventions might include attendance at in person support groups or online forums, and sessions with a social worker to set goals around finding employment and stable housing, and/or accessing financial supports. Previous research has shown that social support following bariatric surgery is associated with greater postsurgical weight loss (Livhits et al., 2011), and social support groups that provide patients with support, coping skills, and nutritional information have increasingly become essential components of bariatric care. It is even a requirement of the ASMBS that bariatric centres offer postsurgical patient support groups in order to be given the designation of Bariatric Surgery Centre of Excellence (Pratt, McLees, & Pories, 2006). Although the ASMBS does not outline specific topics to include in group sessions, typically they involve discussion about adherence to dietary and physical activity guidelines, coping with emotional issues like anxiety or depression, as well as adjusting to life postsurgery (Livhits et al., 2011). According to the ASMBS guidelines, bariatric support groups are only required postsurgery; however, recent research suggests that additional support during the presurgical period, including offering strategies to increase adherence to surgical guidelines and skills to cope with physical symptoms and psychosocial stressors, is also valued by bariatric patients (Atwood, Friedman, Meisner, & Cassin, 2018).

Patients with a higher risk on Patient Readiness items might also benefit from working with a psychologist to help increase behavioural adherence to various surgical guidelines. Specialized interventions designed to enhance and sustain motivation can be useful with patients undergoing weight loss treatment, either as a means of preparing the patient, or helping them to maintain efforts over the longer term. Motivational interviewing is one such intervention that uses a variety of therapeutic conversational skills to increase readiness for change (Miller & Rollnick, 2013). Motivational interviewing could prove useful in helping bariatric patients to resolve ambivalence about changing certain behaviours (e.g., increasing physical activity, improving eating behaviours), enhance self-efficacy for change, and increase adherence with bariatric team recommendations. Indeed, one study has shown that a single session of motivational interviewing delivered to postsurgical patients led to significant improvements in confidence for change, adherence to dietary guidelines, and binge eating symptomatology at 12 week follow-up (David, Sockalingam, Wnuk, & Cassin, 2016).

In addition to addressing Patient Readiness factors, findings from this study also suggest that in order for patients to fully benefit from the improvement in physical health-related quality of life that significant weight loss usually induces, mental health also needs to be addressed. This appears to be particularly true for women with high psychosocial risk, more so than men. Again, it will be important to elucidate which components of the Mental Health subscale are relevant for each patient and tailor interventions accordingly, but interventions could include empirically supported therapy or pharmacotherapy for common comorbidities, such as depression and anxiety, as well problematic personality traits.

With respect to weight, the BIPASS did not predict outcomes at any time point. Bariatric surgery researchers have invested substantial time and resources into the identification of presurgical predictors of weight outcomes; yet, results have been inconsistent. More recently, the focus of research has shifted towards identifying postsurgical factors that contribute to weight regain (e.g., Kamali et al., 2013; Shukla, He, Saunders, Andrew, & Aronne, 2018). For example, there is compelling research showing that nutritional and lifestyle compliance postsurgery is essential to successful long-term weight management (Colles et al., 2008; Freire et al., 2012;

Magro, Geloneze, Delfini, Pareja, Callejas, & Pareja, 2008; Sjöström, et al., 2004), and that problematic eating patterns and overall caloric intake increase the further out patients get from surgery (Faria, de Oliveira, Lins, & Faria, 2010; Sarwer et al., 2008; Sjöström et al., 2004). Several authors have suggested that once weight regain is detected, a thorough evaluation of contributing factors should be conducted, and appropriate interventions targeting those factors should be delivered (Kamali et al., 2013; Shukla et al., 2018). The BIPASS could complement this process, by identifying patients likely to exhibit postsurgical eating behaviours known to contribute to weight regain. This might facilitate the provision of appropriate intervention before substantial weight regain occurs.

Future Directions

Overall, Aim 1 of the present study adds to the literature on the validity and reliability of the BIPASS tool. With respect to the psychometric properties of the BIPASS, it would be beneficial to revisit the initial item pool in order to determine whether the inclusion of additional items increases the internal consistency of the tool. Improvements in the measurement of certain items (e.g., routinely assessing for the presence of personality traits and disorders using empirically validated measures, documenting persistence of poor knowledge following patient education about excess weight gain), may also increase variability in scores and, thus, inter-item and item-factor correlations. Improving item measurement would allow for further testing of the importance of items, including those that were dropped during the factor analytic process, to the prediction of postsurgical outcomes. Indeed, based on findings from the present research one cannot conclude that *Substance Use, Response Bias and Truthfulness, Knowledge and Understanding of Excess Weight Gain,* and *Expectations for Bariatric Surgery* do not add to the prediction of postsurgical outcomes; rather, one can only conclude that these variables did not perform well statistically in the current study, likely due to measurement error.

