

Bariatric surgery in adolescents with severe obesity: Recommendations of the Nutrition Branch, Chilean Pediatric Society

Cirugía bariátrica en adolescentes con obesidad severa: Recomendaciones de la Rama de Nutrición, Sociedad Chilena de Pediatría

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What do we know about the subject matter of this study?

Bariatric surgery in adolescents is a developing issue, its short- and medium-term results are favorable regarding effectiveness and safety, it frequently presents nutritional complications, and its long-term consequences are still unknown.

What does this study contribute to what is already known?

This document provides guidelines for the accurate indication of bariatric surgery as part of a stepped care approach of for the management of the adolescent with severe obesity, considering the current evidence, the vulnerability of the adolescent, and the need for its implementation in a multidisciplinary context.

Abstract

In recent years, severe obesity in adolescents has been rising worldwide, and Chile is no exception to this phenomenon. This condition exponentially increases health risks and it is associated with premature mortality. Since 2008, several guidelines on pediatric obesity treatment have included bariatric surgery as a treatment strategy for certain severely obese adolescents. These procedures have proven to be safe and efficient in adults. Recent evidence shows that, when done in specialized centers, the results would be similar in adolescents in the short and medium term. Nonetheless, in this group of patients, bariatric surgery has risks related to their stage of development, and data on long-term results and complications are still lacking. Therefore, to achieve the expected results, the patient selection, surgery, and follow-up must be carried out by qualified multidisciplinary teams, in hospitals centers that have the appropriate infrastructure, It is essential for the patients a life-long adherence to medical and nutritional monitoring. The objective of this document is to present the position statement of the Nutrition Branch of the Chilean Society of Pediatrics on the different issues to be considered for the adequate indication of these procedures in severely obese adolescents.

Keywords:

Bariatric surgery;
obesity;
adolescence;
pediatrics;
obesity treatment

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Introduction

Obesity is the most common nutritional problem in our population. In Chile, there are no data regarding obesity during the adolescent period. However, the National Board of School Aid and Scholarships (JUNAEB)¹ shows that, in students of 9th year grade, this condition has significantly increased, rising from 8.1% to 13.4% between 2011 and 2016. In 2018, this figure increased to 14.7%, of which 1,9% are severely obese.

Globally, there has been an increase in severe obesity in adolescents and its associated medical and psychosocial comorbidities. These comorbidities have a cumulative impact on health, determining that the duration of obesity carries significant risks of disease and premature mortality. In our country, severe obesity is defined as a body mass index (BMI) $\geq +3$ standard deviation (SD), according to age and sex, as defined in WHO 2007 reference².

Lifestyle interventions, and pharmacologic approaches, have shown a scarce benefit in the control of severe obesity in adolescents, thus, bariatric surgery (weight loss surgery, WLS) has emerged as a treatment option given its safety and efficacy in adults. In the United States, about 1,000 WLS are performed per year on adolescents, which represents less than 1% of the adolescent population with obesity class III (BMI > 40 kg/m²)³.

This article presents the recommendations of the Nutrition Branch of the Chilean Society of Pediatrics (SOCHIPE) for the indication of WLS in adolescents.

1. Why consider WLS in severely obese adolescents?

The Bogalusa study⁴ showed that all adolescents who were severely obese at an average of 12 years of age, maintained obesity in adult life, and 88% also remained severely obese. Recently, a study showed that in children and adolescents there is a significant association between the obesity class and the prevalence of cardiometabolic risk (CMR) factors⁵.

On the other hand, the cumulative effect of persistent obesity from adolescence to adulthood increases the likelihood of complications and premature death related to diabetes and cardiovascular disease^{6,7}. Some studies suggest that this effect would remain, regardless of BMI changes in adulthood⁸.

However, the most important immediate impact of severe obesity on adolescents occurs in psychosocial terms, affecting their quality of life, especially in the areas of physical comfort, body esteem, and social life^{9,10}.

There are few studies on the outcome of lifestyle interventions, specifically in severely obese adolescents. Available data suggest that an older age and a higher BMI will condition less effectiveness in the medical treatment for BMI reduction. In severely obese adolescents, a reduction between 0.3-0.68 kg/m² in BMI has been reported after 1-3 years of treatment¹⁰. The available drug therapy is very limited, achieving, along with lifestyle modification, small reductions in BMI ranging from 0.7-1.7 kg/m²⁽¹¹⁾.

