

Lessons Learned from More than a Decade of Teen-LABS



Thomas Inge, MD, PhD

*Surgeon-in-Chief and Chair, Dept of Surgery, Lurie Children's Hospital of Chicago
Professor of Surgery and Pediatrics, Northwestern Feinberg School of Medicine*

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Disclosures

Relationships with commercial entities

- Consultant with Teleflex/Standard Bariatrics
- Consultant with Mediflix
- Consultant with Eli Lilly, Inc
- Royalties from UpToDate (Wolters Kluwer)

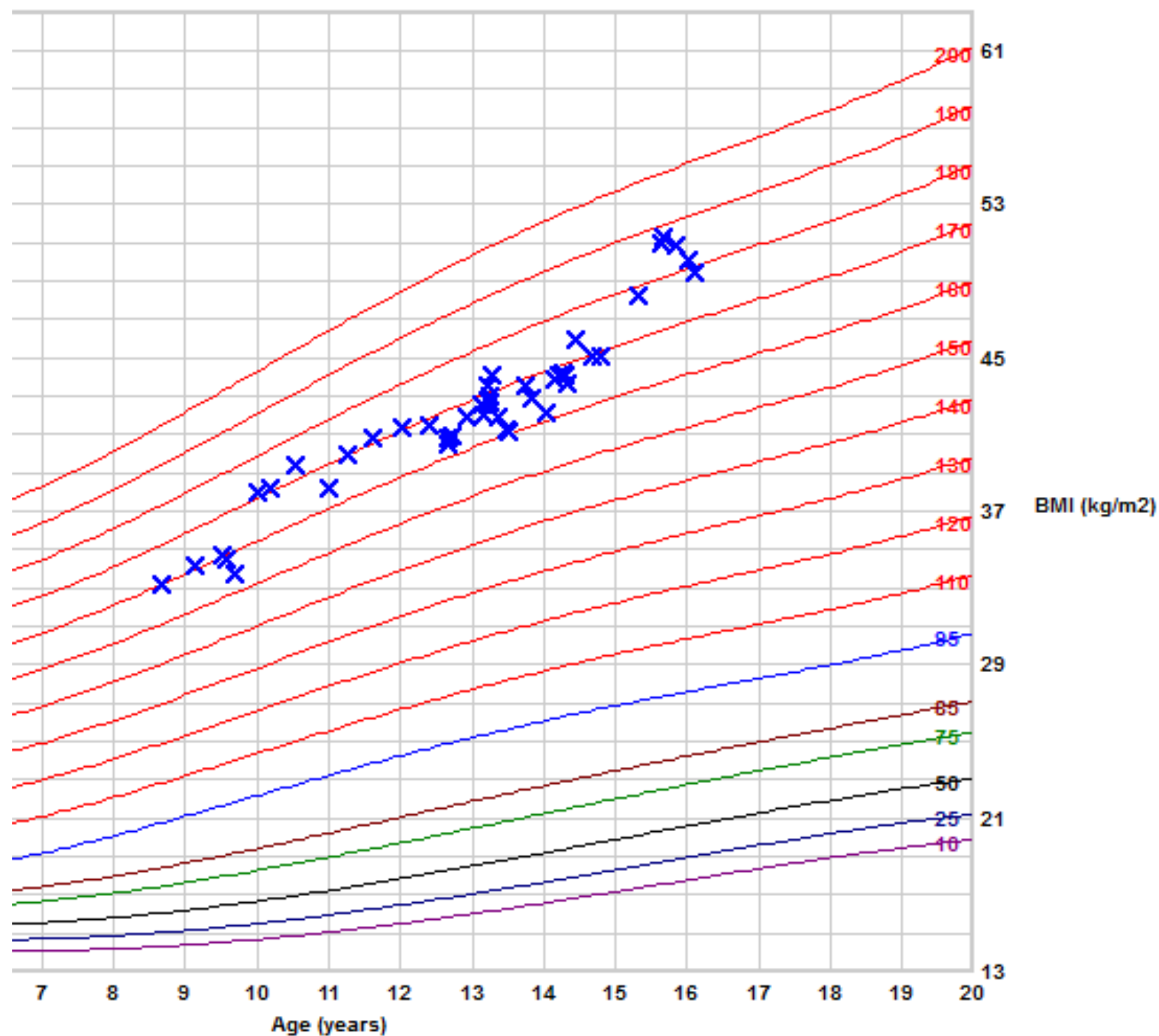
No commercial products will be discussed during this presentation

