Bariatric Surgery in Adolescents: More Than a Last Resort, Important considerations.

Sindhu Ramachandra, Maria G Aramburu de La Guardia, MD, Hatim A Omar, MD

Lehigh Valley Reilly Children's Hospital, Lehigh Valley Health Network, Allentown, PA

Correspondence: Maria G Aramburu de la Guardia. Email: maria.aramburu@lvhn.org
Received: 11/2/2024; **Revised**: 20/2/2024; **Accepted**: 22/2/2024
Key words: adolescents, obesity, disordered eating, bariatric surgery, body image, mental health, best practices.
[**citation**: Ramachandra, Sindhu; Aramburu de La Guardia, Maria G; Omar, Hatim A. (2022). Bariatric Surgery in Adolescents: More Than a Last Resort, Important considerations. DHH, 11(1):https://journalofhealth.co.nz/?page_id=3057].

Introduction

Obesity has become an epidemic in the United States, impacting millions of adults and children across the country. For children and adolescents age 5 – 19, an estimated 14.7 million are affected by obesity (1). Though initially thought to be a condition seen predominantly in high income countries, obesity rates are now rising in low- and middle-income countries as well (2). The World Health Organization defines overweight and obesity in children age 5 – 19 as BMI-for-age greater than 1 standard deviation above the WHO Growth Reference median and BMI-for-age greater than 2 standard deviations above the WHO Growth Reference median respectively (2). While causes for obesity can be multifactorial, the consequences of increased BMI include increased risk of cardiovascular diseases, diabetes, musculoskeletal disorders, and even certain cancers (2). The prevalence of obesity has been shown to differ amongst various racial and ethnic groups, with prevalence among non-Hispanic black and Hispanic youth to be higher than among both non-Hispanic white and non-Hispanic Asian youth (3). Within these groups, Hispanic youth were found to have the highest prevalence, with 25.8% of Hispanic children and adolescents experiencing obesity (3). Childhood obesity is also associated with a higher chance of obesity, premature death, and disability in adulthood (2) making this population a prime target for therapeutics to prevent long-term health consequences.

Metabolic and Bariatric Surgery

Metabolic and bariatric surgery (MBS) is commonly used for treatment of severe obesity in adults after failed attempts at medical and lifestyle interventions. In the 1991 National Institutes of Health guideline for bariatric surgery, procedures such as the vertical banded gastroplasty (VBG) and Roux-en-Y gastric bypass (RYGB) were described for adults who met selection criteria for bariatric surgery, including those with a BMI $\geq$ 40 kg/m^2 or BMI $\geq$ 35 kg/m^2 with co-morbidities (5). However, recent guidelines released by the American Society for Metabolic and Bariatric Surgery (ASMBS) and the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) recommend MBS for adults with a BMI $\geq$ 35 kg/m^2 regardless of the presence or absence of co-morbidities (5). ASMBS released similar guidelines for pediatric MBS in 2018, with indications including BMI $\geq$ 40 kg/m^2 or 140% of the 95th percentile, or BMI $\geq$ 35 kg/m^2 or 120% of the 95th percentile with co-morbid conditions such as obstructive sleep apnea, type 2 diabetes mellitus, idiopathic intracranial hypertension, non-alcoholic steatohepatitis, slipped capital femoral epiphyses, gastroesophageal reflux disease, or hypertension (6). Patients and families should also be evaluated for their ability to adhere to pre- and postoperative treatments such as supplements to prevent micronutrient deficiencies (6). Contraindications for MBS in this population

include a medically correctable cause of obesity, a medical, psychiatric, psychosocial, or cognitive condition that prevents adherence to post-operative recommendations, an ongoing substance abuse problem, or current or planned pregnancy within 12 – 18 months of the procedure (6).

