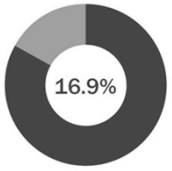
Issues in Pediatric Obesity

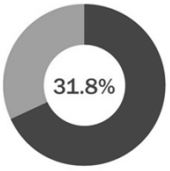
U.S. Childhood Obesity Rates, 2011-2012

More than tripled since 1980[1]
Overall rates have remained the same for the past 10 years[2]



Obese

or 12.7 million
children and adolescents aged 2—19 years[2]



Overweight or Obese

or 23.9 million
children and adolescents aged 2—19 years[2]

1. Fryar CD, Carroll MD and Ogden, CL. National Center for Health Statistics E-Stat, 2012.
2. Ogden CL, et al. JAMA, 311(8):806-814, 2014.

Severe Obesity Rate: U.S. Children and Teens

Ages 2–19 Years

4% ⟶ 6%

1999–2004[1] 2011–2012[2]

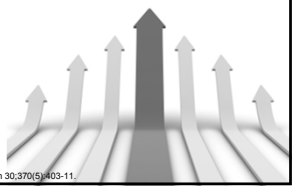
Definitions

CLASS II / Severe Obesity	BMI >120% of the 95th percentile for age and sex *or* BMI ≥35 *whichever is lower*
CLASSIII / Markedly Severe Obesity	BMI > 140% of the 95th percentile for age and sex *or* BMI ≥40 *whichever is lower* [2,3]

Skelton JA, Acad Pediatr 2009; 9: 322-9.
Skinner AC, Skelton JA. JAMA Pediatr 2014; 168: 561-6.
Kelly AS, Barlow SE, Rao G, et al. Circulation 2013; 128: 1689-712.

Lifetime Trajectory

- Obese children are more likely to become obese adults
- Overweight 5-year-olds were four times as likely as healthy-weight children to become obese
- A third of the children who were overweight in kindergarten were obese by eighth grade (n=7,700)



Cunningham SA, Kramer MR, Narayan V. N Engl J Med. 2014 Jan 30;370(5):403-11.

Co-Morbidities of Childhood Obesity

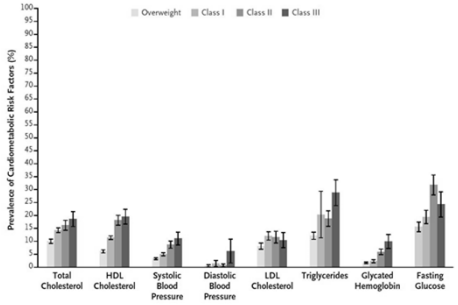
Endocrine	Gastrointestinal	Orthopedic	Neuropsychiatric
•Impaired oral glucose tolerance test (IGT) •Type 2 diabetes •Polycystic ovary syndrome	•Anemia, constipation •Fecal soiling •Gastroesophageal reflux disease (GERD) •Non-alcoholic fatty liver disease (NAFLD)	•Blount's disease •Slipped capital femoral epiphysis (SCFE) •Flat feet	•Binge eating •Compulsive eating •Night eating •Depression •Anxiety •Weight teasing

Cardiovascular:	Pulmonary:	Dermatologic:
•Dyslipidemia •Hypertension	•Asthma •Sleep apnea	•Acanthosis nigricans

Lenders, C, Meyers A, Oh H. A clinical guide to pediatric ambulatory weight management. In: Apovian C, Lenders C, editors. A clinical guide for management of overweight and obese children and adults. Boca Raton (FL): CRC press; 2007 p 197-238.

Greater Severity of Obesity Produces Higher Health Risks

N=8579, 3-19 Years of Age, 1999-2012



Skinner AC, et al. N Engl J Med. 2015 Oct;373(14):1307-17.

CVD Risk Factors in Severely Obese Adolescents

The Teen Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Study

- N=242
- Mean age 17.1 years, median BMI = 50.5 kg/m^2
- 51% had 4 or more major comorbid conditions[1]

Preoperative Prevalence of CVD Risk Factors	
Elevated high-sensitivity C-reactive protein levels	75%
Fasting hyperinsulinemia	74%
Dyslipidemia	50%
Elevated blood pressure	49%
Impaired fasting glucose levels	26%
Diabetes mellitus	14%

