REVIEW

Nutritional Assessment and Preparation for Adult Bariatric Surgery Candidates: Clinical Practice

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ABSTRACT

Bariatric surgery (BS) has proven to be highly efficacious in the treatment of obesity and its comorbidities. However, careful patient selection is critical for its success. Thus, patients should undergo medical, behavioral, and nutritional assessment by a multidisciplinary team. From the nutritional point of view, BS candidates should undergo nutritional assessment, preparation, and education by a registered dietitian in the preoperative period. Currently, detailed specified and comprehensive information on these topics is lacking. The present narrative review aimed to summarize the available literature concerning both the preoperative nutritional assessment components and the preoperative nutritional preparation and education components of patients planning to undergo BS. Current literature indicates that proper management before BS should include a comprehensive nutritional assessment, in which it is advisable to perform a clinical interview to assess patients' medical background, weight management history, eating patterns and pathologies, oral health, physical activity habits, nutritional status, supplementation usage, BS knowledge, surgery expectations and anthropometric measurements. Nutritional preparation and educational strategies should include an individualized preoperative weight-loss nutrition program, improvement of glycemic control, micronutrients deficiencies correction, eating and lifestyle habits adaptation, physical activity initiation, and strengthening knowledge on obesity and BS. At this stage, more well-designed intervention and long-term cohort studies are needed in order to formulate uniform evidence-based nutritional guidelines for patients who plan to undergo BS, including populations at higher nutritional risk. Moreover, postoperative outcomes of presurgical nutritional intervention programs should be studied. *Adv Nutr* 2021;12:1020–1031.

Keywords: obesity surgery, nutrition evaluation, eating behaviors, dietary supplements, weight loss, oral health, glycemic control, physical activity, skeletal status

Introduction

Obesity is a recognized global disease that continues to be a risk factor for chronic medical conditions (1). Bariatric surgery (BS) has gained popularity in the last decades for the treatment of morbid obesity and its metabolic complications (2). However, some patients do not achieve the optimal outcome targets in terms of weight loss [i.e., achievement of ≥50% excess weight loss (EWL)], along with improvement in comorbidities and satisfaction (3). Moreover, it should also be noted that some patients regain a portion or all of their lost weight within a few years following surgery (4, 5). Presently, the leading types of bariatric procedures include sleeve gastrectomy (SG), Roux-en-Y gastric bypass (RYGB), one anastomosis gastric bypass, adjustable gastric banding, and biliopancreatic diversion with (BPD-DS) or without (BPD) duodenal switch (2). Although there are currently no evidence-based protocols for choosing the most appropriate BS procedure type for the patients, in practice the choice is mostly based on individualized goals of therapy, patient preferences, existing comorbidities, personalized risk stratification, and the surgeon's medical opinion and experience (1, 6).

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Supplemental Table 1 is available from the "Supplementary data" link in the online posting of the article and from the same link in the online table of contents at https://academic.oup.com/advances.

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Abbreviations used: BED, binge-eating disorder; BN, bulimia nervosa; BPD, biliopancreatic diversion; BPD-DS, biliopancreatic diversion with duodenal switch; BS, bariatric surgery; EWL, excess weight loss; HbA1c, glycated hemoglobin; NES, night eating syndrome; PTH, parathyroid hormone; RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy; VLCD, very low-calorie diet; 25(OH)D, 25-hydroxyvitamin D.

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The eligibility criteria to undergo BS are currently dependent on the patient's BMI and obesity-related comorbidities (1, 7, 8). Careful patient selection is critical to the success of BS (9). Thus, every patient who plans to undergo BS should undergo medical, behavioral, and nutritional assessment by a multidisciplinary team in order to evaluate his/her suitability to the surgery (1).

From the nutritional point of view, BS candidates should undergo preoperative nutritional evaluation, preparation, and education by a registered dietitian (8, 10–12).

Currently, detailed specified and comprehensive information on nutritional assessment, preparation, and education for BS candidates is lacking. Thus, the aim of the present narrative review is to summarize the scientific literature on preoperative nutritional assessment, preparation, and education of adult patients who plan to undergo BS. This review may assist medical teams, including and especially bariatric dietitians, to plan and perform proper management prior to BS.