The SOCHIPE's Nutrition Branch believes that in appropriately selected severe obese adolescents, a WLS could be a useful therapeutic tool considering the available evidence and scant success of medical treatment, including drugs, taking into account the impact of severe obesity on psychosocial health, quality of life, and increased risk of early morbidity and mortality.

2. What are the current recommendations for performing WLS in adolescents?

Scientific societies^{12,13} recommend a stepped-care approach for the treatment of obesity in children and adolescents, with increasing levels of supervision and intervention according to age, obesity class, associated morbidity, and response to previous treatments.

Stage 4 of this approach considers WLS as a therapeutic alternative in adolescents with severe obesity associated with serious comorbidities that have a negative response to lifestyle interventions.

Since 2008, the international literature¹⁴⁻²¹ suggests that WLS candidates must have a BMI ≥ 35 associated with serious comorbidities or ≥ 40 with less severe ones, along with complete physical maturity, defined as a Tanner IV-V pubertal stage (bone age > 13 years in females and > 15 years in males), or having reached at least 95% of the adult height predicted by bone age. There is no consensus on the minimum chronological age for performing these procedures. In recent multicenter studies, these interventions were performed on adolescents as young as 13 years old²²⁻²⁴. Other requirements are include: unsuccessful organized attempts to lose weight with lifestyle interventions for at least 6 months, with acceptable adherence; adolescent's psychological maturity, and family support. Table 1 presented the current recommendations.

The SOCHIPE's Nutrition Branch adheres to the recommendations of international literature regarding WLS in adolescents, highlighting as an essential condition a solid family support network, along with proven to be directly related to understanding the risks

and benefits of surgery, especially regarding adherence to the indications, increasing the potential success of the procedure. Adolescents should be evaluated in the pre-surgical stage by a mental health team (psychologists and/or psychiatrists) specialized or with experience in adolescent eating disorders and severe obesity, in order to identify psychological morbidity and/or risk behaviors, which should be treated and/or stabilized before surgery.

3. What conditions contraindicate the prescription of WLS in adolescents?

There are absolute and relative contraindications¹⁴⁻²¹. The following are the conditions that render WLS inadvisable:

- Obesity secondary to drugs or endocrinopathies.
- Active consumption of alcohol and/or substances that cause dependency.
- Pregnancy and breastfeeding.
- Pregnancy planning for up to two years after surgery.
- Inability of the adolescent and/or caregivers to un-

derstand the risks and benefits of the procedure, or to comply with pre- and post-operative indications and long-term follow-up.

- Medical, psychiatric, psychosocial, or cognitive condition of the adolescent that prevents adherence to the indications or affects her or his ability to make decisions. Relative contraindications include untreated or uncompensated mental health disorders.

The SOCHIPE's Nutrition Branch believes that the evaluation of absolute or relative contraindications to BC WLS should be carefully carried out assessed by a qualified multidisciplinary team. Furthermore, and considering the psychosocial vulnerability of the adolescent and their dependence on adult care, it additionally includes as a contraindication the proven absence of adequate family support.

4. What are the WLS techniques currently performed on adolescents?

Surgical procedures are classified as restrictive, malabsorptive, and mixed²⁵. Restrictive techniques de-

