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Philadelphia College of Osteopathic Medicine

School of Professional and Applied Psychology

Department of Clinical Psychology

THE ASSOCIATION BETWEEN BODY ESTEEM AND POST-OPERATIVE OUTCOMES IN ADULT WEIGHT-LOSS SURGERY PATIENTS

By Jennifer Rohr Swetkowski

Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Psychology

November 2019

PCOM SCHOOL OF PROFESSIONAL AND APPLIED PSYCHOLOGY™

DISSERTATION APPROVAL

This is to certify that the thesis presented to us by Jennifer Rohr Swetkowski on the 16th day of July, 2020, in partial fulfillment of the requirements for the degree of Doctor of Psychology, has been examined and is acceptable in both scholarship and literary quality.

COMMITTEE MEMBERS' SIGNATURES

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ABSTRACT

Bariatric surgery (weight-loss surgery) remains the most effective long-term treatment for obesity, resulting in improved obesity-related comorbidities and increased life expectancy. There remains, however, a limited understanding of predictors and patient-level factors associated with insufficient weight loss and psychological dysfunction. Body esteem, or feelings of self-worth about one's body and appearance, is a significant concern for individuals undergoing weight-loss surgery, although the relationship between body esteem and weight loss is complex. Indeed, there is a subset of patients who experience suboptimal weight loss and poor psychological outcomes after undergoing bariatric surgery. This retrospective, longitudinal study examined the relationship between pre-operative body esteem and post-operative outcomes, including weight change, post-operative body esteem, depressive symptoms, and adherence to the post-operative diet and vitamin regimen, at one year. Results indicated that body esteem and depressive symptoms improve following weight-loss surgery, although level of pre-operative body esteem did not predict weight change or adherence to the post-operative diet and vitamin regimen. This study did not directly connect body esteem to weight loss following surgery, although improved body esteem could be important for optimizing post-operative psychological health and weight loss. These findings may lend support to patient and provider decisions in clinical care for bariatric surgery and potentially improve post-surgical outcomes.

CHAPTER 1: INTRODUCTION

Statement of the Problem

Obesity is a global health problem that has reached epidemic proportions. Obesity, generally defined by a body mass index (BMI) ≥ 30 kg/m2, refers to excessive fat accumulation that results from a consistently greater energy intake than expenditure that presents a risk to health (Tsai, Carvajal, Egner, & Wadden, 2010). Currently, more than 39% of the world's population is overweight and approximately 13% lives with obesity (World Health Organization, 2015). In the United States, the prevalence of obesity has increased to over 39% in adults and is greatest among women and minority groups, namely those of African-American and Hispanic origin (Hales, Fryar, Carroll, Freedman, & Ogden, 2018). In fact, in 2013 the American Medical Association officially classified obesity as a disease (American Medical Association, 2013). Furthermore, the World Health Organization set obesity as one of its major global health targets in the 2013 World Health Assembly (World Health Organization, 2013).

The etiology of obesity is complex and manifests from a combination of genetic, physiological, psychological, cultural, and socioeconomic factors. Its principle cause, however, is an interaction of genetic and environmental factors characterized by an energy imbalance, namely the excessive accumulation and storage of fat in the body that contributes to weight gain, secondary to excessive intake of calories (Plourde & Prud'homme, 2012). In American culture, a "toxic" food environment and exposure to high calorie, low nutrient, inexpensive foods that are readily accessible promotes dietary excess (Brownell, 2005). A progressively sedentary lifestyle among individuals in which there is a decrease in physical activity further contributes to obesity.

The negative impact of obesity on public health and related health care expenditure is considerable (Farran, Ellis, & Barron, 2013). The Centers for Disease Control and Prevention (2014) estimated that the annual medical cost of obesity in the United States is approximately $147 billion, which constitutes a severe societal and economic crisis. Obesity is a major risk factor for premature death and chronic conditions, such as hypertension, hypercholesterolemia, Type II diabetes, metabolic syndrome, osteoarthritis, obstructive sleep apnea, and depression, and is associated with diminished quality of life (Tsai et al., 2010; Plourde & Prud'homme, 2012). Consequently, the per capita medical costs are more than 40% higher for individuals with obesity compared to those of normal weight and are expected to increase (Finkelstein, Trogdon, Cohen, & Dietz, 2009).

In 2012, the U.S. Preventive Services Task Force (USPSTF) updated its recommendation to screen all adults for obesity and directs clinicians to offer or refer patients with a BMI of ≥ 30 kg/m2 to intensive, multi-component behavioral interventions (Moyer, 2012). Effective behavioral treatment can be provided in primary care settings, specialized weight management clinics, community-based programs, or through referral to a nutritionist or evidence-based commercial program (Carvajal, Wadden, Tsai, Peck, & Moran, 2013). Generally, individuals with obesity are advised by health care professionals to reach and maintain a healthy weight. Behavioral weight-loss programs typically involve caloric restriction and increased physical activity (Jensen at al., 2014). Specifically, lifestyle interventions to influence behavior change target modification of diet and physical activity through strategies that may include elevating motivation, setting manageable weight-loss and nutrition goals, addressing barriers, changing of beliefs and expectations, and providing guidance in the use of self-monitoring skills (Teixeira et al., 2015).

Pharmacological treatment of obesity may also be considered in patients with obesity, although drug therapies are typically recommended concomitantly with behavioral strategies, diet, physical activity, and psychological support (Fujioka, 2002; Pereira & Astorga, 2005). Research suggests there are systematic barriers that preclude use of pharmacological options and involve physician, patient, and health care system factors (Thomas, Mauer, Shukla, Rathi, & Aronne, 2016). More specifically, obstacles such as low recognition of obesity as a chronic disease that requires medical care, limited prescription coverage of obesity treatment (it is estimated that a third of health insurance plans do not reimburse obesity drugs at all), limited training of health care providers, weight bias toward patients with obesity, and a disconnect between expected and actual effectiveness of treatment may limit the adoption of pharmacotherapy in the treatment of obesity (Kyle & Stanford, 2016). Moreover, the medication may be ineffective or associated with adverse events or significant safety concerns and requires continual medical monitoring (Yanovski & Yanovski, 2014). Evidence suggests that if a patient does not lose at least 5% of excess weight after 12 weeks of appropriately dosed drug therapy, the costs of continuing pharmacological therapy may exceed the benefit to the patient (Yanovski & Yanovski, 2014).

Lifestyle interventions are currently the first recommended strategies in obesity management of adults (Jensen et al., 2014). Most behavioral interventions include multiple behavioral management activities, such as individual or group sessions that strategize on maintaining lifestyle changes (Moyer, 2012). Research indicates that in the short term (12 to 26 sessions), these programs are effective, with individuals losing approximately 6% of their baseline weight within the first year (Moyer, 2012). A 5% reduction in weight is considered clinically significant by the U.S. Food and Drug Administration (FDA) and demonstrates improvement in intermediate health outcomes, such as blood pressure, glucose tolerance, and weight circumference. Evidence suggests, however, that relatively little weight loss and associated health benefits achieved in most behavioral weight-loss programs is maintained beyond one year (Wing & Hill, 2001).

When behavioral modification or pharmacological therapy for weight loss results in limited long-term efficacy, bariatric surgery (i.e., weight-loss surgery) may be considered for patients with severe obesity (BMI $\geq$ 40 kg/m2 or 35 kg/m2 with comorbidities). Bariatric surgery remains the most effective long-term treatment for patients with severe obesity (Sjöström, 2013). Despite the demonstrated effectiveness of bariatric surgery for weight loss, the reliability and predictability of weight loss in patients undergoing bariatric surgery remains uncertain. While many patients experience significant weight loss following surgery, some are unable to achieve, or sustain, weight loss (Courcoulas et al., 2014). Insufficient weight loss is a weight loss of less than 50% of excess weight (%EWL = [(Initial Weight) – (Post-op Weight)] / [(Initial Weight) – (Ideal Weight)]) (Brethauer et al., 2015) one year after surgery, while weight regain (there is no generally accepted definition) is an increase in weight after initially successful weight loss (Maleckas, Gudaitytė, Petereit, Venclauskas, & Veličkienė, 2016). It is estimated that approximately 20% to 30% of bariatric surgery patients regain some or all of their initial weight loss approximately two years after surgery (Wimmelmann, Dela, & Mortensen, 2014). This weight recidivism has important health consequences including the recurrence of obesity-related comorbidities (Wimmelmann et al., 2014). Currently, there is a poor understanding of patient-level factors associated with insufficient weight loss over the long term (Courcoulas et al. 2013).

The many life changes that occur around bariatric surgery pose unique social, psychological, and lifestyle challenges. Bariatric surgery is clinically proven to be an effective intervention for managing weight loss and associated comorbidities in individuals with obesity, although there remains limiting understanding of the impact on psychological health (Kubik, Gill, Laffin, & Karmali, 2013). Knowledge of psychosocial factors such as body image, body esteem, and depressive symptoms may lend insight into differential post-surgical weight loss outcomes among bariatric surgery patients. Pre- and post-operative psychological assessment of emotional status related to weight-loss surgery expectations and the potential risk of self-destructive behavior leading to weight regain is warranted.

Body image and body esteem, or feelings of self-worth about one's body and appearance, are significant concerns for many patients undergoing weight-loss surgery (Madan, Beech, & Tichansky, 2008). Indeed, population studies indicate that body dissatisfaction rises as individuals become increasingly overweight (Schwartz & Brownell, 2004). In addition, some patients continue to struggle with weight loss, maintenance and regain, depression, and poor body image after undergoing bariatric surgery (Kubik et al. 2013). Further research is needed to investigate whether pre-operative factors can predict a clinically meaningful difference in weight loss after bariatric surgery (Livhits et al., 2012). Identifying individual-level predictive factors may help with development of interventions to target specific needs of bariatric surgery patients to optimize weight loss.

