

Bariatric Surgery in Youth and Adolescents: The Experience of an Outpatient Obesity Clinic in a Central Hospital in Portugal

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Abstract

Introduction: Obesity in children and adolescents is a huge public health burden. Lifestyle modification interventions in some youth with severe obesity show only marginal effectiveness. As a result of the significant prevalence rate of severe comorbidities and substantial long-term health risks associated with pediatric obesity, bariatric surgery has emerged as an option for adolescents with severe obesity and/or serious weight-related comorbidities who have achieved insufficient progress with other treatments. Weight loss surgery should be conducted in the context of a multidisciplinary program.

Methods: Retrospective analysis of the impact of bariatric surgery on body mass index and improvements of comorbidities in severely obese adolescents followed at the obesity pediatric outpatient clinic of Centro Hospitalar Lisboa Norte between 2012 and 2016.

Results: Twelve adolescents underwent a bariatric procedure during this period. The most prevalent comorbidities were hypertension and insulin resistance. The mean body mass index, after one year, decreased from 48.9 kg/m² at baseline to 38.9 kg/m². Improvements have been seen in many comorbidities. Regarding adverse events, two major surgical complications occurred, two cases of depression, and one weight regain with binge eating.

Discussion: The follow-up of these patients suggests that bariatric surgery appears to be effective in weight loss and the reduction of comorbidities, but surgery and medical complications related to the surgical procedure are significant. Future studies should analyze the impact of the different surgical procedures and postoperative care on the minimization of adverse events, as well as, the long-term follow-up into adulthood.

Keywords: Adolescent; Bariatric Surgery; Body Mass Index; Pediatric Obesity/Complications; Pediatric Obesity/surgery; Treatment Outcome; Portugal

Introduction

Overweight and obesity in youth are a growing and public-health concern affecting a large proportion of children and adolescents.^{1,2} The prevalence of pediatric overweight and obesity has increased in the last decades.^{2,3} Pediatric obesity is associated with comorbid conditions such as hypertension, obstructive sleep apnea, insulin resistance, non-alcoholic fatty liver disease, and dyslipidemia.⁴ Besides, obese teenagers are far more likely to carry obesity into adulthood than to overcome obesity.⁵

Considering the serious implications associated with childhood and adolescent obesity, effective treatment is imperative. Obesity in children is currently managed predominantly with lifestyle interventions, focusing on behavioral and dietary modifications, with slight evidence of short-term success.^{6,7} Given the limited effectiveness of lifestyle interventions and the non-existence of licensed effective drugs to reduce both body mass index (BMI) and comorbidities, surgical procedures with proven health benefits for adults, are being increasingly considered.⁷ The risk factors for adolescent obesity and its persistence into adulthood offer insight into the phenotypes of those individuals. It is crucial to differentiate between those who succeed with nonsurgical management and those who may obtain substantial benefit from early surgical therapy.⁸ The criteria for undergoing bariatric surgery in adults are well established but they cannot be generalized to adolescents. Long-term outcomes are awaited to properly define the indications and limitations.⁹ The

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unique psychological and emotional needs of adolescent patients make the selection process and perioperative management substantially different from adults. Given the unknown long-term risks of this surgery, in still developing adolescents, more stringent criteria for selection have been proposed.⁸ In 2009, updated guidelines were published¹⁰ that indicated similar BMI cutoffs for adolescent and adult surgery, severely obese (BMI ≥ 40 kg/m²) with associated minor comorbidities, or moderate obese (BMI ≥ 35 kg/m²) with severe comorbidity. Furthermore, they also include indications concerning physical maturity (Tanner stage \geq IV, 95% skeletal maturity), the commitment to lose weight through sustained efforts of changing their diet and increasing physical activity, stable psychosocial environment, and long-term follow-up. Contraindications to adolescent bariatric surgery include a medically correctable cause of obesity, a documented substance abuse problem, medical, psychiatric, psychosocial, or cognitive condition that may prevent adherence to postoperative dietary and medication regimens or impair decisional capacity, pregnancy, or breastfeeding.^{4,8,11}

The goal of this study is to retrospectively analyze the impact of bariatric surgery on BMI and the improvement of comorbidities among severely obese adolescents followed at the outpatient pediatric obesity clinic of Centro Hospitalar Lisboa Norte between 2012 and 2016.

