

Surgical Treatment of Pediatric Obesity

Ying Weatherall, MD

December 4, 2024

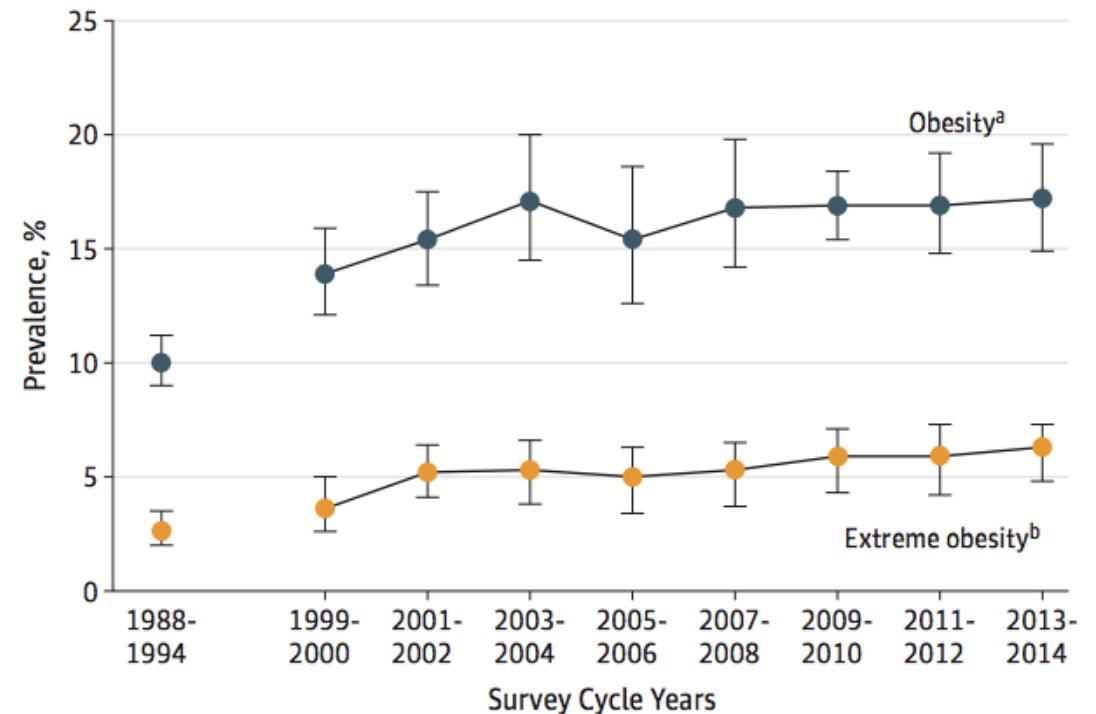
Objectives

- Pediatric obesity prevalence
- Bariatric surgery in the treatment of pediatric obesity
- Le Bonheur Adolescent Bariatric Surgery Program
- Our outcomes
- Future endeavors

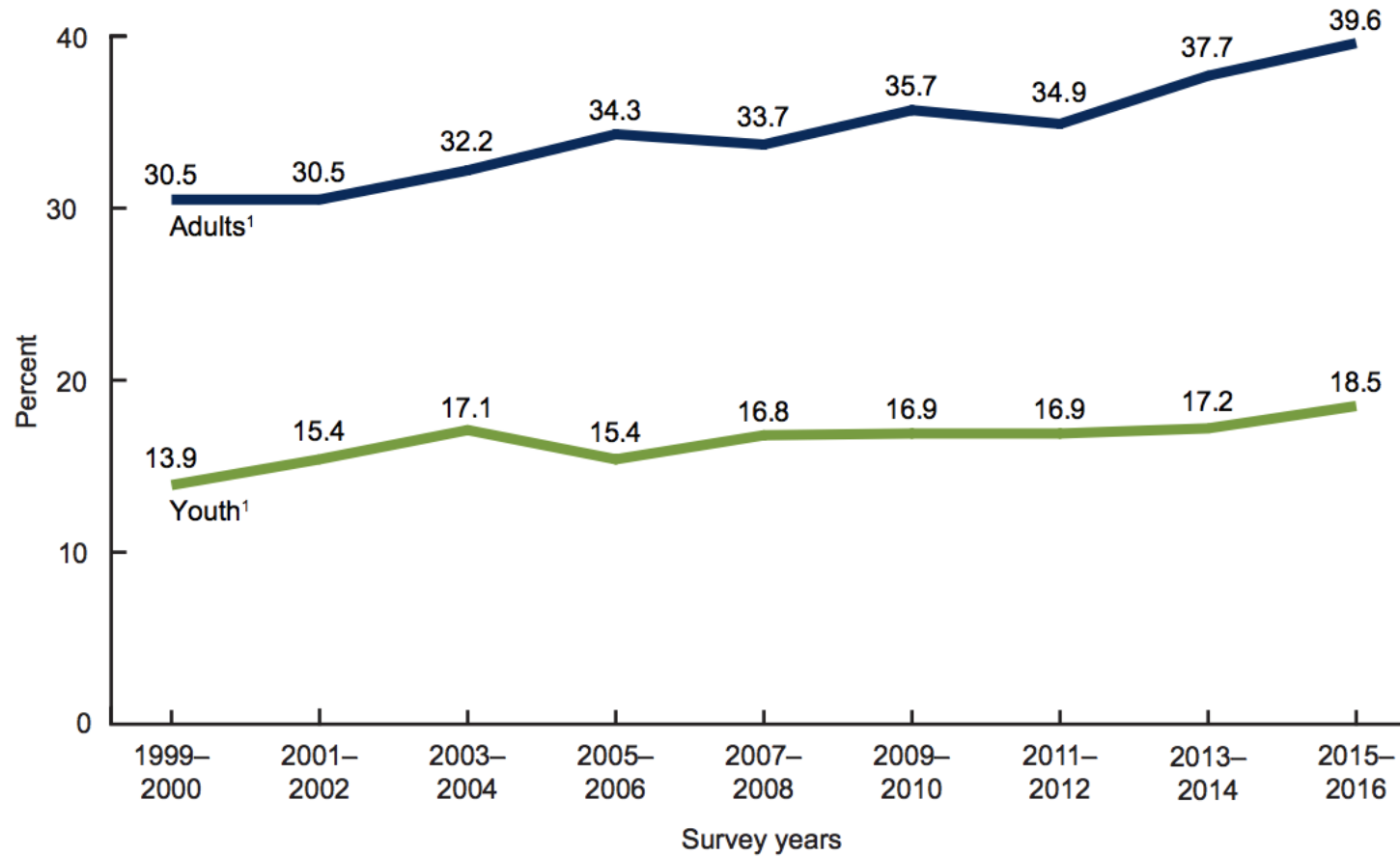
Obesity prevalence

- In the United States, the percentage of children and adolescents affected by obesity has been increasing
- Nearly 1 in 5 school age children and young people (6—19 years) in the U.S. has obesity

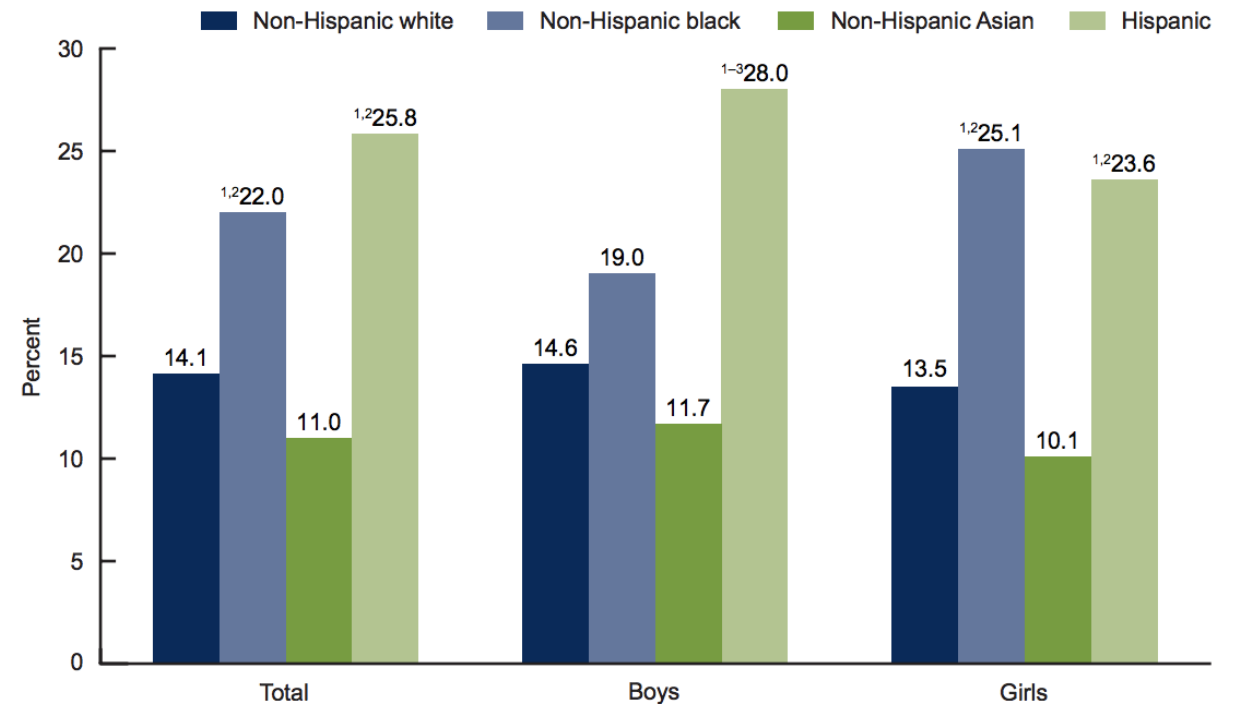
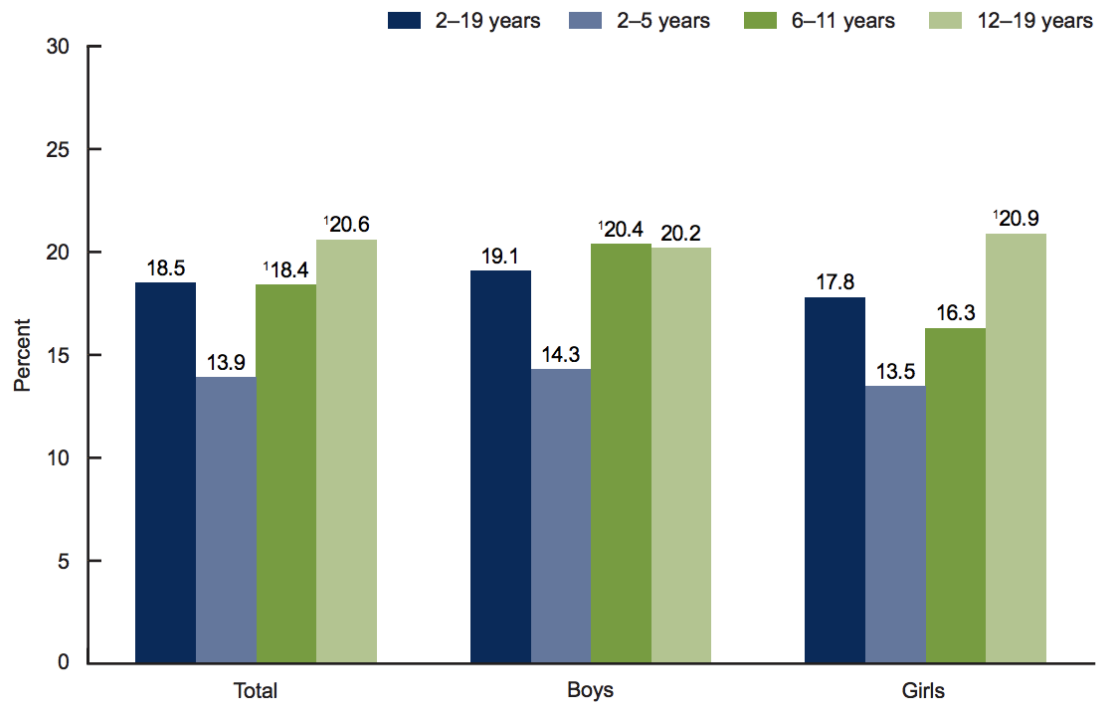
Figure 1. Prevalence of Obesity and Extreme Obesity in US Children and Adolescents Aged 2 to 19 Years From 1988-1994 Through 2013-2014



