Massive weight loss from bariatric surgery has profound health and lifestyle consequences. Research from the past several decades has demonstrated that anatomic and physiological changes from bariatric surgery require not only a change in nutrient intake, but a complete transformation of health and eating attitudes. The body of research demonstrating that bariatric surgery produces sustainable weight loss, improved health, and positive psychological outcomes has also demonstrated that patients continue to suffer from various nutritional deficiencies, psychological battles with food, and negative body image. We believe that in the bariatric population, nutrition and psychology are inextricably linked in promoting long-term successful weight loss and maintenance. We will first review the nutritional and psychological consequences of bariatric surgery, then focus on their interrelationship as an important influence on both the successes and failures in the post-bariatric surgery period.

**NUTRITIONAL CONSIDERATIONS AFTER MASSIVE WEIGHT LOSS**

Anatomic and physiological modification of the gastrointestinal tract in bariatric surgery leads to a diminished ability to absorb nutrients, electrolytes, and bile salts, as well as deficiencies in iron, calcium, and other vitamins and minerals. Dehydration, lactose intolerance, and protein calorie malnutrition are other common sequelae. Alterations in bone metabolism increase long-term risk for osteopenia and osteoporosis. Noncompliance with postsurgical nutritional regimens has been estimated to occur in from one third to almost two thirds of cases and can exacerbate these complications. Psychological issues are often present in patients with morbid obesity and can affect surgical outcomes. These issues include mood and personality disorders, destructive eating behaviors, and poor body image. Nearly one third of patients undergoing bariatric surgery also have a history of substance abuse disorder. The literature suggests that although the mental health of patients improves as a result of bariatric surgery, the benefits may be transient, and problems such as negative personality profiles, detrimental eating patterns, and negative body image persist to some extent. Identification of presurgical psychiatric problems can help identify those patients more likely to achieve lasting weight loss when surgery is combined with long-term follow-up to minimize medical and psychological complications. (Aesthetic Surg J 2008;28:195–199.)
and selenium are also reported. These deficiencies, impacting both erythropoiesis and bone metabolism, are commonly seen among bariatric surgery techniques, particularly when they exclude the duodenum, as in the Roux-en-Y gastric bypass. Dehydration occurs frequently after bariatric surgery because of postoperative nausea and vomiting, and dumping syndrome. Lactose intolerance is also commonplace after bariatric surgery because of decreased lactate production.9 Protein malnutrition, impaired bone metabolism, and anemia are important and recurrent foci of discussion.

Protein calorie malnutrition is frequently observed in patients after bariatric surgery.10 After surgery, patients often have development of a food intolerance to red meat and dairy products, which leads to deficits in protein intake.11,12 Protein consumption of 46 to 56 g/d is recommended, but many fail to comply for a variety of reasons. One series reported that 4.7% of patients had severe protein calorie malnutrition diagnosed at an average 18 months after Roux-en-Y gastric bypass.13 Rates from 1% to 22.5% of protein malnutrition have been claimed.4,14 In our center, about 18% of patients were deficient in their daily protein intake.15 In plastic surgery clinics specializing in patients who have undergone massive weight loss, protein deficiency can result in a significant number of wound complications. Protein deficiencies can lead to even more devastating consequences: hospitalization for protein malnutrition at a rate up to 1% per year.15

Alterations in bone metabolism pose a long-term risk of osteopenia and osteoporosis. Calcium and vitamin D deficiency can occur because of bypass of the duodenum and proximal jejunum (sites of calcium absorption) and jejunum and ileum (sites of vitamin D absorption).4 Relative hypocalcemia stimulates production of parathyroid hormone that in turn increases 1,25-dihydroxyvitamin D and increases release of calcium from bone, increasing the risk of osteoporosis.11 One study found that within 9 months after undergoing Roux-en-Y bypass, patients demonstrated an increase in bone resorption and an associated decrease in bone mass.16 Even high-dose vitamin D treatment did not adequately correct vitamin D deficiency in more than half the patients.17