Table 1. Indications for adolescent bariatric surgery: Expert recommendations

BMI \geq 35 kg/m ² with severe comorbidities:	BMI \geq 40 kg/m ² with mild comorbidities:
<ul style="list-style-type: none"> - Type 2 diabetes mellitus (T2DM) - Moderate to severe sleep apnea (apnea/hypopnea index > 15 events/hour) - Severe steatohepatitis - Pseudotumor cerebri 	<ul style="list-style-type: none"> - Hypertension - Dyslipidemia - Insulin resistance - Glucose intolerance - Mild obstructive sleep apnea (apnea/hypopnea index > 5 y < 15 events/hour) - Panniculitis - Venous stasis disease - Urinary incontinence - Significant impairment of activities in daily living or in quality of life - Steatohepatitis - Gastroesophageal reflux disease - Weight-related arthropathies - Severe psychosocial distress
<ul style="list-style-type: none"> - Tanner sexual maturity IV or V or bone age \geq 13 years in girls and \geq 15 years in boys or completion of 95% of adult stature based on radiologic study - Have failed to attain a healthy weight and improvement of comorbidities in medical treatment at weight loss at least 6 months - Evidence that the patient and his family have the capacity to understand, and motivation to comply with recommended pre and postoperative care in nutritional, kinesiological, psychological and medical follow-up - Evidence for mature decision making, with an appropriate understanding of potential risks and benefits of surgery. Provide informed assent or consent for the bariatric procedure - Ability to make decisions and understand the potential risks and benefits of surgery - If active psychiatric conditions (e.g., depression, binge eating disorder or anxiety) are present, surgery cannot be performed - Avoid pregnancy for 1-2 years after surgery 	

Center and team:

These procedures should be performed in experienced centers and integrated multidisciplinary teams members should include a surgeon, medical nutrition specialist, dietitian, mental health specialist (psychologist / psychiatrist), kinesiologist, social worker and nurse/or administrator

Adapted from references 14-21.

crease gastric capacity, malabsorptive ones reduce the intestinal absorption surface, and mixed ones combine both techniques (Figure 1 a - b).

Between 2004 and 2011, in the United States, an average of 968 WLS were performed in adolescents per year, with a significant decrease in Roux-en-Y gastric bypass (RYGB) (85.7% to 54.4%) and an increase in vertical sleeve gastrectomy (VSG) (0.7% to 26.7%). There was a similar trend in adults, along with important decreases in adjustable gastric banding (AGB)^{3,26}. This last technique is not approved by the FDA in children under 18.

There is no consensus on the most appropriate surgical technique for adolescents. The decision will be based on the obesity severity and the medical and psychosocial conditions of each patient. However, based on available evidence, the SOCHIPE's Nutrition Branch supports the current trend of VSG use in adolescents as a less invasive procedure with fewer surgical and nutritional complications.

5. What are the outcomes of WLS in adolescents?

Recent prospective and multicenter studies show that the outcomes of WLS in adolescents are comparable with those of adults in relation to weight loss, resolution of comorbidities, and complications.

The Teen-LABS, AMOS, and FAB 5+ studies²²⁻²⁴,

report an average weight loss of 43 kg and 15 BMI points at 3-8 years follow-up after RYGB. The VSG cohort of the Teen-LABS study reported an average weight loss of 38 kg and 13 BMI points 3 years after surgery.

The literature on adults has consistently shown that WLS leads to a significant decrease in CMR factors as well as reducing the risk of stroke, myocardial infarction, and death, by about 50%²⁷. Although there are no similar long-term data in adolescents, in the 5 to 8-year post-RYGB follow-up, WLS demonstrated an average resolution of T2DM by 94%, HTN 88%, dyslipidemia 74%, and normalization of transaminases by 92%^{23,24}. The resolution of CMR is not only associated with weight loss, but also with pre-surgical BMI, and the time of surgery. Better medium-term results were observed in adolescents who underwent WLS with BMI < 50 kg/m² compared with those with higher BMI²⁸.

Between 10% and 15% of adolescents present a significant weight regain at 4 to 10-year follow-up after RYGB^{29,30}. Regain of the lost weight loss above baseline occurs in 4% of adolescents at 3-year post-VSG follow-up and 3% in the 3 to 5-year post-RYGB follow-up^{22,24}.

In adolescents, good adherence to pre- and post-operative indications would be a determining factor for adequate weight loss, improved metabolic outcomes, and prevention of nutritional deficiencies³¹. However, the predictive factors for better adherence have not been clearly identified³².

