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REVIEW ARTICLE

Adolescent Weight Loss Strategies: A Literature Review

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Abstract

Since nearly a quarter of individuals aged 2-19 years are classified as obese in the United States, finding effective weight loss solutions to combat this epidemic are essential. Over time childhood obesity usually develops into adolescent and adult obesity contributing to increased prevalence of chronic disease and increased healthcare costs. The purpose of this review is to evaluate the physical and financial costs and benefits and of surgical versus lifestyle treatment interventions for adolescent obesity. Interventions include bariatric surgery and behavioral treatment incorporating components of family support, stimulus control, mindfulness when eating, self-monitoring, increasing physical activity, and managing daily intake. A theory based multicomponent behavioral intervention that includes the child and parent appears to be most successful for younger children. Nevertheless, often these children become obese adults, resulting in numerous treatment interventions. As adolescents become more independent these behavioral interventions are less successful long term. Bariatric surgery may be a life/cost saving alternative to treat obese adolescents. The main costs associated with surgery includes monetary expense of surgery, long-term vitamin/mineral deficiencies, and lifestyle adherence post-surgery.

Surgical complications are no higher in adolescents than adults, however, long term effects on growth remain to be seen. Overall, the age of onset of obesity influences the type of treatment individuals should participate in. Children with obesity younger than 10 years are more likely to respond to behavioral treatment than children with obesity older than 10 years. Adolescents with obesity who are 21 years and younger may respond better to a more aggressive approach of treatment, such as bariatric surgery. Analysis of child and adolescent lifestyle, environment, and support should be conducted to find a successful weight loss intervention.

Introduction

Over the past 20 years, the prevalence of childhood and adolescent obesity has reached epidemic proportions as nearly a quarter of children and adolescents aged 2-19 years are considered obese [1]. The good news is that the prevalence of obese children aged 2-5 years has decreased from 14% to 8% over the last few years [1]. Therefore, children aged 6-11 and adolescents aged 12-19 years constitute the bulk of the childhood obesity epidemic [1] and should be the focus of treatment options. Obesity status among children and adolescents aged 2-19 years of age is derived from Body Mass Index (BMI) and growth charts from the Center for Disease Control. Obesity is defined as BMI at or above the gender-specific 95th percentile [2].

Not all children are at equal risk of developing childhood obesity. For example, childhood obesity rates in the United States differed among the education level of head of household and child's ethnicity [3]. Obesity rates for children who live in an environment where the head of household finished college are nearly half that of children whose head of household did not complete high school. Non-Hispanic white children who live in an environment where the head of household completed college had the lowest prevalence of obesity. This was not the case for non-Hispanic African American boys, who showed no significant relationship between obesity and the level of education of the head of household [3]. There are several explanations for this difference in obesity rate, some of which may be attributed to the schools the children attended, peer pressure or whether the individuals were strength training [4].

Although evidence is mixed regarding the association between ethnicity and obesity, research suggests a strong relationship between preschool aged children obesity rates and low-income families, which may be associated with the head of household's education level. Childhood obesity prevalence was highest in preschool aged children 2-4 years from families with less than a 100% poverty income ratio (PIR) [5].

Over time, childhood obesity usually develops into adolescent and adult obesity, contributing to increased prevalence of obesity, diabetes, hypertension, hyperlipidemia, and overall healthcare costs for future generations [6]. Childhood obesity not only places the child's physical health at risk, it also diminishes the mental health status of children and adolescents because psychosocial functioning decreases with increased BMI [4]. Today's youth are endangering their future physical and mental capabilities as well as their financial stability; therefore, this epidemic needs to be stopped. Moreover, there is a need to assess the most safe, cost effective way for adolescents to lose weight and keep it off.

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What is best way to stop this adolescent obesity epidemic from spreading? Perhaps the best way to determine that is by completing a cost-benefit analysis of various treatment options for adolescent obesity which compares the total expected cost against the total expected benefits of each treatment option. In retrospect, the treatment option benefits should overshadow its costs in the long-term.

There are two main interventions to treat adolescent obesity; behavioral treatment and surgical weight loss procedure [4, 7]. Recommendations are constantly changing and much conflict revolves around these two distinct treatment options [8-10]; however, by using cost-benefit analysis, a systematic approach may be used to determine which treatment option is best for obese individuals in the long-term. The purpose of this review is to evaluate the physical and financial costs and benefits of surgical versus behavioral treatment interventions for adolescent obesity.