Literature Search

A literature search was performed with the proposed line of searches for narrative reviews (13). The search included 3 electronic databases: PubMed, Google Scholar, and the Cochrane Library. Articles published up to May 2020 were selected. A combination of the relevant search terms of both BS and nutritional/clinical parameters was used (**Supplemental Table 1**). Reference lists of cited articles were also manually searched for additional relevant articles. The inclusion criteria were all types of articles with human subjects in English. The exclusion criteria were articles for which full text was not available and studies that focused on pediatric patients.

Current Status of Knowledge

Table 1 summarizes the recommended components of the presurgery nutritional assessment (1, 7, 11, 12, 14–22) and **Table 2** summarizes the recommended components of the preoperative nutritional preparation process (1, 11, 12, 17, 19, 20, 23–27).

Nutritional and clinical assessment

Eating behaviors.

Following BS, patients are expected to maintain various eating behaviors including dividing food intake into 4–6 meals throughout the day, consuming high-protein foods, chewing food slowly and thoroughly, ending meals when feeling "comfortably full," avoiding carbonated and high-calorie drinks, increasing water intake, separating liquids from solids, limiting consumption of calorie-dense foods and drinks, and avoiding binge eating, grazing, or snacking (11, 17, 25). However, poor eating habits were found to be prevalent among candidates for BS (17, 28–30) and maladaptive eating behaviors have been associated with poorer surgery outcomes (30–32). Therefore, detailed presurgical assessment of eating behaviors, including number and types of meals per day, liquid intake, eating patterns, eating pathologies, and eating pace, is crucial in order to learn and practice the needed behavioral changes before the surgery (11, 18, 28).

Special attention should be given to patients who restrict or avoid specific food groups, or to those who adhere to any dietary pattern that increases the risk of insufficient nutrient intake (33). Intervention should be made to help improve diet quality as needed. In cases where participants are found to be struggling to make the needed behavioral changes, more focus should be put on developing the needed coping skills (18). Presently, there is a lack of consensus regarding the definitions and methods to assess and address problematic eating behaviors prior to BS.

Eating disorders.

Accumulating evidence suggests that BS candidates are likely to present with eating disorders and/or problematic eating behaviors, and these problems may persist, be exacerbated, or even develop following the surgery (30). A recently published review found that a variety of often problematic eating behaviors appear more common among BS candidates as compared with nonobese populations (17). The literature suggests that 4–49% of candidates may present with binge eating disorder (BED; i.e., eating a large amount of food in a short time), 2–42% with night eating syndrome (NES), ~3% with bulimia nervosa (BN), and 17–54% may meet the criteria for food addiction (17, 30, 34). However, variety in literature exists regarding the exact numbers of each eating disorder, with mixed findings related to gender (17). Screening for eating disorders should be done by the multidisciplinary team prior to the surgery and should be performed by qualified health professionals, including psychologists, social workers, psychiatrists, and dietitians (1, 7). According to the recently published position statement by the International Federation for the Surgery of Obesity and Metabolic Disorders, BED and NES are not considered as contraindications for BS, but untreated BN is considered a contraindication (7).

While presurgical evaluation of eating disorders is recommended in order to provide the necessary mental health support, established guidelines for assessment and how to proceed when an eating disorder is identified are limited and inconsistent (1, 35, 36). Structured diagnostic interviews are considered as the "gold standard" in assessing eating disorder conditions, but they are very time consuming and require highly skilled personnel (37). Some self-reported questionnaires are currently available, but they are not all validated among BS candidates (e.g., Eating Disorder Examination Questionnaire, the Binge Eating Scale, Questionnaire on Eating and Weight Patterns, Three Factor Eating Questionnaire) (37). However, minimization of problematic

TABLE 1 The recommended components of routine pre-surgery nutritional assessment[1]