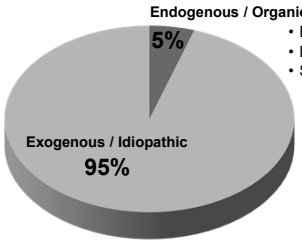
Every 5-unit increase in BMI increased risk levels by:
- 15% impaired fasting glucose
- 10% elevated blood pressure
- 6% elevated high-sensitivity C-reactive protein levels (P < .01)

Teen-LABS Consortium Members:
- Cincinnati Children's Hospital Medical Center
- Texas Children's Hospital
- Children's of Alabama
- University of Pittsburgh Medical Center
- Nationwide Children's Hospital, *and a*
- Data coordinating center

Funded by NIH in 2006

1.Inge TH, et al. JAMA Pediatr. 2014 Jan;168(1):47-53.
2.Michalsky MP, et al. JAMA Pediatr. 2015 May;169(5):438-44.

Causes of Childhood Obesity



- Endocrine disorders
- Developmental delays
- Syndromes

- Environmental: psychosocial, lifestyle
- Hereditary

From: Lenders, C, Meyers A, Oh H. A clinical guide to pediatric ambulatory weight management. In: Apovian C, Lenders C, editors. A clinical guide for management of overweight and obese children and adults. Boca Raton (FL): CRC press; 2007 p 197-238.

Lower Academic Achievement

- Children who are overweight or obese are more likely to have lower academic achievement than non-overweight or obese children[1,2,3]
- Children who are persistently overweight or obese are likely to score poorer academically in math than their healthy weight peers[4]
- Adolescents with metabolic syndrome (composite of obesity components) have significantly lower overall intelligence scores[5]

1. Sabia JJ. Southern Economic Journal. 2007;73(4):871-900.
2. Jaswal R, Susma J. Int J Edu Sci.2012;4(3):275-278.
3. Datar A, Sturm R. Int J Obes (Lond). 2006 Sep;30(9):1449-60.
4. Gable S, Krull JL, Chang Y. Child Development, doi:10.1111/j.1467-8624.2012.01803.x, 2012.
5. Yau PL, et al. Pediatrics. 2012 Oct;130(4):e856-64.

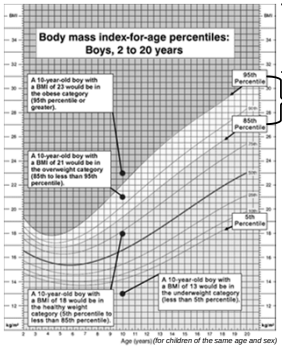
Costs of Childhood Obesity

- $19,000 estimated incremental lifetime medical cost per 10-year-old obese child vs. healthy-weight 10-year-old child[1,2]
- $14.1 billion annually prescription drug, emergency room and outpatient visits associated with childhood overweight and obesity
- A child who is obese has higher expenditures:
  - $194 for outpatient visits
  - $114 for prescription drugs
  - $25 for emergency room[2]
- Average total annual health cost under private insurance:
  - $3,743 child treated for obesity
  - $1,108.50 all other children
- Hospitalizations of children and youths with a diagnosis of obesity:
  - Nearly doubled between 1999 and 2005
  - Total costs increased $125.9 million (2001) to $237.6 million (2005)[3]

1. Finkelstein EA, Graham WC, Malhotra R. Pediatrics. 2014 May;133(5):854-62.
2. Trasande L. and Chatterjee S. Obesity (Silver Spring). 2009 Sep;17(9):1749-54.
3. Trasande L, Liu Y, Fryer G, Weitzman M. Health Aff (Millwood). 2009 Jul-Aug;28(4):w751-60.

Measuring Pediatric Obesity

CDC Growth Charts: 2 to 20 Years



Severe Obesity:
BMI >120% of 95th percentile

Obesity:
BMI ≥95th percentile

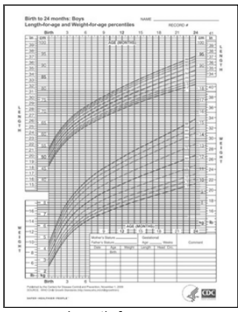
Overweight:
BMI ≥85th and <95th percentile

Plot BMI for children and adolescents (ages 2 to 20) to determine percentile

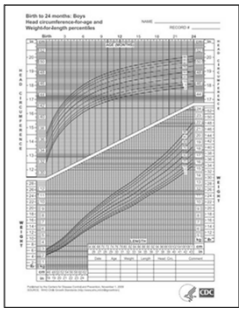
www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html