In addition, replication of the CFA in a separate sample of bariatric surgery candidates, including those who are assessed but who do not undergo surgery, would increase confidence in the factor structure. Furthermore, convergent and discriminant validity of the BIPASS tool should be examined in relation to measures that have previously been validated in a bariatric population in order to support its construct validity. Lastly, it will be important for future research to test whether inter-rater reliability is as high between bariatric clinicians (as opposed to researchers), particularly clinicians from different disciplines.

Results from Aim 2 of this study should also be replicated using a prospective research design. Scoring psychosocial risk in real time (i.e., as assessments are progressing and cases are discussed in interprofessional rounds) would allow for the inclusion of additional information that was not possible to capture through the retrospective design. This is particularly relevant for more sensitive information that might not be included in a patient's chart in order to avoid misinterpretation or stigmatization, such as personality pathology and response bias. A prospective design would also allow investigators to track treatment planning by the bariatric team both before and after surgery, as well as the extent to which patients engage in recommendations and/or more intensive interventions. Relatedly, it will be necessary for future research to examine whether interventions delivered postsurgery do improve outcomes, particularly for high-risk patients. It will also be important to extend follow-up beyond 2 years, in order to examine predictors of longer-term weight maintenance and regain, and to explore additional outcome variables relevant to long-term health and wellbeing in bariatric patients, including physical activity, adherence to postsurgical dietary guidelines, medical morbidity, body image, and weight-specific measures of quality of life.

The above recommendations would be supported by efforts to increase adherence to follow-up. Several reviews have examined retention strategies characteristic of studies with high adherence rates (i.e., where at least 80% of the sample return for follow-up), and have found that they tend to: 1) utilize multiple contact numbers and enlist the cooperation of family and friends; 2) offer flexible hours and convenient locations; 3) assign one case person to each patient; 4) provide incentives in the form of financial compensation and/or letters of appreciation; and 5) provide reminders by both mail and phone (Robinson et al., 2015). Overall, better retention has been attained in studies that use more than one of these strategies.

Efforts to increase adherence during the postsurgical period have previously been explored by the TWH-BSP. In a study by Santiago and colleagues (2019), several retention strategies were implemented in a quality care initiative, including reminder phone calls and emails approximately 4 weeks prior to scheduled visits, the use of a script to tailor appointments to patients' needs, and an online website of follow-up care information that patients could access. The authors found that advance cancellations increased by 6%, allowing clinicians to increase nonroutine patient appointments, which resulted in $20,000 of cost savings. However, appointment attendance rates increased by only 1.8%. It will be important for future research to continue developing and testing strategies to increase adherence to postsurgical follow-up.

Conclusion

In conclusion, this study found some support for the utility of the BIPASS tool. The BIPASS demonstrated excellent inter-rater reliability and adequate internal consistency for the Total score. However, internal consistency estimates for the subscale scores were poor to adequate, and BIPASS items did not account for a sizeable proportion of the variance in the suitability for surgery construct. Future research should focus on improving the measurement of BIPASS items in order to improve the tool's psychometric properties. The strengths of the BIPASS are its standardization of the presurgical psychosocial evaluation process, as well as its ability to categorize patients by presurgical risk status. This will allow for improved communication and decision-making regarding psychosocial risk among bariatric teams, and will facilitate the further exploration of presurgical predictors of postsurgical outcomes. Findings also provide preliminary support for the predictive validity of the BIPASS tool with respect to binge eating symptomatology and health-related quality of life at 1 year postsurgery. However, the BIPASS did not predict weight outcomes postsurgery. Thus, the BIPASS tool can be used to identify patients at increased risk of certain poor outcomes early in the postsurgical course, thereby facilitating appropriate and efficient interventions.

Appendix A:

Over the last 2 weeks, how often have you been bothered by any of the following problems? Please circle the appropriate number.

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself – or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3
(For staff coding: Total Score _____	=	_____ +	_____ +	_____)
PHQ 9	=	_____	**Reviewed by:**	_____

If you check off any of these problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not at all difficult	Somewhat difficult	Very difficult	Extremely difficult
€	€	€	€

Spitzer, Williams, Kroenke, et al.,1999.