Obesity prevalence



Obesity prevalence and disparities



National Health Statistics Reports

Number 158 ■ June 14, 2021

National Health and Nutrition Examination Survey 2017–March 2020 Prepandemic Data Files—Development of Files and Prevalence Estimates for Selected Health Outcomes

Bryan Stierman, M.D., M.P.H.; Joseph Afful, M.S.; Margaret D. Carroll, M.S.P.H.; Te-Ching Chen, Ph.D.; Orlando Davy, M.P.H.; Steven Fink, M.A.; Cheryl D. Fryar, M.S.P.H.; Qiuping Gu, Ph.D.; Craig M. Hales, M.D., M.P.H.; Jeffery P. Hughes, M.P.H.; Yechiam Ostchega, Ph.D., R.N.; Renee J. Storandt, M.T.(A.S.C.P.), M.S.P.H.; and Lara J. Akinbami, M.D.

Obesity prevalence

Table 2. Prevalence, confidence intervals, standard errors, and sample sizes of selected health outcomes using 2017–2018 data files compared with 2017–March 2020 prepandemic data files: United States, 2017–2018 and 2017–March 2020

Health outcome	2017–2018			2017–March 2020 prepandemic		
	Sample size	Prevalence percentage (95% confidence interval)	Standard error	Sample size	Prevalence percentage (95% confidence interval)	Standard error
Childhood obesity (2–19 years) ¹	2,824	19.3 (17.2–21.5)	1.0	4,749	19.7 (17.9–21.6)	0.9
Childhood untreated or restored dental caries (2–19 years) ²	2,835	45.7 (41.1–50.3)	2.1	4,765	46.0 (42.9–49.1)	1.5
Adult obesity (20 years and over) ³	5,120	42.4 (38.8–46.2)	1.8	8,295	41.9 (39.4–44.3)	1.2
Adult severe obesity (20 years and over) ⁴	5,120	9.2 (7.5–11.2)	0.9	8,295	9.2 (8.0–10.6)	0.6
Adult hypertension (18 years and over) ⁵	4,761	44.7 (41.3–48.3)	1.6	7,948	45.1 (42.5–47.6)	1.2
Adult diabetes (20 years and over) ⁶	2,274	14.5 (12.3–16.9)	1.0	3,757	14.8 (13.1–16.7)	0.8
Older adult complete tooth loss (65 years and over) ⁷	1,328	13.1 (9.7–17.2)	1.7	2,075	13.8 (10.6–17.6)	1.7

Obesity prevalence and disparities

Table 3. Prevalence of children and adolescents aged 2–19 years with obesity, by demographic characteristics: United States, 2017–March 2020

Characteristic	Both sexes		Boys		Girls	
	Sample size	Prevalence percentage (95% confidence interval)	Sample size	Prevalence percentage (95% confidence interval)	Sample size	Prevalence percentage (95% confidence interval)
Total	4,749	19.7 (17.9–21.6)	2,410	20.9 (18.9–22.9)	2,339	18.5 (16.3–21.0)
Age group (years):						
2–5	1,141	¹ 12.7 (10.8–14.8)	566	13.6 (10.8–16.8)	575	¹ 11.8 (9.3–14.8)
6–11	1,765	20.7 (17.9–23.7)	894	² 22.9 (19.5–26.5)	871	³ 18.5 (15.2–22.1)
12–19	1,843	22.2 (19.7–24.8)	950	² 22.6 (19.7–25.7)	893	21.7 (18.1–25.7)
Race and Hispanic origin:						
Non-Hispanic white	1,471	^{4–6} 16.6 (13.7–19.8)	743	⁶ 17.6 (14.8–20.7)	728	^{4–6} 15.4 (11.2–20.5)
Non-Hispanic black	1,270	⁵ 24.8 (21.6–28.1)	662	^{5,6} 18.8 (15.9–22.1)	608	^{3,5,6} 30.8 (26.0–35.8)
Non-Hispanic Asian	420	⁶ 9.0 (6.5–12.2)	208	⁶ 13.1 (8.8–18.4)	212	^{*,3,6} 5.2 (2.3–9.9)
Hispanic	1,143	26.2 (22.4–30.2)	562	29.3 (23.1–36.0)	581	23.0 (19.6–26.6)
Family income relative to federal poverty level (FPL):						
130% or less FPL	1,748	⁷ 25.8 (22.8–29.1)	864	⁷ 26.4 (22.4–30.8)	884	⁷ 25.2 (22.3–28.3)
More than 130% through 350% FPL	1,514	21.2 (18.5–24.0)	789	20.7 (17.6–24.1)	725	21.7 (18.3–25.3)
More than 350% FPL	956	11.5 (8.9–14.5)	471	15.1 (11.1–19.8)	485	³ 8.2 (5.0–12.5)

Annals of Surgery

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Disparity Between United States Adolescent Class II and III Obesity Trends and Bariatric Surgery Utilization, 2015-2018

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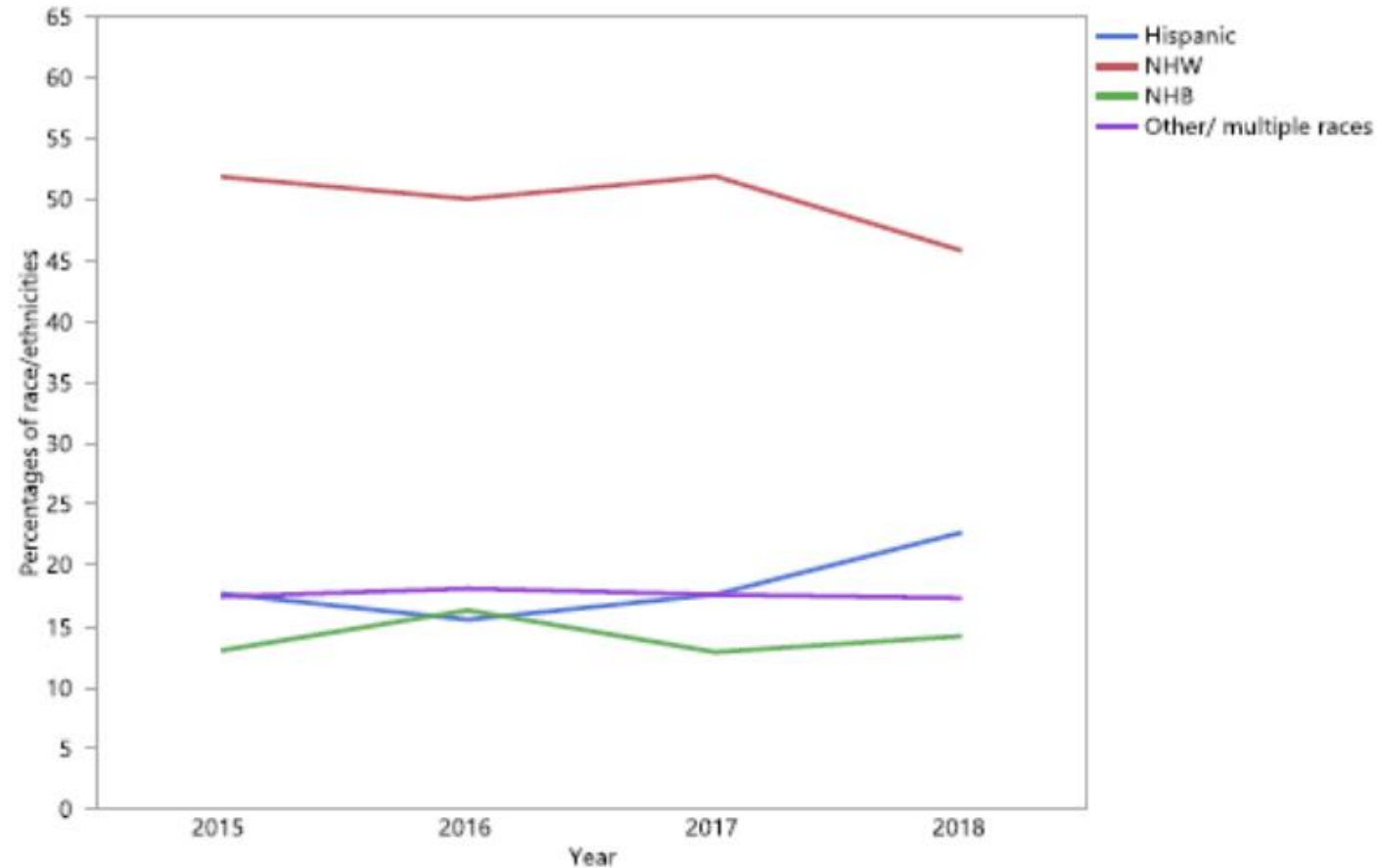
Nestor de la Cruz- Muñoz, MD^d