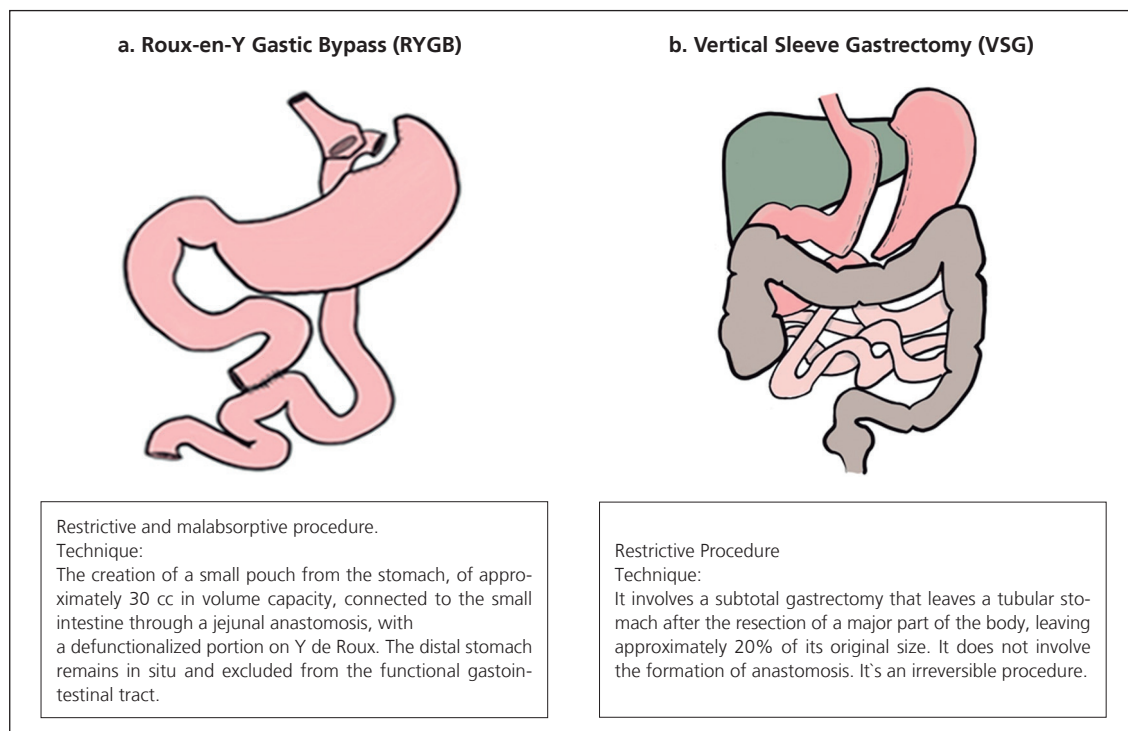


Figure 1. Bariatric procedures most commonly performed in adolescents. Figures: courtesy of Dr. Daniel Echeverría

Regarding the quality of life, studies of up to 5 years of follow-up show that, along with considerable and lasting weight loss, adolescents report marked and sustained improvement in the weight-related quality of life^{9,23}.

Mental health outcomes at 1 and 2 years of follow-up show a reduction of depression and anxiety symptoms^{9,33}. The impact of weight regain on these domains, as well as the medical co-morbidities resolution on adolescent psychosocial health is unknown⁹.

Regarding weight loss results, improvement of CMR factors, quality of life, and mental health, WLS has shown favorable effects on midterm outcomes in severely obese adolescents, highlighting the importance of adequate adherence to the indications for achieving and maintaining these results. The development and implementation of innovative strategies that favor adherence to indications are a priority aspect in the care of these patients. All adolescents should be carefully monitored after surgery to promote positive mental health and reduce the risk of future complications in this area.

6. What are the complications associated with WLS in adolescents?

The surgical, medical, and nutritional complications should be considered when evaluating the appropriateness of these procedures.

The surgical morbidity and mortality of WLS are directly related to the experience of the surgical team and the hospital center³⁴. In a 3-year follow-up, the Teen-LABS study²² reported early major complications in 9% of RYGB and 5% in VSG, including intestinal obstruction and leaks, sepsis, and postoperative bleeding. Minor complications reached 15% (RYGB

17% and VSG 12%). Most major and minor complications occurred before discharge from hospital and there were no deaths. Late complications occurred in 10-15% which included hernias, cholelithiasis, intestinal obstruction, and stenosis. A recent 5-year post-RYGB follow-up study on adolescents³⁵, reported 1.9% mortality and 19% of abdominal reinterventions, of which cholecystectomy accounted for almost half of these procedures (9.4%), followed by bowel obstruction 2.5%, and herniorrhaphy 2.0%. Table 2 shows the early and late postoperative complications.

