



# Long-Term Outcomes of Weight Loss Intervention in Adolescents

David Warner, Stephen Hugdal, Christopher Clifford  
University of Nevada School of Medicine, Reno, NV 89557



## Introduction

Obesity is one of the most rampant public health issues that exists today. A large fraction of the United States population is clinically obese, including the adolescent population. It is estimated that over 5 million young people in the United States are obese [6]. It is well documented that obesity is associated with medical conditions such as hypertension, diabetes, and musculoskeletal dysfunction, and it has been shown that young people with obesity are also at risk for such medical conditions.

In recent years, a great deal of research has been conducted to curb the obesity epidemic.

**Bariatric surgery** offers dramatic weight loss, but carries with it usual risks of surgery, such as infection and death, as well as procedure-unique complications such as malabsorption and post-operative leak.

**Lifestyle modification** lies on the more conservative side of obesity intervention, but its results tend to be more modest, and less sustained over many years.

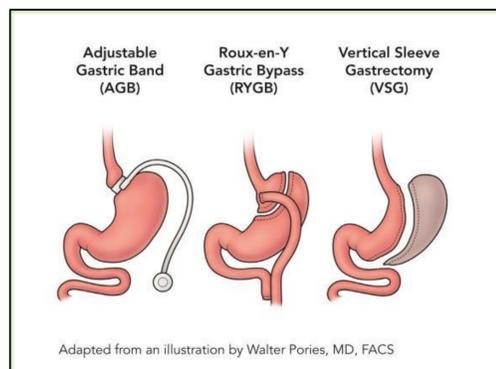
While these issues in treatment aren't limited to the population of obese adolescents, this population presents a unique set of challenges as compared to adults, as well as a unique opportunity to affect the trajectory of obesity and the related healthcare costs associated with this epidemic.

## Question

Are long term outcomes of weight loss and obesity-related comorbidities more prevalent in adolescents who have undergone bariatric surgery or who have used non-surgical (pharmacological/lifestyle changes) approaches?

## Methods

A literature search was performed for studies involving weight loss following both bariatric surgeries including banding and roux-en-Y bypass, as well as behavior modification, diet and exercise modification, and pharmacologic therapy. Changes in weight, various secondary outcomes, and adverse events were compared across studies.



Adapted from an illustration by Walter Pories, MD, FACS  
Fig. 1. Variations of bariatric surgical procedures.

## Results

Author	Study Population	Type of Study	Intervention	Methods	Change in Weight	Adverse Events	Secondary Outcomes
Gothberg, et al (2014)	N = 81 (age 13-18)	Prospective Cohort	Laparoscopic Roux-en-Y Gastric Bypass	<ul style="list-style-type: none"> <li>Assessed mean weight loss and post operative comorbidities.</li> <li>Assessed quality of life with SF-36 scale.</li> </ul>	At 2 years, 57% had continuing weight loss, 43% had increase in weight (range -9.7 to +4.2 kg); 32% body weight loss	<ul style="list-style-type: none"> <li>Internal hernia repair (6.2%)</li> <li>Cholecystectomy (7.4%)</li> <li>Poor adherence to vitamin and mineral supplements (33%)</li> </ul>	significant improvement in all 4 physical health domains, and 2/4 mental health domains of the SF-36 scale score
Nadler, et al (2009)	N = 45 (age 14-17)	Prospective Cohort	Laparoscopic Adjustable Gastric Banding	<ul style="list-style-type: none"> <li>Change in loss of "excess weight"</li> <li>Various comorbid conditions assessed pre- and post operatively</li> </ul>	At 2 years, excess weight loss 47% +/- 22% (N = 41)	Over the course of 2 years, <ul style="list-style-type: none"> <li>B12 levels significantly lower</li> </ul>	<ul style="list-style-type: none"> <li>Dyslipidemia went from 17 to 5 patients</li> <li>Depression went from 10 to 6 patients</li> <li>HTN went from 11 to 0 patients</li> <li>Glucose tolerance went from 9 to 0 patients</li> <li>OSA went from 5 to 4 patients</li> </ul>
Ford, et al (2010)	N = 106 (age 9-17)	Randomized controlled trial	Eating behavior modification using automated immediate feedback device during meals	<ul style="list-style-type: none"> <li>Change in BMI-SDS.</li> <li>Change in body fat-SDS</li> <li>Portion reduction</li> </ul>	At 12 months, trial group had a mean reduction of BMI-SDS of 0.4 compared to loss of 0.14 in the control	None	<ul style="list-style-type: none"> <li>Trial group had reduction in portion size of 14% compared to 6% in the control</li> <li>Trial group had reduction in body fat SDS of 0.32 compared to 0.07 in the control</li> </ul>
Davis, et al (2009)	N = 41 (age 14-18)	Randomized controlled trial	Nutrition education, strength training, and combined aerobic and strength training (CAST)	% change in BMI z-score	At 16 weeks, N + CAST group showed a decrease of BMI z-score by -2.8% (± 5.7%)	Did not report	Did not report
Berkowitz, et al (2003)	N = 43 (age 13-17)	Randomized Control Trial	Behavior therapy + sibutramine	% change in BMI	At 1 year, participants lost a total of 7.0 kg (9.3 kg when correcting for height), equal to an 8.6% reduction in initial BMI	<ul style="list-style-type: none"> <li>increased BP and/or pulse (6)</li> <li>ecchymoses (2)</li> <li>VPCs (1) All were significant enough to discontinue medication</li> </ul>	Did not report