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Utilization of weight loss surgery

- Studied MBS utilization rates by analyzing 2015—2018 NHANES and MBSAQIP datasets
- Overall utilization rates for youth was 1.81 per 1,000 and 5.56 per 1,000 for adults
 - NHANES data showed 4.8 million US youths between age 2 and 19 with class II/III obesity
 - MBSAQIP data during the same time period included a total 1,862 surgeries in this age group
- Perioperative complication rates were similar between youths and adults


Utilization of weight loss surgery



ORIGINAL CONTRIBUTIONS



Thirty-Day Outcomes of Bariatric Surgery in Adolescents: a First Look at the MBSAQIP Database

Maher El Charr^{1,2} • Keith King^{1,3}  • Amin Al-Mardini¹ • Alvaro Galvez^{1,3} • Leonardo Claros^{1,2} • Jill Stoltzfus^{1,2}

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Disparities

- Males had higher preoperative BMI and higher rates of OSA and dyslipidemia
- Blacks more commonly presented with BMI over 50 kg/m² (42.7% versus 27.2% in Whites)
- Blacks had higher preoperative BMI:
 - Than whites (52.4% vs 47.3%)
 - Than Hispanics (52.4% vs 48.7%)
- Blacks had higher rates of preoperative hypertension, OSA, and asthma

Original Investigation

Perioperative Outcomes of Adolescents Undergoing Bariatric Surgery The Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Study

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Marc P. Michalsky, MD; Carroll M. Harmon, MD, PhD; Anita Courcoulas, MD; Mary Horlick, MD;
Stavra A. Xanthakos, MD, MS; Larry Dolan, MD; Mark Mitsnefes, MD, MS; Sean J. Barnett, MD; Ralph Buncher, ScD;
for the Teen-LABS Consortium

Table 1. Demographic, Anthropometric, and Procedural Characteristics for the 242 Participants

Characteristic	No. (%)
Age at operation, mean (SD), y	17.1 (1.56)
Age group, y	
13-15	65 (26.9)
16-17	91 (37.6)
18-19	86 (35.5)
BMI, median (IQR) [range]	50.5 (45.2-58.3) [34.0-87.7]
BMI group	
<40	6 (2.5)
40-49	109 (45.0)
50-59	77 (31.8)
≥60	50 (20.7)
Female	183 (75.6)
Race/ethnicity	
White	174 (71.9)
Black	54 (22.3)
Asian	1 (0.4)
American Indian or Alaskan Native	1 (0.4)
>1 race/ethnicity	12 (5.0)
Hispanic	17 (7.0)
Waist circumference, median (IQR) [range], cm	145.9 (136.3-157.8) [112.8-194.0]
Sagittal abdominal diameter, mean (SD), cm	31.7 (4.01)
Surgical procedure	
RYGB	161 (66.5)
AGB	14 (5.8)
VSG	67 (27.7)

Abbreviations: AGB, adjustable gastric band; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); IQR, interquartile range; RYGB, Roux-en-Y gastric bypass; VSG, vertical sleeve gastrectomy.

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Weight Loss and Health Status 3 Years after Bariatric Surgery
in Adolescents

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Mike K. Chen, M.D., Stavra A. Xanthakos, M.D., Mary Horlick, M.D., and C. Ralph Buncher, Sc.D.,
for the Teen-LABS Consortium*

TEEN-LABS: 3 year follow up

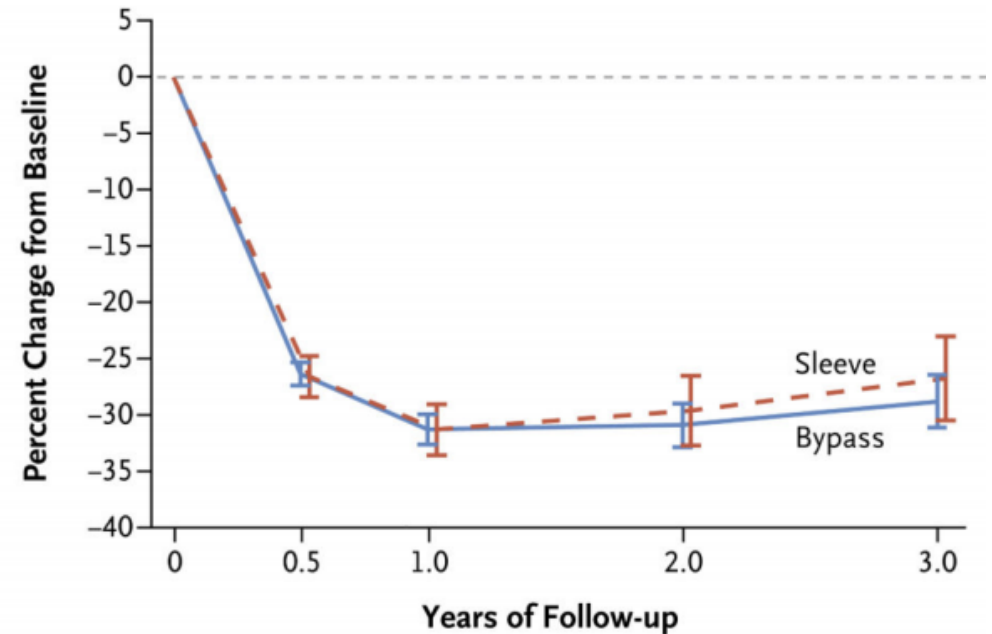
- 228 adolescents
 - 161 RYGB, 67 SG
 - **Gastric banding patients excluded**
- Follow-up at 6 months, 1 year, 2 years, and 3 years after surgery
- 88% all postoperative visits completed
 - 89% at 6 months
 - 90% at 1 year
 - 89% at 2 years
 - 85% at 3 years
 - 89% of postoperative visits were at clinical center; 8% at participants' home; 3% self-reported assessments conducted via phone

	RYGB	SG
Absolute change (kg)	-42	-38
Percent change	-28	-26
Absolute change (BMI)	-15	-13
Percent change	-28	-26

Comorbidities

- 95% remission of type II diabetes
 - 76% remission of pre-diabetes
- 86% remission of kidney disease
- 74% remission of hypertension
- 66% remission of dyslipidemia
- Improvement in quality of life
- Low iron levels in 57%
- Low B12 levels in 8%