Purpose of the Study

Although it may seem evident that patients will feel better about their bodies after bariatric surgery, this may not be the reality (Wimmelmann et al., 2014). There is a subset of patients who experience suboptimal outcomes, namely less than expected weight loss and notable weight regain. Weight regain is an important issue after bariatric surgery and is considered a long-term complication as weight regain can lead to recurrence of obesity-related conditions and impaired quality of life (Karmali et al., 2013). Pre-operative psychoeducation may affect patient expectations and ability to prevent weight regain (Madan, Tichansky, & Taddeucci, 2007). Few studies have analyzed which bariatric surgical patients, and by which mechanisms, are more likely to lose or regain weight following surgery (Karmali et al., 2013). More research is needed in this field to understand lifestyle and mental health factors that drive weight regain after bariatric surgery (Maleckas et al., 2016). In turn, further research is required to explore how weight regain may be prevented, rather than treated.

Currently, there is a limited understanding of how to predict which bariatric surgical patients are likely to comply with post-operative recommendations and achieve weight-loss goals (Teixeira et al., 2015). Despite the effectiveness of weight-loss surgery in reducing obesity-related comorbidities, information regarding persisting psychological issues after surgery is lacking (Jumbe et al., 2017). There is need for research that identifies psychosocial and behavioral predictors of long-term weight control, including successful weight loss and maintenance, to better inform patient care and patient-provider discussions about post-operative expectations.

The purpose of this retrospective, longitudinal study was to examine the relationship between pre-operative body esteem and post-operative outcomes, including weight change, change in level of body esteem, adherence to the prescribed vitamin and diet regimen, and depressive symptoms. Promising interventions such as bariatric surgery for obesity require long-term commitment and evaluation; patients must be prepared to engage in comprehensive lifestyle changes. The strategies and behavioral changes identified as most effective to improve bariatric surgery outcomes would be integrated into future interventions and health care professionals would be appropriately trained on how to regularly implement these techniques within their practices. Obesity is a complex, chronic disease and its successful treatment requires improved understanding of the predictors, psychological experience, and underexplored variability involved in long-term weight management (Jumbe et al., 2017). Moreover, research to examine whether the efficacy of bariatric surgery may be further enhanced by implementing behavioral and lifestyle-modification techniques in the management of patients is warranted. Improved weight change and mental health outcomes following bariatric surgery will have substantial clinical and public health relevance.

Hypotheses

Hypothesis 1: Body esteem, as measured by total Body Esteem Scale for Adolescents and Adults (BESAA) scores during the pre-operative period, will predict change in weight at one year following bariatric surgery.

Hypothesis II: Body esteem will have improved significantly preoperatively to one-year postoperatively as measured by total BESAA scores.

Hypothesis III: There is an inverse relationship between pre-operative body esteem scores as measured by the total BESAA and depression scores as measured by the Beck Depression Inventory (BDI) at one year following weight-loss surgery.

Hypothesis IV: Pre-operative body esteem scores as measured by the BESAA will predict level of adherence to the post-operative diet and vitamin regimen as measured by blood nutrient laboratory values at one year following weight-loss surgery.

CHAPTER 2: REVIEW OF THE LITERATURE

Bariatric Surgery and Weight Loss

Bariatric surgery includes a variety of procedures and remains the most effective treatment for patients with severe obesity (i.e., BMI ≥ 40 kg/m2 or BMI ≥ 35 kg/m2 with certain comorbid conditions), resulting in improved obesity-related comorbidities and increased life expectancy (Adams et al., 2012; Pope, Finlayson, Kemp, & Birkmeyer, 2006; Sjöström et al., 2004). The various types of bariatric procedures include Roux-en-Y gastric bypass (RYGB), laparoscopic adjustable gastric banding (LAGB), vertical banded gastroplasty (VBG), duodenal switch, biliopancreatic diversion (BPD), and sleeve gastrectomy (SG). The mean percentage of weight loss by procedure is 61.6% (56.7%-66.5%) for RYGB, 47.5% (40.7%-54.2%) for LAGB, 68.2% (61.5%-74.8%) for VBG, and 70.1% (66.3%-73.9%) for BPD or duodenal switch (Buchwald et al., 2004). For SG, the median percentage weight loss at five years is 59%, and 53.9% at eight years (Gadiot et al., 2017). A recent systematic review suggests that bariatric surgery has significant and sustained effects on weight loss and substantially reduces obesity-related comorbidities for the majority of bariatric surgery patients, including Type 2 diabetes, hypertension, hyperlipidemia, and sleep apnea (Chang et al., 2014).

Evidence from comparative effectiveness trials and large, long-term observational studies has revealed that all bariatric procedures result in greater weight loss than any lifestyle intervention or medical treatment at both short- and long-term (>5 years) follow up (Courcoulas et al., 2014). Accordingly, the number of bariatric surgeries performed has risen 14-fold in recent years (Finucane et al., 2011; Santry, Gillen, & Lauderdale, 2005). Weight loss is achieved by reducing the size of the stomach with restrictive techniques including inserting a gastric band, removing a portion of the stomach, or by resecting and re-routing the small intestine to a small stomach pouch. The RYGB and LAGB had accounted for most of the bariatric surgical procedures performed in the United States over the last decade (Mitchell et al., 2014), with SG now the most popular procedure (Khorgami et al., 2017).

Consensus among researchers regarding criteria for success in the surgical treatment of obesity is a minimum loss of 50% of excess weight and long-term weight maintenance (Brolin, 2002). In general, bariatric surgery patients will lose approximately 50% to 70% of excess weight within the first year after surgery. Two-year follow-up results have demonstrated an approximate 59% loss of excess body weight (Buchwald et al., 2009). Longer term, large observational studies have shown sustained (>5 years) weight loss with bariatric surgery (Courcouras et al., 2014). Moreover, long-term study results up to 10 years post-surgery suggest that a maintained weight loss of approximately 10% is adequate for long-term benefits on health-related quality of life (Karlsson, Taft, Ryden, Sjöström, & Sullivan, 2007).

Most patients will reach their weight-loss nadir and regain some weight at approximately 18 to 24 months postoperatively (0-15% initial body weight; Courcoulas et al., 2013; Still et al., 2014). The reasons for this regain may be physiological (e.g., return to set point) or behavioral (e.g., adherence to diet). Some patients, however, will regain more than 10% to 15% body weight, and this weight regain is believed to largely relate to behavioral factors that may indicate difficulties with adherence, such as food-related urges and substance use (Odom et al., 2010).

There are pre-operative patient level factors that appear to be predictive of weight loss after bariatric surgery. Research indicates that a higher pre-operative BMI is associated with less weight loss after bariatric surgery (Livhitz et al., 2012; Still et al., 2014). Other pre-operative patient factors that are predictive of weight loss, namely age and biological sex, cannot be modified. Research findings suggest that patients greater than 50 years of age when undergoing weight-loss surgery have both poorer short- and long-term weight loss (Still et al., 2014; Wood et al., 2016). It is speculated that greater weight loss among younger patients may be related to their increased physical mobility and decreased comorbidity rates (Herpertz et al., 2003). Biological sex also appears to be predictive of weight loss following bariatric surgery, with males losing more weight, on average, than females (Dallal, Quebbemann, Hunt, & Braitman, 2009; Ma et al., 2006).

Research suggests there are key nutritional and physical activity recommendations to promote health and weight-loss after bariatric surgery. The consensus of The American Association of Clinical Endocrinologists, The Obesity Society, and The American Society for Metabolic & Bariatric Surgery, and others is that patients should be advised to 1) avoid foods and beverages high in fat and simple sugar to prevent dumping syndrome, 2) reduce consumption of dry or stringy foods such as red meat to prevent blockage complications, 3) increase fruit and vegetable intake to at least five servings a day for added fiber and nutrients, 4) eat the appropriate amount of protein to avoid deficiencies, and 5) reduce intake of all high calorie foods to maximize weight loss (Mechanick et al., 2008). These recommendations may guide initial food choices, although research suggests that compliance with directives after bariatric surgery may decrease over time and only a small number of patients receive any dietetic follow-up at all (Harbottle, 2011). Therefore, continual monitoring and identification of high-risk eating patterns after surgery and the development of supportive post-operative interventions are important to optimize surgical outcomes for bariatric patients (Wimmelmann et al., 2014).

The literature varies on the contribution of physical activity toward weight loss following bariatric surgery and there is no consensus on the amount of exercise required to maintain weight loss over time (Okay, Jackson, Marcinkiewicz, & Papino, 2009). However, guidelines developed by the NHLBI Obesity Education Initiative Expert and the U.S. Preventive Services Task Force recommend at least 30 minutes of daily aerobic activity (i.e., 2,500 to 3,000 kcal per week) to foster weight loss and reduce associated comorbidities (Okay et al., 2009).

Obesity and Psychosocial Functioning

Although a primary goal of bariatric surgery is to improve, resolve, and prevent medical comorbidities, the improvement of psychological functioning is also important. Psychological distress is a major issue for individuals with obesity, although the impact of weight-loss surgery on psychological health is unclear (Kubik et al., 2013). Not all patients report psychological benefits after bariatric surgery and some patients continue to struggle with weight loss, maintenance, and regain.