WHO Growth Charts: 0 to 2 Years

CDC Recommendation



Length-for-age
Weight-for-age



Head circumference-for-age
Weight-for-length

www.cdc.gov/growthcharts/who_charts.htm

Treatment Approaches

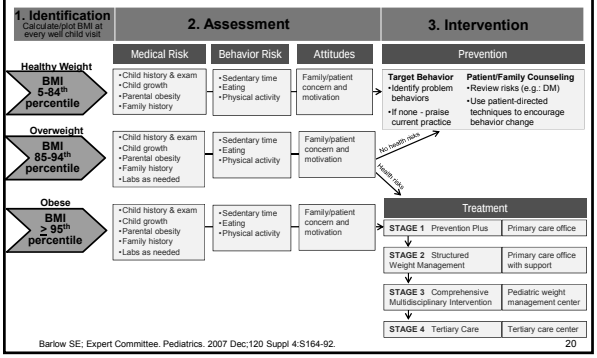
Stages of Treatment for Pediatric Obesity

Recommendations of American Academy of Pediatrics

Prevention Plus	Structured Weight Management	Comprehensive Multidisciplinary Intervention	Tertiary Care Intervention
Ambulatory care clinic: • Addresses medical evaluation and initial lifestyle counseling by primary care provider • Typically follow-up visits tailored to family needs	Ambulatory care clinic: • Addresses evaluation and lifestyle counseling by primary care • Providers and additional support from other health care professionals (e.g. registered dietitians, mental health providers) • Typically involves monthly follow-up	Weight management clinic: • Includes care by a multidisciplinary team consisting of specialists in medicine, dietetics, mental health, and exercise • Typically involves weekly or bi-weekly follow-up	Tertiary care center: • Intensive interventions for select patients by a specialty clinic multidisciplinary team • Tailored to the patient and may involve pharmacological and surgical options

Ireland K, Newby P, Keefe E, Meyers A, Lim-Miller A, Lenders C. In: Encyclopedia of Human Biology. Dulbecco and Abelson, eds. Chapter 626: Prevention and Treatment of Pediatric Obesity, 3rd edition. Elsevier; 2014 (In press)

Steps to Prevention and Treatment of Childhood Obesity: ≥ 2 Years Old



Barlow SE; Expert Committee. Pediatrics. 2007 Dec;120 Suppl 4:S164-92.

Goal of Weight Management Treatment

Improvement of long-term physical health through lifestyle changes

- Focus on motivation and readiness
- Refer to mental health clinician or dietitian
- Use elements of client-centered motivational interviewing as time allows
- Interventions should be family-based

Lenders C, Oliver L, Lakhani S, et al. Pediatric obesity medicine. In: Augustyn M, Zuckerman B, Caronna E, editors. Zuckerman and Parker's Handbook of Developmental and Behavioral Pediatrics. 3rd edition. Philadelphia: Lippincott Williams & Wilkins; 2011. p. 288-94.

Pediatric Weight Goals

Age	BMI Category *Percentile*	Weight Goals
2-5 years	85-94th with health risks	Weight maintenance *-or-* slow gain
	≥ 95th	Maintenance *-or-* weight loss of up to 1 lb/month if BMI >21 kg/m^2
6-11 years	85-94th with health risks	Maintenance
	95-99th	Gradual weight loss (1 lb/month)
	> 99th	Weight loss (maximum 2 lb/week)
12-18 years	85-94th with health risks	Maintenance or gradual weight loss
	95-99th	Weight loss (maximum 2 lb/week)
	> 99th	Weight loss (maximum 2 lb/week)

Adapted from: Barlow SE; Expert Committee. Pediatrics. 2007 Dec;120 Suppl 4:S164-92.

Case Study

Case: 16 y.o. girl

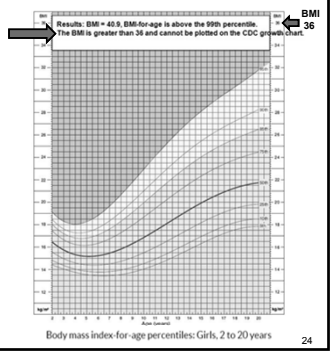
CC:
Weight gain of ~50 lbs over the last two years

FH: DM and CAD
Both parents obese:
- Father BMI 33 kg/m^2
- Mother BMI 31.5 kg/m^2

Anthropometric Measures
- Weight 242 lbs
- Height 5' 5"
- BMI 40.3 kg/m^2
- WC 37.5 in

Medications
- None

BMI 40.3 places BMI-for-age **above the 99th percentile**



Body mass index-for-age percentiles: Girls, 2 to 20 years

Case: 16 y.o. girl

Lab Data
- BP 140/90
- HbA1c 6.2%
- FBG 150-175 mg/dL
- TC 205 mg/dL
- TG 160 mg/dL
- LDL-C 130 mg/dL
- HDL-C 43 mg/dL
- Insulin 55
- Glucose 95
- Glucose Tolerance:
  - Glucose 2 hour 150
  - Insulin 210

What is an appropriate treatment plan for this obese adolescent girl?
- Diet?
- Exercise?
- Behavioral Intervention?
- Medications?
- Bariatric Surgery?