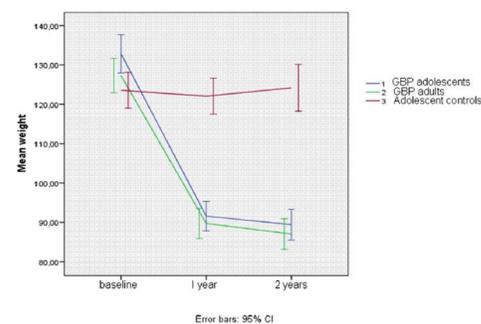


Fig. 2. Weight change over 2 years in adolescents and adults undergoing bypass surgery (n = 81 + 81) and adolescents in conventional treatment (n = 81). Mean (95% CI). From Gothberg, et al, study on LRGB.



Fig 3. Mandometer used in Ford, et al study.

## Conclusions, cont'd

Modification of diet and exercise (cardiovascular and strength training) is widely considered the first line therapy for obesity. While it has been shown that a combination of nutrition education and an exercise regimen reduces body weight [4], results tend to be less substantial than other methods previously referenced. A major advantage of lifestyle modification is the low level of risk of physical harm to the patient. While exercise-related injuries are possible consequence of strength training, there were none reported in the Davis study.

Behavior modification is another avenue in which weight loss can be achieved. Novel feedback models have demonstrated a significant weight loss effect by reducing rate of food intake, and thus the portion sizes of trial subjects [3]. While the use of a mandometer such as the one in the Ford study may be somewhat impractical for a patient to use, this study does demonstrate that immediate feedback can indirectly reduce the portion size of a meal, and thus facilitate weight loss.

## Discussion

Pediatric obesity is a very complex public health issue. Unless a reasonable and useful standard of care for adolescent obesity emerges, it stands to reason that the obese adult population may continue to grow rapidly as obese youths come of age.

Development of a standard will prove to be challenging, as the comparison of results of behavioral, pharmacological, and surgical weight loss strategies can be quite difficult. Although there are several high quality studies in print today, healthcare providers must interpret them cautiously, and recommend therapies appropriately based on the needs of the individual patient.

Future studies must analyze the sustainability of surgical weight loss versus lifestyle modification, both in terms of BMI reduction, management of chronic disease secondary to obesity, and risk-benefit ratio of surgical complications.

## References

- Nadler, et al. Laparoscopic adjustable gastric banding for morbidly obese adolescents affects android fat loss, resolution of comorbidities, and improved metabolic status. J Am Coll Surg. 2009
- Gothberg, et al. Laparoscopic Roux-en-Y gastric bypass in adolescents with morbid obesity--surgical aspects and clinical outcome. Semin Pediatr Surg. 2014 Feb;23(1):11-6.
- Ford, et al. Treatment of childhood obesity by retraining eating behaviour: randomised controlled trial. BMJ 2010; 340: b5388.
- Davis, et al. Aerobic and Strength Training Reduces Adiposity in Overweight Latina Adolescents. Med Sci Sports Exer 2009; 41(7): 1494-1503.
- Berkowitz, et al. Behavior therapy and sibutramine for the treatment of adolescent obesity: a randomized controlled trial. JAMA 2003; 289: 1805-1812.
- O'Brien, et al. Laparoscopic Adjustable Gastric in Severely Obese Adolescents: A Randomized Trial. JAMA 2012; 303(6): 519-526.

## Conclusions

Obesity is a vast problem, and the existing therapies are controversial. Data from both the Gothberg and Nadler studies indicate that the most significant weight loss and resolution of comorbidities can be achieved with surgery; however, complication rates were more serious, some requiring further surgical intervention such as internal hernia repair and cholecystectomy (1, 2).

Pharmacological intervention (e.g. Sibutramine) may be of benefit to adolescents as summarized by the Berkowitz study. However, patients must be monitored while on sibutramine since this medication has serious adverse side effects such as increases in BP/pulse rate as well as the risk of developing ventricular premature complexes (VPCs) [5]. The current recommendation reported from this study is that weight-loss medications should only be used on an experimental basis until more longitudinal data can be collected.