Anemia among patients who have undergone massive weight loss is multifactorial, owing to numerous deficiencies of various erythropoietic agents. In one study monitoring for 10 years 348 patients who had undergone gastric bypass, iron, B12 or folate deficiencies were found in 82% of patients, and 54% had anemia.18 Oral or sublingual supplementation can readily reverse anemia because of iron, folate, and B12.10,18-21 A multivitamin alone can prevent folate and B12 deficiencies but not iron deficiency, which necessitates additional iron supplementation.21 Iron absorption occurs in the duodenum and is aided by gastric acids. The exclusion of the duodenum from digestive continuity and decreased acid production in the gastric remnant contributes to iron deficiency. Without iron supplementation, ferritin levels are depleted at 2 years after surgery in patients receiving placebo.21

Other micronutrient deficiencies are frequent topics of discussion. Significant thiamine deficiency can occur acutely after bariatric surgery in patients with prolonged vomiting and can be associated with severe and sometimes irreversible neurological symptoms.22 Wernicke’s encephalopathy from postbariatric surgery thiamine deficiency is rare, but reported.23 Another series reported a 14.5% selenium deficiency, most of which was described as subclinical.4 However, in a case report, a patient after a 100-kg weight loss had selenium deficiency–related cardiomyopathy and heart failure.24 More rarely, copper deficiency after bariatric surgery has led to demyelinating neuropathy, and pyridoxine deficiency lead to sideroblastic anemia with marrow changes.25

In discussing patients who have undergone surgical weight loss, it is significant to note that various nutritional deficits are present in morbidly obese patients before surgery.3 One report found a 62% prevalence of vitamin D deficiency in morbidly obese patients, whereas another showed a 16% preoperative thiamine deficiency.27 In a study of 379 morbidly obese patients before surgery, 19% of women and 40.7% of men had deficiencies in iron and or already had anemia.22

PSYCHOLOGICAL CONSIDERATIONS AFTER MASSIVE WEIGHT LOSS

Psychological issues related to morbid obesity incontrovertibly impact bariatric surgery outcomes. Before surgery, about two thirds of patients appear to have at least one psychiatric diagnosis.28,29 In one large study, 66% of patients had a lifetime history of at least one Axis I diagnosis (clinical disorders including major mental disorders), with 38% meeting Diagnostic and Statistical Manual criteria at the time of preoperative evaluation. Moreover, 29% of this group had one or more Axis II disorders (underlying pervasive personality disorders), whereas 27% had a lifetime incidence of binge eating disorder.29 Similar rates of diagnoses of Axis I and II disorders are reported elsewhere.30,31 A dominant feature in the literature in this area is the observation of a high incidence of mood and personality disorders, destructive eating behaviors, and poor body image in the morbidly obese patients. Although massive weight loss improves some of these issues, the improvement appears to be transient. The patient’s psychological profile appears to have a significant impact on successful weight loss, but weight loss appears to have a more transient impact on the psychology.

Depressive disorders are the most common diagnoses in the bariatric population, followed by anxiety disorder.32 The incidence of depressive disorder in the bariatric surgical patients ranges from 4.4% to 53% in literature.15,33,34 Depressive symptoms negatively impact physical function and increased eating in response to negative emotion and impaired appetite regulation.35,36 Although female patients were more depressed than their male counterparts, their postoperative psychological improvement was also more significant.37
While depression and anxiety disorders are the most prevalent, other diagnoses are also noteworthy. High incidences of somatization (29.3%), social phobia (18%), hypochondriasis (15%), and obsessive-compulsive disorder (13.6%) were found in the bariatric population. A series of patients treated at a bariatric surgery clinic demonstrated a 72% incidence of personality disorders, including histrionic, borderline, schizotypal, and passive-aggressive. Compared with published norms, the patients undergoing bariatric surgery were consistently found to be psychopathically deviant or disordered in their personality traits. Interestingly, 32.6% had lifetime diagnoses of substance abuse disorder, suggesting that substance abuse and weight problems may share some common foundation.

Binge eating disorder (BED), marked by consumption of an objectively large quantity of food in a brief period during which time a person experiences subjective loss of control, has been extensively studied in the preoperative morbidly obese. BED has a reported incidence of anywhere from 4% to 50% in the bariatric population, although the true incidence is likely closer to 10%.