Objectives

- Describe terminology and prevalence of pediatric severe obesity
- Compare adult and adolescent bariatric outcomes
- Share results of longterm outcomes of bariatric surgery in teenagers, weight, health and nutritional
- Discuss potential impact of environmental pollutants on outcomes

BMI Percentiles for Pediatric Obesity (2025)

Class	Pediatric	Adult BMI
1	BMI 95 th to <120 th P	BMI ≥30
2	BMI 120 th to <140 th P	BMI ≥35
3	BMI 140 th to <160 th P	BMI ≥40
4	BMI 160 th to <180 th P	BMI ≥50
5	BMI ≥ 180 th P	BMI ≥60



Apply patient filter

Show gestation-adjusted age chart (up to 3 years)

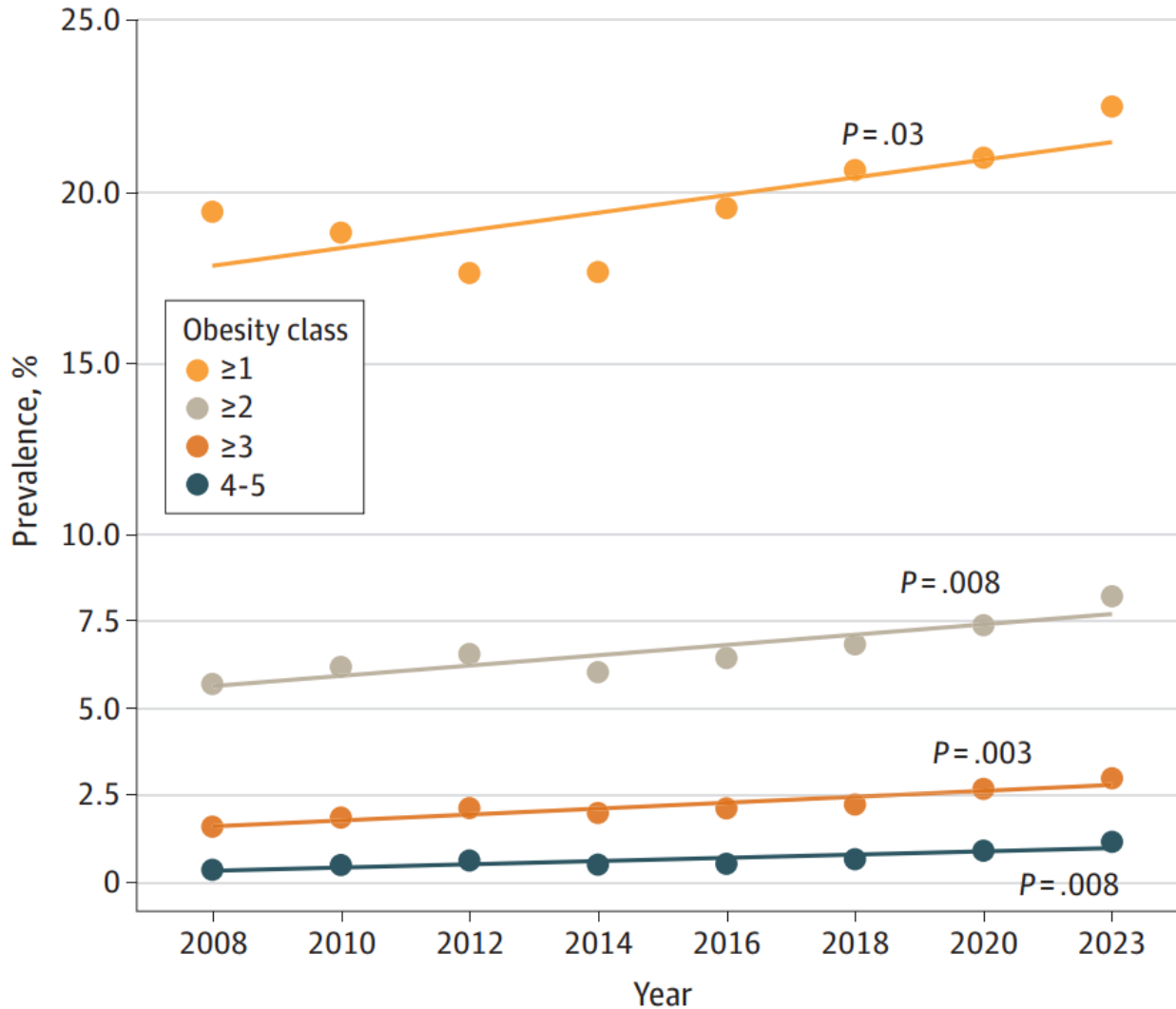
Show encounter specialty data points only