Research suggests that depressive symptoms and mood disorders are commonly seen among adults with severe obesity (Rydén & Torgerson, 2006). For individuals seeking weight-loss surgery, significant psychopathology is reported, with a lifetime prevalence of 84% reporting major mental disorders (Herpertz et al., 2003). Moreover, stigmatization toward individuals with obesity is well established, with several decades of research showing that weight-based stigma, prejudice, and discrimination are pervasive across many life domains, including employment, health care, education, media, public accommodations, interpersonal relationships, and the home environment (Puhl & Heuer, 2009). Research indicates a consistent association between experiences of weight stigma and adverse mental health consequences such as an increased risk for depression, body dissatisfaction, and weight-related health behaviors like binge eating, increased caloric consumption, and avoidance of physical activity (Himmelstein, Puhl, & Quinn, 2018; Puhl & Suh, 2015). Furthermore, higher perceived weight stigma before bariatric surgery is related to less weight loss one year after surgery (Lent et al., 2014), which may relate to motivational challenges to change behavior when feeling negatively evaluated.

Weight-loss Surgery and Body Esteem/Body Image

Body image and body esteem, or feelings of self-worth about one's body and appearance, are significant concerns for individuals with obesity. Individuals with obesity are likely to report dilemmas with body esteem and body image (Madan et al., 2008; Schwartz & Brownell, 2004). Body image has been defined in several ways, although it commonly refers to thoughts, feelings, and perceptions associated with the body and bodily experience (Cash & Pruzinsky, 1990). Body esteem, or feelings of self-worth about one's body and appearance, is a more global, multi-dimensional construct and is determined by a combination of feelings and cognitions across several domains, including appearance, weight satisfaction, and attributions of positive evaluations about one's body and appearance to others (Mendelson, Mendelson, & White, 2001).

Few studies have investigated the body esteem of patients after weight loss surgery (Madan et al., 2008). Although Madan et al. (2008) demonstrated that body esteem improves following bariatric surgery, the study had several limitations. First, the study compared pre-operative patients with a different group of post-operative patients, prohibiting longitudinal comparisons of the same individuals over time. Additionally, post-operative patients were asked to recall how they would have responded to the Body-Esteem Scale for Adolescents and Adults (BESAA) questionnaire before surgery, which may have biased the results. Moreover, the sample size was small (n= 27), which did not allow for correlation of BESAA scores with weight loss. Finally, the study did not collect data regarding comorbidities or depressive symptoms, which could have skewed results.

Body image dissatisfaction has been identified as a psychological correlate of obesity (Latner, 2012; Sarwer & Steffen, 2015; Sarwer, Wadden, & Foster, 1998). Not all studies with individuals with obesity, however, find a relationship between BMI and body dissatisfaction (Adami, Meneghelli, Bressani, & Scopinaro, 1999; Sarwer, Thompson, & Cash, 2005). This lack of consistent association suggests that, besides being overweight, other factors may influence body image in assessing dissatisfaction with weight and shape. This complex relationship between body image and BMI warrants further investigation.

Most individuals report some specific concerns with their appearance. Among individuals with obesity, research indicates that there is variation across gender and ethnicity related to body image satisfaction. Findings among bariatric surgery candidates with extreme obesity suggest that women report significantly higher body dissatisfaction than men (Grilo, Masheb, Brody, Burke-Martindale, & Rothschild, 2005). Among women with obesity, it is reported that nearly half (47%) are most dissatisfied with their waist and abdomen (Sarwer et al., 1998). With regards to ethnicity, research demonstrates that compared to African-American women, Caucasian women report greater body image dissatisfaction (Sarwer, Dilks, & Spitzer, 2011).

Although some body image dissatisfaction among people with obesity is typical in Western society because of its emphasis on the “thin ideal” body type, an excessive dissatisfaction with body image may indicate significant psychological distress. Research demonstrates that significantly more women with obesity than women of healthy weight report camouflaging their body with clothing, becoming upset when contemplating their appearance, and avoid looking at their bodies (Sarwer et al., 1998). Many studies have reported body image satisfaction improves after bariatric surgery, however a significant number of individuals continue to report body image concerns such as scarring or the undesirable hanging skin that often results from significant weight loss (Kubik et al., 2013). These body image concerns are linked to increased depressive symptoms and decreased self-esteem in bariatric populations (Pona, Heinberg, Lavery, Ben-Porath, & Rish, 2016). Furthermore, research has demonstrated that for patients with obesity, some changes in body image are accounted for by their overweight status, while other changes reflect distressing internal struggles such as a preoccupation with body weight and shape and self-disparagement (Adami et al., 1999).

Weight-loss Surgery and Depression

While bariatric surgery is an effective treatment modality for people with obesity to achieve weight loss, there is limited understanding of its influence on psychological functioning. Psychological distress such as depression is important to measure before and after surgery since it may contribute greatly to patients’ overall well-being and ability to remain adherent to the recommended postoperative lifestyle (Kubik et al., 2013). Psychological evaluation of patients with obesity seeking bariatric surgery is particularly critical as this population has a higher prevalence of depressive symptomology compared to individuals with obesity in the community (Yusufov et al., 2017). Study findings suggest that self-esteem may help explain the relationship between BMI and depression or suicidality in bariatric surgery candidates, particularly for men. Additionally, it has been reported that antidepressants are the most frequently prescribed type of medication in the bariatric patient population (Cunningham et al, 2012).

Research suggests that pre-operative psychopathology may independently predict surgical weight loss (Wimmelmann et al., 2014). In other words, post-operative health behavior may be influenced by pre-operative levels of psychopathology leading to suboptimal weight loss. Research also suggests that the presence of depression following weight-loss surgery predicts a decrease in post-operative improvements such as depression and body image (Jumbe, Hamlet, & Meyrick, 2017). Alternatively, psychological distress secondary to obesity is likely to decrease with weight loss, which may contribute to better long-term weight loss maintenance. A recent meta-analysis, however, found no clear evidence to support a relationship between pre-operative mental health conditions, namely depression and binge-eating disorder, and post-operative weight loss (Dawes et al., 2016). Thus, additional research is required to better understand whether pre- or post-operative mental status may be a better indicator of long-term weight loss.

Research has shown that having a pre-operative diagnosis of depression is positively correlated with missed appointments following bariatric surgery, which may lead to unsatisfactory weight loss outcomes (Toussi, Fujioka, & Coleman, 2009). Moreover, pre-operative depressive symptoms can potentially affect post-operative patient expectations of weight loss and quality of life (Toussi et al., 2009). For example, some patients react negatively to unmet expectations of weight loss or unseemly skin changes which can precipitate, or worsen, depression. Lent et al. (2014) found that greater internalized weight bias was associated with more depressive symptoms prior to bariatric surgery as well as with less weight loss one year after surgery.

There is moderate quality evidence to support an association between bariatric surgery and lower rates of post-operative depression (Dawes et al., 2016). In addition, research indicates that depressive symptoms generally improve for bariatric patients in the year following weight-loss surgery compared to patients with obesity treated with diet and exercise (Karlsson, Sjöström, & Sullivan, 1998). Meta-analyses have further strengthened the association between bariatric surgery and decreased depression among patients post-operatively (Herpertz et al., 2003; Dawes et al., 2016). Research suggests that individuals with severe obesity, especially younger women with poor body image, have sustained improvement in depression, as measured by the Beck Depression Inventory, following weight-loss surgery (Dixon, Dixon, & O'brien, 2003). The extent of mental health improvement in bariatric surgery patients may also be related to the amount of weight loss achieved (Karlsson et al., 1998). Research suggests that depressive symptoms are significantly related to negative changes in BMI (Mitchell et al., 2014). Conversely, post-operative weight regain has been associated with increased depression (Bocchieri, Meana, & Fisher, 2002).

A small subset of bariatric patients reports minimal or no improvement in mood following weight loss surgery (van Hout, Boekestein, Fortuin, Pelle, & van Heck, 2006). Research shows that some patients may be dissatisfied with their weight loss and other patients may recognize that their existing issues are still problematic and can no longer be attributed to their weight (Waters et al., 1991). Toussi et al. (2009) found that patients with depressive symptoms after surgery were much more likely than non-depressed patients to miss post-surgical appointments and was associated with poorer weight loss compared to their nondepressed counterparts. Further studies are needed to clarify the association between depressive symptoms and weight loss and to investigate whether pre-operative factors can be addressed to promote clinically meaningful differences in weight loss and psychosocial outcomes in the long term after bariatric surgery (Livhitz et al., 2012).

Weight-loss Surgery and Post-operative Nutrition

Despite the advantages of substantial weight loss and improvement in comorbid conditions observed after bariatric surgery, these procedures are accompanied by nutritional risk. Nutritional deficiencies after bariatric surgery can arise from a variety of factors, including surgical modifications of the gastrointestinal tract that reduce dietary intake and promote malabsorption, or because of poor patient compliance with treatment recommendations (e.g., diet, protein shakes, and multivitamin supplementation; Beckman & Earthman, 2013). A recent meta-analysis has demonstrated potential nutritional problems of decreased plasma/serum iron, serum copper, and serum zinc status following bariatric surgery (Freeland-Graves, Lee, Mousa, & Elizondo, 2014). Deficiency of vitamin B12, folate, calcium, and vitamin D has also been frequently observed after

RYGB surgery (Shah, Simha, & Garg, 2006). It is important to note that differences in levels of these vitamins and minerals pre- and post-surgery may be influenced by time period after surgery, a pre-existing deficiency, type and dose of vitamin–mineral supplements, and malabsorption due to elimination of parts of the gastrointestinal tract (Freeland-Graves et al., 2014).

The most common of the nutritional deficiencies following bariatric surgery is vitamin D (Beckman & Earthman, 2013). Even prior to weight-loss surgery, it has been shown that individuals with obesity have decreased bioavailability of vitamin D (Wortsman, Matsuoka, Chen, Lu, & Holick, 2000). Moreover, the inverse relationship between BMI and serum vitamin D level has been demonstrated in the large Framingham (Cheng et al., 2010) and National Health and Nutrition Examination Survey (NHANES) studies (Yetley, 2008). Research indicates that low vitamin D levels in bariatric surgery patients can result in bone loss, particularly in the hip and lumbar spine areas (Scibora, Ikramuddin, Buchwald, & Petit, 2012). Therefore, vitamin D supplementation in the bariatric surgery patient population is not only important, but research suggests that the generally recommended daily dosage of 400 to 800 IU may not be adequate for this patient population (Beckman & Earthman, 2013).