Methods

This study is a literature review of articles related to adolescent weight loss: lifestyle methods or bariatric surgery. Pubmed, Web of Science, and GoogleScholar databases were searched using the key words adolescent, bariatric surgery, weight loss surgery, cost benefit analysis of adolescent bariatric surgery, prevalence of adolescent obesity, lifestyle interventions for adolescent obesity, and surgical solutions for adolescent obesity. The references in these articles were reviewed for additional articles. Articles for this review included original research, literature review articles, quantitative, and qualitative studies in the English language. The selected articles in this review focused on bariatric surgery or lifestyle interventions as a solution for the rising adolescent obesity rates and the cost-benefit relationship between lifestyle interventions and bariatric surgery.

Results

Out of 212 articles found, 28 articles were chosen for inclusion

Author	Component of Behavioral Treatment	Description	Additional Terminology/ Example	Utilization of Component in Research	Definition
Burke et al [12]	Self-Monitoring	Maintaing food diaries and activity logs.	Term: Food Diary	Knop et al (2013): Extremely Obese Children Response Better Than Extremely Obese Adolescents to Lifestyle Interventions.	Individuals write down how much food was consumed as well as the serving size and method of food preparation.
Olson et al [13]	Mindfulness	Slowing the rate of eating, allowing hunger signals to subside.	Example: Slower eating, being aware of each bite of food consumed.	Knop et al (2013): Extremely Obese Children Response Better Than Extremely Obese Adolescents to Lifestyle Interventions.	Focus on the texture, taste, and smell when eating.
Redfern et al [15]	Goal Setting	Setting realistic weight loss goals.	Example: setting a weight loss goal every week/month, following MyPlate guidelines.	Jortberg et al (2016): The Fit Family Challenge: A Primary Care Childhood Obesity Pilot Intervention.	Examining the barriers associated with the goal as well as fining solutions to overcoming barriers.
Redfern et al [15]	Behavioral Contracting	Positive reinforcement of successful outcomes.	Example: Rewards.	Knop et al (2013): Extremely Obese Children Response Better Than Extremely Obese Adolescents to Lifestyle Interventions.	A reward an individual deems important may be given as weight loss goals are achieved.
Rachal et al [16]	Education	Nutritional Education	Term: Nutritional Education	Knop et al (2013): Extremely Obese Children Respond Better Than Extremely Obese Adolescents to Lifestyle Interventions.	Dietitian provides a structured meal plan according to individuals' needs and food preferences.
Swift et al [17]	Increasing Physical Activity	Increasing time spent doing physical activity	Example: engaging in physical activity once every hour.	Danielsson, et al (2012): Response of Severely Obese Children and Adolescents to Behavioral Treatment.	The main goal is decreasing inactivity and screen time.
Jacob et al [11]	Parental Involvement	Parental support is vital in pediatric obesity behavioral treatment programs.	Example: Use of Transtheoretical Model	Jortberg et al (2016): The Fit Family Challenge: A Primary Care Childhood Obesity Pilot Intervention.	**Pre-Contemplation:** no intention to change **Contemplation:** considering to make the chance, but not committed **Preparation:** intention to change **Action:** modifying behavior **Maintenance:** maintaining behavior change.

Table 1: Types of Behavioral Treatment Components.

in this literature review. Through these articles, a cost-benefit relationship was examined between adolescent obesity and adolescent bariatric surgery.

Behavioral Therapy

Often considered the first line of treatment for obesity, behavioral based therapy involves a structured diet and exercise regime plus other behavioral based components. Much like adult weight loss programs, pediatric weight loss programs incorporate various aspects of behavioral therapy. However, unlike adult weight loss programs, parent involvement and parent modeling of healthy behaviors are essential in pediatric weight loss programs as the most successful weight management programs are family based [4].

Behavioral therapy encompasses a variety of methods including self-monitoring, stimulus control, slower eating, goal setting, behavioral contracting, education, increasing physical activity, and parental involvement [11]. See Table 1. Self-monitoring through food diaries and/or activity logs, allows individuals to track daily activities [12]. Stimulus control allows environmental modification to prevent overeating. For instance, limiting the availability of non-nutrient dense food items in an individual's home creates an encouraging environment to eat healthfully. Eating at a slower rate embodies mindfulness, allowing individuals to focus on food texture, smell, and taste [13, 14]. Behavioral contracting and goal setting go hand in hand as positive reinforcement (i.e. rewards) aid individuals in meeting their weight loss goal [15]. Nutrition education provides skill development to create a structured meal plan per one's needs and food preferences. This is key for both children/adolescents and parents [16]. Increasing physical activity assists in positive reinforcement because it decreases screen time and increases fat loss [17]. Finally, social support and parent involvement are of upmost importance in pediatric behavioral therapy because both hold the power to instigate behavior change [11, 14]. Table 2 provides research studies that showed benefits of using behavioral treatment methods (Tables 1,2).