Current procedures commonly used to perform MBS include laparoscopic RYGB and laparoscopic sleeve gastrectomy. Both procedures combine mechanisms of restriction, through reducing the size of the gastric pouch, and malabsorption, due to digestive contents bypassing regions of the small intestine needed for adequate nutrient absorption. RYGB is performed by creating a small gastric pouch using a stapling device, and then attaching it to a loop of the distal jejunum (7). As a result, food goes through the small gastric pouch and directly into the attached portion of small intestine, creating both a restrictive and malabsorptive effect (8). In a sleeve gastrectomy, however, over 80% of the stomach is resected, and the remaining gastric pouch is formed into a tube to induce a primarily restrictive effect (7). Other procedures previously used in adolescent MBS include gastric banding, which involves placement of an adjustable band to divide the stomach into a smaller pouch but is now used less frequently due to increasing need for revisional surgery in these patients (8,9).

Metabolic and Bariatric Surgery Outcomes

Studies surrounding the use of MBS in the treatment of adolescents with severe obesity have shown significant improvements in both weight and cardiometabolic health in this population. Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS), a prospective study of MBS in adolescents, showed that the mean percent weight loss at 3 years following MBS was 27%, with a 28% mean percent weight loss in the group that underwent RYGB and 26% in the group that underwent sleeve gastrectomy (10). At 3 years post-operatively, only 2% of patients who underwent RYGB and 4% of patients who underwent sleeve gastrectomy exceeded their pre-surgical weight (10). Additionally, 74% of the participants who had elevated blood pressure prior to MBS saw their blood pressure normalize by 3 years after surgery, and similar trends were seen for participants who had dyslipidemia at baseline (10). The Adolescent Morbid Obesity Surgery (AMOS) study examining laparoscopic RYGB use in adolescents with severe obesity noted a 74-100% resolution of comorbidities and cardiovascular risk factors such as type 2 diabetes, dyslipidemia, and elevated blood pressure, in addition to substantial weight loss in this population (11). Inge et al. set out to compare the five-year outcomes of laparoscopic RYGB in adolescents and adults and found that there was no significant difference in percent weight change between the two groups (12). In fact, adolescents were more likely than adults to have post-surgical remission of co-morbid conditions such as hypertension and type 2 diabetes (12).

With increasing evidence pointing to the benefits of MBS in the adolescent population, nutritional outcomes must also be considered, as there is a risk of long-term nutritional deficiencies following these procedures. Inge et al. followed micronutrient outcomes for 2 years following RYGB and found low ferritin levels in 48% of adolescents 2 years post-operatively (10). They also reported a low baseline 25-hydroxyvitamin D in 25% of adolescents, which increased to 38% of adolescents 2 years post-operatively (10). On the other hand, AMOS reported 63% of adolescents who underwent RYGB had vitamin D insufficiency at 5 years post-operatively, compared to 57% of adolescents in the control group (11). Low ferritin was also seen in 66% of adolescents who underwent RYGB, compared to 24% who had low ferritin or iron at baseline (11). Given these findings, ASMBS guidelines note that it is important MBS patients receive a comprehensive pre-

operative nutritional assessment examining their serum iron, ferritin, folate, total iron-binding capacity, thiamin, vitamin B12, vitamin A, vitamin B6, calcium, parathyroid hormone, alkaline phosphatase, vitamin D, phosphorous, magnesium and zinc levels (6,13). Adequate vitamin and mineral supplementation following MBS is also crucial to avoid nutritional deficiencies and changes in bone mineral density, warranting close follow up with a multidisciplinary team (13).

Candidates for Metabolic and Bariatric Surgery

Current ASMBS guidelines do not include cutoffs for tanner pubertal stage or linear growth in adolescents considering MBS (6). However, bariatric surgery was previously not suggested by some until patients had reached Tanner stage 3 or peak height velocity. Teen-LABS study participants were divided into two groups: ages 13 to 15 and ages 16 to 19 at the time of surgery (16). Five-years following surgery, both groups showed similar changes in BMI percentage from baseline (16). These groups also displayed similar resolution of hypertension and dyslipidemia, but younger adolescents had a lower likelihood of nutritional deficiencies post-operatively (16). These findings suggest a need for individualized assessment of adolescents considering MBS, as timing of MBS as a weight-loss intervention may be specific to each patient. Thorough discussions should be had between patients and physicians to determine optimal timing for surgery, with stages of pubertal and physical development as a consideration rather than a determining factor.