Altogether, vitamin D and other mineral deficiencies can be damaging if left untreated and can affect overall quality of life. As multivitamins and supplements are readily available, vitamin and mineral deficits are easily preventable. For vitamin and mineral supplementation to be effective, lifelong patient compliance is critical. Study results have demonstrated, however, that only 77% of patients were taking vitamin supplements more than 18 months after weight-loss surgery (Wardé-Kamar, Rogers, Flancbaum., & Laferrère, 2004). Nutritional deficiencies can result from a number of causes, although are commonly related to non-compliance with post-operative dietary and vitamin intake recommendations.

In addition to adhering to a prescribed multivitamin and supplement regimen, adequate protein consumption is a critical dietary modification for patients undergoing bariatric surgery. Indeed, bariatric patients are at risk of protein deficiency (Schollenberger et al., 2016). Possible reasons for protein insufficiency following weight-loss surgery might be the restricted food intake and the malabsorption of nutrients after surgery (Faria, Faria, Buffington, de Almeida Cardeal, & Ito, 2011). Importantly, a protein-rich diet facilitates satiety and the reduction in overall energy intake (Westerterp-Plantenga, Nieuwenhuizen, Tome, Soenen, & Westerterp, 2009). Research indicates that adequate intake of protein facilitates weight loss, especially body fat loss, and protects against muscle mass wasting in patients who undergo bariatric surgery (Schollenberger et al., 2016). Dietary proteins have also been shown to play an important role in body weight regulation, which is critical for the bariatric surgery population. Research suggests that chronic inadequate protein intake is detrimental and can lead to loss of lean tissue and decreased functional status and quality of life (Beckman & Earthman, 2013). There is strong, quality evidence to support the recommendation that after bariatric surgery, patients consume 60 to 120 grams of protein per day (Heber et al., 2010).

Eating behavior is a key determinant of obesity and influences weight management following bariatric surgery (Sarwer, Dilks, & West-Smith, 2011). Self-report data from patients suggest that patients eat 50% to 80% fewer calories than they did prior to surgery, specifically up through eight years after RYGB surgery (Mathes &

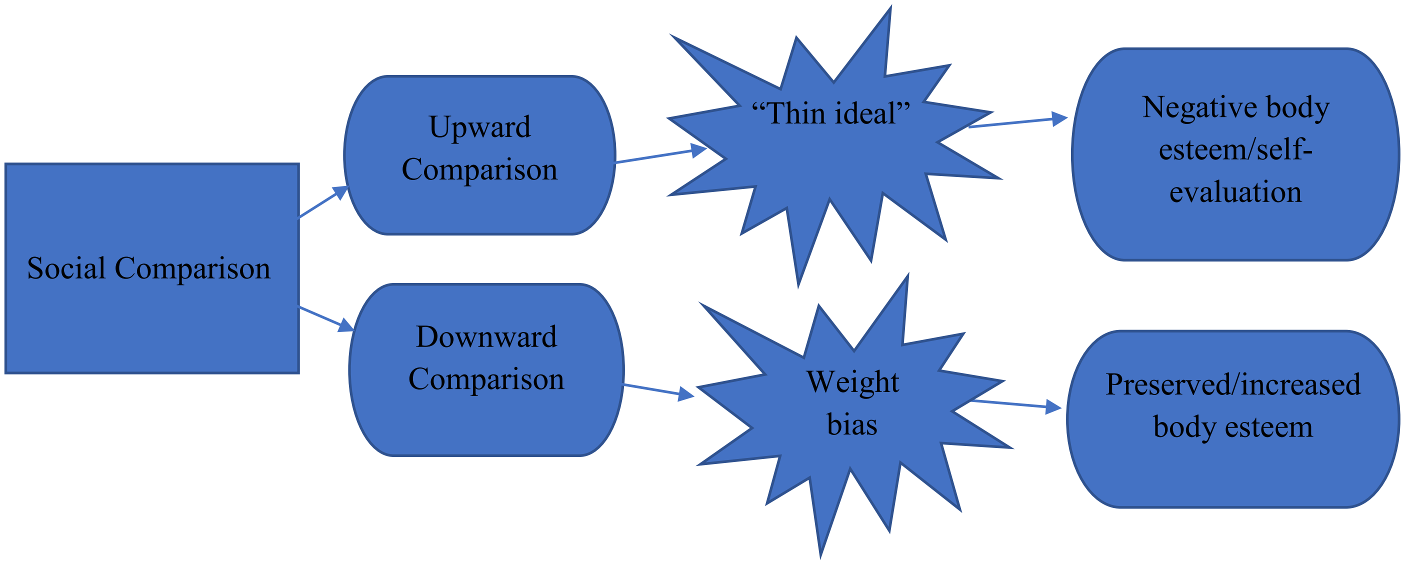
Spector, 2012). Although dietary recall and food-frequency questionnaires are readily accessible and practical to administer to a wide array of individuals, it is important to recognize that these inventories are vulnerable to inaccuracies. People, especially individuals with obesity, typically underestimate their food consumption. Currently, the amount of weight loss in the months and years following surgery, as well as weight regain, are strong objective indicators of post-operative diet and lifestyle compliance and can serve as a proxy for compliance with the prescribed post-operative diet (Maleckas et al., 2016). Understanding which factors contribute to a higher risk of disturbed eating behaviors that are characteristic of many individuals with obesity is important for the development of new interventions aimed at changing eating behavior following bariatric surgery (Mathes & Spector, 2012).

Social Comparison Theory

Theoretical work, such as Social Comparison Theory, may potentially provide a framework for explaining variability in weight-loss and psychosocial outcomes following bariatric surgery. According to this theory proposed by Leon Festinger (1954), individuals are driven to acquire an accurate self-assessment by evaluating their own opinions and abilities in comparison to others. To perform this evaluation, humans seek out standards against which to compare themselves, and when objective standards are not available, they make comparisons with available others. Essentially, individuals determine their own social and personal worth by comparing themselves in a variety of domains against a benchmark provided by others, such as attractiveness, to reduce uncertainty in these domains.

The social comparison process involves individuals evaluating their own attitudes, abilities, and beliefs in relation to others. In the case of body esteem and weight loss, individuals often engage in upward social comparisons against mainstream media images that present the "thin ideal" to be the norm for societal views of attractiveness (Fitzsimmons-Craft, 2011). By comparing themselves against this form of societal ideal, often the result is negative feelings toward the self. In research using social comparison theory to understand body image, Halliwell (2012) found that appearance comparisons are essential to the development of body image concerns. Engaging in frequent appearance comparisons with dissimilar targets (e.g., thinner) leads to body dissatisfaction, particularly for women. By contrast, findings from research with young adult women with overweight and obesity suggests that thinner comparators are associated with increases in dieting and exercise cognitions, as well as actual behaviors (Rancourt, Leahey, LaRose, & Crowther, 2015). Moreover, social comparisons to emotionally close friends magnify the effects of upward comparisons on exercise thoughts and weight-related behaviors. Given the inconsistent findings, having a better understanding of the mechanisms of social comparisons may provide opportunity to intervene and interrupt negative body image and disordered eating.

Figure 1. Social Comparison Theory and Weight



Beck's Theory of Depression

Beck's Theory of Depression (1967) explains how individuals suffering from depression appraise events in a negative way. Essentially, Beck argued that negative automatic thoughts, originated from dysfunctional beliefs, are the cause of depressive symptoms. There are three mechanisms that are responsible for depression, namely the cognitive triad (negative thoughts about the self, the world and the future), negative self-schemas, and cognitive distortions (errors in thinking).

Similar to social comparison, Beck's theory gives a possible structure for understanding the association between individuals with obesity and higher prevalence of depression. The cognitive triad would suggest that if a person with obesity has a core schema of being ugly or a failure and negatively views her body in a society that promotes the "thin ideal", she may interpret situations in a dysfunctional and unrealistically defeatist way; she may see the world as posing obstacles she is unable to overcome. In turn, she may see the future as hopeless because her negative self-view will prohibit improvement of her situation. As the components of the triad interact, they interfere with healthy cognitive processing and thinking. She may continually compare herself to individuals of typical weight, which may lead to symptoms of depression. The negative thoughts and depressed mood often persist, even when evidence to the contrary is presented.

CHAPTER 3: METHOD

The purpose of this retrospective, longitudinal study was to examine the relationship between pre-operative body esteem and post-operative outcomes including weight change, change in body esteem, adherence to the prescribed vitamin and diet regimen, and depressive symptoms, in adult patients undergoing bariatric surgery. This study used a correlational research design.

Participants

Archival data was retrieved on 216 adult patients who underwent bariatric surgery at a large, rural, comprehensive medical center in the northeastern United States. All patients who entered the bariatric surgery program between September 15, 2004 and September 15, 2016 were offered participation in a longitudinal research program and provided written informed consent. Moreover, all bariatric surgery candidates at this medical center were required to participate in a 6 to 12-month multidisciplinary pre-operative clinical curriculum consisting of medical evaluation, as well as surgical, nutritional, and lifestyle education. Patients were encouraged to lose 10% of their body weight before surgery to enhance the safety of the procedures and demonstrate readiness to make behavioral changes (Lent et al., 2017).

Inclusion and Exclusion Criteria

Participant data were included if the patient was between the ages of 18 and 65 years on surgery date, was at least one-year post-surgery (+/- 3 months), and had completed the BESAA both pre- and postoperatively.