Parameters	Measurements and evaluation strategies
Medical background	• Anamnesis should include comorbidities (e.g., diabetes mellitus, hypertension, sleep apnea), gastrointestinal symptoms, psychological background, substance use, sleep hygiene
Weight-management history	• Family history of obesity • Onset of obesity • Previous weight-loss regimens
Eating patterns	• Number and types of meals per day • Liquid intake • Eating patterns (e.g., vegetarian, lactose free, gluten free) • Dysregulated eating • Eating pace • Dietary restrictions including avoidance of certain food groups and/or aversion of certain foods • Evaluation of nutrients intake (energy, macronutrients and micronutrients intake by 24-h recall or food diary)
Eating pathologies	• Eating disorders assessment by multidisciplinary team using structured diagnostic interviews and/or self-reported validated questionnaires as needed
Anthropometric measurements	• Weight • Height • Waist circumference • Consider body-composition assessment by DXA or BIA if available
Nutritional status	• Screening for nutritional deficiencies • Tests should include at least: serum PTH, serum calcium, 25(OH)D, serum albumin, vitamin B-12, folate, blood cell count, iron, ferritin, transferrin, total iron binding capacity, electrolytes • Consider more extensive testing in patients undergoing malabsorptive procedures or with specific findings and at-risk patients (i.e., vitamins A, K, and E; thiamin; 24-h urine calcium excretion; zinc; and copper)
Supplementation use	• Type and dose of supplementation intake • Ability to swallow pills
Skeletal status	• DXA at spine and hip prior to malabsorptive surgeries (e.g., RYGB and BPD/BPD-DS) and in patients at higher risk[2]
Oral health	• General oral hygiene • Numbers of masticatory functional unities and chewing ability • If needed, consider referring to dentist for consultation
Physical activity habits	• Type, intensity, and frequency of exercise performance per week by specific questionnaires or objective measurements (e.g., pedometer) • Possible limitations and barriers to perform exercise • Mobility level by subjective assessment • Physical function assessment by validated methods such as the sit-to-stand test, hand grip, the 6-min walk test, or 12-min walk-to-run test
Bariatric surgery knowledge	• General knowledge of nutrition • Knowledge of surgical options and the optional side effects of the surgeries • Knowledge of the needed eating techniques and lifestyle habits • Knowledge of the risks of nutritional deficiencies, their consequences, and the high importance of adherence to supplementation regime following BS • Knowledge of the needed follow-up regime • It is recommended to use BS nutritional knowledge questionnaires if available
Surgery expectations	All the following should be determined if they are realistic: • Weight goal expectations • Expectations regarding the improvements in comorbidities • Expectations regarding the improvements in other life components

[1] BIA, bioelectrical impedance analysis; BPD, biliopancreatic diversion; BPD-DS, biliopancreatic diversion with duodenal switch; BS, bariatric surgery; PTH, parathyroid hormone; RYGB, Roux-en-Y gastric bypass; 25(OH)D, 25-hydroxyvitamin D.
[2] Women aged ≥65 y, men aged ≥70 y, and younger patients who have conditions associated with bone loss or low bone mass.

eating prior to surgery should be considered in specific cases (38).

Currently, there is inconsistent evidence regarding the association between preoperative eating disorders and post-operative weight loss (39, 40). This might be related to differences in study methodologies and differences in time of follow-up since the surgery (39). However, there is higher consistency for the association between the development or re-emergence of binge-eating symptoms postoperatively and worse surgical outcomes (40, 41). Binge eating is

TABLE 2 The recommended components of the presurgery nutritional preparation process[1]