Furthermore, incorporation of a family-focused behavioral modification program into primary care practices for children aged 6-12 years dramatically improved BMI and lifestyle factors associated with obesity. These lifestyle factors included daily fruit and vegetable intake, physical activity, screen time, number of times spent with family activity, intake of sugar-sweetened beverages, and number of times eating out each week [18]. Moreover, when incorporating family into a behavioral therapy lifestyle intervention, a parent's readiness to change should be evaluated using the Transtheoretical Model [11]. Defining a parents' readiness for change allows for a more individualized plan of care, leading to child adherence of behavioral therapy.

The Transtheoretical Model may also be used to measure a child's or adolescent's readiness to change in regards to living a healthful lifestyle that facilitates weight loss. Children and adolescent readiness to change is largely influenced by their age. Younger children (< 10 years) are more likely to be under the control of parents; while older adolescents (> 10 years) are less likely to be influenced by their parents. As children grow into adolescents they also experience more peer pressure, which may dictate what they eat or the activities in which they participate [8, 11, 19]. In multiple behavioral therapy intervention studies, children between the ages of 6-10 years showed a greater decrease in BMI compared to adolescents aged 10-16 years [8, 11, 19]. These results show lifestyle intervention to be effective for extremely obese children, but not necessarily for extremely obese adolescents.

Cost of Behavioral Therapy

Although behavioral therapy is considered the first line of treatment for adolescents with obesity, yet many researchers and health professionals are unaware of its long-term effectiveness. This lack of evidence concluding behavioral therapy works in the long-term leads to assumptions of failed attempts at weight loss. Thus, behavioral therapy for adolescent weight loss may not be effective in the long run. Individuals, especially adolescents, may not adhere to behavioral therapy due to decreased motivation, increased preference for non-nutrient dense foods, increased hunger, lack of physical activity, and time constraints [20]. These costs may be due to peer pressure, lack of patience, and basic growth needs of adolescents. Peer pressure may cause obese adolescents to engage in the same activities as friends. Rather than participating in sports, they may go to a friend's house and play video games.

Additionally, individuals' motivation may decrease as time goes on without any weight loss. Adolescents are generally impatient, and they need the help of their support systems to keep them motivated to lose weight [9,18-19]. Moreover, adolescents may just be naturally hungry because they are growing and need enough nutrients to grow to a healthy weight [4]. This may dampen weight loss efforts. Obesity treatment options for the adolescent age group may need to rely on more extreme options, such as surgery.

Bariatric Surgery Treatment

An alternative treatment to behavioral therapy is bariatric surgery for obese adolescents; however, this option is only considered after behavioral therapy has failed. It is argued that bariatric surgery is an effective method to alleviate obesity in adolescents compared with behavioral therapy techniques. Adolescent bariatric surgery has increased in popularity as there were approximately 1600 surgeries completed per year since 2009, with the three most common surgeries including Laparoscopic Adjustable Band (LAGB), vertical sleeve gastrectomy (VSG), and Roux-en-Y-Gastric Bypass (RYGB) [7]. Table 3 shows the types of bariatric surgery with benefits and complications of each type of surgery.

Laparoscopic Adjustable Gastric Banding

Laparoscopic adjustable gastric banding (LAGB) involves insertion of an inflatable silicone elastic band dividing the stomach into an upper and lower section connected by a