How do you begin the conversation?

Healthy Behavioral Changes: DIET and PHYSICAL ACTIVITY

Dietary Recommendations

- Data on best dietary approaches are still emerging
- Diet composition does not seem to impact weight measures– it is a net decrease in kilocalorie intake that has impacts
- Effect of diet composition on weight measures and metabolic markers is significant in short-term but not long-term studies of obese adolescents

Lenders CM, et al. Pediatr Clin North Am. 2011 Dec;58(6):1425-38, x-xi.

Targeted Dietary Behaviors

- Limit sugar-sweetened beverages with goal of eliminating entirely
- Increase vegetables and fruits
  - Non-starchy vegetables as much as possible
  - Fruits with limitations (up to 3-4 servings/day)
- Eat breakfast everyday
- Limit meals eaten out at restaurants
- Increase family meals at home- parents and children sit at table and eat together
- Limit portion sizes

Adapted from: Barlow SE; Expert Committee. Pediatrics. 2007 Dec;120 Suppl 4:S164-92.

Goal Setting: S.M.A.R.T. Goals

Specific
Measureable
Attainable
Relevant
Timely

Example:
After doing a dietary recall, you discover that your 8 year old patient is drinking up to 5 cups of juice per day.

Normal goal:
"Bobby will stop drinking juice."

S.M.A.R.T. goal:
"Starting today, Bobby will drink only 2 cups of juice per day."

Suggestions for Changes

- Do not keep sugar-sweetened beverages in the home
- Make ½ plate vegetables and fruits at lunch and dinner
- Strategize to ensure child doesn't skip meals– pack lunch, use "grab-and-go" breakfast items
- Use "fist" method for determining portion sizes

Feeding Behavior Recommendations

- Offer meals and snacks at set times daily, consistent on day-to-day basis when possible
- Do not allow "grazing" between meals
  - Instead offer meals and snacks consistently every 2-4 hours
  - If hunger is expressed between scheduled feeding times, offer water
- Offer family meals as often as possible with parents and children together at the table and engaging in pleasant mealtime conversation. Parents should model healthy eating behaviors.

Feeding Behavior Recommendations

- Do not short order cook or cater to individual likes/dislikes of each family member; parent decides what will be offered at each meal
  - Children need repeated exposures to new foods to accept them
- Children should not be forced to eat certain foods or certain amounts of foods
  - Can result in child having food aversions in the future and/or keep child from being able to regulate his own hunger
- Children should not be restricted to only set amount of certain foods
  - Healthy children are able to regulate their own hunger
- Food should never be used as a reward, bribe, or punishment

Physical Activity Recommendations

- Increase physical activity with a goal of at least one hour of physical activity daily
- Suggestions:
  - Enroll in physical activity programs if possible
  - Set up active play group with child's peer group
  - Use local parks and playgrounds
  - Join a local community/recreation center
  - Encourage activity in the home like dancing, exercise videos and calisthenics
  - Take homework/study breaks to move
  - Walk to get places as much as possible (school, stores, etc.)

Other Lifestyle Recommendations

- Limit "screen time" to no longer than 2 hours per day
- Remove televisions from child's sleep area
- Achieve regular uninterrupted nightly sleep of ≥ 8-10 hours per night
  - Set bedtime that is followed nightly
  - Set bedtime routine to prepare for sleep each night

Other Treatment Options: MEDICATIONS

Which anti-obesity medications are FDA-approved for use in pediatrics?

- Phentermine/topiramate
- Orlistat
- Naltrexone/bupropion
- Metformin

Lenders CM. Curr Opin Endocrinol Diabetes Obes. 2015 Oct;22(5):331-9.