A Weight Change from Baseline



The NEW ENGLAND JOURNAL of MEDICINE

CORRESPONDENCE

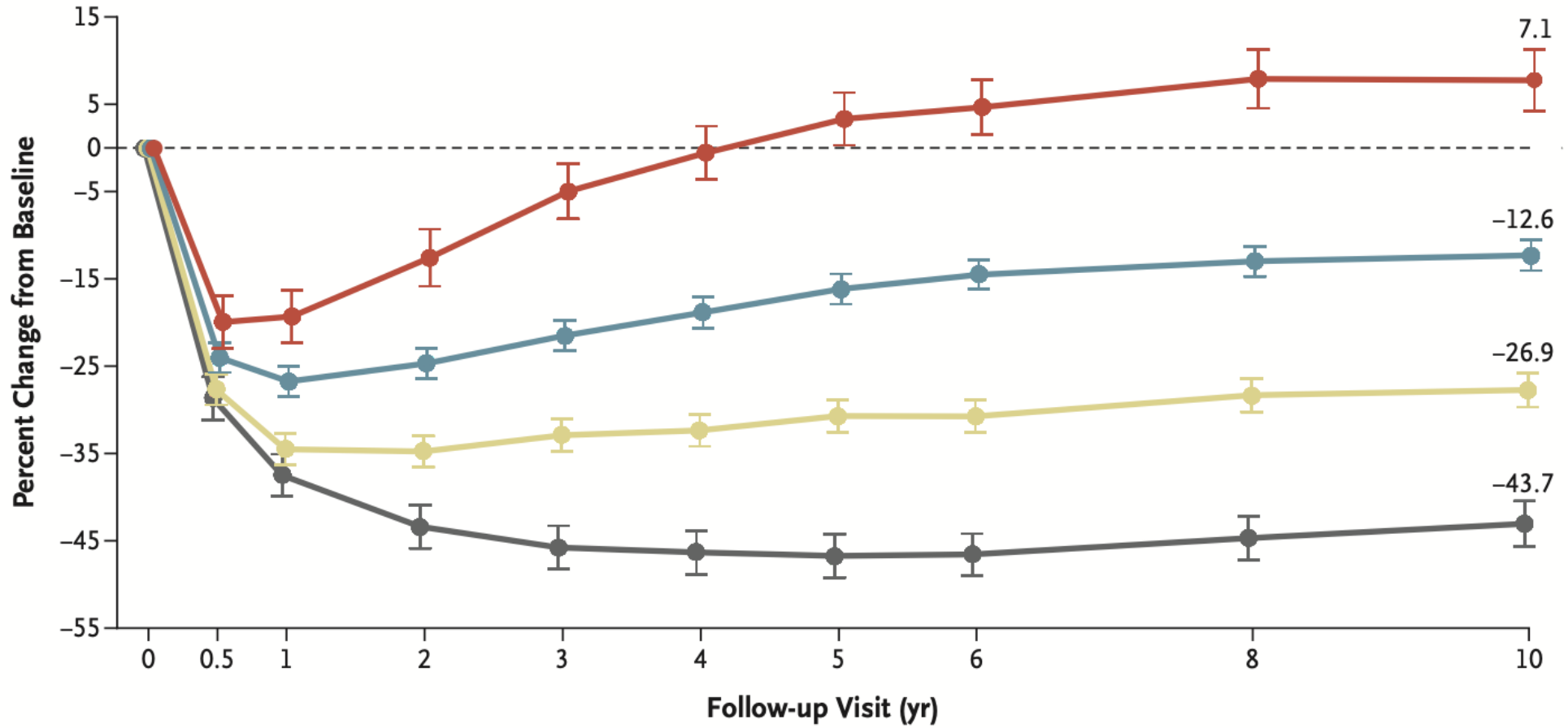


Ten-Year Outcomes after Bariatric Surgery in Adolescents

TEEN-LABS: 10 year follow up

- 83% of the 10-year postop visits were completed
- BMI change in bypass patients -20.6%
- BMI change in sleeve patients -19.2%
- Identified four distinct trajectories of change in BMI over time
- Remission of coexisting conditions:
 - 55% for type 2 diabetes
 - 57% for hypertension
 - 54% for dyslipidemia

B Trajectories of Changes in BMI





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SURGERY FOR OBESITY
AND RELATED DISEASES

Surgery for Obesity and Related Diseases 14 (2018) 882–901

Review article

ASMBS pediatric metabolic and bariatric surgery guidelines, 2018

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Meg H. Zeller, Ph.D.^l, Jeffrey Zitsman, M.D., F.A.C.S., F.A.A.P.^m

Pediatric bariatric surgery guidelines

- ASMBS Pediatric Committee updated guidelines published in 2012
- Treatment of obesity required life-long multidisciplinary approach with combinations of lifestyle changes, nutritional, medications, and MBS
- MBS should not be withheld from adolescents with severe co-morbidities, as early intervention can reduce the risk of persistent obesity and end organ damage from long-standing comorbidities
- **Metabolic and bariatric surgery is a proven, effective treatment for severe obesity in adolescents and should be considered standard of care. Pediatricians and PCP should recognize that children with severe obesity require tertiary care and refer early to an MBS center with advanced treatments and support.**

Indications for MBS

- Cardiovascular disease
- Type 2 diabetes
- Obstructive sleep apnea
- Non-alcoholic fatty liver disease
- Idiopathic intracranial hypertension
- Slipped capital femoral epiphysis, Blount's disease
- Gastroesophageal reflux disease
- Quality of life

Special considerations

- Mental health
- High-risk social context
- Child maltreatment
- Substance use behaviors
- Disordered eating

Table 1
Indications and contraindications for adolescent metabolic and bariatric surgery (MBS)

Indications for adolescent MBS include

- BMI ≥ 35 kg/m² or 120% of the 95th percentile with clinically significant co-morbid conditions such as obstructive sleep apnea (AHI > 5), T2D, IIH, NASH, Blount's disease, SCFE, GERD, or hypertension; or BMI ≥ 40 kg/m² or 140% of the 95th percentile (whichever is lower).
- A multidisciplinary team must also consider whether the patient and family have the ability and motivation to adhere to recommended treatments pre- and postoperatively, including consistent use of micronutrient supplements.

Contraindications for adolescent MBS include

- A medically correctable cause of obesity
 - An ongoing substance abuse problem (within the preceding yr)
 - A medical, psychiatric, psychosocial, or cognitive condition that prevents adherence to postoperative dietary and medication regimens.
 - Current or planned pregnancy within 12 to 18 mo of the procedure
-

BMI = body mass index; AHI = apnea-hypopnea index; T2D = type 2 diabetes; IIH = idiopathic intracranial hypertension; NASH = nonalcoholic steatohepatitis; SCFE = slipped capital femoral epiphysis; GERD = gastroesophageal reflux disease.

Special considerations

- Given the lack of other options in children with Prader-Willi Syndrome, other syndromic obesity, or hypothalamic obesity (such as a result of craniopharyngioma), MBS should be considered, especially when comorbidities exist
- When the adolescent is able to assent, then MBS should be done only if one can obtain assent as well as parental consent. When a child does not have the decisional capacity, but is able to demonstrate the ability to make lifestyle changes required by MBS with or without the assistance of a dedicated caregiver, then MBS should be considered. Both parents and the entire multidisciplinary team with consultation of the ethics committee, where appropriate, should agree that MBS is the best course of action for the adolescent

Pediatric bariatric surgery guidelines

- Sleeve gastrectomy has become most used in adolescents with severe obesity for several reasons:
 - Near-equivalent weight loss to the RYGB in adolescents
 - Fewer reoperations
 - Better iron absorption
 - Near-equivalent effect on comorbidities as RYGB in adolescents
 - Due to asymptomatic GERD after VSG in adults, periodic postoperative screening could be considered after VSG in adolescents.
- **Can recommend either RYGB or sleeve gastrectomy for weight loss in adolescents.**
- There is no data to support requiring medical weight loss before considering surgery. Prior attempts at weight loss should be removed as a barrier to definitive treatment for obesity

Pediatric bariatric surgery guidelines

- All adolescents with severe obesity should be referred, early, to MBS programs that are established for adolescents and follow MBSAQIP program recommendations
- When there is inadequate weight loss or failure of resolution of certain comorbidities, then conversion to RYGB is recommended; though it may be reasonable to try the addition of weight loss medications as well
- Nutritional supplements
- Pregnancy
- Transition to adult MBS program for lifelong care



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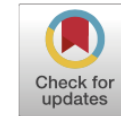
Contents lists available at [ScienceDirect](#)

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jped surg.org



Bariatric surgery practice patterns among pediatric surgeons in the United States



Ruth A. Lewit^{a,b}, Carroll M. Harmon^{c,d}, Robert Ricca^e, Barrie S. Rich^f, Mehul V. Raval^g, Ying Z. Weatherall^{a,b,*}

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Adolescent Obesity Rates in the United States

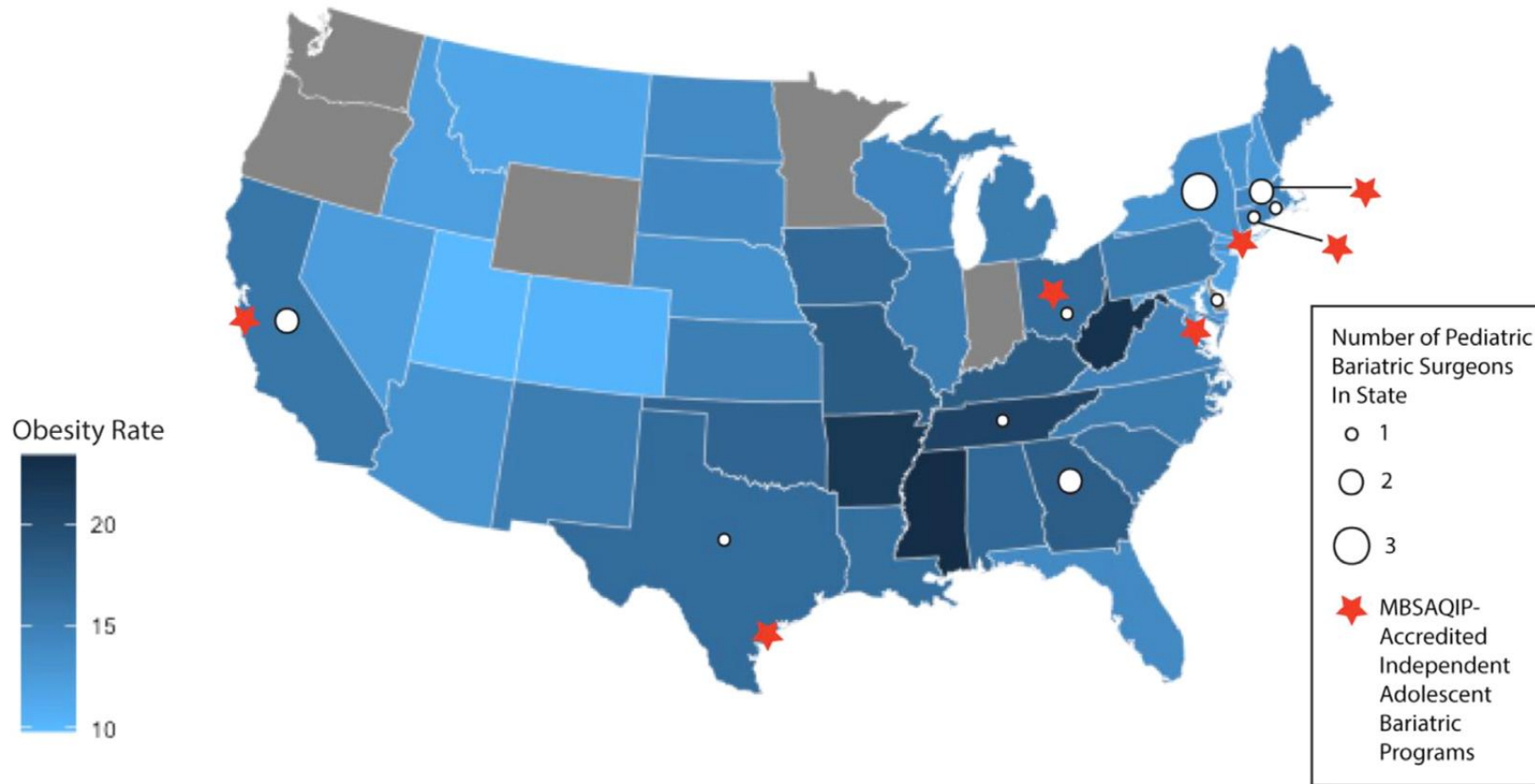


Fig. 1. Adolescent Obesity Rates in the United States. Respondents of the survey who performed a metabolic and bariatric surgery within the last year are indicated by circles ($n = 17$, two did not provide their practice location). MBSAQIP-accredited Adolescent Centers are indicated with stars.