Legend

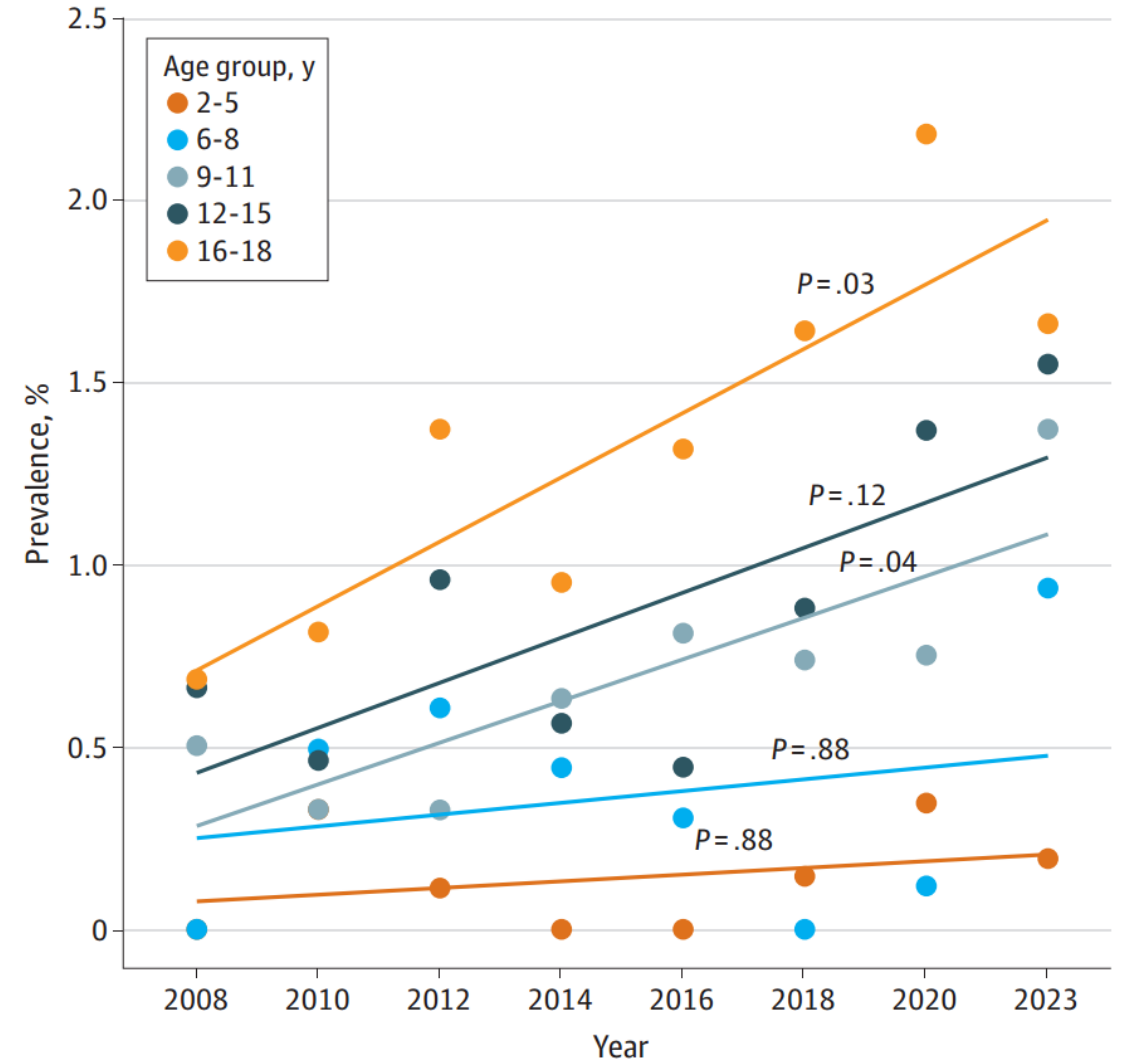
- 200 pct of the 95th
- 190 pct of the 95th
- 180 pct of the 95th
- 170 pct of the 95th
- 160 pct of the 95th
- 150 pct of the 95th
- 140 pct of the 95th
- 130 pct of the 95th
- 120 pct of the 95th
- 110 pct of the 95th
- 95th percentile
- 85th percentile
- 75th percentile
- 50th percentile
- 25th percentile
- 10th percentile