Methods

A retrospective review of the database of adolescent patients who underwent bariatric surgery between 2012 and 2016 was conducted. Data were collected from the medical records and included demographic characterization, age at onset of obesity and follow-up at the clinic, pre-surgery BMI, comorbid conditions, type of bariatric surgery, post-surgery BMI, improvement of comorbidities after the surgery, and post-surgery complications.

The analyzed comorbidities were hypertension, hyperlipidemia, insulin resistance, diabetes mellitus type 2 (the diagnostic criteria applied were the same as those that define the disease in adults: fasting plasma glucose ≥ 126 mg/dL or plasma glucose two hours after an oral glucose tolerance test ≥ 200 mg/dL or occasional plasma glucose ≥ 200 mg/dL or hemoglobin A1c $\geq 6.5\%$),¹² non-alcoholic fatty liver disease, depression, and sleep apnea. The definition of hypertension was adjusted for age and gender (the diagnostic criteria applied was systolic or diastolic blood pressure more than 99th percentile + 5 mmHg for age, gender, and height). Improvement of hypertension was defined as systolic or diastolic blood

pressure less than 99th percentile + 5 mmHg for age, gender, and height without medication. A homeostatic model assessment (HOMA) for insulin resistance value of 2.6¹³ was considered as the upper limit of normal. The diagnostic criteria applied for hyperlipidemia were total cholesterol ≥ 200 mg/dL or cholesterol from low-density lipoproteins (LDL-C) ≥ 130 mg/dL or triglycerides ≥ 130 mg/dL.¹⁴ Improvement of hyperlipidemia was defined as normal lipid values in the absence of medication. Adverse events included perioperative complications, need for revision of the gastric banding procedures, and side effects related to the process.

Patients were selected for bariatric surgery based on BMI > 40 kg/m² or 35 kg/m² with associated comorbidities, failure to lose weight after participation in a formal weight management program, psychological assessment to confirm motivation for surgery, and commitment to compliance with follow-up visits, diet, and family support. Every patient was individually assessed by an experienced multidisciplinary team that included a qualified and experienced pediatrician, surgeon, psychologist, social assistant, nutritionist, and exercise physiologist. The selection process was based on team discussion and agreement. All the patients were counseled alone and with their parents as a second step, requiring the active participation of the patient and their parents/relevant caregivers.

Results

Twelve adolescents (Table 1), six females and six males underwent a bariatric procedure between January 2012 and December 2016. The mean age of the onset of obesity was 6.18 years with a standard deviation (SD) of 3.06 years, mean age of onset of the follow-up was 13.75 years (SD 2.34 years) and the mean age of the intervention was 18.12 years (SD 1.53 years). The most prevalent comorbidities (Table 2) were hypertension (6/12) and insulin resistance (5/12). Pre-surgery, mean age was 18.17 years (SD 1.52 years), mean weight was 141.88 kg (SD 17.99 kg), and mean BMI 48.9 kg/m² (SD 5.19 kg/m²).

Eight laparoscopic adjustable gastric bandings (LAGB) and four sleeve gastrectomies (SG) took place. The mean post-surgery BMI (Figs. 1 and 2) decreased from 48.9 kg/m² to 44.8 kg/m² after one month, 40.7 kg/m² after six months and 38.9 kg/m² after one year.

When analyzing the adolescents submitted to surgery (LAGB and SG) for a longer time period, including the six cases with BMI information after, at least, three years of surgery, it can be noticed that those adolescents with a basal higher BMI had a less significant decrease in BMI in