Appendix B: GAD-7

Over the last 2 weeks, how often have you been bothered by any of the following problems? Please circle the appropriate number.

	Not at all	**Several days**	**More than half the days**	**Nearly every day**
1. Feeling nervous, anxious or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

Appendix C: BES

Below are groups of numbered statements. Read all of the statements in each group and **circle the one** that best describes the way you feel about your eating behavior.

1.

1. I don't feel self-conscious about my weight or body size when I'm with others.
2. I feel concerned about how I look to others, but it normally does not make me feel disappointed with myself.
3. I do get self-conscious about my appearance and weight which makes me feel disappointed in myself.
4. I feel very self-conscious about my weight and frequently, I feel intense shame and disgust for myself. I try to avoid social contacts because of my self-consciousness.

2.

1. I don't have any difficulty eating slowly in the proper manner.
2. Although I seem to "gobble down" foods, I don't end up feeling stuffed because of eating too much.
3. At times, I tend to eat quickly and then, I feel uncomfortably full afterwards.
4. I have the habit of bolting down my food, without really chewing it. When this happens I usually feel uncomfortably stuffed because I've eaten too much.

3.

1. I feel capable to control my eating urges when I want to.
2. I feel like I have failed to control my eating more than the average person.
3. I feel utterly helpless when it comes to feeling in control of my eating urges.
4. Because I feel so helpless about controlling my eating I have become very desperate about trying to get in control.

4.

1. I don't have the habit of eating when I'm bored.
2. I sometimes eat when I'm bored, but often I'm able to "get busy" and get my mind off food.
3. I have a regular habit of eating when I'm bored, but occasionally, I can use some other activity to get my mind off eating.
4. I have a strong habit of eating when I'm bored. Nothing seems to help me break the habit.

5.

1. I'm usually physically hungry when I eat something.
2. Occasionally, I eat something on impulse even though I really am not hungry.
3. I have the regular habit of eating foods, that I might not really enjoy, to satisfy a hungry feeling even though physically, I don't need the food.
4. Even though I'm not physically hungry, 1 get a hungry feeling in my mouth that only seems to be satisfied when I eat a food, like a sandwich, that fills my mouth. Sometimes, when I eat the food to satisfy my mouth hunger, I then spit the food out so I won't gain weight.

6.

1. I don’t feel any guilt or self-hate after I overeat.
2. After I overeat, occasionally I feel guilt or self-hate.
3. Almost all the time I experience strong guilt or self-hate after I overeat.

7.

1. I don’t lose total control of my eating when dieting even after periods when I overeat.
2. Sometimes when I eat a “forbidden food” on a diet, I feel like I “blew it” and eat even more.
3. Frequently, I have the habit of saying to myself, “I’ve blown it now, why not go all the way” when I overeat on a diet. When that happens I eat even more.
4. I have a regular habit of starting strict diets for myself, but I break the diets by going on an eating binge. My life seems to be either a “feast” or “famine.”

8.

1. I rarely eat so much food that I feel uncomfortably stuffed afterwards.
2. Usually about once a month, I eat such a quantity of food, I end up feeling very stuffed.
3. I have regular periods during the month when I eat large amounts of food, either at mealtime or at snacks.
4. I eat so much food that I regularly feel quite uncomfortable after eating and sometimes a bit nauseous.

9.

1. My level of calorie intake does not go up very high or go down very low on a regular basis.
2. Sometimes after I overeat, I will try to reduce my caloric intake to almost nothing to compensate for the excess calories I’ve eaten.
3. I have a regular habit of overeating during the night. It seems that my routine is not to be hungry in the morning but overeat in the evening.
4. In my adult years, I have had week-long periods where I practically starve myself. This follows periods when I overeat. It seems I live a life of either “feast or famine.”

10.

1. I usually am able to stop eating when I want to. I know when “enough is enough.”
2. Every so often, I experience a compulsion to eat which I can’t seem to control.
3. Frequently, I experience strong urges to eat which I seem unable to control, but at other times I can control my eating urges.
4. I feel incapable of controlling urges to eat. I have a fear of not being able to stop eating voluntarily.

11.

1. I don’t have any problem stopping eating when I feel full.
2. I usually can stop eating when I feel full but occasionally overeat leaving me feeling uncomfortably stuffed.
3. I have a problem stopping eating once I start and usually I feel uncomfortably stuffed after I eat a meal.
4. Because I have a problem not being able to stop eating when I want, I sometimes have to induce vomiting to relieve my stuffed feeling.