Pediatric Obesity Prevalence, 2-18 year olds in US

A Obesity classes overall

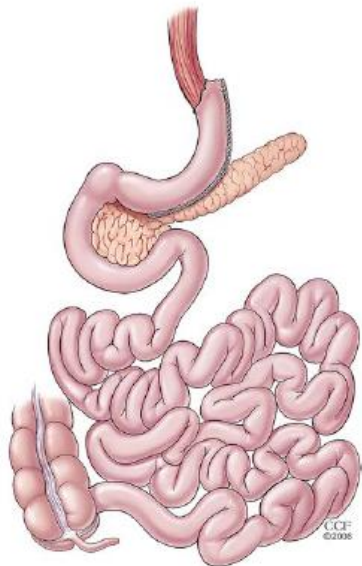


C Obesity class 4-5 by age



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Selection criteria for adolescent bariatric surgery

BMI Class	<u>AND:</u>
Class 2	T2DM, obstructive sleep apnea (OAH1 >5), advanced NASH, pseudotumor cerebri, Blount's disease, SCFE, GERD, hypertension
Class 3 or more	Comorbidity not required



A Consortium funded by:

National Institutes of Diabetes & Digestive & Kidney Diseases



with additional funds from the Office of Research on Women's Health

Working together to further understand Bariatric Surgery...

www.Teen-LABS.org

Question: Is early intervention in Teens more successful than surgery in Adults?