Team Members in Adolescent Bariatric Surgery Programs

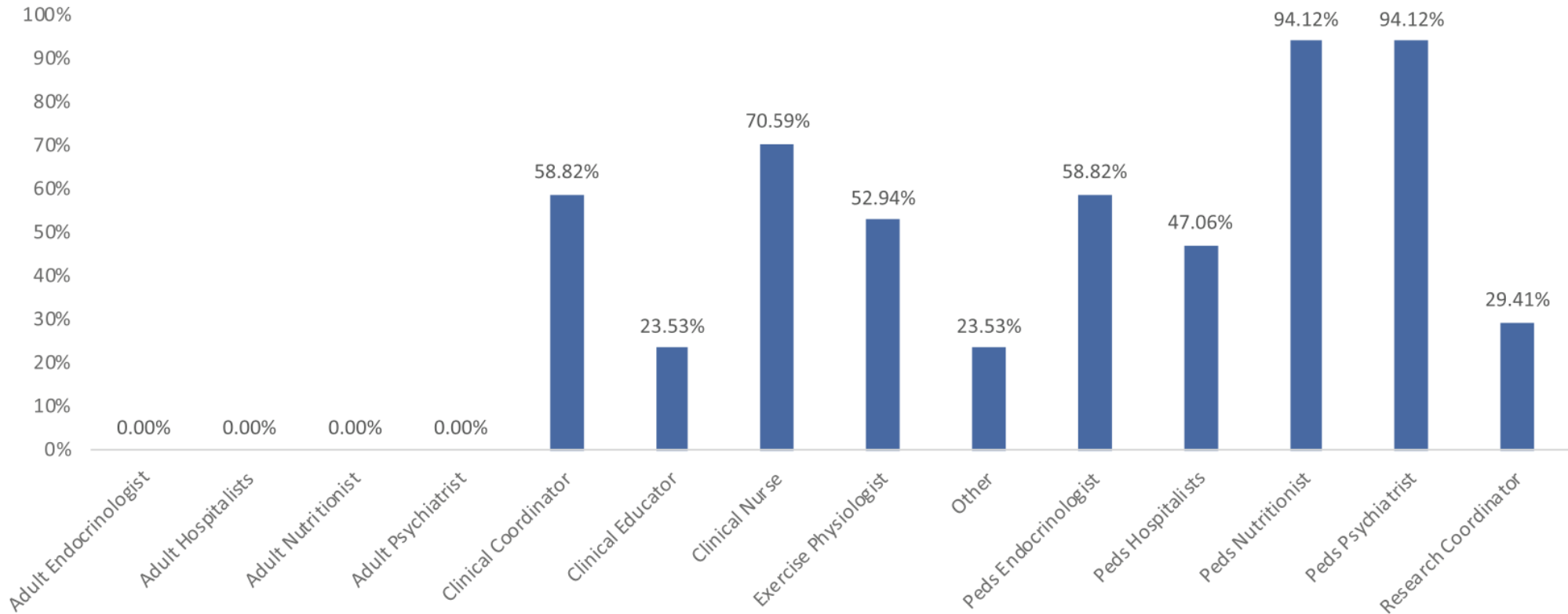
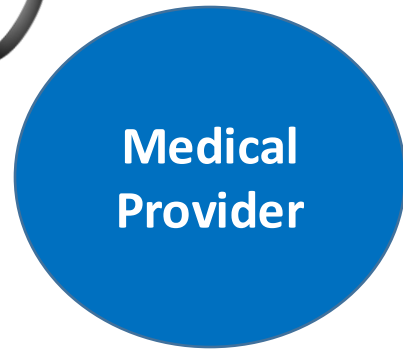
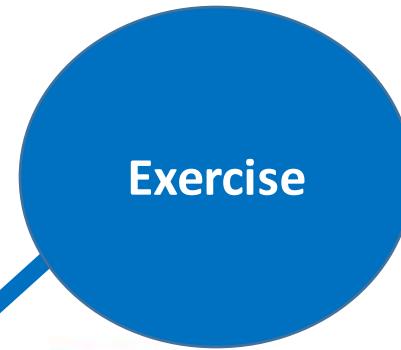
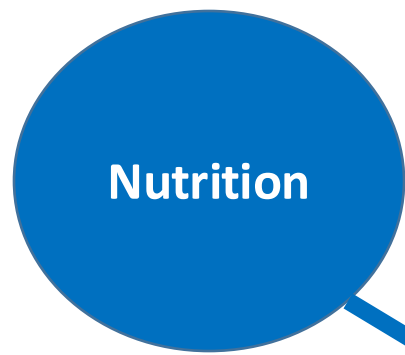


Fig. 2. Frequency that specialty team members were included in adolescent metabolic and bariatric surgery programs.

The Healthy Lifestyle Clinic

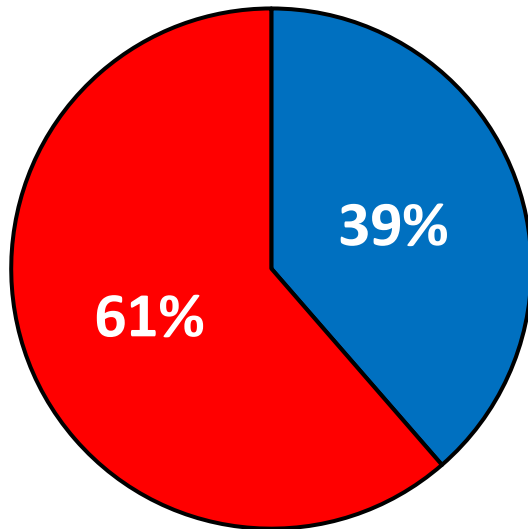


- Pediatrics
- Endocrine
- Renal
- Cardiology
- Pulmonary
- Genetics
- Surgery

Healthy Lifestyle Clinic Patients

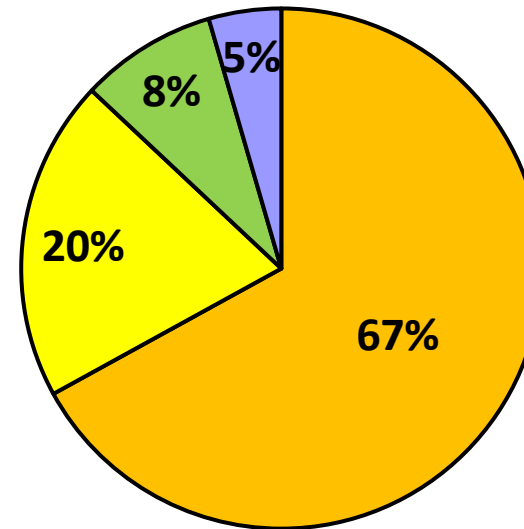
- 1700 patients served during 13,300 visits October 2014 to December 2023
- Age 1-20 years (average 12.2 years), > 80% have severe obesity