Micronutrient deficiency secondary to dietary restriction and malabsorption is the most important mid and long-term complication of WLS (Table 3), and is directly related to inadequate adherence to both dietary and supplemental indications^{15,34,37,38}. Failure to take post surgical micronutrient supplementation is significantly higher in adolescents than in adults and adds up to 70% of non-adherent subjects at 6 months follow-up³⁸. The most frequent deficiencies are iron, vitamin D, calcium, vitamin B12, thiamine, and zinc. In addition, micronutrient deficiencies have been reported in the pre-surgical evaluation of these adolescents^{22,23}. Figure 2 shows the frequency of micronutrient deficiencies in different studies²²⁻²⁴.

A reduction in bone mineral density (BMD) has been observed in the follow-up of adults up to two years post-RYGB. Hyperparathyroidism due to vitamin D deficiency and skeletal unloading due to rapid weight loss would be the probable mechanisms causing BMD³⁹. In adolescents, a study⁴⁰ reported a 7.4% reduction in bone mineral content at 2 years post-RYGB and a decrease between 0.1 to 1.5 SD in BMD. This loss was significantly correlated with weight loss, however, BMD remained appropriate for age, sex, and new body weight. Further research is required to determine the long-term impact of BC on bone mass.

Table 2. Common complications early and late of bariatric surgery in adolescents

Type	Anatomical change	Common early complications (≤ 30 days)	Late complications (> 30 días)	Commentary
Roux-en-Y Gastric Bypass	Restrictive-Malabsorptive	- Anastomotic leak or obstruction - Operative wound infection - Thrombosis	- Vitamin and mineral deficiency - Dumping Syndrome - Cholelithiasis - Gastrojejunal anastomotic stricture - Ulcers, fistulas and hernias	With laparoscopic techniques, early complications are reduced
Sleeve gastrectomy	Restrictive	- Anastomotic leak	- Vitamin and mineral deficiency - Gastroesophageal reflux - Cholelithiasis	Vagus nerve is preserved (Dumping Sx decreases)

Adapted from references 15, 16, 18, 19, 34.

Table 3. Nutritional deficiencies after bariatric surgery

Nutrient	Clinical manifestations	Biomarker (s)	Observations
Iron	Chronic fatigue, microcytic anemia and Pica Syndrome	Ferritin, total iron binding capacity, complete blood count with differential	Iron deficiency is perhaps the most common and earliest nutritional deficiency following bariatric surgery. Women of childbearing age at greater risk
Vitamin B1	Ophthalmoplegia, nystagmus, ataxia, encephalopathy, rapid visual loss (Wernicke Encephalopathy) Isolated peripheral neuropathy: difficulty walking, painful paresthesias and weakness	Serum thiamin	Body storage last 18 days, it is the most frequent deficit in patients with persistent vomiting and/or excessive low weight post bariatric surgery
Vitamin B12	Macrocytic anemia, polyneuropathy, paresthesias, delusions, hallucinations, psychosis and permanent neurological damage	CBC, serum vitamin B12, plasma homocysteine and methylmalonic acid levels (subclinical deficit screening)	Subclinical deficiency up to 25% post weight loss surgery adults
Folate	Megaloblastic anemia and neurological symptoms; memory deficit and irritability	CBC and red blood cell folate	
Vitamin D	Decreased bone mineral density	Serum 25 (OH) vitamin D levels, calcium, phosphorus, alkaline phosphatase, and PTH (parathyroid hormone)	High prevalence deficiency in the general population
Vitamin K	Coagulation disorders, bleeding, bruising, ecchymosis	Prothrombin time	
Vitamin A	Xerophthalmia, night blindness	Plasma retinol	
Vitamin E	Neuropathy, ataxia	Plasma alpha-tocopherol	
Zinc	Rash, acne, taste disturbances, immune impairment	Plasma zinc	

Adapted from references 37, 38, 43.