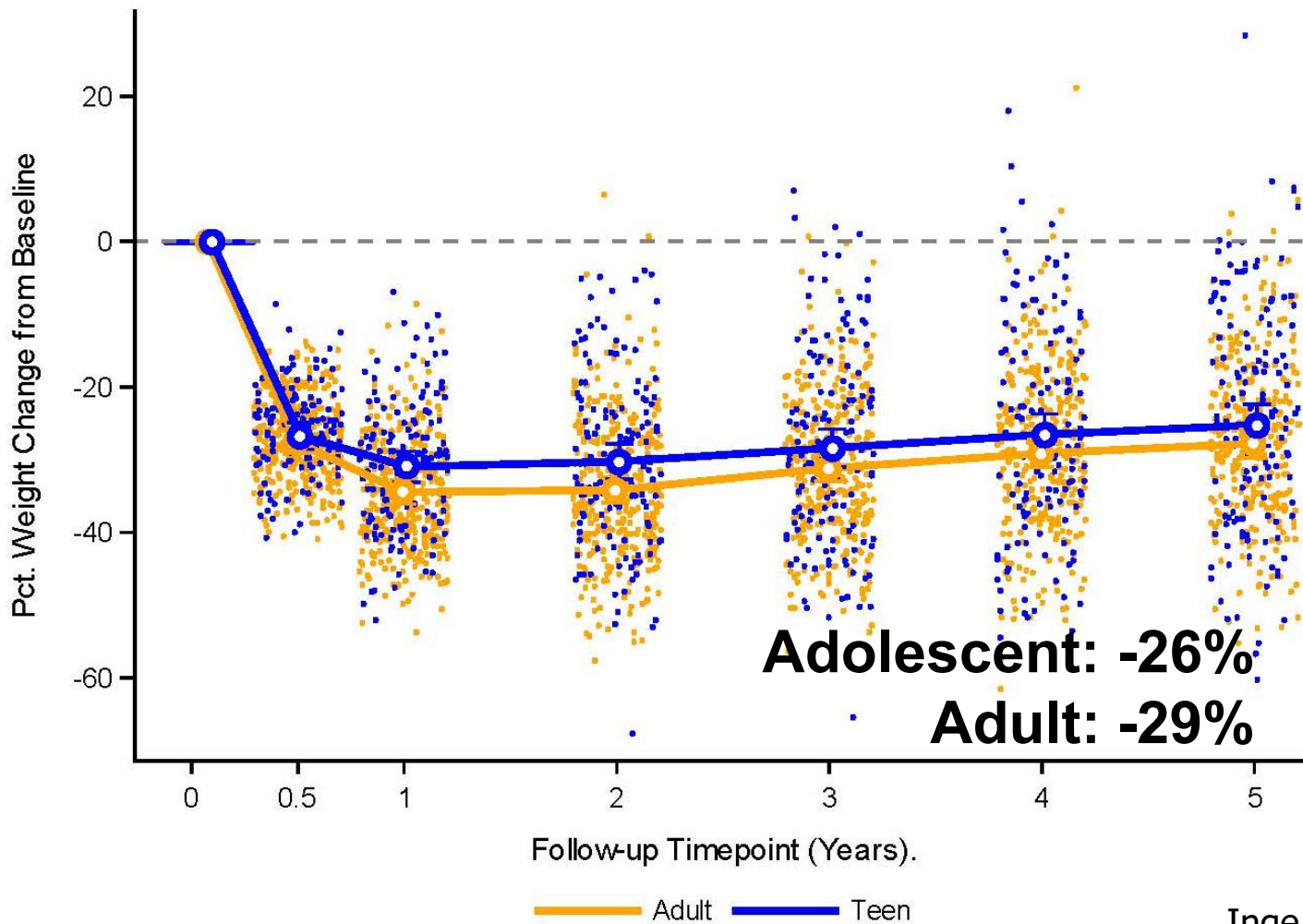
Study Design

- Multi-center, prospective, observational studies
- Teen LABS coordinated with (adult) LABS for standardized methodology and definitions
 - Teen LABS: ages \leq 19 years; enrollment 2006-2012
 - LABS: ages \geq 18 years; enrollment 2006-2009

Analysis Cohorts

- RYGB only
 - 161 Teen LABS subjects (age 13-19 yrs)
 - 396 LABS subjects, with obesity since age 18 (ages 25-60 yrs)

Body weight change after gastric bypass in Adults and Teens



Adolescent:

n=165, age 13-19yrs

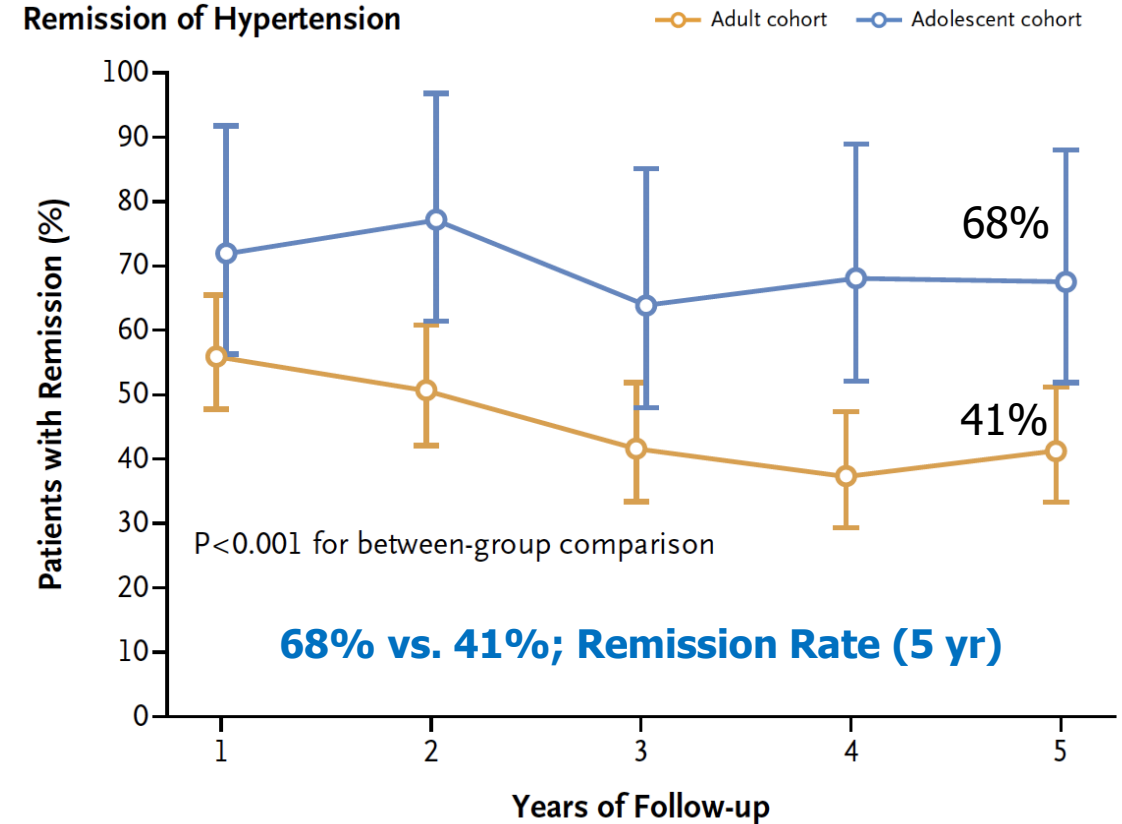
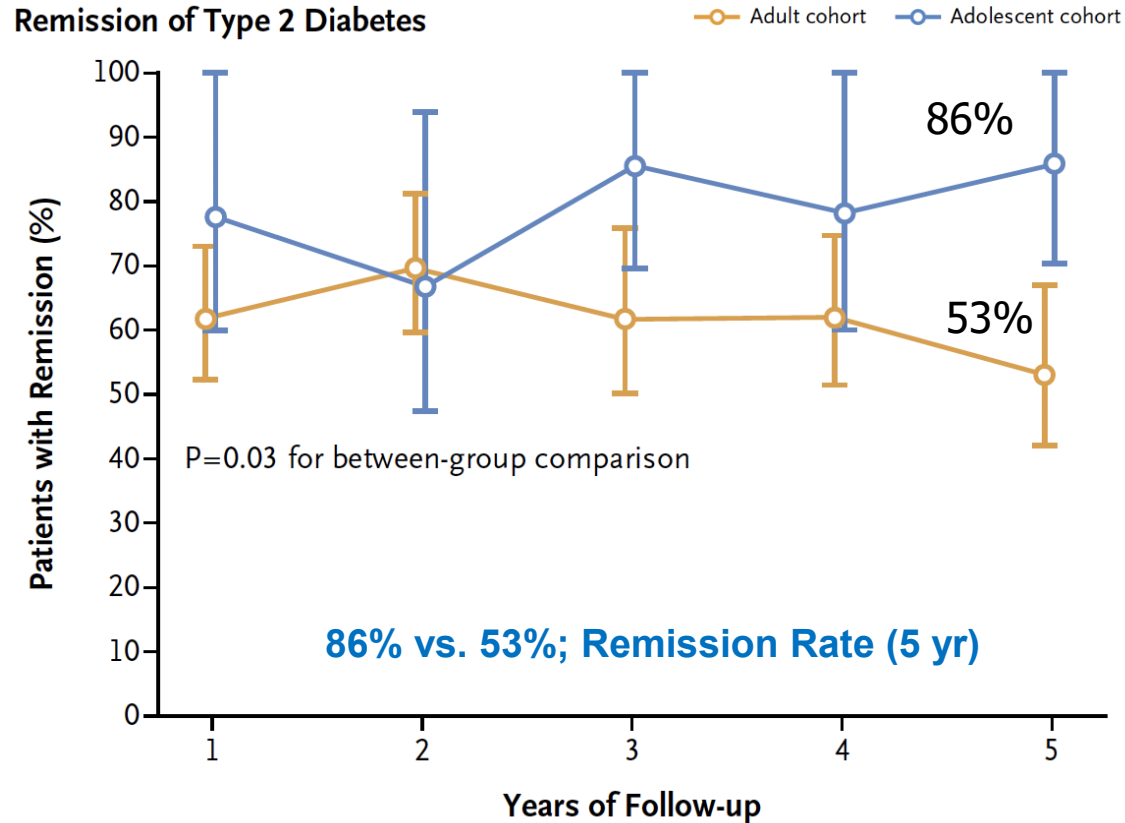
Adult:

n=396, ages \geq 25-60yrs

All gastric bypass

SAME OUTCOMES!

Remission T2DM and HTN: Adults vs. Teens (5 years)



DIFFERENT HEALTH OUTCOMES!