It is currently unclear what the optimal timing for MBS would be in this population. The Follow-up of Adolescent Bariatric Surgery (FABS) study showed that adolescents who present at higher BMI values lose more weight post-surgically than those who present at lower BMI values (17). However, those with higher baseline BMI values were also found to plateau at a higher weight on average (17). It is important to consider the impact of delaying MBS until adulthood, particularly by examining the outcomes of MBS in adolescents when compared to adults. Five-year outcomes of the Teen-LABS study showed that weight loss overall was similar between both adults and adolescents who underwent MBS (18). Interestingly, adolescents had remission of type 2 diabetes and hypertension more often than their adult counterparts (18). Despite this, adolescents were more likely to undergo abdominal reoperation and experience nutritional deficiencies in the short-term (18). This data is important to consider when discussing the timing of MBS as an intervention in adolescents with obesity, as certain patients may benefit from surgery early on, while others may benefit from waiting until adulthood. This further highlights the need for comprehensive education for patients and families considering MBS, as potential risks should be reviewed and weighed on an individual basis under the guidance of health professionals.

The growing prevalence of mental health disorders in adolescents necessitates a pre-surgery mental health evaluation. Rofey et al. found that adolescents with severe obesity have no higher self-reported rates of psychopathology than age-normative reference values (14). This suggests that adolescents with obesity are at no greater psychopathology risk than other adolescents. They also note that adolescents participating in non-surgical lifestyle modification programs presented with greater psychopathology (14). This affirms the need for mental health providers as members of the MBS evaluation team and raises the question of the role mental health conditions should play in evaluation of these patients as surgical candidates. ASMBS guidelines include a section regarding adolescent mental health, specifying that while active psychosis, suicidality and substance abuse are contraindications to MBS, the presence of mental health disorders should not preclude adolescents with obesity

from receiving MBS (6). However, they emphasize the need for close monitoring both pre- and post-operatively to reduce the risk of further mental health complications (6).

While a standardized protocol for mental-health evaluation in adolescents with obesity has not been developed, Sysko et al. suggest an evaluation procedure that includes a clinical interview, self-report questionnaire, and cognitive assessment (15). In this evaluation, providers are also attempting to assess for any adherence issues with previous weight-loss attempts, as these may play a role in the patient's ability to adhere to pre- and post-surgical recommendations (15). This evaluation also elicits information about the patient's family environment, as this may also be a crucial factor in ensuring adherence to specific medical recommendations associated with this procedure (15). Even without a standardized protocol for mental health evaluation, it is important that mental health providers consider these aspects in adolescents who are considering MBS to optimize post-surgical outcomes and set these patients up for success.

Conclusion

Previously, MBS was often considered a last resort treatment for adolescents with obesity due to a scarcity of evidence detailing its effectiveness and long-term outcomes. However, studies have clearly shown that MBS should be considered in adolescents who meet eligibility criteria, particularly those with associated co-morbidities. Open communication between physicians, patients, and families is required to discuss the various risks and benefits of MBS in adolescents with obesity. This would hopefully allow for individualized treatment plans to be developed to ensure optimal surgical and non-surgical care outcomes in this population. Prior to undergoing MBS, it is also crucial that adolescent patients be evaluated holistically to consider their medical history, lifestyle, and mental health to determine if they are ideal candidates for surgical intervention. Physicians should also be cognizant of a patient's ability to adhere to post-operative recommendations, including vitamin and mineral supplementation, to avoid post-operative nutritional deficiency.