Author	Participants	Intervention measurements	Study Design	Intervention	Key Findings
The et al [6]	8,834 children and adolescents aged 12-21 years	Observation of weight status of individuals from 1996-2009 in schools.	Cohort design involving individuals enrolled in the US Longitudial Study of Adolescent Health. Tracked individuals until they were 24-33 years in 2009 to determine current weight status.	Involved the National Longitudal Study of Adolescent Health in schools in the U.S. Schools chosen based on (1) urbanicity (2) school size (3) school type (4) ethnicity	1996: 79 adolescents were severely obese 60 individuals remained obese into adulthood. 2009: 703 adolescents were non-severaly obese; were classifiend as severely obese in adulthood. Obese adolescents were significantly more likely to develop severe obesity in young adulthood than normal weight adolescents.
Danielsson et al [8]	643 children aged 6-16 years	Understand severity of obesity Daily physical activity Adopt healthy eating habits Daily sedentary behavior BMI	Longitudial observational study involving children and adolescents aged 6-16 years who started behavioral treatment between 1998-2006	National Childhood Obesity Center: Family members and obese child. Invovled (1) very low calorie diets (2) pharmacological treatment (3) monitoring of daily intake and goals (4) intensify treatment if failed-treatment checks ranged from weekly to monthly to annually	0.5 mean BMI reduction in 20% of children aged 10-13 years. 0.5 mean BMI reduction in 8% of adolescents aged 14-16 years. 0.7 mean BMI reduction in 58% of children aged 6-9 years. Treatment was more successful for younger children aged 6-9 years during the 3 year observation period.
Jortberg et al [18]	264 children aged 6-12 years with a BMI >85th %tile	BMI BMI z scores Daily fruit & vegetable intake Sugar sweetened beverage intake Weekly times eating out Daily physical activity Freq of family activity Screen time	Single-Intervention Pilot involving 29 family medicine and pediatric community practices in 1 state for 1 year with 1 year follow-up.	Fit Family Challenge: family members and obese child. Involved (1) weekly contact and goal-setting with manager (2) monthly group visit attendance with parent(s) (3) collection of weekly goals and monthly weight, height, blood pressure, and lifestyle factors.	↓ BMI %tile and BMI z-scores for participants who completed 9-15 months of follow-up. ↑daily fruit and vegetable intake ↓ intake of sugar-sweetened beverages ↓ number of times eating out/ week. ↑ daily physical activity, ↑ number of times /week of family activity ↓ daily screen time,
Knop et al [19]	1,291 children aged 9-13 years	Daily dietary intake Food labels Stimulus control Mindfulness Behavioral contracting Self-monitoring Increase physical activity Family support	Observational study analyzing outcome of 1-year lifestyle intervention.	Incorporated behavioral treatment of Obeldicks. Involved: (1) maximizing the diet (2) reading 'stop and go' food labels (3) stimulus control (4) mindfulness when eating (5) self-monitoring (6) self-monitoring (7) increasing physical activity (8) family support.	Extremely obese children <10 years: greater BMI reduction than obese children. Extremely obese adolescents >10 years: lower reduction in BMI than obese adolescents. Extremely obese children <10 years had a greater BMI reduction than extremely obese adolescents >10 years.

Table 2: Behavioral Treatment Studies.

channel, causing food to empty into the lower section at a slower rate. LABG has a quicker recovery time and shorter hospital stay; however, long-term weight loss is likely less [21-24].

Vertical Sleeve Gastrectomy

The vertical sleeve gastrectomy (VSG) reconstructs the stomach and takes place by stapling along the greater curvature of the stomach in order to decrease stomach size, but maintain digestive/gastric emptying processes [9]. The VSG results in fewer nutrient deficiencies, reduced appetite, and early satiety along with remission of diabetes mellitus; however, VSG sleeve leakage may occur over time [25]. Moreover, excess weight loss is greater than LAGB and similar to LAGB, this

Author	Type of Surgery	Description	Estimated Weight Loss (EWL)	Side Effects	Disadvantages	Advantages
Marihart et al [26]	Roux-en-Y Gastric Bypass (RYGB)	Divides stomach into two sections, with the upper part being a small pouch that connects to the jejunum using a Y-shaped limb of small intestine; causing food to bypass the duodenum. Digestive secretions mix chyme at the junction of the jejunum and duodenum.	50% of excess weight loss within first 6 months post-surgery. Weight stays off for up to 10 years.	Dumping Syndrome, bone loss, hernia/ gallstone formation.	Thiamin, Vitamin B-12 and D, Iron, Copper, and Calcium deficiencies; decreased protein consumption/ absorption.	Alleviation of obesity-related comorbidities (i.e. hypertension, type ll diabetes, high cholesterol, sleep apnea, heartburn, etc.).
Marihart et al [26]	Laparscopic Adjustable Gastric Banding (LAGB)	An inflatable silicone elastic band divides the stomach into one upper and lower section, which are connected by a thin channel, causing food to empty into the lower pouch at a slower rate.	Weight loss is slow and weight regain is likely to occur over time.	Vomiting, acid reflux, band may become loose or leak.	50% long-term failure rate, weight fluctuations due to band reposition surgeries.	Quicker recovery, not permanent, shorter hospital stay.
Serrano et al [9] Marihart et al [26]	Vertical Sleeve Gastrectomy (VSG)	Re-sizing of the stomach occurs through stapling along the greater curvature of the stomach removing roughly 75% of the stomach. Normal digestive processes/emptying occurs through a narrow band connecting the stomach and small intestine.	Greater than 50% EWL.	Sleeve leakage.	Post-surgery weight gain after 5 years is likely to occur.	Decreased nutrient deficiencies, reduced appetite, early satiety, diabetes mellitus remission.