Deaths and Re-Operations From Surgery to 5 Years

	Teen-LABS			LABS		
	Patients No. (%)	Number of Events	Rate per 500 person-years (95% CI)	Patients No. (%)	Number of Events	Rate per 500 person-years (95% CI)
Deaths	3 (1.9)	3	1.96 (0.63,6.08)	7 (1.8)	7	2.26 (1.08,4.74)
Intra-abdominal operations within 5 years	32 (20)	46	19.45 (12.8,29.8)	51 (16)	55	10.43 (6.8,15.7) [†]
Cholecystectomy	21 (14)					7.1 (3.9,12.8)
Surgery for bowel obstruction	6 (4)					1.4 (0.4,4.8)
Repair internal hernia	4 (2)					1.3 (0.4,4.5)
Gastrostomy	2 (1)					0.3 (0.05,2.3)
Other	10 (6)	10	3.9 (1.5,10.0)	13 (4)	13	2.1 (0.8,5.3)

Deaths
 Teens: sepsis (n=1, 3yr)
 overdose (n=2, 4yr, 4yr)
 Adults: periop (n=3)
 indeterminate (n=2, 1 & 5yr)
 suicide (n=1, 3yr)
 colon CA (n=1, 4yr)



[†]P < 0.05 for group comparison.

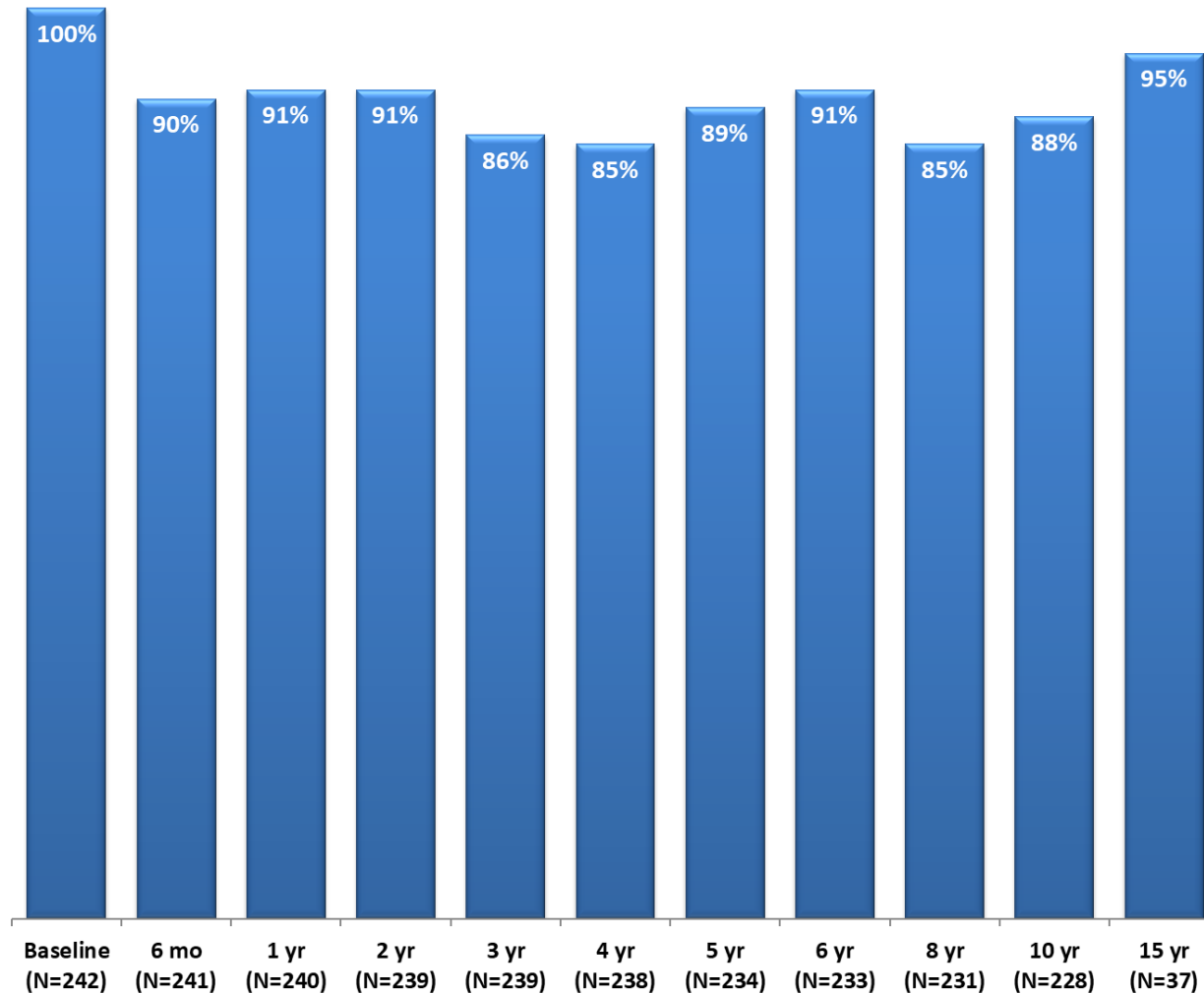
Next Questions:

Can you study teens **long term**?