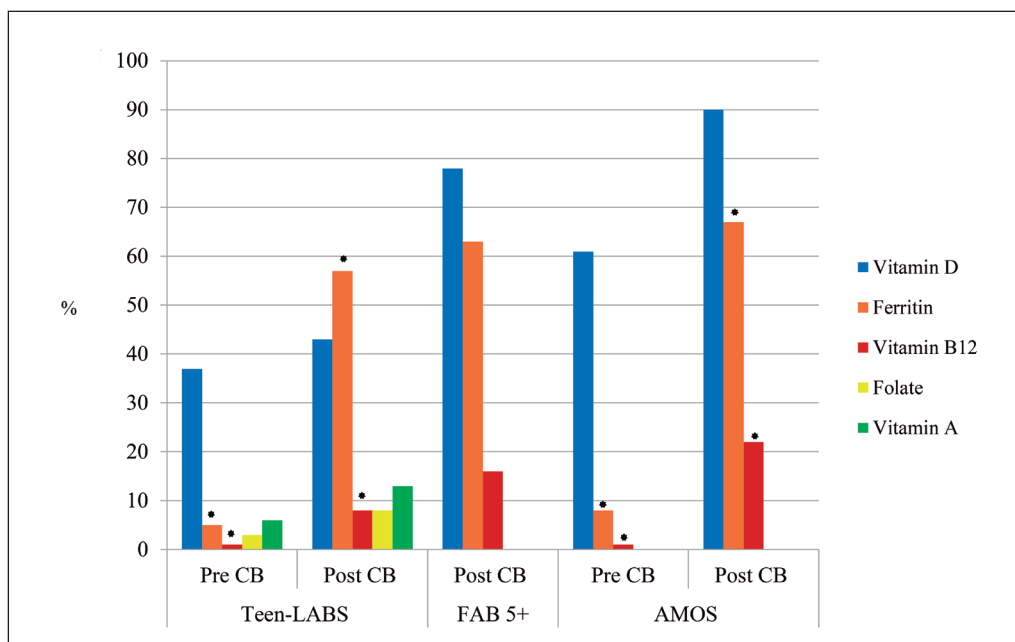


Figure 2. Frequency of micronutrient deficiency pre and post bariatric surgery in adolescents in the Teen-LABS (22), FAB-5 + (24), AMOS (23) studies. (•) Significant differences between groups (p < 0.05).

WLS is associated with rare but serious immediate complications related to surgery. The most frequent complications are micronutrient deficiencies, often marginally symptomatic, but with great impact on health and development of the adolescent on the mid- and long-term follow up. Therefore, the SOCHIPE's Nutrition Branch strongly recommends that WLS be performed in specialized hospital centers, by experienced surgeons, and long-term follow-up by a multidisciplinary team.

7. Why does WLS on adolescents needs a multidisciplinary approach? Which team members should be considered?

International guidelines on adolescent WLS agree on the recommendation of a multidisciplinary care model with a comprehensive and collaborative approach.

A weight loss program that includes a medical-surgical stepwise treatment of obesity in adolescents must operate under standardized protocols, have clear objectives, be carried out in hospital centers with quality standards, and qualified professionals from different disciplines. It is suggested that multidisciplinary follow-up should be maintained for at least 2 years after surgery^{36,41,42} and that follow up must be carried out by a physician nutrition specialist and a dietitian throughout life.

The guidelines of the pediatric committee of the American Society for Metabolic and Bariatric Surgery (ASMBS)¹⁵ suggest a multidisciplinary team that includes:

1. Bariatric surgeon with experience in adolescents.
2. Pediatrician specialized in clinical nutrition.
3. Dietitian with experience in treating pediatric obesity and family interventions.
4. Psychologist and/or psychiatrist with training in pediatrics/adolescence and with experience in the treatment of obesity and eating disorders.
5. Kinesiologist or exercise physiologist.

The role of each professional is outlined below:

1. The surgeon is responsible for performing the procedure, perioperative care, and surgical complications^{41,42}.
2. The physician nutrition specialist should evaluate the severity of obesity, physical maturity, rule out secondary causes of obesity, detect and treat comorbidities and nutritional deficiencies, and identify pathologies that may contraindicate surgery or increase its complications⁴².
3. The dietitian must carry out a comprehensive nutritional evaluation, food education, to calculate

nutritional requirements, and dietary prescriptions aiming to satisfy individualized nutritional needs, as well as to regulate the food pattern towards the postoperative dietary prescription⁴¹⁻⁴³.