Table 1. Details of the 12 adolescent patients

Patient	1	2	3	4	5	6	7	8	9	10	11	12
Gender	F	M	M	M	F	F	F	M	F	F	M	M
Age at onset of obesity (years)	6	11	10	6	5	5	10	5	1	NI	6	3
Age at onset of follow-up (years)	10	12	15	15	11	16	10	14	16	15	16	15
Pre-surgery												
Age (years)	17	20	19	19	20	20	16	19	18	17	17	16
Weight (kg)	132	145	142	174	156	133.5	135.5	150	126.6	109	167	132
BMI (kg/m ²)	47.6	45.7	44	49	47	56	55	51.9	42,7	40.3	52.3	55
Post-surgery												
Type of surgery	LAGB	LAGB	SG	LAGB	SG	LAGB	LAGB	SG	SG	LAGB	LAGB	LAGB
BMI (kg/m ²) progression												
1 month	43	42.8	43.1	45.7	43.2	52.1	54.4	45.9	37.1	36.1	NI	49
3 months	39.2	46	33.7	44.6	43.2	51.3	57	43	34.9	34.8	NI	NI
6 months	38.4	36.9	31.5	44.3	NI	50.4	55.9	30.9	31.1	NI	NI	46.7
1 year	35.3	36.8	29.9	NI	NI	44.9	56.9	25.1	36.1	NI	NI	46.3
2 years	28	40	NI	35.6	42.8	48.9	NI	NI	NI	NI	NI	NI
3 years	41.3	32.8	NI	35.6	NI	52.6	56	25.5	NI	NI	NI	NI

BMI - body mass index; F - female; LAGB - laparoscopic adjustable gastric banding; M - male; NI - no information; SG - sleeve gastrectomy.

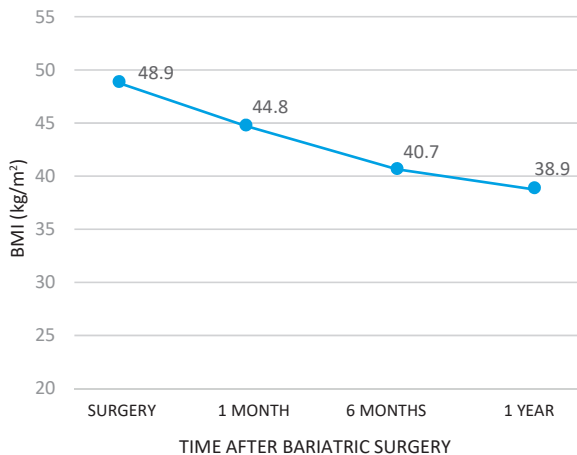
Table 2. Progress of comorbidities

Preoperative comorbidity	Follow-up one year after bariatric surgery
Hypertension (n = 6)	Four resolved
Insulin resistance (n = 5)	Four resolved
Hypertriglyceridemia (n = 2)	All resolved
Sleep apnea (n = 2)	All resolved
Diabetes mellitus type 2 (n = 2)	One resolved
Non-alcoholic fatty liver disease (n = 1)	No change
Asthma (n = 1)	No change
Depression (n = 1)	Resolved

had undergone laparoscopic adjustable gastric bandings (two patients) and sleeve gastrectomy (one patient). As considered, the progress of the comorbidities was (Table 2):

- Four out of six patients diagnosed with hypertension pre-surgery, resolved their hypertension;
- Four out of five patients diagnosed with insulin resistance had this condition resolved;
- Two out of two patients diagnosed with sleep apnea also had their condition resolved;
- Two out of two patients with hypertriglyceridemia currently have their lipid profile within the normal range without any medication;
- One out of two patients with type 2 diabetes mellitus (DM) resolved this condition;
- One patient diagnosed with depression resolved their depressive symptoms with no need for further medication;
- One patient with non-alcoholic fatty liver disease had no change after surgery.