Participants were excluded from the study if they refused consent, were outside the age criterion, were undergoing a revision to a previous bariatric surgical procedure, or had not completed the BESAA before and after surgery.

Measures

Body Esteem Scale for Adolescents and Adults. The BESAA (Mendelson et al., 2001) is a 23-item, self-report measure based on the view that global self-esteem is multidimensional and determined by a combination of feelings of adequacy in particular domains, and individual ratings of importance of that domain. The scale has three subscales that measure general feelings about appearance (BE-Appearance), weight satisfaction (BE-Weight), and positive evaluations attributed to others about one's body and appearance (BE-Attribution) (Mendelson et al., 2001). The BESAA is composed of 23 statements regarding the three subscales of body esteem on a five-point Likert scale [ranging from *Never* (0), *Seldom* (1), *Sometimes* (2), *Often* (3), or *Always* (4)], with higher scores indicating higher body esteem. A psychometric analysis of the BESAA indicated that its subscales have high internal consistency (Cronbach's α= .81-.94) and high test-retest reliability (r = .83-.92; Mendelson et al., 2001). Additionally, there is good evidence for the discriminant, convergent, and face validity of the three BESAA subscales.

Beck Depression Inventory, Second Edition. The BDI-II is a 21-item, self-report measure of the severity of depression (Beck, Steer, & Brown, 1996). Items range from 0 to 3 and are totaled to create an overall depression score ranging from 0 to 63. The total score is then labeled either minimal (0-13), mild (14-19), moderate (20-28), or severe (29-63), with higher scores equating to greater perceived depression. A psychometric analysis of the BDI-II demonstrated that it has high internal consistency (Cronbach's $\alpha = .91$) and test-retest reliability ($r = .93$; Beck et al., 1996).

Nutrient data. Post-operative dietary and vitamin adherence as measured by blood nutrient laboratory values was assessed one-year post-surgery (+/- 3 months). Laboratory values within specified normal ranges were used as proxies for dietary and vitamin adherence and include calcium, vitamin D, vitamin B12, and iron, per the pre-determined data that were collected. Given the rigor of pre-operative medical clearance, any patients with underlying conditions that would have affected vitamin and nutrient levels would have been treated and any issues resolved prior to weight-loss surgery.

Participant characteristics. Patient information including age, sex, BMI, medical diagnoses, weight, and surgery type/date were collected from the electronic health record (EHR) at baseline and when appropriate, at one year +/- 3 months post-surgery.

Weight change. Change in weight pre- to postoperatively was calculated using percent change in BMI at one year to obtain body weight change.

Procedures

Patients evaluated for bariatric surgery at the medical center clinic were approached by research assistants to participate in longitudinal research. Patients that expressed interest were informed about the study by research assistants during this clinic visit and provided informed consent to participate. Several patient-reported questionnaires were administered before bariatric surgery as standard of care and are included in the health system's electronic health record (EHR) for use during clinical encounters. These include measures of body esteem and depression, which were included in this study. Questionnaires were administered in the bariatric clinic using touch screens located within clinic rooms or by paper and pencil questionnaires, depending on the specific clinic location. At patients' one-year postoperative clinic visits, research assistants or clinical staff re-administered psychosocial and physical functioning surveys. To allow for variability in clinic appointment schedules, measures and EHR data within a one year +/- 3 month-window were included.

Data collected from each patient were stored in locked file cabinets, on password protected databases at the medical center, and for certain surveys, placed directly into their EHR for clinical use. Data extracted were transferred to a new data set where the information was de-identified, checked for any data entry errors, and analyses were run in SPSS Version 24.0 (IBM).

Demographic Analysis

Descriptive statistics were used to characterize the study sample, including mean, standard deviations, and frequencies/percentages.

Statistical Analyses

For this retrospective, longitudinal study, linear regression evaluated the relationship between weight loss at one-year postoperatively (primary outcome) and several pre-operative patient factors, including body esteem (BESAA total score) and three pre-operative factors known to relate to post-operative weight loss: age, biological sex and surgical BMI (Hypothesis I). First, correlations tested for, and quantified, the relationship between each of the four factors and the primary outcome of weight loss.

Based on the relationship of the individual predictor variables with the primary outcome of interest, factors were entered stepwise into a multiple linear regression.

Linear regression shows whether the predictor variable(s) of interest explain a statistically significant amount of variance in weight loss after accounting for all other variables. Assumptions associated with linear regression including normality, linearity, homoscedasticity, and multicollinearity were evaluated prior to analyses. The normality assumption checked the univariate descriptive statistics (*M, SD,* skewness, kurtosis). Estimates of correlations are more reliable and valid if the variables are normally distributed. The assumption of linearity asserts a linear relationship between the outcome variable and the independent variables; scatterplots determine whether there is a linear or curvilinear relationship. Homoscedasticity assumes that bivariate distributions are evenly spread about the line of best fit and similar across the values of the independent variables. A plot of standardized residuals versus predicted values shows whether data are equally distributed across all values of the independent variables. Moreover, multiple regression assumes that the independent variables are not highly correlated with each other. This assumption of no multicollinearity was tested using the acceptable levels for Variance Inflation Factor (VIF) and Tolerance values. If any of these assumptions had been violated, transformations would have been conducted to correct for distributional problems, outliers, lack of linearity, or unequal variances to enable the data to be symmetric and more easily analyzed.

To evaluate potential improvements in body esteem pre-operatively to one-year postoperatively as measured by total BESAA scores (Hypotheses II), paired t-tests were computed. The paired sample t-test is a statistical procedure used to determine whether there are significant differences in means between two sets of observations. For the paired sample t-test, each participant was measured twice using the BESAA, resulting in pairs of observations. The paired sample t-test has four main assumptions including 1) the dependent variable must be continuous, 2) the observations are independent of one another, 3) the dependent variable should be approximately normally distributed (noting that the sampling distribution of the differences between scores should be normal, not the scores themselves), and 4) the dependent variable should not contain any outliers that will skew results. No outliers were identified, and data were normally distributed.

To evaluate whether there is an inverse relationship between pre-operative body esteem scores as measured by the total BESAA and depression scores as measured by the BDI at one year following weight-loss surgery (Hypothesis III), a Pearson correlation was used. The assumptions of a Pearson correlation are as follows: level of measurement, related pairs, absence of outliers, normality of variables, linearity, and homoscedasticity. Level of measurement refers to each variable and, for a Pearson correlation, each variable should be continuous. Related pairs refer to the pairs of variables; each participant should have a pair of values. Absence of outliers refers to having no outliers in either variable as an outlier can skew the results of the correlation by pulling the line of best fit formed by the correlation too far in one direction or another. The normality assumption checked univariate descriptive statistics (*M, SD,* skewness, kurtosis) of the variables to determine whether estimates of correlations were reliable and valid. The assumption of linearity asserts a linear relationship between the outcome variable and the independent variables. Homoscedasticity assumes that bivariate distributions are evenly spread about the line of best fit and similar across the values of the independent variables.

To examine whether pre-operative body esteem scores as measured by the BESAA predict level of adherence to the post-operative diet and vitamin regimen as measured by blood nutrient laboratory values at one year following weight-loss surgery (Hypotheses IV), logistic regression was employed. Logistic regression was used to explain the relationship between pre-operative body esteem (ordinal independent variable) and post-operative dietary and vitamin adherence (binary dependent variable) where the outcome of adherence was measured by only two possible outcomes. Micro-nutrient levels at one-year post-surgery were coded as "in" or "out" of range. Bi-serial correlations tested for, and quantified, the relationship between post-operative body esteem and micro-nutrient levels in or out of range at one year.

Several assumptions must be met to proceed with logistic regression. First, binary logistic regression requires the dependent variable, post-operative dietary adherence, to be binary. Second, this statistical method requires the observations to be independent of each other. Third, logistic regression requires there to be little or no multicollinearity among the independent variables and assumes that the independent variables are not highly correlated with each other. Finally, logistic regression assumes a linear relationship between the outcome variable and the independent variable.

Sample size and power considerations

Given the use of archival data, a post-hoc power analysis for this retrospective study was conducted using G*Power based on Hypothesis I, the relationship between pre-operative body esteem and weight loss at one year. Results indicated that assuming regression and four predictor variables (biological sex; age; surgical BMI; total BESAA score), a sample size of 216 patients, an effect size of 0.15, and a significance level of

0.05, the power level was 0.99, which exceeded the generally accepted minimum requirement of a power level of 0.80.

CHAPTER 4: RESULTS

Sample Characteristics

An analysis of the demographic characteristics was performed for those individuals who completed the entire study. The screening and selection of the sample is provided in Figure 2, resulting in a total sample size of 216 participants included in analyses. Descriptive statistics (including means, standard deviations, and percentages) were used to describe the personal characteristics of the sample. The sample was predominantly female (84.7%), which is representative of the larger population of individuals who undergo bariatric surgery (Courcoulas et al., 2013). Patients had a mean age at the time of surgery of 45.8± 10.4 years and ranged in age from 19 to 65 years. Participants identified as 97.2% White, followed by 2.3% Black, and 0.5% with ethnicity unspecified in the database. Of the surgery type, 172 patients (79.6%) underwent RYGB, 37 patients (17.1%) SG, 6 patients (2.8%) BPD or duodenal switch, and 1 (0.5%) patient LAGB. The mean pre-operative BMI for patients was 46.5 kg/m^2 (SD = 7.4) and the mean post-operative BMI was 36.1 kg/m^2 (SD = 6.3). Sample characteristics are outlined in Table 1.