Table 3: Types of Bariatric Surgery Procedures.

surgery results in decreased nutrient defiencies [26]. However, the hospital stay for VSG is longer than with LAGB [9, 26].

Roux-en-Y Gastric Bypass

Finally, Roux-en-Y-Gastric Bypass (RYGB) divides the stomach into two sections, with the upper part being a small pouch that connects to the jejunum using a Y-shaped limb of small intestine; causing food to bypass the duodenum. Digestive secretions mix chyme at the junction of the jejunum and duodenum. RYGB has a high successful rate for weight loss and reduction of obesity-related comorbidities, such as diabetes, hypertension, and hyperlipidemia; however, it also can cause severe nutrient deficiencies, including vitamins B-12 and D, iron, copper, calcium, and even protein [26, 27].

Adolescent Bariatric Surgery Eligibility.

Similar to adults, adolescents may be eligible for bariatric surgery if they have a BMI $\geq$ 35 kg/m^2 with a severe comorbidity; comorbidities may include moderate to severe obstructive sleep apnea, type ll diabetes, hypertension, or nonalcoholic steatohepatitis. Adolescents may also be qualified for bariatric surgery if they have a BMI $\geq$ 40 kg/m^2 with a less severe comorbidity. Exclusions to surgery include those with substance abuse as well as psychosocial, medical, or cognitive conditions. These conditions often prevent adherence to recommendations and the inability to understand the risks and benefits of weight loss surgery. The main long-term complications associated with bariatric surgery in children and adolescents include nutrient deficiencies, especially vitamin $B_{12,}$ thiamin, vitamin D [7] and even protein associated with low calorie intake after surgery [27]. However, often times the benefits, such as remission of diabetes, hyperlipidemia, hypertensions, and sleep apnea outweigh the monetary and physical costs of surgery [7].

Adolescent Bariatric Surgery

Research has been conducted to evaluate the success and safety of bariatric surgery and the effect surgery has on children and adolescent growth [7, 9, 28]. While short-term complications were lower in children and adolescents who underwent LAGB, BMI reductions were greater for children and adolescent who underwent RYGB [28]. Additionally, weight loss outcomes were the same for individuals younger and older than 18 years of age; thus, bariatric surgery in children and adolescents have the same short-term complication rates and weight loss results as adult surgeries [28].

As seen in Table 4, all bariatric surgical procedures approved for adolescents resulted in excess weight loss three years post-surgery [7, 9]. Excess weight loss after both RYGB and VSG in patients 21 years or younger were improved in comparison with weight loss in patients 22-59 years of age 3 years post-surgery. Therefore, both VSG and RYGB offer long-term weight loss benefits in individuals 21 years of age or younger [9]. Furthermore, RYGB, specifically, improved adolescent lipid levels, hemoglobin A1c, and obesity related symptoms in patients 1-year post-surgery [9].