Parameters	What should be included?
Adaptation of the needed eating and lifestyle habits	• Regular meal patterning by dividing food intake into 4–6 meals throughout the day and avoidance of meal skipping • Chewing food slowly and thoroughly • Emphasis on eating high-protein foods • Emphasis on solid foods in most of the meals to increase satiety • Ending meals when feeling "comfortably full" by attention to physiological hunger and satiety signals • Avoiding carbonated and high-calorie drinks, increasing water intake, and avoiding drinking during meals • Limiting consumption of calorie-dense foods and drinks, but increasing consumption of nutrient-dense foods • Emphasis on healthy eating
Micronutrients deficiencies correction	• Correct micronutrients deficiencies according to available guideline recommendations
Preoperative weight loss	• Preoperative weight-loss program according to the specific needs and circumstances of the patient
Improvement in glycemic control for patients with diabetes	• Presurgery glycemic control can be optimized by using dietary plan, physical activity, and pharmacotherapy when needed • Reasonable targets for diabetic patients preoperatively are HbA1c values of <7.0% • Reasonable targets for diabetic patients in cases of advanced macrovascular or microvascular complications, extensive comorbid condition, or long-lasting diabetes are HbA1c values of <8.0%
Physical activity initiation	• Providing physical activity program in terms of type, intensity, and frequency according to the patient's mobility level, functional abilities, cardiorespiratory fitness, barriers, and motivation
Strengthening knowledge on nutrition, obesity, and the BS process	Education regarding the following: • General knowledge on nutrition • Causes of obesity • Surgical options, potential complications, and the hospitalization process • Eating habits and dietary supplement regimen required for BS patients • Physical activity plan, stress management, and other lifestyle strategies for long-term success • The importance of long-term treatment plan by the BS multidisciplinary team • Expectations regarding weight loss, comorbidity improvement, and other life components should be discussed • Education may be delivered by personal appointments, live classroom sessions, phone-based support, video, website, slideshow, written materials, or by combinations of different approaches
Childbearing age women candidates for BS	• Nutritional counseling on recommended supplementations for women of childbearing age before BS, after BS, before conceiving, and during pregnancy • Referring to an obstetrician to discuss birth-control options

[1]The nutritional preparation and educational process should include all or some of the components listed in the table as needed. BS, bariatric surgery; HbA1c, glycated hemoglobin.

physically impossible immediately after surgery; however, loss of control over eating behavior or grazing can remain or evolve postoperatively and lead to less successful weight outcomes, vomiting, and related complications (41).

High-nutritional-risk candidates.

Presently, there are almost no formal nutritional contraindications for BS, although some populations may be considered at higher nutritional risk, including patients with untreated eating disorders (7, 38) or significant levels of food aversion, multiple nutritional deficiencies (42) or hypoalbuminemia (43), sarcopenic obesity (22), reduced bone density (21), poor oral hygiene (44), poor glycemic control (1), advanced kidney disease (45), and patients who underwent ≥1 BS in the past. Although there is paucity of literature regarding these populations in terms of nutritional assessment, preparation, and outcomes, in clinical practice they are often required to undergo more extensive nutritional assessment and may be referred for consultation with additional health professionals.

Anthropometric measurements.

Weight and BMI are the main anthropometric measures used in the BS field. However, it is also necessary to consider classifying patients on the basis of body-composition measures as these measures expand the understanding on the metabolic profile of the patients (22). MRI and computed tomography are considered to be "gold standards" for body-composition assessment, but DXA and bioelectrical impedance analysis are more widely available instruments to determine body composition (46). Presently, there are insufficient data to

determine the optimal BS procedure for a patient based on body composition (7). Moreover, accurate instruments to measure body composition are not available in all medical centers.

Nutritional deficiency screening and supplementation.
The high rate of micronutrient deficiencies among patients with severe obesity prior to BS has been previously reported (42, 47–58), with a higher rate among women as compared with men (42, 59–62), patients with higher BMI (60, 63), or specific ethnic groups (42, 59). Preoperative nutritional deficiency prevalences of 22–76% for vitamin D deficiency, 6–50.5% for iron deficiency, 24.2–39% for elevated parathyroid hormone (PTH), 0–56% for folate deficiency, and 15.8–19.6% for anemia were previously described (42, 47, 49, 50, 52, 53, 55, 57, 59, 60, 62, 64). Impaired presurgery nutritional status is found to be related to postoperative nutritional deficiencies and can be associated with further metabolic complications such as bone loss (11, 21, 47, 65, 66). Most available guidelines emphasize the need to correct preoperative nutritional deficiencies as part of the preparation process (11, 14, 16, 67–70) and some have suggested to combine a multivitamin supplement during the preoperative period (14). The preoperative nutritional screening parameters recommended by most guidelines include measurements of vitamin B-12, folate, blood cell count, iron, ferritin, transferrin, total iron binding capacity, electrolytes, albumin, calcium, PTH, and 25-hydroxyvitamin D [25(OH)D] (11, 14, 16, 42, 67–71), and several guidelines also recommend more extensive testing in the case of specific findings and/or at-risk-group patients, especially prior to malabsorptive procedures (16, 68–70). Additional preoperative measurements that have been recommended include thiamin; zinc; copper; vitamins A, K, and E (16, 68–70); and 24-h urinary calcium excretion (16, 42, 68–70).