Figure 2. Results of the Screening and Selection of the Sample

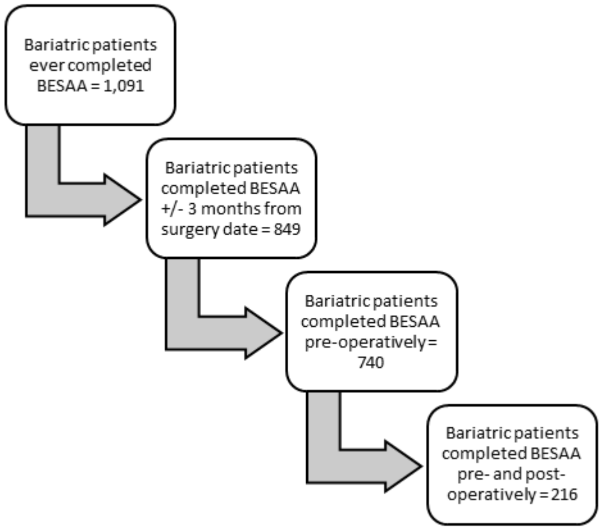


Table 1

Sample Characteristics (*N*=216)

	Mean (SD)	**Percentage**
Age (years)	45.8 (10.4)	
Sex		
Female		84.7
Male		15.3
Race/Ethnicity		
White/Caucasian		97.2
Black/African American		2.3
Unspecified		0.5
Weight loss surgery type		
Roux-en-Y Gastric Bypass (RYGB)		79.6
Sleeve Gastrectomy (SG)		17.1
Biliopancreatic Diversion/Duodenal Switch (BPD)		2.8
Laparoscopic Adjustable Gastric Banding (LAGB)		0.5
Body Mass Index (kg/m^2)		
Pre-operative	46.5 (7.4)	
One-year Post-operative (± 3 months)	36.1 (6.3)	

Descriptive Statistics of Administered Measures

Scores for each of the administered measures were calculated. Score ranges, means, and standard deviations for each of the measures administered are presented in Table 2. Body esteem scores, as measured by the Body Esteem Scale for Adolescents and Adults (BESAA) at the pre- and post-operative periods, ranged from 0 to 85, with higher scores indicating higher body esteem. Mean BESAA score for the pre-operative period was 27.37, and mean score for the post-operative period was 50.41. For percentage change in BMI, scores ranged from -6.24 to -44.07, with a mean change of -22.43. Higher negative scores reflect greater weight loss. For depressive symptoms, as measured by the Beck Depression Inventory (BDI) at the pre- and post-operative periods, scores ranged from 1 to 45. Total score is labeled either minimal (0-13), mild (14-19), moderate (20-28), or severe (29-63), with higher scores indicating greater perceived depression. Mean BDI score for the pre-operative period was 17.18, and mean score for the post-operative period was 8.59.

Table 2

Score Ranges, Means, And Standard Deviations of Administered Measures

	Min	*Max*	*M*	*SD*
BESAA (N=216):				
Pre-operative	0	65	27.25	.94
Post-operative	8	85	50.07	1.07
% Change in BMI (N=216)	-6.24	-44.07	-22.43	.39
BDI:				
Pre-operative (n = 56)	1	45	17.18	10.76
Post-operative (n= 56)	1	37	8.59	7.97

Hypothesis I

Multiple linear regression was conducted to determine whether body esteem, as measured by total Body Esteem Scale for Adolescents and Adults (BESAA) scores during the pre-operative period, accounting for the relative contribution of initial BMI, age, and biological sex, would predict change in weight at one year following weight-loss surgery. By accounting for these covariates known to relate to postoperative outcomes (Dallal et al., 2009; Livhits et al., 2012; Still et al., 2014), the potential statistical influence of these variables was considered, which may have otherwise affected the dependent variable of weight loss.

Prior to conducting the regression, the relevant assumptions of this statistical test were evaluated. The correlations among predictor variables were examined and are presented in Table 3. Multicollinearity was unlikely to be a problem because none of the correlations were .7 or above. To test for normality, an examination of histograms and Shapiro-Wilk (.124; .349) were obtained and examined and indicated that the assumption of normality was met. A comparison of standardized residuals (ZRESID) against standardized predicted values (ZPRED) revealed that the assumptions of linearity and homoscedasticity were met. Moreover, tests of skewness and kurtosis found that the variables were largely normally distributed. No transformations of data were required.

Table 3

Correlation Coefficients Among Weight Loss Predictor Variables (N = 216)

	Surgery Age	Sex	Pre-op BMI	BMI change
Surgery Age	1.00			
Sex	-.007	1.00		
Pre-op BMI	-.127	.005	1.00	
BMI change	.096	-.065	-.031	1.00

Model 1 examined pre-operative BMI, surgery age, and sex as predicting change in weight following surgery. Model 2 analyzed pre-operative body esteem, in addition to pre-operative BMI, surgery age, and sex, as predicting change in weight following surgery. The results of the multiple linear regression analysis, as shown in Table 4, revealed a multiple correlation of $R = .133$ with a coefficient of determination of .018 ($R^2 = .018$), indicating that approximately 1.8% of the variance observed can be attributed to this combination of predictor variables. The adjusted coefficient of determination ($AdjR^2 = -.001$) suggests that there would be relatively no change from sample to population if the population had been evaluated.

The overall regression analysis, as shown in Table 5, revealed a non-significant regression ($F(4, 211) = .956$, $p = .432$), indicating that the combination of these predictors did not make a significant contribution to the prediction of body esteem. As shown in Table 6, an examination of the predictor variable (controlling for age, sex, and pre-operative BMI) revealed that body esteem did not make a significant contribution to the prediction of change in weight one-year following bariatric surgery. Body esteem prior to weight-loss surgery was not related to change in patient weight following surgery.

Table 4

Model 1 and Model 2 Summary[c] *(N = 216)*

Model	R	R^2	Adjusted R^2	Standard Error of the Estimate	R^2 change	F change	df1	df2	Sig. F change
1	.117[a]	.014	.000	5.600	.014	.981	3	212	.403
2	.133[b]	.018	-.001	5.602	.004	.884	1	211	.348

[a] Predictors: (Constant), Surgery Age, Sex, Pre-op BMI
[b] Predictors: (Constant), Surgery Age, Sex, Pre-op BMI, Pre-op BESAA Total
[c] Dependent Variable: Percentage BMI Change

Table 5

Overall Regression Analysis[a] *(N = 216)*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	92.304	3	30.768	.981	.403[b]
	Residual	6648.485	212	31.361		
	Total	6740.789	215			
2	Regression	120.040	4	30.010	.956	.432[c]
	Residual	6620.749	211	31.378		
	Total	6740.789	215			

[a] Dependent Variable: Percentage BMI Change
[b] Predictors: (Constant), Surgery Age, Sex, Pre-op BMI, Pre-op BMI
[c] Predictors: (Constant), Surgery Age, Sex, Pre-op BMI, Pre-op BMI, Pre-op BESAA Total

Table 6

Coefficients of Predictor Variable to the Dependent Variable[a] (N = 216)

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	-23.849	3.161		-7.545	.000
Sex	-.991	1.059	-.064	-.936	.350
Pre-op BMI	-.014	.052	-.019	-.276	.783
Surgery Age	.050	.037	.093	1.358	.176
2 (Constant)	-24.718	3.294		-7.504	.000
Sex	-1.138	1.071	-.073	-1.063	.289
Pre-op BMI	-.017	.052	-.022	-.316	.752
Surgery Age	.056	.037	.103	1.485	.139
Pre-op body esteem	.027	.029	.066	.940	.348

[a] Dependent Variable: Percentage BMI Change

Hypothesis II

To evaluate whether body esteem would improve preoperatively to one-year postoperatively in participants undergoing weight-loss surgery, a paired samples t-test was performed. Prior to conducting a paired samples t-test for changes in body esteem post-operatively, the relevant assumptions were assessed. First, the data were normally distributed as evidenced by examination of the histogram and Shapiro-Wilk (.124; .349).

Sample size was also adequate as there were at least 30 cases per group. Homoscedasticity was not violated, and tests of skewness and kurtosis found that the variables were largely normally distributed. The assumptions of normality and linearity were met.

Significant improvements in body esteem ($p < .001$) from the pre-operative period to one-year post-operatively were identified. Results are presented in Table 7 and suggest that body esteem improves following bariatric surgery, at one year.

Table 7

Paired Samples Test Analysis (N = 216)

	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% confidence lower	95% confidence upper	t	df	Sig. (2-tailed)
Pair 1: BESAA Pre-op BESAA Post-op	22.829	17.851	1.215	25.223	20.435	18.795	215	.000
	Paired Samples Statistics							
	Mean	N	Std. Deviation	Std. Error Mean				
BESAA Pre-op	27.25	216	13.507	.919				
BESAA Post-op	50.07	216	15.491	1.054				

Hypothesis III

To examine the relationship between pre-operative body esteem and depressive symptoms at one year following weight-loss surgery, a Pearson product-moment correlation was conducted. Results indicated a significant negative relationship between pre-operative body esteem and post-operative depression (r = -.301, p = .005) and are presented in Table 8.

The relationship between pre-operative body esteem and depressive symptoms may be further understood by examining the relationship between pre- and post-operative depression. A Pearson product-moment correlation was conducted, and results indicated a significant positive relationship between pre-operative depression and post-operative depression (r = -.395, p = .002) at one year. Results are presented in Table 9.