Author	Participants	Intervention measurements	Study Design	Intervention	Key Findings
Serrano et al [9]	54 children and adolescents aged <21 years.	Excess Weight Loss (EWL) HbA1c	Patients who had bariatric surgery at specified institution between January 2009-December 2013 were evaluated to determine the safety and efficacy of weight loss surgery in children and adolescents.	Participants underwent either RYGB (37 patients) or VSG (14 patients) in order to treat obesity and obesity-related cormorbidities, such as asthma, diabetes, dyslipidemia, hypertension, obstructive sleep apnea, and polycystic ovarian syndrome.	Excess weight loss (EWL) at 3, 6, 12, 24, and 36 months was 35.2, 47.6, 62.4, 58.1, and 61.8% for patients who had RYGB; EWL was 29.7, 44.7, 57.4, 60.3, and 59.0% at 3, 6, 12, 24, and 36 months for patients who underwent VSG. Complications in the RYGB group included 1 anastomotic bleed, 1 post-operative stricture, and 1 patient who developed vitamin deficiency that manifested into peripheral neuropathy, which happens in a little less than 10% of cases. Overall, RYGB was more beneficial than VSG in improving lipid levels and HbA1c at 1 year post-operation.
Strauss et al [27]	10 adolescents aged <17 years.	Excess Weight Loss (EWL) Vitamin/mineral deficiencies	Retrospective review with 1 year follow-up conducted in 9 participants.	Participants were well informed, motivated, and demonstrated previous attempts at weight loss. Prior to surgery families were instructed to contact individuals in a gastric bypass support group who had previously undergone surgery. All participants underwent gastric bypass and had successful recoveries post-surgery.	9 out of the 10 adolescents have excess weight loss of 30 kg; obesity-related morbidities were resolved in all adolescents. Five participants had mild iron deficiency anemia, three had transient folate deficiency, and one had protein deficiency related to malnutrition following surgery.
Lennerz et al [28]	167 participants.	BMI	Prospective Longitudinal study analyzing registry of adolescent bariatric surgery patients.	Collecting and analyzing data from online registry used by hospitals. Data included: (1) type of surgery (2) surgical technique (3) anthropometric measures (4) vital/biochemical parameters (5) comorbidities (6) short/long-term complications	Short-term complications were lower for gastric banding (4.1%) than for gastric bypass (9.5%) or sleeve gastrectomy (16.7%). Weight loss and BMI reduction were higher for gastric bypass (-50 Kg and -16.4 kg/m^2) compared to gastric banding (-28 kg and -9.5 kg/m^2). Results of weight loss surgery did not differ between <18 years of age and >18 years of age.

Table 4: Adolescent Bariatric Surgery Treatment Studies.

Costs of Bariatric Surgery

Morbidly obese adolescents experience long-term weight loss using bariatric surgery. Adolescents found long-term success with weight loss, financial stability, and improved quality of life following bariatric surgery [29, 30]. Three years after surgery, individuals experienced an increase of 0.199 quality adjusted life years compared to adolescents who did not undergo bariatric surgery [29]. Bariatric surgery was not found to be cost-effective at three years post-surgery; however, became cost-effective five years post-surgery. Researchers suggest that adolescents who undergo bariatric surgery will save $157 per year, approximately [30]. With an improved quality of life, remission of comorbid diseases, and financial security, adolescent bariatric surgery supports individuals' health status in the long-term.

References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM (2014) Prevalence of childhood and adult obesity in the united states 2011-2012. JAMA 311: 806-814. [View Article]
2. Ogden CL, Carroll MD, Kit BK, Flegal KM (2012) Prevalence of obesity and trends in body mass index among us children and adolescents 1999-2010. JAMA 307: 483-490. [View Article]
3. May AL, Freedman D, Sherry B, Blanck HM (2013) Obesity-United States, 1999-2010. MMWR Suppl 62: 120-128. [View Article]

4. Kelly AS, Barlow SE, Rao G, Inge TH, Hayman LL, et al. (2013) Severe obesity in children and adolescents: Identification, associated health risks, and treatment approaches: A scientific statement from the American Heart Association. Circulation 128: 1689-1712. [View Article]

5. Childhood obesity facts (2015) obesity-among-preschoolers. [View Article]

6. The NS, Suchindran C, North KE, Popkin BM, Gordon-Larsen P (2010) Association of adolescent obesity with risk of severe obesity in adulthood. JAMA 304: 2042-2047. [View Article]

7. Desai NK, Wulkan ML, Inge TH (2016) Update on adolescent bariatric surgery. Endocrinol Metab Clin North Am 45: 667-676. [View Article]

8. Danielsson P, Kowalski J, Ekblom O, Marcus C (2012) Response of severely obese children and adolescents to behavioral treatment. Arch Pediatr Adolesc Med 166: 1103-1108. [View Article]

9. Serrano OK, Zhang Y, Kintzer E, Moran-Atkin E, Choi J, et al. (2016) Outcomes of bariatric surgery in the young: A single-institution experience caring for patients under 21 years old. Surg Endosc 30: 5015-5022. [View Article]