4. Kinesiology assessment of physical condition, strength, tone, flexibility, gait, balance, and posture is necessary for adolescents seeking WLS as they have a high prevalence of musculoskeletal pathology and impaired functional mobility⁴⁴. Fundamental objectives at this stage should be the safe prescription of exercise, better use of leisure time, education on the benefits of exercise for sustained weight loss, preservation of bone and muscle mass, and their development, along with improvement of comorbidities and mental health^{42,44}.
5. Evaluation and psychological support are essential in the process of selection, preparation, and follow-up of the adolescent who will undergo WLS, which will have a significant influence on the adherence to the indications^{15,41,42,45}. The psychologist has to evaluate the cognitive, emotional, and social maturity of the adolescent, as well as the presence of factors that may negatively affect psychosocial health. Targeted assessment of symptoms of depression or anxiety, quality of life, and family functioning is recommended.

The time needed for evaluation and preparation for surgery is variable. The Teen-Labs centers report 10 months on average (range 7.5 to 13.5 months) and at least 6 visits for each professional on the team⁴⁴. Figure 3 shows a flowchart of evaluation, preparation for surgery, and recommended psychological follow-up.

The SOCHIPE's Nutrition Branch considers that the treatment of severely obese adolescents requires a multidisciplinary approach and that WLS is a therapeutic alternative for selected cases. The multidisciplinary team, recognized as a specialized medical-surgical obesity treatment program for adolescents, ensures a comprehensive evaluation and appropriate follow-up. In addition, we suggest including a social worker to evaluate if the socioeconomic and family conditions favor the care and fulfillment of pre and postoperative indications. Finally, developing a plan for transitioning to adult care is also crucial.

8. Which are the ethical aspects to consider before prescribing WLS on adolescents?

Among the fundamental ethical principles that should be explored and discussed regarding adolescent WLS indication are the beneficence and autonomy principles⁴⁶.