While requirements for medical intervention prior to surgical intervention are not as clearly outlined, it is important that MBS be considered a powerful tool alongside pharmacologic intervention in these patients. There is room for further study on the use of medications in conjunction with MBS, which may even prove to be an ideal treatment approach for obesity in adolescents. Additional studies examining the timing of MBS and its effect on adolescent growth and development may also provide insight on optimal timing for surgical intervention in this group. Due to the extensive pre- and post-operative planning and care required for these patients, multidisciplinary teams consisting of nutritionists, adolescent medicine physicians, pediatric surgeons, mental health professionals and other specialists may be best equipped to treat these patients and thus ensure they receive appropriate monitoring and follow up after undergoing MBS. Nevertheless, recent evidence suggests that bariatric surgery in adolescents may become standard of care, given findings of sustained weight loss and co-morbidity reduction, espousing a need for more physicians and surgical teams who are equipped to appropriately evaluate and manage this population.

References

1. Centers for Disease Control and Prevention. (2022, May 17). *Childhood obesity facts*. Centers for Disease Control and Prevention; CDC. https://www.cdc.gov/obesity/data/childhood.html
2. World Health Organization. (2021, June 9). *Obesity and overweight*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
3. Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). Prevalence of Obesity Among Adults and Youth: United States, 2015-2016. *NCHS data brief*, (288), 1–8.
4. Upadhyay, J., Farr, O., Perakakis, N., Ghaly, W., & Mantzoros, C. (2018). Obesity as a Disease. *The Medical clinics of North America*, *102*(1), 13–33. https://doi.org/10.1016/j.mcna.2017.08.004
5. Eisenberg, D., Shikora, S. A., Aarts, E., Aminian, A., Angrisani, L., Cohen, R. V., de Luca, M., Faria, S. L., Goodpaster, K. P. S., Haddad, A., Himpens, J. M., Kow, L., Kurian, M., Loi, K., Mahawar, K., Nimeri, A., O'Kane, M., Papasavas, P. K., Ponce, J., Pratt, J. S. A., … Kothari, S. N. (2023). 2022 American Society of Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) Indications for Metabolic and Bariatric Surgery. *Obesity surgery*, *33*(1), 3–14. https://doi.org/10.1007/s11695-022-06332-1
6. Pratt, J. S. A., Browne, A., Browne, N. T., Bruzoni, M., Cohen, M., Desai, A., Inge, T., Linden, B. C., Mattar, S. G., Michalsky, M., Podkameni, D., Reichard, K. W., Stanford, F. C., Zeller, M. H., & Zitsman, J. (2018). ASMBS pediatric metabolic and bariatric surgery guidelines, 2018. *Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery*, *14*(7), 882–901. https://doi.org/10.1016/j.soard.2018.03.019
7. Runkel, N., Colombo-Benkmann, M., Hüttl, T. P., Tigges, H., Mann, O., & Sauerland, S. (2011). Bariatric surgery. *Deutsches Arzteblatt international*, *108*(20), 341–346. https://doi.org/10.3238/arztebl.2011.0341
8. Beamish, A. J., Ryan Harper, E., Järvholm, K., Janson, A., & Olbers, T. (2023). Long-term Outcomes Following Adolescent Metabolic and Bariatric Surgery. *The Journal of clinical endocrinology and metabolism*, *108*(9), 2184–2192. https://doi.org/10.1210/clinem/dgad155
9. Altieri, M. S., Yang, J., Telem, D. A., Meng, Z., Frenkel, C., Halbert, C., Talamini, M., & Pryor, A. D. (2016). Lap band outcomes from 19,221 patients across centers and over a decade within the state of New York. *Surgical endoscopy*, *30*(5), 1725–1732. https://doi.org/10.1007/s00464-015-4402-8
10. Inge, T. H., Courcoulas, A. P., Jenkins, T. M., Michalsky, M. P., Helmrath, M. A., Brandt, M. L., Harmon, C. M., Zeller, M. H., Chen, M. K., Xanthakos, S. A., Horlick, M., Buncher, C. R., & Teen-LABS Consortium (2016). Weight Loss and Health Status 3 Years after Bariatric Surgery in Adolescents. *The New England journal of medicine*, *374*(2), 113–123. https://doi.org/10.1056/NEJMoa1506699
11. Olbers, T., Beamish, A. J., Gronowitz, E., Flodmark, C. E., Dahlgren, J., Bruze, G., Ekbom, K., Friberg, P., Göthberg, G., Järvholm, K., Karlsson, J., Mårild, S., Neovius, M., Peltonen, M., & Marcus, C. (2017). Laparoscopic Roux-en-Y gastric bypass in adolescents with severe obesity (AMOS): a prospective, 5-year, Swedish nationwide study. *The lancet. Diabetes & endocrinology*, *5*(3), 174–183. https://doi.org/10.1016/S2213-8587(16)30424-7
12. Chalklin, C. G., Ryan Harper, E. G., & Beamish, A. J. (2021). Metabolic and Bariatric Surgery in Adolescents. *Current obesity reports*, *10*(2), 61–69. https://doi.org/10.1007/s13679-021-00423-3