Sex



■ Male ■ Female

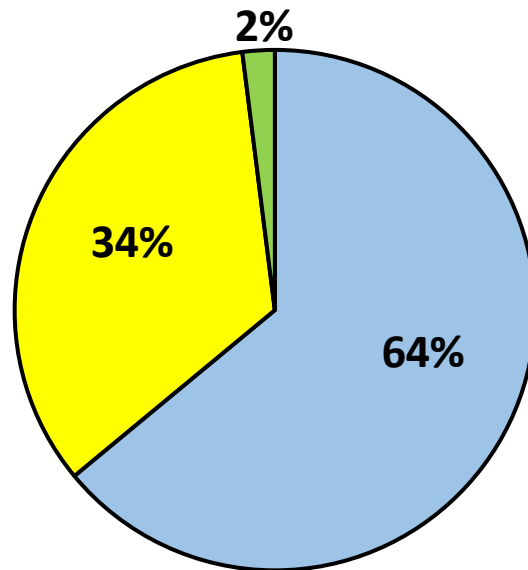
Race/Ethnicity



■ Black ■ White ■ Hispanic ■ Other

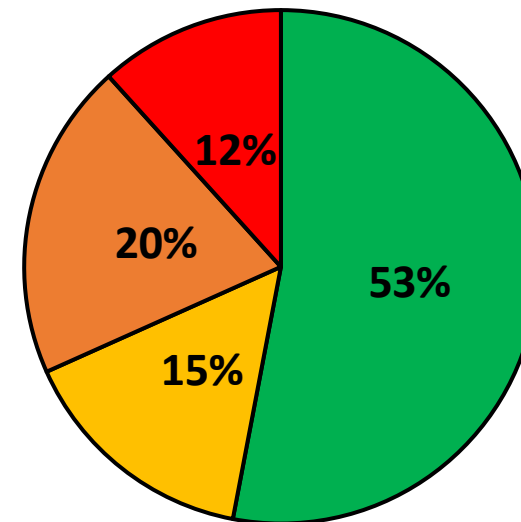
Healthy Lifestyle Clinic Patients

Health Insurance



■ Medicaid ■ Private ■ Self-pay

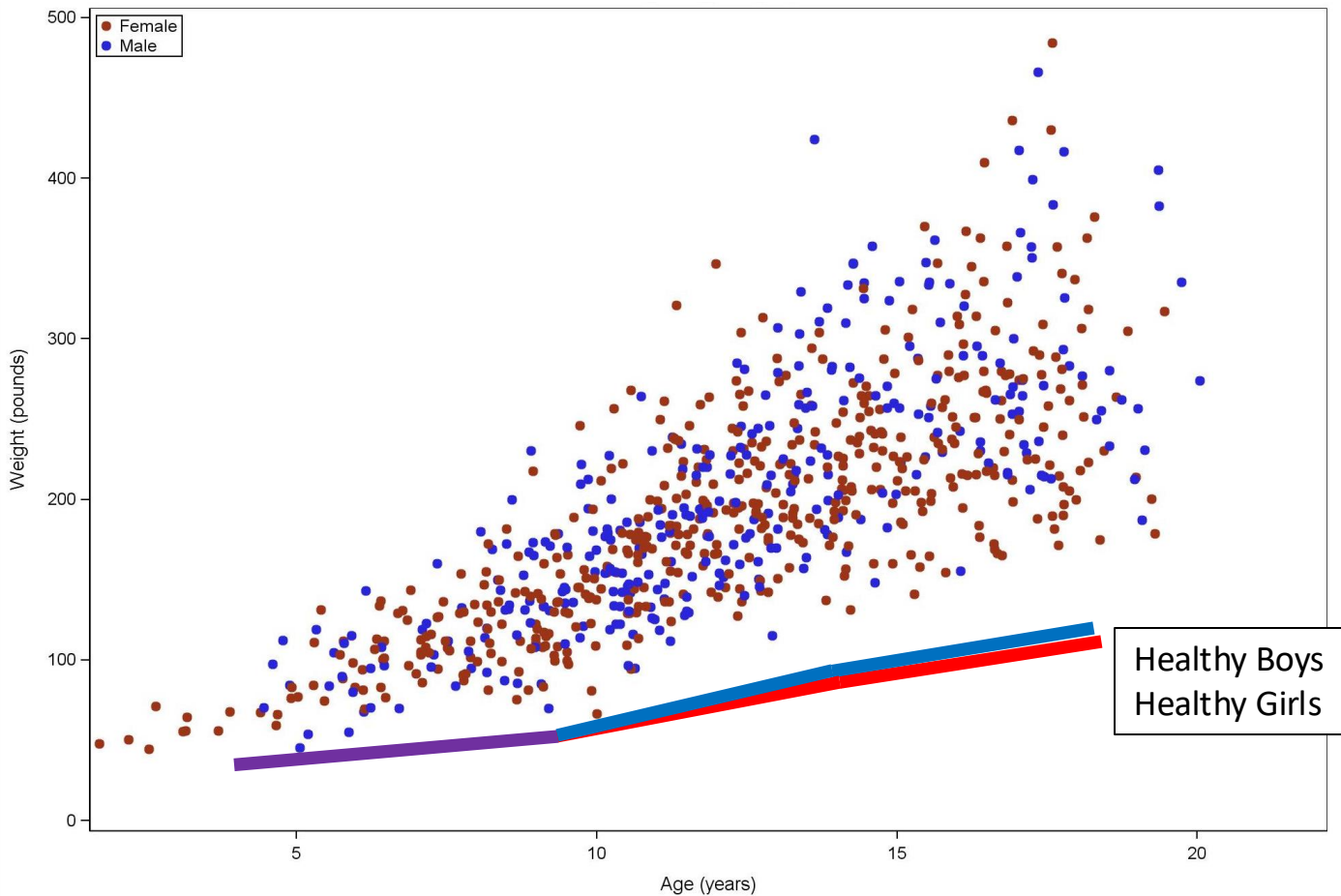
Level of Household Food Security



■ High Food Security ■ Marginal Food Security
■ Low Food Security ■ Very Low Food Security

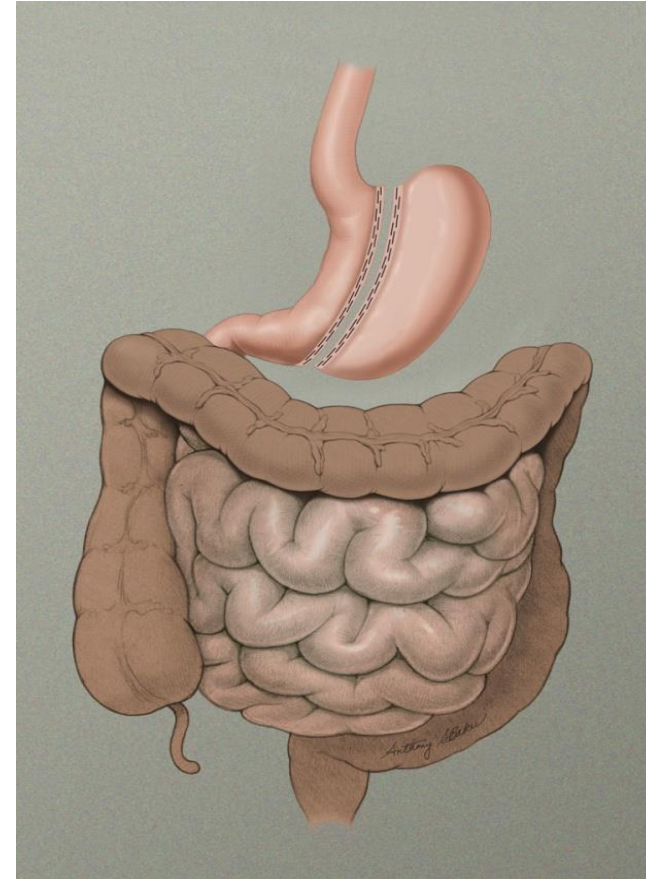
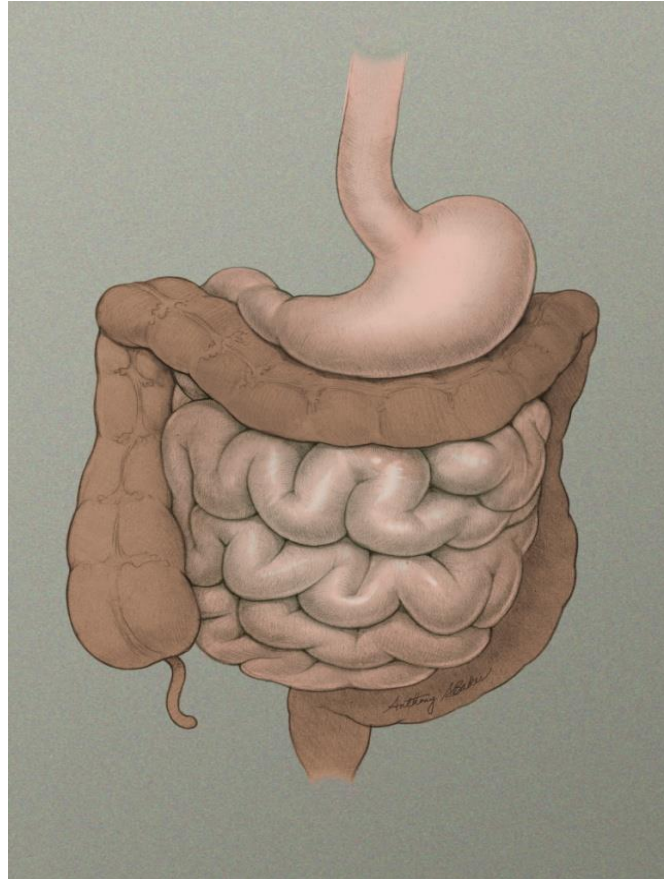
Healthy Lifestyle Clinic Patients

Body Weight by Age



- 88% have Severe Obesity
- BMI %ile: 99.9 ± 2.1
- Percent of 95th %ile: $153 \pm 28\%$
- Body Fat %: 47.2 ± 6.8

Sleeve gastrectomy (SG)



LeB Bariatric surgery patients

- Tanner stage 4 patients who have also reached skeletal maturity (15-year-olds or 14-year-olds with pressing co-morbidities)
- Requisites:
 - BMI ≥ 35 kg/m² with a medical co-morbidity or BMI ≥ 40 kg/m²
 - Physical, cognitive, and emotional maturity
 - Weight loss efforts in a behavior-based treatment program (HLC)
 - Completion of 6 surgeon-led visits
- Completions of 6 surgeon-led visits
 - Initial visit → Complications → Physiology → Pre- and post-operative diet stages → Vitamins → High risk behaviors → Ready for surgery
- Obtain PCP endorsement early in the bariatric surgery track
- Patient/caregiver must show understanding of potential complications, changes to GI anatomy, diet stages, and need for vitamins long term
- Insurance approval

Preoperative psychological evaluation

- Psychologists assess adolescents' psychological readiness and suitability for bariatric surgery.
 - Motivation
 - Adherence
 - Ability to understand and articulate:
 - risks and benefits of the procedure,
 - pre- and post-surgical requirements
 - Independent decision-making
 - Psychological functioning

Preoperative nutrition

Assess

- Dietary Intake, eating problems
- Nutritional knowledge, food security

Preoperative Diet

- Reduce glycogen stores, shrinks livers, improves access to stomach
- 3-4 weeks before surgery (based on BMI)
- High protein, Low in fat and carbs
- Daily Intake = ~1000 calories, 60—90g protein
 - 2-3 meal replacement shakes
 - 1 small, balanced meal in the evening



Postoperative nutrition

Patients follow strict diet for 3 months after surgery.