Weight Loss Medications in Pediatrics

- Orlistat: only approved weight loss medication
- FDA: short-term and long-term medications approved for use in adults can be prescribed in adolescents who are at least 16 years old
- Recent adult guidelines discourage 'off-label' use of pharmacological agents that are prescribed in conditions associated with obesity (e.g. T2DM) until further studies are performed in obese individuals without these conditions (e.g. metformin)
- Need for weight loss medication guidelines in pediatrics

Lenders CM. Curr Opin Endocrinol Diabetes Obes. 2015 Oct;22(5):331-9.

Pharmacotherapy in Childhood Obesity

	Orlistat (n=357)	Sibutramine (n=454)	Metformin (n=54)
Weight (kg)	-2.5	-7.7	-3.15
BMI (kg/m2)	-0.86	-2.8	1.38
BMI z-score	NA	-0.20	-0.18
Glucose (mg/dL)	NA	NA	-3.9
Insulin (mcU/mL)	NA	0 to -7	-8.2
Lipids	NA	Variable	Variable

Data summarized from: Freemark M. Diabetes Care. 2007 Feb;30(2):395-402.

- Orlistat 120 mg is currently the only agent approved by the FDA (in 2003) for management of obesity in adolescents
  FDA CDER Division of Metabolic and Endocrine Drug Products (HFD - 510). Clinical review for NDA 20-766/S018. www.fda.gov/cder/foi/esum/2003/20766se5-018_Orlistat_BPCA_CLINICAL_ltr.pdf (accessed 2007 Jan 8).
- Sibutramine was withdrawn from the US market on October 8, 2010 because of an increased risk of myocardial infarction (MI) and stroke
  Abbott Laboratories agrees to withdraw its obesity drug Meridia. FDA, U.S. Food and Drug Administration. http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm228812.htm. Accessed: October 8, 2010.

Commonly Used Medications in Obese Children and Adolescents (<16 Years Old)

Table 2. Commonly used medication in obese children and adolescents (<16 years old)

Pharmacological agent	Dose	Mode of action	Indication (FDA)	Contraindication	Possible complications
Orlistat (Xenical 120 mg/ **Orlistat 120 mg** Alli 60 mg/caps, OTC) **Alli 60 mg**	120 mg 3 times a day	Inhibits pancreatic lipase resulting in fat malabsorption	>12 years old	Hypertension	GI disturbance
	Before meal		BMI >2 kg/m^2 above the 95th percentile	Dyslipidemia	Oily spotting
Plus	(lower dose for Alli)			Failure to decrease dietary fat	Fat-soluble vitamin malabsorption
MVI with A (5000IU), D (400IU), E (300IU) and K (25 μg) >2 h apart from orlistat				Frequent meals at restaurant	
				Noncompliant with daily intake of multivitamin	
Metformin 500 mg Metformin hydrochloride (Glucophage 500 mg/ day)	Start with 500 mg/day, increase by 500 mg/week (max 2000 mg/day)	Activation of AMP-activated protein kinase (AMPK) results in better insulin sensitivity	>10 years old with T2DM	Stop for surgical and radiological procedure	Nausea, diarrhoea
				Currently considered off-label for paediatric weight loss because not enough evidence	Lactic acidosis in renal or liver disease or hypoxic state
					Low serum B12

The list of brand names available in the market and possible complications is not exhaustive. Please refer to the package insert and the FDA web site for more details.
Adjustment of dosage may be required in presence of select medical and surgical conditions. Please refer to the package insert and the FDA web site for more details.
Weight loss is modest 2–3% from baseline. The use of Glucophage XR is approved for use only in adolescents at least 16 years of age. FDA, US Food and Drug Administration; GI, gastrointestinal.

Lenders CM. Curr Opin Endocrinol Diabetes Obes. 2015 Oct;22(5):331-9.

Other Treatment Options: BARIATRIC SURGERY

Adolescent Surgery Prevalence

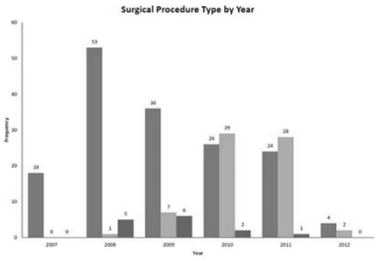
- 1996-2000 stable
- 2000-2003 tripled to estimated 771 procedures per year
- Only 0.7% of total overall U.S. procedures per year (2007)

> Best estimates in the U.S. suggest that approximately 1,500 to 2,000 surgical weight-loss procedures are carried out in the adolescent age group each year[2]
>
> - Marc P. Michalsky, MD
> June 18, 2015