Skeletal status.
The main mechanisms for bone deterioration accompanied with BS include mechanical unloading, decreased absorption mostly of calcium and vitamin D, and hormonal changes (21, 72). It has previously been demonstrated that calcium absorption decreases after RYGB (73, 74) and BPD procedures (75–78). Impaired calcium absorption also appears after SG (79), and could be related to the reduction in gastric acidity (80) and to a low oral calcium intake postsurgery (81). Additionally, significant macronutrient deficiency and specifically protein depletion could negatively impact bone health following BS (82, 83).

Currently, there are almost no randomized controlled trials evaluating the strategies of optimizing patients' management before and after bariatric procedures with regard to the prevention of bone deterioration (84). Most proposed preoperative management approaches include biochemical assessment of 25(OH)D concentration, serum PTH, calcium, albumin, phosphorus, alkaline phosphatase, and 24-h urinary calcium excretion, with the treatment of vitamin D deficiency prior to the surgery (16, 21, 84). Furthermore, skeletal evaluation prior to BS should include performing DXA at the spine and hip prior to malabsorptive surgeries (e.g., RYGB and BPD/BPD-DS) and in patients at higher risk, such as women aged ≥65 y, men aged ≥70 y, and younger patients who have conditions associated with bone loss or low bone mass (21, 84).

Oral health.
Oral cavity changes among BS patients were found to be related to the development of dental caries and wear, hypersensitivity, and periodontal disease (85). It has been suggested that low calcium intake, increased frequency of regurgitation and gastroesophageal reflux, increased food intake at shorter intervals, and resultant oral pH imbalance were associated with increased development of oral complications such as dental caries, dental erosion, and increased salivary flow rate following BS (85). Although this topic has received only modest attention in the literature so far, some nutrition-promotion strategies for adequate oral hygiene were shown to be effective in the prevention of the main oral health problems in patients who underwent BS, including reduction in the quantity and frequency of consumption of foods and beverages with added sugar, avoidance of eating at night, diminishing consumption of acidic foods (e.g., citrus fruit and vinegar), and avoidance of a dry mouth by frequent drinking with small sips during the day (86). Moreover, it was recommended that, in case of regurgitation or vomiting, teeth should not be brushed immediately to avoid removing dissolved dental tissue (85, 86). In light of these findings, it is important to monitor oral status before and after the surgery. According to a study among candidates for BS, low socioeconomic status, advanced age, smoking, and diabetes were found to be related to impaired oral health (44). Thus, preventive assessment of oral health and education strategies should be implemented from the time of the preoperative period (87), and probably special attention should be paid to the populations at higher risk (44).

Patients scheduled for BS are encouraged to chew well and slowly in order to optimize the digestion process; reduce the incidence of common physiological complications after surgery such as vomiting, diarrhea, abdominal pain, or dumping syndrome (87, 88); and to prevent phytobezoar formation (89). It has been shown that having ≥8 masticatory functional unities, which means teeth that have an antagonist, is important for maintenance of efficient masticatory function (44, 88). Food texture should be adapted to the dental status and, in some cases, a rational approach would be to recommend mixed textures or soft foods (88). However, it is important to note that eating soft foods may cause frequent hunger, which, in turn, could enhance maladaptive eating behavior such as grazing, which is related to worse surgery outcomes (90).

Nutritional preparation

Preoperative weight loss.