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
"Progressive" Clear Liquids	Full Liquids	Pureed/Blended Foods	Soft Foods	Regular
POD 0 up to POD 5	Weeks 1-4	Weeks 5-8	Weeks 9-12	Weeks 12 – LIFE
All clear liquids fortified with protein	High protein liquids Same as pre-op w/o solid food	All food must be blended before consumption	Soft protein foods + liquids and smooth foods	All textures 4-6 small meals balanced day
Start 6 fl oz, gradual increase to 20 fl oz		64+ oz/day non-carbonated, sugar-free fluids 60-90 g/day of protein		



Slide courtesy of Nichole Reed, RD

Postoperative stay—ERAS

- Designed bariatric surgery “unit”
- Dietary progression
- Multi-modal pain and nausea management
- DVT prophylaxis
- Respiratory care
- Physical activity

Patient care pathway—follow-up

- 10 days after surgery
- POD 3 weeks
- POD 7 weeks
- POD 11 weeks
- Monthly for first year
- Q3 months for second year
- Q6 months going forward
- Adult program for transition of care

Procedural volume

Sleeve Gastrectomy Volume

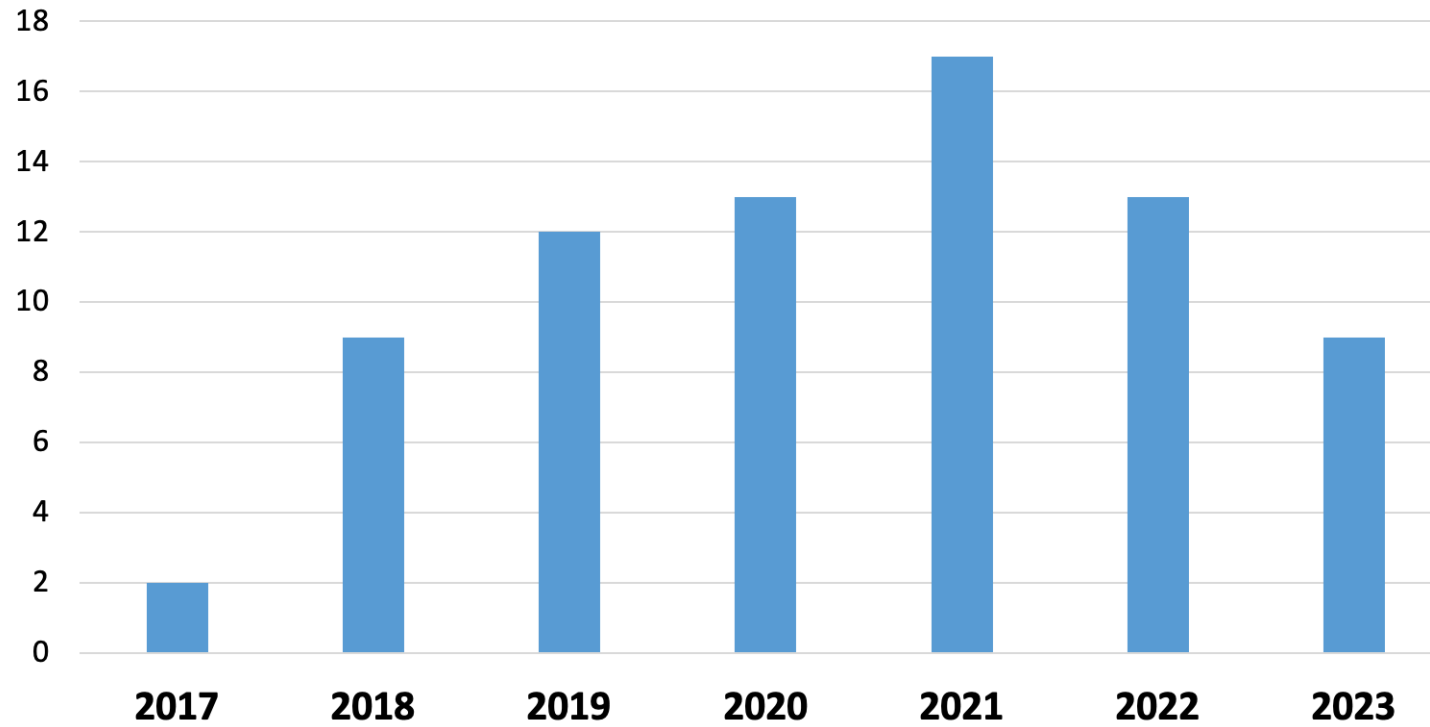


Chart Area

Procedural outcomes

- No in-hospital or 90-day mortality
- Length of stay: 1—2 nights

Adverse events

- Readmissions
 - Hypoglycemia (1), Hypokalemia (1), Vomiting (1)
 - Acute pancreatitis (1)
 - Infected abdominal wall hematoma (1)
 - Staple line leak (1)
 - DVT (1)
- Reoperations—1
- Endoscopy—1

- Unplanned ICU admission—0

Patient demographics

Patient Demographics

n=74	Mean ± SD
Age (years)	17.0 ± 1.3
Body Mass Index (BMI)	53.7 ± 10.5
BMI Percentile	99.9 ± 0.3
BMI Z score	2.75 ± 0.33

	N(%)
Sex	
Female	45 (60.0)
Male	29 (40.0)
Race	
African American	59 (79.7)
Caucasian	9 (12.1)
Other	6 (8.2)
Insurance	
Public	58 (78.4)
Private	16 (21.6)



LeB ABSP comorbidities

Comorbidity	In the setting of severe obesity
Obstructive sleep apnea	72%
Hypertension	28%
Type 2 diabetes	14%
Blount disease	7%
Pseudotumor cerebri	5%



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Prevalence of Upper Gastrointestinal Inflammation in Teens With Obesity Prior to Sleeve Gastrectomy



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Weight loss outcomes

Table 2 – Postoperative percent TBWL at three time points among patients with various patterns of UGI inflammation on preoperative EGD.

Location of inflammation	Baseline, n (%)	Percent TBWL			P-value (versus no inflammation of any type)*	Percent TBWL at 12 mo		
		3 mo (n = 24), mean ± SD	6 mo (n = 22), mean ± SD	12 mo (n = 15), mean ± SD		Inflammation, mean ± SD (n)	No inflammation, mean ± SD (n)	P-value
All patients	30 (100%)	17.9 ± 5.0	20.8 ± 6.7	22.0 ± 8.1	–	–	–	–
None	9 (30%)	20.7 ± 7.1	22.3 ± 7.9	27.0 ± 7.4	–	–	–	–
Any	21 (70%)	16.7 ± 3.4	20.2 ± 5.0	20.1 ± 7.9	0.17	20.1 ± 7.9 (11)	27.0 ± 7.4 (4)	0.17
Esophageal	9 (30%)	18.6 ± 3.2	22.0 ± 6.0	25.8 ± 6.9	0.80	25.8 ± 6.9 (5)	20.1 ± 8.3 (10)	0.19
Gastric	10 (33.3%)	15.2 ± 2.7	18.7 ± 2.5	16.7 ± 4.8	0.06	16.7 ± 4.8 (5)	24.6 ± 8.3 (10)	0.036 [†]
Duodenal	9 (30%)	16.3 ± 2.0	18.9 ± 3.9	14.1 ± 5.7	0.03 [†]	14.1 ± 5.7 (9)	25.7 ± 7.3 (4)	0.015 [†]

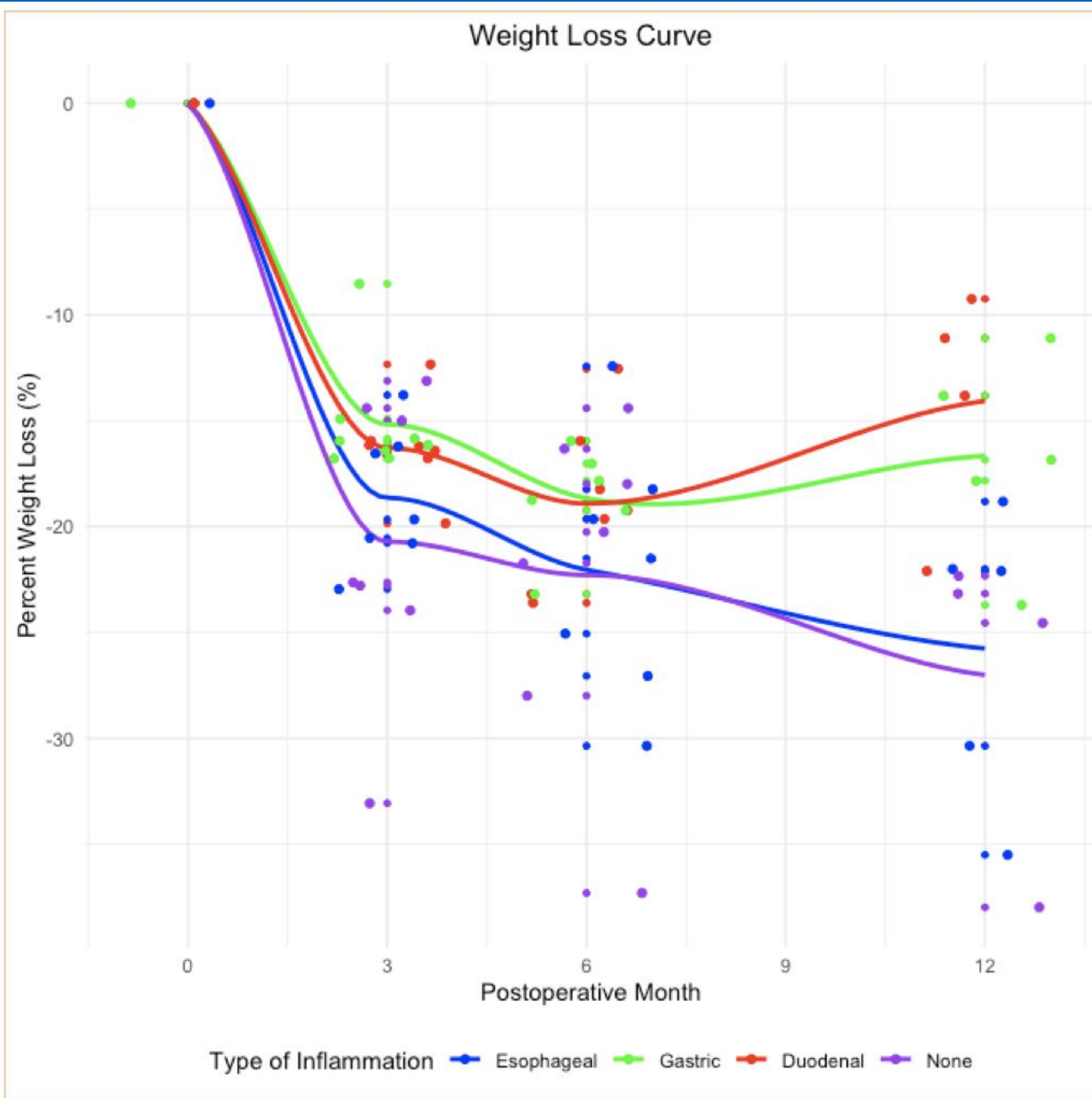
Patients with preoperative gastric inflammation had significantly less TBWL 12 mo after SG compared to patients without gastric inflammation, and those with duodenal inflammation had significantly less TBWL over the same time frame compared to patients without duodenal inflammation. Those with duodenal inflammation also had significantly less TBWL compared to those without any inflammation at 12 mo.