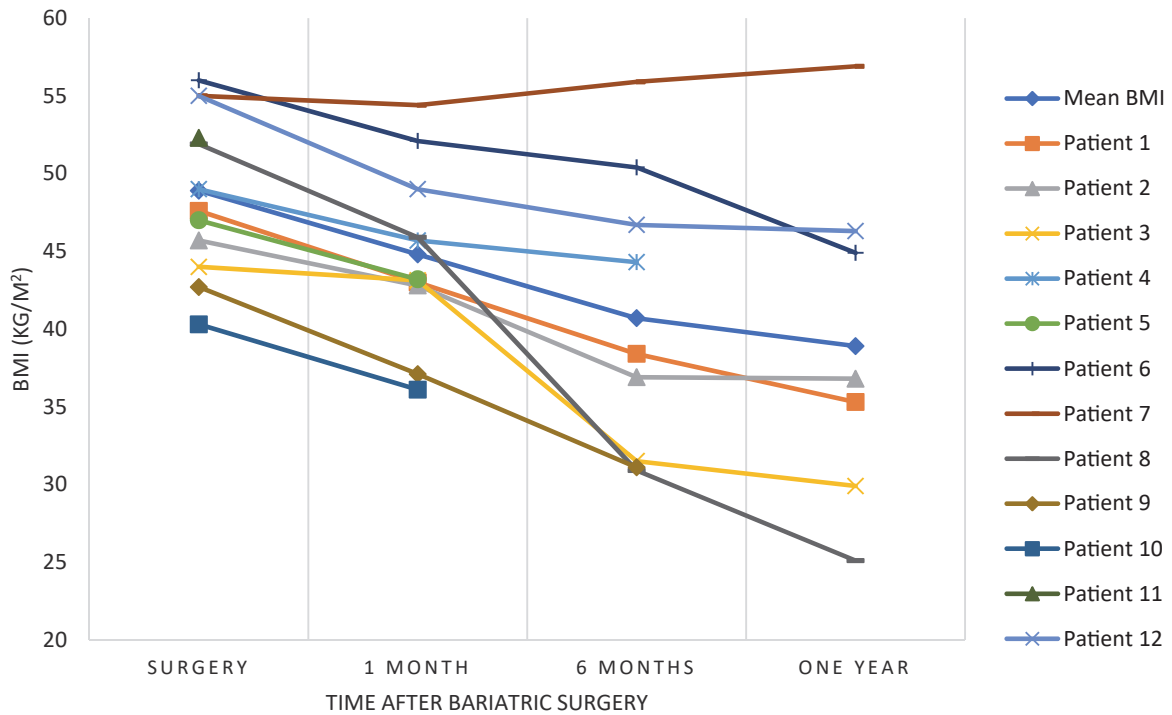
Adverse events included two major surgical complications and three psychiatric disorders. Both surgical complications were related to laparoscopic adjustable gastric banding. One of them was a short-term complication consisting of a band slippage requiring its removal nine days after the intervention. The other one was a long-term complication, 13 months after surgery, which consisted in band migration with the perforation of the gastric fundus and the formation of hepatic and splenic abscesses. Two patients developed depressive symptoms (10 and 14 months after the surgery) and one developed a binge eating disorder with weight regain.



BMI - body mass index.

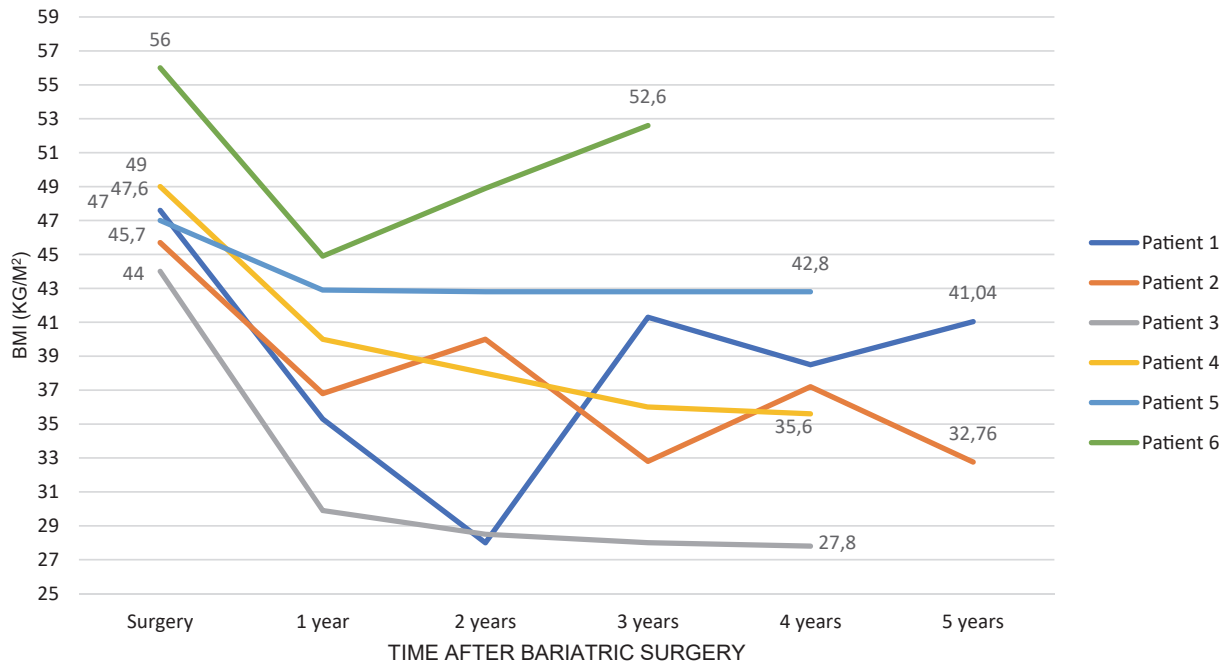
Figure 1. Mean body mass index after bariatric surgery.