Presurgery weight loss is often recommended in order to reduce liver volume by reducing its glycogen, water, and fatty deposits and to improve the technical aspects of the surgery (1, 20, 91). Moreover, weight loss during presurgery preparation programs might be seen as a proxy for adherence to the medical team's advice (18). Thus, many centers recommend a supervised weight-loss program (11, 92). However, data concerning the feasibility, effectiveness, duration, and the most appropriate macronutrient composition are not well established (11, 20, 93–95). Some methods suggested for the preoperative period include low-carbohydrate diets (11, 14), very-low-calorie diets (VLCDs), low-calorie diets, very-low-energy meal replacements, nutritional supplements such as omega-3 fatty acids, antiobesity drugs, and intragastric balloons (91, 94, 96).

A systematic review of the effects of VLCDs with 400–800 kcal/d for up to 12 wk on weight loss, liver size, and surgical complications during the preoperative period, which included 9 studies (3 randomized controlled trials and 6 observational studies; $n = 849$ patients), found weight loss of −2.8 to −14.8 kg, liver size reduction of −5% to −20%, and no significant effect on perioperative complications (94). Moreover, VLCDs were shown to be maximally beneficial in a 2- to 4-wk time frame (94). A systematic review that evaluated different methods to reduce liver volume prior to RYGB and included 7 observational studies which investigated the effect of low-calorie diets ($n = 169$ patients) concluded that preoperative diets with 456–1520 kcal/d for up to 12 wk reduced liver size by −5% to −20% (91). A systematic review that assessed feasibility and effectiveness of preoperative very-low-energy meal replacements for up to 16 wk on weight loss and surgical risks, which included 13 studies (2 randomized controlled trials and 11 observational studies; $n = 750$ patients) specifically in BS candidates, found weight loss of −3.1% to −27% and liver size reduction of −5.1% to −43.4% (96). Nevertheless, in a large-scale retrospective cohort study in 394,016 patients that assessed whether preoperative weight loss is associated with 30-d postoperative complications, weight loss prior to laparoscopic RYGB or SG was not found to be associated with increased readmission, reoperation, mortality, or another intervention (97).

According to the updated position statement on insurance-mandated preoperative weight-loss requirements published by the American Society for Metabolic and Bariatric Surgery, mandated preoperative weight loss is not supported by medical evidence and has not been shown to provide any benefit for surgery outcomes (95). Currently, well-designed randomized controlled trials and long-term prospective studies are needed in order to support the practice of weight-loss regimes presurgery (95). Moreover, the practices for super-obese patients or in cases of weight gain during the preparation process were almost not mentioned in the literature and should be better explored and defined. The bariatric medical team may recommend a preoperative weight-loss program according to the specific needs and circumstances of the patient (20, 95, 98). Caution should prevail when weight loss is achieved by inappropriate pathways, such as fasting or the use of nonapproved drugs or supplements (18).

Preoperative glycemic control.

Many diabetic patients awaiting BS have poor glycemic control (26). The achievement of optimal glycemic control preoperatively is important in order to reduce the lengths of hospital stay and the risks of wound infections and other complications following surgical procedures (1, 10, 26). Moreover, preoperative glycated hemoglobin (HbA1c) concentrations appear to predict the likelihood of diabetes remission post-BS (99). However, it is important to correctly classify diabetes subtype prior to the surgery to identify patients whose diabetes is unlikely to remit postsurgery (100). Reasonable targets for glycemic control preoperatively are an HbA1c value of <7.0% in general, but <8.0% in cases of advanced macrovascular or microvascular complications, extensive comorbid conditions, or long-lasting diabetes (1). Presurgery glycemic control can be optimized by adopting a healthy dietary plan, use of medical nutrition therapy, increased physical activity, and pharmacotherapy, when needed (1, 26). It is important to note that many antihyperglycemic medications may contribute to weight gain, but others may be weight-neutral or even cause weight reduction (26, 101). To date, studies investigating programs to improve glycemic control prior to BS are lacking. In a retrospective study in 75 BS candidates with poorly controlled type 2 diabetes (HbA1c values of 9.0% ± 1.2%) who were invited to participate in an interprofessional bariatric glycemic optimization program, which included individualized nutritional counseling and exercise prescription, adjustment of antihyperglycemic therapy, and weekly phone calls, 92% reached the target HbA1c values of ≤8.0% (26).