Table 8

Correlation between Pre-operative Body Esteem and Post-operative Depression

		Body esteem pre-op	Depression post-op
Body Esteem Pre-op	Pearson Correlation	1	-.301*
	Sig. (2-tailed)		.005
	N	211	87
Depression Post-op	Pearson Correlation	-.301*	1
	Sig. (2-tailed)	.005	
	N	87	87

*Correlation is significant at the 0.01 level (2-tailed)

Table 9

Correlation between Pre-operative Depression and Post-operative Depression

		Depression pre-op	Depression post-op
Depression Pre-op	Pearson Correlation	1	.395*
	Sig. (2-tailed)		.002
	N	92	57
Depression Post-op	Pearson Correlation	.395*	1
	Sig. (2-tailed)	.002	
	N	57	93

*Correlation is significant at the 0.01 level (2-tailed)

The relationship between pre-operative body esteem and post-operative depression was further assessed by a multiple regression analysis. Model 1 examined pre-operative depression as predicting post-operative level of depression at one year. Model 2 analyzed pre-operative body esteem, in addition to pre-operative depression, as predicting change in depression following surgery. The results of the regression analysis, as shown in Table 10, revealed a multiple correlation of $R = .436$ with a coefficient of determination of .190 ($R^2 = .190$), indicating that approximately 19% of the variance observed can be attributed to pre-operative depression and pre-operative body esteem. The adjusted coefficient of determination ($AdjR^2 = .160$) suggests that there would be further decreased predictability (3%) from this combination of predictor variables.

Table 10

Model 1 and Model 2 Summary[c] *(N = 56)*

Model	R	R^2	Adjusted R^2	Standard Error of the Estimate
1	.395[a]	.156	.140	8.089
2	.436[b]	.190	.160	7.995

[a] Predictors: (Constant), Pre-op Depression
[b] Predictors: (Constant), Pre-op Depression, Pre-op Body Esteem
[c] Dependent Variable: Post-op Depression

Table 11

Overall Regression Analysis[a] *(N = 56)*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	663.763	1	663.763	10.145	.002[b]
	Residual	3598.448	55	65.426		
	Total	4262.211	56			
2	Regression	810.345	2	405.173	6.338	.003[c]
	Residual	3451.865	54	63.923		
	Total	5262.211	56			

[a] Dependent Variable: Post-op Depression
[b] Predictors: (Constant), Pre-op Depression
[c] Predictors: (Constant), Pre-op Depression, Pre-op Body Esteem

Table 12

Coefficients of Predictor Variable to the Dependent Variable[a] *(N = 56)*

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	3.367	1.928		1.746	.086
Pre-op Depression	.283	.089	.395	3.185	.002
2 (Constant)	7.004	3.066		2.284	.026
Pre-op Depression	.244	.092	.340	2.666	.010
Pre-op Body Esteem	-.123	.082	-.193	-1.514	.136

[a] Dependent Variable: Post-op Depression

The overall regression analysis, as shown in Table 11, revealed a significant regression (F (2, 54) = 6.338, p = .003), indicating that the combination of these predictors did make a significant contribution to the prediction of post-operative depression one year following surgery. As shown in Table 12, an examination of the predictor variables (pre-op depression, pre-op body esteem) revealed that pre-operative depression made a significant contribution to the prediction of post-operative depression (p = .002); body esteem did not make a significant contribution to the prediction of post-operative depression (p = .136) at one-year following bariatric surgery. Therefore, patient body esteem prior to weight-loss surgery was not related to change in depressive symptoms following surgery at one year.

Hypothesis IV

To investigate whether pre-operative body esteem would predict level of adherence to the post-operative diet and vitamin regimen as measured by blood nutrient laboratory values at one year following weight-loss surgery, a logistic regression was conducted. Prior to conducting the logistic regression, the relevant assumptions of this statistical test were evaluated. Multicollinearity was unlikely to be a problem because none of the correlations were .7 or above. To test for normality, an examination of histograms and Shapiro-Wilk (.124; .349) were obtained and examined and indicated that the assumption of normality was met. A comparison of standardized residuals (ZRESID) against standardized predicted values (ZPRED) revealed that the assumptions of linearity and homoscedasticity were met. Moreover, tests of skewness and kurtosis found that the variables were largely normally distributed.

A binary logistic regression was performed to examine the relationship between pre-operative body esteem and level of adherence to the post-operative diet and vitamin regimen. Specifically, blood laboratory values within specified normal ranges were used as proxies for dietary and vitamin adherence and included calcium, vitamin D, vitamin B12, and iron. Based on the American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient, these micronutrient values were coded categorically as either in or out of range (Parrott et al., 2017). Overall, the relation between body esteem and each micronutrient was not significant. For vitamin D, Exp(B) = 1.012, 95% [.979, 1.045], p = .488. For calcium, Exp(B) = .333, 95% [.000, .000], p = .144. For iron, Exp(B) = .999, 95% [.966, 1.033], p = .948. For vitamin B12, not enough data were provided to run analyses and report results. These data indicate that level of participant body esteem is not related to adherence to the prescribed post-operative diet at one year.

CHAPTER 5: DISCUSSION

The current study examined the relationship between pre-operative body esteem and post-operative outcomes after bariatric surgery, including weight change, change in level of body esteem, depressive symptoms, and adherence to the prescribed vitamin and diet regimen. Overall, the study found that body esteem significantly improved following weight-loss surgery. In addition, it was found that lower levels of body esteem prior to weight-loss surgery was associated with higher levels of post-operative depression. Finally, the present study did not find pre-operative body esteem to be predictive of weight change at one year following bariatric surgery or to relate to adherence to the postoperative regimen.

Hypothesis I asserted that level of body esteem during the pre-operative period would predict change in weight at one year following weight-loss surgery. Research generally indicates mixed results regarding a clear relationship between body dissatisfaction and weight (Adami et al., 1999; Latner, 2012; Sarwer & Steffen, 2015). Within the construct of body esteem, several domains are included, with body weight being a critical aspect; heavier individuals report being more dissatisfied with their bodies compared to normal-weight counterparts (Mendelson et al., 2001; Weinberger, Kersting, Riedel-Heller, & Luck-Sikorski, 2016). Previous research also suggests, however, lower prevalence of body dissatisfaction in individuals with obesity who are not seeking treatment for their weight in comparison to those who are seeking treatment (Sarwer et al., 1998; Vieira et al., 2012). Therefore, the seemingly complex relationship between body satisfaction and individual weight status warranted further exploration. Results of the current study revealed that body esteem was not associated with change in weight one-year following bariatric surgery.

Similar to findings by Adami et al. (1999), the lack of association between body esteem and weight in this study indicates that factors other than body esteem influence weight change after undergoing bariatric procedures. In other words, post-operative health behavior may be affected by pre-operative levels of psychopathology, in conjunction with or independent of body esteem, leading to suboptimal weight loss (Wimmelmann et al., 2014). Body esteem, or feelings of self-worth about one's body and appearance, is a multi-dimensional construct and is determined by a combination of feelings across several domains, including appearance, weight satisfaction, and attributions of positive evaluations about one's body and appearance to others (Mendelson et al., 2001). Research findings have demonstrated that females have lower body esteem regarding weight status than do males, and the difference appears to be consistent across the age range. Evidently, the difference in body esteem between males and females has widened over the past 50 or more years, particularly in adolescents (Feingold & Mazzella, 1998). Women in general are significantly more dissatisfied with body weight and shape compared to men, so simply being female is a risk factor for body image distress in our culture (Cash & Roy, 1999). As social comparison theorizes, girls may incorporate unattainable stereotypes about an ideal appearance and weight purported by society and may consequently develop dissatisfaction with their body into adulthood. Perhaps not only being female, but other aspects that reflect our increasingly toxic environment and sedentary lifestyle may account for limited weight loss following bariatric surgery in some patients, regardless of body esteem. It is also possible that post-operative mental status might prove a better indicator of long-term weight loss compared to pre-operative body esteem. Furthermore, research suggests that while obesity and body image may have an indirect correlation, there may also be a threshold effect (Sarwer & Thompson, 2002). In other words, after surpassing a certain BMI, patients do not appear to have an increase in body image dissatisfaction.

The second hypothesis asserted that body esteem would improve preoperatively to one-year postoperatively. Results indicated that patients' body esteem did substantially improve following bariatric surgery. In fact, scores improved pre- to postoperatively by 84% on average, which is likely a reflection of not only statistical but clinical significance. This finding corroborates a recent review by Kubik et al. (2013) that found improved body image following weight-loss surgery. Improved body esteem is another important, durable benefit of bariatric surgery beyond weight change and improved health (Courcoulas et al., 2014; Madan et al., 2008). A large literature has documented the impairments in quality of life and psychological correlates such as body image and depression in people with obesity (Kubik et al., 2013; Latner, 2012; Madan et al., 2008; Sarwer, Wadden, & Foster, 1998; Schwartz & Brownell, 2004; Taylor, Forhan, Vigod, McIntyre, & Morrison, 2013). These impairments, in addition to weight status, are believed to play an influential role in the decision to undergo bariatric surgery.

The current study replicated findings from previous research that demonstrated body esteem improves following bariatric surgery (Clark et al., 2003; Madan et al., 2008; Pecori, Cervetti, Marinari, Migliori, & Adami, 2007). In addition, this study improved upon the reliability of prior research (Madan et al., 2008) by comparing the same sample of patients both pre- and post-operatively, allowing for longitudinal comparisons of the same individuals over time. Unlike prior research (Madan et al., 2008) in which post-operative patients were asked to recall how they would have responded to the BESAA (body esteem) questionnaire before surgery, which may have biased the results, the current research queried patients in real time. Additionally, the sample size for the current study was adequate to allow for correlation of BESAA scores with weight loss.

Hypothesis III examined the relationship between pre-operative body esteem and depressive symptoms at one year following weight-loss surgery. Findings indicated a moderate negative relationship between the variables, suggesting that lower levels of pre-operative body esteem were associated with higher levels of depression following surgery. Once level of pre-operative depression was factored into the analysis, however, the impact of pre-operative body esteem on post-operative depression dissipated.