the long run, in some cases, reaching a plateau after five years (Fig. 3). Three out of those six patients maintained or increased their BMI. Those showing a decreased BMI



BMI - body mass index.

Figure 2. Evaluation of body mass index after bariatric surgery.



BMI - body mass index.

Figure 3. Long-term evaluation of BMI after bariatric surgery.

Discussion

Severe obesity in adolescents is associated with multiple comorbidities, impaired quality of life, and an increased risk for later cardiovascular and metabolic disorders with the potential to reduce life expectancy.^{5,15} Prevention of

severe pediatric obesity is the goal and ideal outcome. However, widespread prevention is unlikely to become a reality, and the numerous children and adolescents affected by this condition need safe and effective treatments.⁷ There is wide agreement that non-surgical options should be explored as a first step, including lifestyle interventions

and behavioral modification.^{7,9} However, no consensus exists regarding the definitive treatment for morbidly obese children and adolescents who failed nonsurgical multidisciplinary therapy regimes.¹⁶ In fact, children and adolescents have distinctive metabolic, developmental, and psychological needs, which must be carefully considered to avoid the inappropriate use of weight loss surgery.

Psychosocial and mental health is increasingly becoming an important parameter requiring evaluation pre- and post-obesity surgery.⁴ In our study, weight loss surgery was performed in the context of a multidisciplinary program with specific expertise in adolescent medicine and still, psychological complications occurred post-surgery. Little is known about the impact of bariatric surgery on adolescent psychological health. From the limited reports available, there is an agreement that adolescents seeking weight-loss surgery demonstrate higher levels of depressive symptoms and impaired health-related quality of life.⁹ High rates of suicide are observed in post-bariatric surgery populations, and a 2% rate of attempted suicide was observed in adolescents in the two years after bariatric surgery.¹³ This emphasizes the need for providing particular support to the most potentially vulnerable adolescents.^{9,17}

Our results indicate that weight loss surgery is clinically beneficial for selected adolescents with severe obesity and medical comorbidities, with good outcomes in weight loss and comorbidities improvement. Nevertheless, this was demonstrated only in a small proportion of our sample (success rate of 25%) mostly due to follow-up losses.

Most children in this study underwent laparoscopic adjustable gastric banding. An argument used in favor of this procedure is its reversibility.^{9,10} However, for optimal effectiveness, it requires long-term supportive follow-up by trained health professionals. The need for revisional procedures for the enlargement of the stomach above the band or injury to the tubing is intrinsic to the gastric banding procedure.^{10,12} In our study, both surgery complications were related to laparoscopic adjustable gastric banding, in line with what has been described by other series.^{10,18} Sleeve gastrectomy appears to be promising for the long-term management of adolescent morbid obesity, and as the number of cases increases over the years, more data supporting safe outcomes are being reported.^{10,19} It has the potential to become the preferred surgical intervention in adolescence over laparoscopic adjustable gastric banding with fewer complications, as it avoids intestinal bypass and foreign body placement while improving weight loss.¹³ However, the resection of the stomach and inability to restore the anatomy after sleeve gastrectomy, may be regarded as a disadvantage of this technique considering the specific age range of these patients.⁹

The international community seeks to anatomically change the upper digestive tract as little as possible in young people. In each case, the choice of the type of bariatric surgery took into consideration the potential complications of the procedure and the behavioral and family support profile. With laparoscopic adjustable gastric banding, there are fewer immediate postoperative complications, but in the long run, the complications are more frequent with this procedure.

The main limitations of this study were the small cohort of patients and follow-up losses (25% and 50% at one and three years, respectively). A long-term follow-up would have been valuable information to determine the surgical efficacy and to know which type of surgery was the most effective. The low adherence to clinical follow-up after surgery was essentially due to the transition of these cases to the adult team. On the other hand, adolescence is known to be a naturally troubled transition phase with social and behavior changes, which also impacts compliance.