Preoperative physical activity.

Physical activity constitutes one of the pillars of a healthy lifestyle and it has an important contribution before and after BS (102). Engaging in physical activity after BS was associated with higher quality of life (20), improved insulin sensitivity (103, 104), reduced detrimental effect on bone mass (21, 105), and better body composition (106, 107), although the effect on higher weight-loss outcomes is questionable (108–110). Candidates for BS are a population at risk of a sedentary lifestyle, thus beginning active habits prior to surgery may be beneficial (111–113). Although evidence on the effects of preoperative engagement in physical activity is scarce and inconsistent, overall it appears that preoperative physical activity improved physical fitness (114–116), glycemic control, and lipid profile (102). Furthermore, it has been shown that early intervention with physical activity prior to the surgery was associated with higher postoperative physical activity level (111, 115, 117).

The multidisciplinary team and physical activity specialists should discuss with BS candidates the possibility

of beginning exercise prior to surgery and reap its benefits. Addressing barriers to exercise may assist patients in performing physical activity. Thus, it is recommended to discuss with BS candidates the potential barriers to exercise, including body pain, physical limitations, lack of self-confidence and motivation, shame, environmental factors, and restricted resources (118). Patients who are willing to exercise should receive medical authorization for this purpose first, while medical tests such as pulmonary function or cardiac stress tests might be considered in accordance with the patient's medical condition (69). It is suggested to assess the mobility level of patients by subjective assessment in order to recommend appropriate physical activity in terms of type, frequency, and intensity (20). Physical function assessment should be done by using validated tools such as the sit-to-stand test (20), hand-grip-strength test (119), and the 6-min walk test or 12-min walk-to-run test (20). It has been recommended to advise candidates for BS to initiate an exercise program that combines aerobic exercises (20, 120) and resistance exercises (117), according to their individual abilities (120). It is recommended to gradually increase the volume of exercise in order to reduce injury risk. In order to increase difficulty, it has been advised to first increase the duration and frequency of the exercise and later the intensity (121). Low-impact activities that do not involve purposeful collision or contact have a lower risk for injury (e.g., walking, bicycling or riding a stationary bike, dancing, and swimming). For patients with a history of joint pain or musculoskeletal problems, exercise types such as cycling or swimming, with a lower impact on body-weight load, should be suggested (20). The recommendations for substantial health benefits from physical activity are the same as for the general population, and are based on the American College of Sports Medicine (120). However, the general advice for adults, especially those with chronic conditions, is to engage in regular physical activity and to reduce their sedentary lifestyle.

BS nutritional knowledge.

Transfer of nutritional and behavioral knowledge from a registered dietitian to patients who plan to undergo BS is considered to be a standard of care in BS practice (23).

Currently, it appears that there is no gold-standard tool for the assessment of BS nutrition knowledge among BS candidates, although some questionnaires have been suggested (19, 23, 122–124). The Eating After BS questionnaire, scored on a 0- to 89-point scale, was developed by a local expert panel from Canada and went through a process of face validity. The mean Eating After BS questionnaire score presurgery among 119 BS candidates was 46.9 ± 14.4 (23). Our group previously developed the BS Nutritional Knowledge Questionnaire, scored on a 0–100-point scale, which went through a process of face, content, and construct validity (19). The mean BS nutrition knowledge score with this tool among 200 BS candidates was 64.5 ± 13.4 (19). These findings suggest that the level of knowledge among BS candidates could be relatively low.

A major component of the preoperative process involves comprehensive patient education regarding causes of obesity, surgical options, the hospitalization process, potential medical and nutritional complications, expectations, eating habits required for BS patients, the dietary supplement regimen needed following the surgery, physical activity plan, stress management, other lifestyle strategies for long-term success, and the importance of the long-term treatment plan by the multidisciplinary team (1, 10, 16, 24, 25, 125). Presurgery, weight-loss expectations should be discussed with all patients and be relevant to the acceptable average EWL according to the planned BS procedure (5, 9, 11, 19, 24, 126). For patients undergoing secondary surgeries, poorer weight outcomes are expected and should be discussed with patients (127, 128).