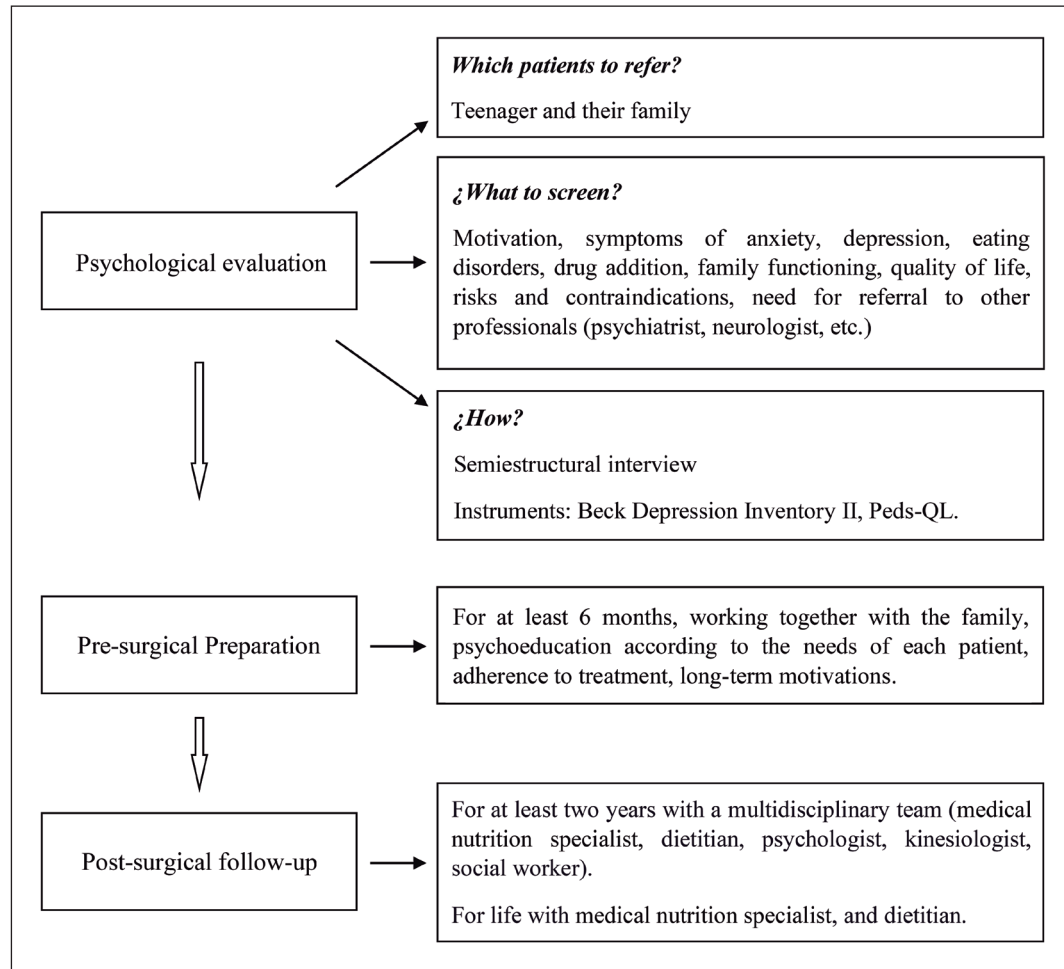


Figure 3. Flow chart for evaluation, preparation, and psychological follow up to adolescents for bariatric surgery.

In order to determine the beneficence of this therapeutic option, it is necessary to evaluate whether there is an overall benefit for the patient who will undergo surgery and whether the surgery will be effective in controlling the underlying pathology. The available evidence shows that WLS is effective in weight reduction and comorbidities resolution in severely obese adolescents, in the short- and mid term studies. However, there is still the question of its long-term effectiveness, considering that few publications have evaluated both its benefits and risks beyond 8-10 years. Even so, the beneficence principle is ratified if it is determined that WLS will improve the patient's condition more than any other available treatment. The statement above reaffirms the importance of a thorough multidisciplinary evaluation, since without the fulfillment of the agreed criteria to validate a candidate, this principle would be violated^{46,47}.

Regarding the principle of autonomy, the multidisciplinary team must provide to the patient and family comprehensive and clear information about the procedure, its risks, and benefits. When carrying out the

process of informed consent and/or assent, we must ensure the understanding of this information.

The following is a list of aspects that should be included in the request for consent/assent to the procedure⁴⁷:

1. Clear information about the diagnosis, including obesity degree and associated comorbidities.
2. The procedures available for adolescents, including visual material that describes the procedure and allows them to understand the difference between them.
3. Risks and benefits of the surgical procedure to be performed.
4. Risks and benefits of not performing the surgery.
5. The behavioral changes expected after WLS to achieve weight and comorbidities resolution goals, emphasizing adherence to nutritional indications, including the schedule of post-operative check-ups.
6. Financial aspects of the procedure and follow-up, including the cost of complications if any.
7. Expected results after the procedure.

The SOCHIPE's Nutrition Branch believes that the ethical principles of beneficence and autonomy must be considered before deciding on surgery. The detailed evaluation of the medical and psychosocial conditions of the adolescent as well as of her/his family environment will allow the identification of candidates who meet the selection criteria and especially those in which the benefits of these procedures exceed the known risks at least in the medium term. It is also very important that both, the patient and the family, make a fully informed decision through an adequate process of consent and assent.

Conclusion

WLS is a therapeutic option to consider in a selected group of severely obese adolescents who meet the requirements and recommendations outlined above, in order to improve their quality of life, reduce metabolic risks, associated diseases, and early mortality.

The available evidence has demonstrated the safety and effectiveness of these procedures in weight loss and improvement of associated diseases, with mid-term results comparable with those observed in adults. However, these are invasive and irreversible procedures, with long-term results and complications largely unknown in adolescents, therefore, their indication, performance, and follow-up must be performed by qualified multidisciplinary teams dedicated to the comprehensive care of these patients to ensure their safety and expected results.

Finally, it is of the utmost importance to note that WLS should not be indicated as an isolated procedure, but rather associated with a set of interventions aimed at strengthening permanent lifestyle changes.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

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