1.Tsai WS, Inge TH, Burd RS. Arch Pediatr Adolesc Med 2007; 161:217.
2.http://health.usnews.com/health-news/blogs/eat-run/2015/06/18/weight-loss-surgery-for-kids-a-good-idea- despite-many-misconceptions

Type of Bariatric Surgery Used on Adolescents

Majority (90%) are RYGB[1]



Surgical Procedure Type by Year[2]
February 28, 2007 to December 30, 2011
N=242

- 66% Laparoscopic Roux-en-Y gastric bypass
- 28% Vertical sleeve gastrectomy
- 6% Adjustable gastric banding

Tsai WS, Inge TH, Burd RS.Arch Pediatr Adolesc Med 2007; 161:217.
Inge TH, et al. JAMA Pediatr. 2014 Jan;168(1):47-53.

Current Clinical Practice Guidelines for Weight Loss Surgery in Adolescents, U.S. and Canada

SEVEN GUIDELINES!

Title	Author(s)	Developed by	Year
Appropriateness criteria for bariatric surgery: Beyond the NIH guidelines	Yermilov et al.	Expert panel of surgeons, including an internal medicine panelist	2009
ASMBS pediatric committee best practice guidelines	Michalsky et al.	ASMBS surgical expert panel	2012
Best practice updates for pediatric/adolescent weight loss surgery	Pratt et al.	Betsy Lehman Center of Patient Safety & Medical Error Reduction Expert Panel; Multispecialty expert panel including surgeons	2009
Expert committee recommendations regarding the prevention, assessment and treatment of child and adolescent overweight and obesity: Summary report	Barlow	AMA, Health Resources & Services, and CDC convened expert committee—multispecialty expert panel including a surgeon	2007
Prevention and management of obesity (mature adolescents and adults)	ICSI	ICSI multispecialty expert panel, including a surgeon	2011
Prevention and treatment of pediatric obesity: An Endocrine Society clinical practice guideline based on expert opinion	August et al.	SAGES surgical expert panel	2008
SAGES guideline for clinical application of laparoscopic bariatric surgery	SAGES	SAGES surgical expert panel	2008

AMA, American Medical Association; ASMBS, American Society for Metabolic and Bariatric Surgery; CDC, Centers for Disease Control and Prevention; ICSI, Institute for Clinical Systems Improvement; NIH, National Institutes of Health; SAGES, Society of American Gastrointestinal & Endoscopic Surgeons.

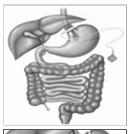
Brei MN, Mudd S. J Pediatr Health Care. 2014 Jul-Aug;28(4):288-94.

Bariatric Surgery in Morbidly Obese Adolescents: Systematic Review and Meta-analysis

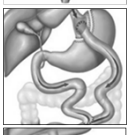
- PubMed, Embase, and Cochrane reviewed
- N=37 studies in patients ≤18 years old
- Results: substantial weight loss and improvement of comorbidity with an acceptable complication rate
- Conclusion: surgical intervention is applicable in appropriately selected morbidly obese adolescents

RESULTS
Mean body mass index (BMI) loss:

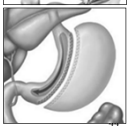
11.6 kg/m^2 after LAGB (95 % CI 9.8–13.4)



16.6 kg/m^2 after RYGB (95 % CI 13.4–19.8)



14.1 kg/m^2 after LSG (95 % CI 10.8–17.5)



Paulus GF, et al. Obes Surg. 2015 May;25(5):860-78.

Case: 16 y.o. girl: TREATMENT PLAN

CC:
Weight gain of ~50 lbs over [illegible]

FH: D[illegible]
Both [illegible]
- Fath[illegible]
- Moth[illegible]

Anthro Measu
- Wei[illegible]
- Heig[illegible]
- BMI
- WC

Medicat
- None

Lab Data
[illegible] mg/dL
[illegible]
- Glucose 2 hour 150
- Insulin 210

- Dietary changes
- Structured exercise
- Join behavioral group
- Medications
  - *Metformin: start 500 mg/day*
  - *Orlistat: 120 mg 3x/day*
- Bariatric Surgery
  - *Exhaust options above before considering*

Summary: Pediatric Obesity

- Overall rates of obesity have stabilized while severe obesity is increasing in childhood and adolescents
- The greater the severity of obesity, the greater the health risks
- Recommendation: calculate and plot BMI at every well-child visit
- Ask permission before delving into topic of weight
- Use appropriate terminology and Stages of Change
- Orlistat, Alli plus MVI, and metformin are the most commonly used medications
- Surgery is recommended for select patients