Patients with BED had more depressive symptoms and associated minor disturbances of eating behavior such as grazing and night eating. Although some studies reported that non-binge eaters had a significantly higher excess body mass index loss than binge eaters, other long-term studies determined no difference in ultimate weight loss impact between patients in the BED and non-BED groups. However, binge eaters had more eating disturbances such as less restriction, more disinhibition, more hunger, as well as more psychopathological traits (passive-aggressive, aggressive-sadistic, manic, ethanol dependence, major depression). One study found that 46% of patients who had undergone bariatric surgery reported loss of control over eating marked by objective or subjective bulimic episodes.

Body image dissatisfaction is significantly greater in the morbidly obese compared with normal-weight control subjects. Body image dissatisfaction is more prominent in women and is associated with a higher incidence of depression, low self-esteem, and perfectionism. After undergoing bariatric surgery and weight loss, patients improved in self-image and self-satisfaction, sometimes into published normal range. However, self-disparagement and preoccupation of body shape remained significantly different from control subjects, suggesting that some negatively charged aspects of body image remain, regardless of weight loss. Body contouring surgery after weight loss also further improved body image and was independent of mood.

Overall, the psychology of the morbidly obese influences perceived and real outcomes of massive weight loss. Mental health tends to improve in the first couple of years after weight loss surgery, but the positive transformation may not be enduring. Massive weight loss can lessen depression, anxiety symptoms, paranoid ideation, and improve interpersonal relationships. The literature suggests, though, that improvements in mood deteriorate over time and that psychiatric abnormalities, negative personality profiles, detrimental eating patterns, and negative body image attitudes persist to some degree despite overall improvements in psychological profiles.

DISCUSSION

The patient who has undergone bariatric surgery undergoes a tremendous physical transformation, as well as a complete nutritional and lifestyle overhaul. It is only natural that during this same period patients also undergo a psychological upheaval. Improvements in body image, social activity, social satisfaction, and satisfaction with life are seen in conjunction with massive weight loss.

Although many of the outcomes of bariatric surgery are quite positive, it would be inaccurate to paint a rosy picture. Nutritional complications are not only common, they are the norm among patients who undergo bariatric surgery. Patient noncompliance is the most important factor in development of postsurgical nutritional deficiencies, with noncompliance with oral supplementation estimated at 33% to 64%. Some personality traits among the morbidly obese, including hypersensitivity and poor impulse control, are believed to preclude adjusting to demands imposed by bariatric surgery. After surgery, patients who undergo bariatric surgery are asked to follow strict regimens of diet, exercise, and vitamin intake (Table). Perhaps these demands are excessive in a population predisposed to binge eating, maladaptive psychological responses, and underlying depressive symptoms.

Many patients have a psychological relationship with food that extends beyond nutritional needs. In many patients after bariatric surgery, satiety increased and the rapidity of eating decreased. Patients with preexisting psychiatric abnormalities continued to engage in more destructive eating patterns such as binge eating and disinhibition. Emotional eaters tend to eat to fulfill a psychological vacancy rather than physical need. It’s not surprising, then, that even after physiological and anatomic alteration, patients who undergo bariatric surgery would reinitiate their prior relationship with food,
maladaptive or not. In a time of stress, individuals often turn to comfort foods; is it so surprising that after a major surgery, patients who have undergone bariatric surgery have difficulty adhering to a very foreign regimen of small, protein-rich meals and vitamin supplementation? Although the nutritional failures are not to be taken lightly, it is also important to ensure continued psychological health during this tremendously stressful period. Many of these individuals may eat as maladaptive coping mechanism for psychological problems, contributing to obesity.\textsuperscript{42} Optimization of psychological treatment and social resources can only help thwart the negative impulses and social stress that revive old habits.

Ultimately, massive weight loss from bariatric surgery initiates a remarkable physical transformation that often parleys into a revolution in personal relationships, body satisfaction, and social standing. Nutritional complications of bariatric surgery are, for the most part, correctible with careful adherence to a protein-rich diet and vitamin supplementation, as well as frequent monitoring. Proper identification of preexisting maladaptive personality, eating, and thought patterns can assist in identification of individuals least likely to comply and achieve successful, healthy weight loss. Consistent, long-term follow-up is also essential to minimize both medical and behavioral complications.▷

**DISCLOSURES**

The authors have no disclosures with respect to the contents of this article.

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