Education can be delivered by personal appointments, live classroom sessions, phone-based support, video, website, slideshow, written materials, or by combinations of different approaches (24). However, standardization is missing and the optimal type or timing for education intervention presurgery remains inconclusive among centers in terms of curriculum, length of program, frequency of sessions, teaching methods, and educators (24).

Digital communication methods such as online-education programs may be utilized to increase patient engagement and minimize barriers such as time, distance, and expenses (5, 24, 129). To date, these technologies remain underutilized in BS and research on preparation for BS by digital communication tools has received only modest attention so far (130). Most published data concentrated on specific parameters such as presurgery psychosocial interventions (131), physical activity intervention by telehealth (116), and the impact of video lectures as compared with booklets (19, 123, 132) or learning sessions with online courses (133). One study in 20 BS candidates used a mobile technology that included encouraging messages and video-based education modules to prepare patients for BS and found positive trends of behavior changes and weight loss prior to the surgery (122).

Childbearing-age women who are candidates for BS.

The majority of patients undergoing BS are women of childbearing age (27, 134). A substantial proportion of women willing to undergo surgery are those seeking a future pregnancy (135). Since both obesity and BS have a great effect on fertility and pregnancy outcomes (1, 27, 136), it is important to advise BS women candidates both on the positive effects and potential risks (137). Thus, there is high importance of nutritional counseling for all women candidates of BS in order to educate and prepare them for the effect of the surgery on fertility and pregnancy outcomes, the need of close management by a multidisciplinary team before and during pregnancy, frequent nutritional screening for vitamin and mineral status, and the importance of adherence to the supplementation regime including the adaptations for pregnancy regarding specific micronutrients such as folic acid, vitamin A, iron, and iodine (11, 16, 27, 138).

For women of childbearing age, a consultation with an obstetrician to discuss birth-control options is important preoperatively as pregnancy should be discouraged within the first 12–18 mo following surgery to ensure that pregnancy does not occur during the rapid weight-loss period, which could affect fetal growth (1, 14, 27, 139). It has been shown that only 39% of surgeons discuss contraception use with BS patients and only 25% routinely refer patients for contraceptive advice given by a reproductive health specialist (140). Changes in the absorption pathways may occur postsurgery, affecting oral contraceptive absorption, especially following malabsorptive procedures (1, 141), but also to some degree after SG (135).

Furthermore, it is recommended for women of childbearing age who undergo BS to have a daily oral intake of 800–1000 μg folic acid to reduce the risk of neural tube defects (16), although other guidelines recommend higher doses in specific cases (14, 142). Additionally, since anemia during pregnancy is common in women with a history of BS, this issue also requires special attention both for prevention and treatment among women of childbearing age who are candidates for BS (143).

Conclusions

Nutrition preparation before BS is an important component of achieving optimal outcome targets, in terms of weight loss and prevention of nutritional complications. This preparation should include a comprehensive assessment of the nutritional and medical status as well as health-related behaviors of the candidates by a registered dietitian, followed by appropriate counseling and intervention, and the provision of relevant knowledge about the surgery. The main focus in the preoperative period should be on eating habits, nutritional status balance, lifestyle changes, and knowledge acquisition. In addition, personalized weight-loss management, intervention-targeted glycemic control, and physical activity engagement are recommended. Presently, there are almost no formal nutritional contraindications to BS, but some populations may be considered at higher nutritional risk. Special guidance should be given to those women who are within the reproductive age range and who wish to conceive in order to enable a healthy pregnancy and proper development of the fetus.

At this stage, more well-designed intervention and long-term cohort studies are needed in order to formulate uniform evidence-based nutritional guidelines for patients who plan to undergo BS, including for populations at higher nutritional risk. In addition, postoperative outcomes of presurgical nutritional intervention programs should be studied.

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