SD = standard deviation.

*P-value for inflammation versus those without any inflammation at 12 mo.

[†]P < 0.05.

Weight Loss Curve



	Baseline Mean \pm sd	6 Month Post Mean \pm sd	% change Mean \pm sd
Body Weight (kg)	153.8 \pm 37.1	125.9 \pm 36.0	18.7 \pm 8.0
Body Mass Index (kg/M ²)	53.7 \pm 10.5	43.9 \pm 10.4	18.4 \pm 8.0
Body Fat Mass (kg)	82.5 \pm 22.5	61.9 \pm 23.1	26.3 \pm 13.5
Lean Body Mass (kg)	71.3 \pm 15.5	64.0 \pm 14.9	10.3 \pm 5.5
Skeletal Muscle Mass (kg)	40.7 \pm 9.3	35.9 \pm 9.0	12.0 \pm 6.1
Body Fat Level (%)	53.4 \pm 2.8	48.1 \pm 6.8	10.1 \pm 9.8
Basal Metabolic Rate (Kcal/day)	1910.6 \pm 334.3	1753.0 \pm 322.4	8.3 \pm 4.4

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Insurance Approval for Laparoscopic Sleeve Gastrectomy in Adolescents in the Midsouth

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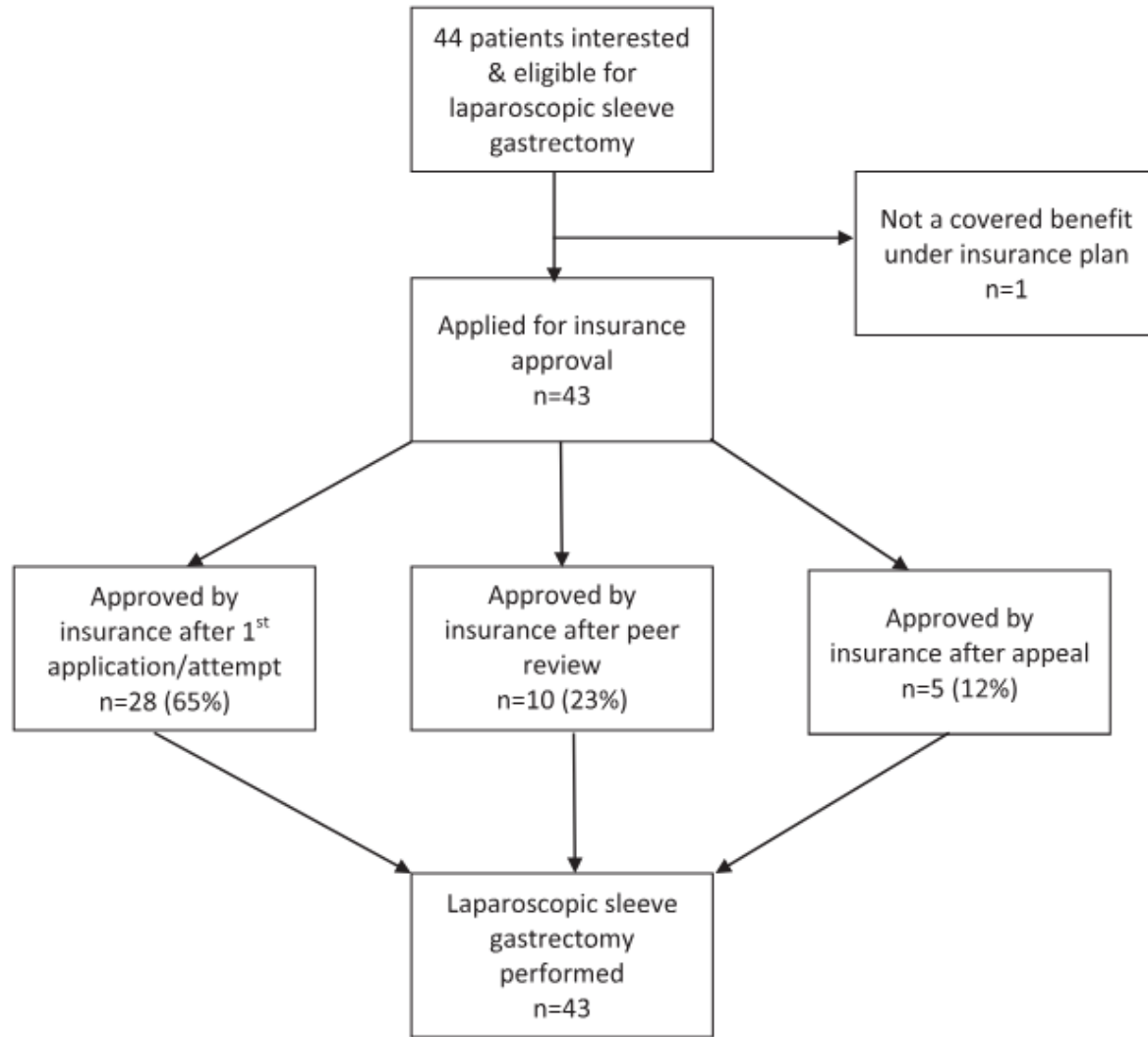


Figure 1. Flow diagram of insurance approval process.

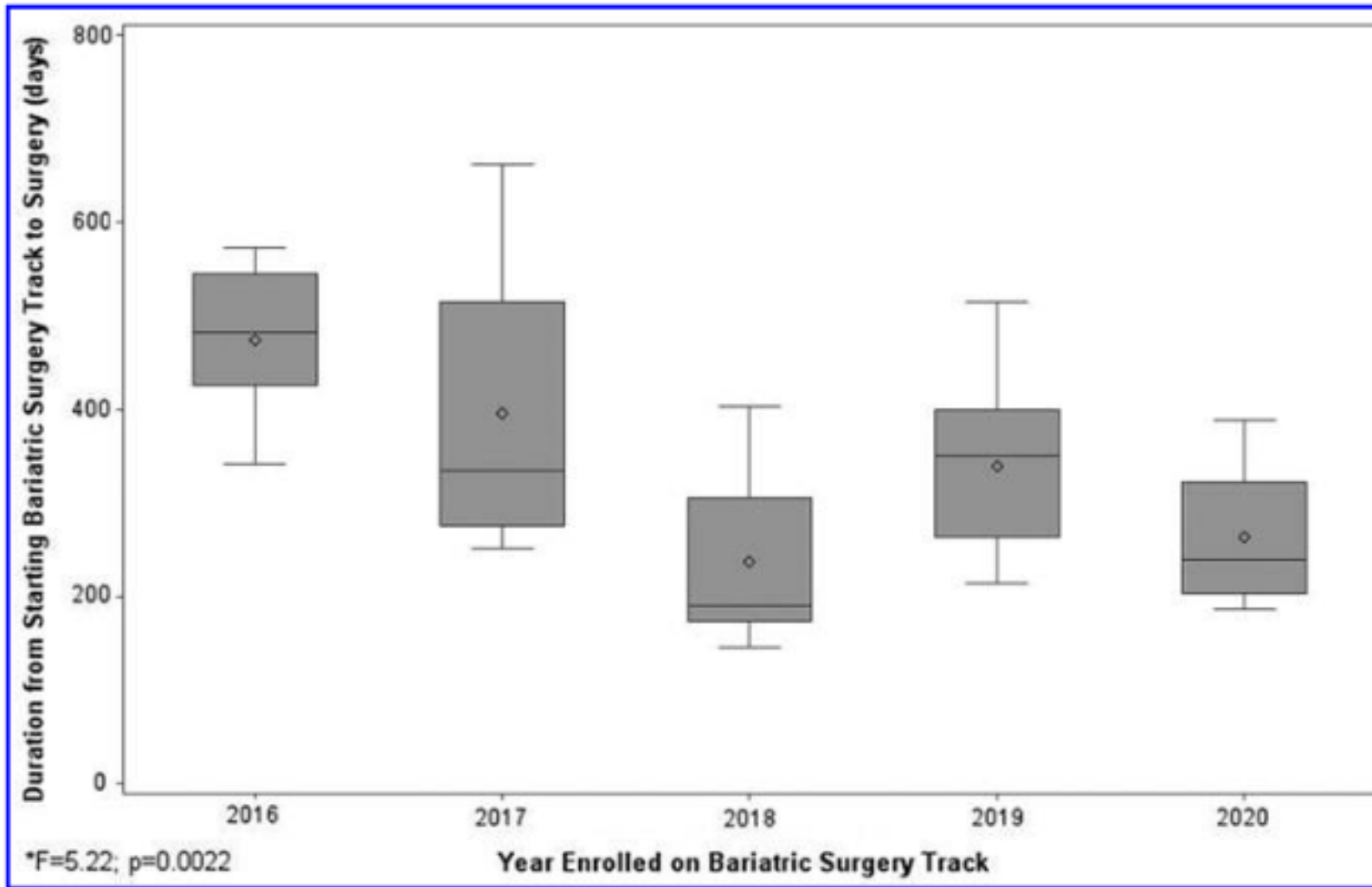


Figure 2. Duration from starting bariatric surgery track to surgery.

Future endeavors

- Long-term weight loss outcomes
- Body composition changes
- Medications
- MBSAQIP verification
- Destination program for adolescents with obesity

Thanks you!

- Questions?