Consistent with previous work, findings from the current study indicate that depressive symptoms improve following weight-loss surgery (Dawes et al., 2016; Dixon et al., 2003; Herpertz et al., 2003). Research suggests the extent of mental health improvement in bariatric surgery patients may be related to achieved weight loss (Karlsson et al., 1998). Other findings attribute improvement of mental health to not only weight loss, but resultant gains in body image, self-esteem, and self-concept (Kubik et al., 2013).

Currently, there is limited understanding of psychological health following bariatric surgery, perhaps due in part to the focus on medical outcomes rather than a focus on the biopsychosocial perspective of overall health outcomes. Despite undisputed significant weight loss and improvements in comorbid conditions, the literature suggests persisting psychological distress related to depression and body image for some patients at longer term follow-up (Jumbe et al., 2017). The presence of depressive disorders after bariatric surgery is associated with diminished post-surgical improvements, inferring a need for clinical intervention when post-operative depression is identified (Jumbe et al., 2017).

Research findings have shown that decreased BMI following bariatric surgery is associated with improvements in depressive symptoms, at least within the first year after surgery (Mitchell et al., 2014). While previous work has suggested that pre-operative psychopathology may predict surgical weight loss (Wimmelman et al., 2014), a recent meta-analysis found no clear evidence to support a relationship between pre-operative mental health conditions such as depression and post-operative weight loss (Dawes et al., 2016). Lent et al. (2014), however, found that greater internalized weight bias prior to weight-loss surgery was associated with less weight loss one year after surgery. Perhaps a cluster of psychosocial factors other than, or in addition to, body esteem, such as weight bias, expectations regarding the amount of weight loss, or post-operative mental status may prove to be more accurate indicators of long-term weight loss following bariatric surgery. Reframing weight-loss procedures to encompass the psychological experiences of patients may help to optimize both psychological and weight-loss outcomes following surgery.

Hypothesis IV asserted that pre-operative body esteem would predict level of adherence to the post-operative diet and vitamin regimen at one year following bariatric surgery. Nutritional deficiencies after bariatric surgery can manifest from several factors such as poor patient compliance with treatment recommendations for diet and vitamin supplementation. For study participants, micronutrient values, including vitamins D and

B12, iron, and calcium, were identified as either in or out of range for expected normal values. From this study, it does not appear that level of participant body esteem prior to weight-loss surgery is related to adherence to the prescribed post-operative diet at the one-year mark. However, given that weight change is the best proxy of post-operative adherence and no relationship was found between weight and BESAA scores, it is not surprising that a null relationship was also found between BESAA scores and vitamin deficiencies.

Unlike the current study, previous research has suggested that insufficient micronutrients and minerals appear to be common in patients following weight-loss surgery (Beckman & Earthman, 2013; Freeland-Graves et al., 2014; Gletsu-Miller & Wright, 2013). Research indicates that insufficient vitamin D appears to be the most common problem before, and up to five years after, sleeve gastrectomy and RYGB, despite implementing a vitamin D supplementation protocol (Beckman & Earthman, 2013). Based on predictors such as amount of patient body fat and the degree of malabsorption following surgery, findings show that there is high variability in response to vitamin D supplementation in patients undergoing weight-loss surgery. Accordingly, it may not be reasonable to recommend a similar dose across individuals, rather a customized approach may be optimal. The results of the current study suggest that this study population may have been compliant with the recommendations for vitamin and mineral supplementation. It is also possible that optimal dosing may need to be further refined and that the current analyses reflecting acceptable vitamin and mineral levels may have been influenced by a pre-existing deficiency, the time period after surgery, or type of vitamin or mineral supplements.

Macronutrients, such as protein, have been shown to play an important role in body weight regulation (Schollenberger et al., 2016). Research indicates that bariatric surgery leads to an increased risk for developing protein malnutrition (Damms-Machado et al., 2012; Friedrich et al., 2013). Possible reasons for the decreased protein might be the restricted food intake, differing food intolerances, and the malabsorption of nutrients after surgery. Given the nature of this retrospective study, data on protein levels were not collected from participants and therefore not reported.

Strengths

This study has several strengths. The study incorporated a combination of clinical and patient-reported data that improves the overall quality of findings. A variety of patient characteristics regarding psychosocial correlates were evaluated over a 12-year period, which captured a significant length of time and possible nuances of societal influences related to body esteem on the target population. In addition, this study collected data prospectively, in real time, which adds to the reliability of the reported information.

Limitations

This study has several limitations. First, a non-negligible number of bariatric patients did not complete the BESAA before and after surgery and were not included in the analyses. It is possible that this subgroup of patients may differ in important ways from those patients who did participate. Another limitation of the study is its shorter-term patient follow-up of one year. This timeframe may not adequately capture long-term patient outcomes following weight-loss surgery, given that most patients do not reach their weight loss nadir until 18 months or beyond. Furthermore, as the sample consisted predominantly of a homogeneous rural, Caucasian adult population, the findings are potentially limited when generalizing to minority or urban populations.

It is possible that the correlational analyses that characterized much of this study are not sensitive to the complex relationships that appear to exist among obesity, weight-loss surgery, and psychological functioning [(e.g., binge eating disorder might moderate obesity and depression) Schwartz & Brownell, 2004]. Additionally, although all measures are psychometrically sound, the current study only uses one measure per construct; this could limit the accuracy of the conclusions drawn from these measures given that a multi-method approach, such as informant reports, can provide useful additional information regarding symptomatology and level of behavioral change in adults undergoing weight-loss surgery. Furthermore, the archival nature of the study prohibits the gathering of additional information and results are limited by the data that were collected. For example, data on protein levels could have provided important macronutrient information related to the post-operative diet, although these data were not collected from participants.

Clinical Implications

When considering the benefits of weight-loss surgery such as improved obesity-related comorbidities, the psychological aspects should be examined as well. It is important to consider the psychological context of these weight-loss procedures to facilitate optimization of patient outcomes. Research suggests that body image distress is generally correlated with other symptoms of psychological distress (Schwartz & Brownell, 2004). Despite undisputed significant weight loss and improvements in comorbidities following weight-loss surgery, current literature indicates persisting concerns of depression and body image for patients at longer term follow-up, compared to control groups (Schwartz & Brownell, 2004). Consequently, weight-loss surgery patients who feel negatively about their bodies could be psychologically vulnerable and may be less able to motivate themselves to make healthy behavior changes that lead to sustained weight loss.

This retrospective, longitudinal study examined the relationship between pre-operative body esteem and post-operative outcomes including change in weight, change in level of body esteem, adherence to the prescribed vitamin and diet regimen, and depressive symptoms, in adult weight-loss surgery patients. More specifically, the study investigated whether pre-operative factors are associated with a clinically meaningful difference in these outcomes at one year following bariatric surgery. The purpose for this research was to identify risk groups among weight-loss surgery patients who may require additional support with dietary and psychological follow-up. This study found that patients' body esteem improved following weight-loss surgery, meaning that feelings of self-worth about their body and appearance across several domains, including appearance, weight satisfaction, and attributions of positive evaluations about one's body and appearance to others, was enhanced. This improvement in body esteem is yet another benefit of weight-loss surgery.

This study also suggests that although level of body esteem was not linked to weight loss following bariatric surgery, improvement in body esteem could be an important component of psychological health and readiness for the recommended post-operative lifestyle. It is also important for providers to note that even if a patient does not experience improvement in body esteem, this factor will not prevent an individual from losing weight. In other words, level of body esteem does not appear to be de-motivating for patients trying to lose weight following bariatric surgery. Results provide useful information to inform patient and provider decisions in routine clinical care regarding weight-loss surgery.

Future Directions

Considering the increasing public health risks and costs associated with obesity and body esteem concerns for patients undergoing weight-loss surgery, further research is needed to investigate whether specific pre-operative factors can predict clinically meaningful differences in post-operative outcomes after bariatric surgery. Additionally, a small subgroup of the population with obesity seeks weight-loss surgery, and they may differ in important ways from those who do not (Schwartz & Brownell, 2004). Research with individuals with obesity from the general population seeking non-surgical or no treatment would provide richer detail around issues of body esteem. Moreover, the relationship between body dissatisfaction, self-efficacy, and behavior change requires attention in research as there is currently limited information.

Retrospective, self-report measures and correlational analyses have been common in the literature regarding weight-loss surgery and psychological functioning; however, these tools are subject to certain limitations. Therefore, qualitative research that adequately captures the trajectory of bariatric surgery patients and their weight loss, social support, and psychological experience is warranted. Since appropriate consumption of micro- and macronutrients is another important lifelong dietary modification for patients undergoing weight-loss surgery, future research may consider collecting more robust data related to micro- and macronutrient consumption to provide better insight into post-operative dietary behaviors. In addition, much of the literature pertaining to body image after weight-loss surgery is typically limited to the two-year post-bariatric period (Sarwer, Thompson, Mitchell, & Rubin, 2008). As many bariatric patients initially lose weight rapidly within the first year with subsequent slowing of weight loss, or even regaining of weight, within two years after surgery, longitudinal research is needed to better understand the relationship between weight-loss surgery and post-operative outcomes in adult patients.

Conclusion

The obesity epidemic is a global public health crisis and has led to a myriad of chronic health conditions, rising costs, and premature death for individuals with obesity. Bariatric surgery remains the most effective long-term treatment for obesity, although there has been limited understanding of pre-operative, patient-level factors associated with insufficient weight loss and poor mental health outcomes. The findings of the present study suggest that an individual undergoing weight-loss surgery may experience improved body esteem and decreased depressive symptoms, up to a year post-operatively. Level of body esteem prior to surgery may not directly affect weight loss or dietary behaviors at one year, although it can be surmised that improved body esteem can have long term benefits, including psychosocial enhancement. Continued understanding of the predictors, psychological experience, and variability involved in long-term weight management may improve weight change and health outcomes following bariatric surgery and will have meaningful clinical and public health relevance.

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