13. Mechanick, J. I., Apovian, C., Brethauer, S., Garvey, W. T., Joffe, A. M., Kim, J., et al. (2019). Clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures - 2019 update: cosponsored by American association of clinical endocrinologists/American college of endocrinology, the obesity society, American society for metabolic & bariatric surgery, obesity medicine association, and American society of anesthesiologists - *executive summary*. *Endocrine practice: official journal of the American College of Endocrinology and the American Association of Clinical Endocrinologists*, *25*(12), 1346–1359. https://doi.org/10.4158/GL-2019-0406
14. Rofey, D. L., Zeller, M. H., Brode, C., Reiter-Purtill, J., Mikhail, C., Washington, G., Baughcum, A. E., Peugh, J., Austin, H., Jenkins, T. M., Courcoulas, A. P., & TeenView Writing Group in cooperation with the Teen-LABS Consortium (2015). A multisite view of psychosocial risks in patients presenting for bariatric surgery. Obesity (Silver Spring, Md.), 23(6), 1218–1225. https://doi.org/10.1002/oby.21065
15. Sysko, R., Zandberg, L. J., Devlin, M. J., Annunziato, R. A., Zitsman, J. L., & Walsh, B. T. (2013). Mental Health Evaluations for Adolescents Prior to Bariatric Surgery: A Review of Existing Practices and a Specific Example of Assessment Procedures. Clinical obesity, 3(3-4), 62–72. https://doi.org/10.1111/cob.12019
16. Ogle, S. B., Dewberry, L. C., Jenkins, T. M., Inge, T. H., Kelsey, M., Bruzoni, M., & Pratt, J. S. A. (2021). Outcomes of Bariatric Surgery in Older Versus Younger Adolescents. *Pediatrics*, *147*(3), e2020024182. https://doi.org/10.1542/peds.2020-024182
17. Inge, T. H., Jenkins, T. M., Zeller, M., Dolan, L., Daniels, S. R., Garcia, V. F., Brandt, M. L., Bean, J., Gamm, K., & Xanthakos, S. A. (2010). Baseline BMI is a strong predictor of nadir BMI after adolescent gastric bypass. *The Journal of pediatrics*, *156*(1), 103–108.e1. https://doi.org/10.1016/j.jpeds.2009.07.028
18. Inge, T. H., Courcoulas, A. P., Jenkins, T. M., Michalsky, M. P., Brandt, M. L., Xanthakos, S. A., Dixon, J. B., Harmon, C. M., Chen, M. K., Xie, C., Evans, M. E., Helmrath, M. A., & Teen–LABS Consortium (2019). Five-Year Outcomes of Gastric Bypass in Adolescents as Compared with Adults. The New England journal of medicine, 380(22), 2136–2145. https://doi.org/10.1056/NEJMoa1813909