According to our findings, it is noteworthy that adolescents with a higher BMI had a less significant decrease in BMI in the long term, in some cases, reaching a plateau after five years. However, it is not clear to what extent weight loss will be sustained and whether comorbid conditions will recur if significant weight is regained. Long-term prospective studies are needed to establish the safety and efficacy of surgical procedures and to clarify whether reductions in morbidity and mortality outweigh the risks of serious surgical complications. The relatively small number of adolescent bariatric procedures requires cooperation between international centers with bariatric programs to ensure better data and the development of consensual guidelines. Nonetheless, it remains important to highlight the need to implement effective lifestyle programs for overweight and obese children as a first-line approach to limit the progression to severe obesity.

WHAT THIS STUDY ADDS

- No consensus exists regarding the definitive treatment for morbidly obese children and adolescents who failed nonsurgical multidisciplinary therapy regimes.
- Our study indicates that weight loss surgery is clinically beneficial for selected adolescents with severe obesity and medical comorbidities, with good outcomes in weight loss and comorbidities improvement; but adverse events are a reality.
- According to our findings, adolescents with a higher body mass index had a less significant decrease in body mass index in the long term. However, it is not clear to what extent weight loss will be sustained and whether comorbid conditions will recur if significant weight is regained.
- Long-term prospective studies are needed to establish the safety and efficacy of surgical procedures and to clarify whether reductions in morbidity and mortality outweigh the risks of serious surgical complications.
- The relatively small number of adolescent bariatric procedures requires cooperation between international centers with bariatric programs to ensure better data and the development of consensual guidelines.

Conflicts of Interest

The authors declare that there were no conflicts of interest in conducting this work.

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There were no external funding sources for the realization of this paper.

Protection of human and animal subjects

The authors declare that the procedures followed were

in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data

The authors declare that they have followed the protocols of their work center on the publication of patient data.

Provenance and peer review

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Cirurgia Bariátrica em Jovens e Adolescentes: A Experiência de uma Consulta de Obesidade num Hospital Central Português

Introdução: A obesidade em crianças e adolescentes é um problema de saúde pública. O sucesso no controlo de peso em alguns jovens com obesidade mórbida, através de intervenções na modificação do estilo de vida, apresenta eficácia parcial. Considerando a elevada prevalência de comorbilidades a curto e longo prazo associados à obesidade pediátrica, a cirurgia bariátrica emergiu como opção em adolescentes com obesidade mórbida e/ou patologias associadas ao excesso de peso, sem melhoria com outras opções terapêuticas. A cirurgia bariátrica, deve ser realizada no contexto de um acompanhamento médico multidisciplinar.

Métodos: Foi feita a análise retrospectiva do impacto da cirurgia bariátrica no índice de massa corporal e na melhoria das comorbilidades em adolescentes com obesidade mórbida, seguidos na consulta de obesidade pediátrica do Centro Hospitalar Lisboa Norte entre 2012-2016.

Resultados: Doze adolescentes foram submetidos a cirurgia bariátrica durante esse período. As patologias mais frequentes foram a hipertensão arterial e a

insulinorresistência. Assistiu-se a uma diminuição do índice de massa corporal médio de 48,9 kg/m² para 38,9 kg/m² um ano após intervenção cirúrgica. Adicionalmente houve uma melhoria das comorbilidades associadas. Relativamente aos efeitos adversos, destacaram-se duas complicações cirúrgicas, dois casos de depressão e um caso de *binge eating* com conseqüente ganho ponderal.

Discussão: A análise destes casos sugere que a cirurgia bariátrica é eficaz na perda ponderal e controlo das doenças secundárias ao excesso de peso, no entanto, as complicações cirúrgicas e médicas após cirurgia não são desprezíveis. São necessários mais estudos para analisar o impacto dos diferentes procedimentos cirúrgicos, cuidados a considerar de forma a minimizar os efeitos adversos e avaliar os resultados a longo prazo.

Palavras-Chave: Adolescente; Cirurgia Bariátrica; Índice de Massa Corporal; Obesidade Pediátrica/Cirurgia; Obesidade Pediátrica/Complicações; Portugal; Resultado do Tratamento