10. Stroud AM, Parker D, Croitoru DP (2016) Timing of bariatric surgery for severely obese adolescents: A markov decision-analysis. J Pediatr Surg 51: 853-858. [View Article]

11. Jacob JJ, Isaac R (2012) Behavioral therapy for management of obesity. Indian J Endocrinol Metab 16: 28-32. [View Article]

12. Burke LE, Wang J, Sevick MA (2011) Self-monitoring in weight loss: A systematic review of the literature. J Am Diet Assoc 111: 92-102. [View Article]

13. Olson KL, Emery CF (2015) Mindfulness and weight loss: A systematic review. Psychosom Med 77: 59-67. [View Article]

14. Lifestyle management of adult obesity: Behavioral strategies (2013) Virtual Health Care Team, University of Missouri-Columbia. [View Article]

15. Redfern J, Enright G, Raadsma S, Allman-Farinelli M, Innes-Hughes C (2016) Effectiveness of a behavioral incentive scheme linked to goal achievement: Study protocol for a randomized controlled trial. Trials 17: 33. [View Article]

16. Rachal A, Pope J, Kim Y, Erickson D (2015) The effect of nutrition education on diet quality and weight loss in pre-surgical bariatric patients. J Acad Nutr Diet 115: A28. [View Article]

17. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS (2014) The role of exercise and physical activity in weight loss and maintenance. Prog Cardiovasc Dis 56: 441-447. [View Article]

18. Jortberg BT, Rosen R, Roth S, Casias L, Dickinson LM, et al. (2016) The fit family challenge: A primary care childhood obesity pilot intervention. J Am Board Fam Med 29: 434-443. [View Article]

19. Knop C, Singer V, Uysal Y, Schaefer A, Wolters B, et al. (2015) Extremely obese children respond better than extremely obese adolescents to lifestyle interventions. Pediatr Obes 10: 7-14. [View Article]

20. MacLean PS, Wing RR, Davidson T, Epstein L, Goodpaster B et al. (2015) NIH working group report: Innovative research to improve maintenance of weight loss. Obesity (Silver Spring) 23: 7-15. [View Article]

21. Angrisani L, Lorenzo M, Borrelli V (2007) Laparoscopic adjustable gastric banding versus roux-en-y gastric bypass: 5-year results of a prospective randomized trial. Surg Obes Relat Dis 3: 127-132. [View Article]

22. Chakravarty PD, McLaughlin E, Whittaker D, Byrne E, Cowan E, et al. (2012) Comparison of laparoscopic adjustable gastric banding (lagb) with other bariatric procedures; a systematic review of the randomised controlled trials. Surgeon 10: 172-182. [View Article]

23. Neff KJ, Olbers T, le Roux CW (2013) Bariatric surgery: The challenges with candidate selection, individualizing treatment and clinical outcomes. BMC Medicine 11: 8. [View Article]

24. Tice JA, Karliner L, Walsh J, Petersen AJ, Feldman MD (2008) Gastric banding or bypass? A systematic review comparing the two most popular bariatric procedures. Am J Med 121: 885-893. [View Article]

25. Scott WR, Batterham RL (2011) Roux-en-y gastric bypass and laparoscopic sleeve gastrectomy: Understanding weight loss and improvements in type 2 diabetes after bariatric surgery. Am J Physiol Regul Integr Comp Physiol 301: R15-27. [View Article]

26. Marihart CL, Brunt AR, Geraci AA (2014) Older adults fighting obesity with bariatric surgery: Benefits, side effects, and outcomes. SAGE Open Medicine 2: 2050312114530917. [View Article]

27. Strauss RS, Bradley LJ, Brolin RE (2001) Gastric bypass surgery in adolescents with morbid obesity. J Pediatr 138: 499-504. [View Article]

28. Lennerz BS, Wabitsch M, Lippert H, Wolff S, Knoll C, et al. (2014) Bariatric surgery in adolescents and young adults--safety and effectiveness in a cohort of 345 patients. Int J Obes 38: 334-340. [View Article]

29. Klebanoff MJ, Chhatwal J, Nudel JD, Corey KE, Kaplan LM, et al. (2017) Cost-effectiveness of bariatric surgery in adolescents with obesity. JAMA Surg 152: 136-141. [View Article]

30. Bairdain S, Samnaliev M (2015) Cost-effectiveness of adolescent bariatric surgery. Cureus 7: e248. [View Article]

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