12.

1. I seem to eat just as much when I'm with others (family, social gatherings) as when I'm by myself.
2. Sometimes, when I'm with other persons, I don't eat as much as I want to eat because I'm self-conscious about my eating.
3. Frequently, I eat only a small amount of food when others are present, because I'm very embarrassed about my eating.
4. I feel so ashamed about overeating that I pick times to overeat when I know no one will see me. I feel like a "closet eater."

13.

1. I eat three meals a day with only an occasional between meal snack.
2. I eat 3 meals a day, but I also normally snack between meals.
3. When I am snacking heavily, I get in the habit of skipping regular meals.
4. There are regular periods when I seem to be continually eating, with no planned meals.

14.

1. I don't think much about trying to control unwanted eating urges.
2. At least some of the time, I feel my thoughts are pre-occupied with trying to control my eating urges.
3. I feel that frequently I spend much time thinking about how much I ate or about trying not to eat anymore.
4. It seems to me that most of my waking hours are pre-occupied by thoughts about eating or not eating. I feel like I'm constantly struggling not to eat.

15.

1. I don't think about food a great deal.
2. I have strong cravings for food but they last only for brief periods of time.
3. I have days when I can't seem to think about anything else but food.
4. Most of my days seem to be pre-occupied with thoughts about food. I feel like I live to eat.

16.

1. I usually know whether or not I'm physically hungry. I take the right portion of food to satisfy me.
2. Occasionally, I feel uncertain about knowing whether or not I'm physically hungry. At these times it's hard to know how much food I should take to satisfy me.
3. Even though I might know how many calories I should eat, I don't have any idea what is a "normal" amount of food for me.

Appendix D: SF-36 version 2.0

This survey asks for your views about your health. This information will let us know how you feel and how well you are able to do your usual activities.

Answer every question by <u>checking</u> the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

	Excellent	**Very Good**	**Good**	**Fair**	**Poor**
1. In general would you say your health is:	1	2	3	4	5

	Much better now than 1 year ago	**Somewhat better now than 1 year ago**	**About the same now as 1 year ago**	**Somewhat worse now than 1 year ago**	**Much worse now than 1 year ago**
2. Compared to **1 year ago**, how would you say your health in general is now?	1	2	3	4	5

3. The following items are about activities you might do during a typical day. **<u>Does your health now limit you</u>** in these activities? If so, how much?

<u>Activities</u>	**Yes, limited a lot**	**Yes, limited a little**	**No, not limited at all**
a. Vigorous activities, such as running, lifting heavy objects, or participating in strenuous sports	1	2	3
b. Moderate activities, such as moving a table, pushing a vacuum, cleaning, bowling, or golfing	1	2	3
c. Lifting or carrying groceries	1	2	3
d. Climbing several flights of stairs	1	2	3
e. Climbing one flight of stairs	1	2	3
f. Bending, kneeling or stooping	1	2	3
g. Walking more than a mile	1	2	3
h. Walking several blocks	1	2	3
i. Walking one block	1	2	3
j. Bathing or dressing yourself	1	2	3

4. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health**?

	Yes	No
a. Cut down the amount of time you spend on work or other activities	1	2
b. Accomplished less than you would like	1	2
c. Were limited in the kind of work or other activities	1	2
d. Had difficulty performing the work or other activities (e.g., it took extra effort)	1	2

5. During the **past 4 weeks**, have you had any of the following problems with work or daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?

	Yes	No
a. Cut down the amount of time you spend on work or other activities	1	2
b. Accomplished less than you would like	1	2
c. Didn't do work or other activities as carefully as usual	1	2

	Not at all	Slightly	Moderately	Quite a bit	Extremely
6. During the **past 4 weeks**, to what extend have your physical health or emotional problems interfered with your normal **social activities** with family, friends, neighbours, or groups?	1	2	3	4	5

	None	Very mild	Mild	Moderate	Severe	Very severe
7. How much **bodily pain** have you had during the **past 4 weeks**?	1	2	3	4	5	6

	Not at all	A little bit	Moderately	Quite a bit	Extremely
8. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including work outside the home and housework)?	1	2	3	4	5

9. These questions are about how you feel and how things have been during the **past 4 weeks**.

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of pep?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and blue?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
10. During the **past 4 weeks**, how much of the time has your **physical health or emotional problems** interfered with your social activities (like visiting with friends, relatives, etc.)?	1	2	3	4	5

11. How **true** or **false** is each of the following statements to you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a. I seem to get sick a little easier than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

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