Is the weight loss **durable**?

Are the **health improvements** long lasting?

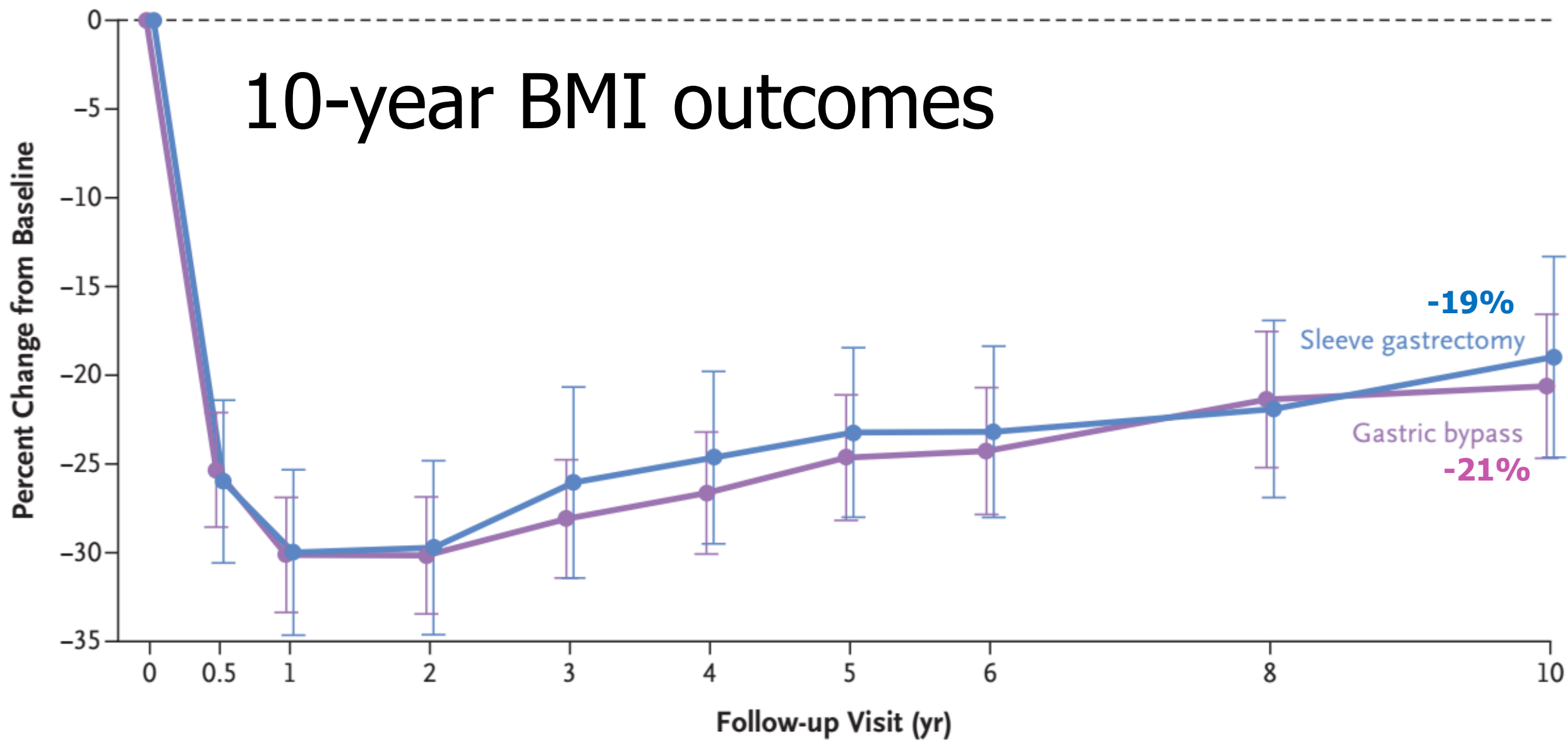
Teen-LABS research visit completion (%)



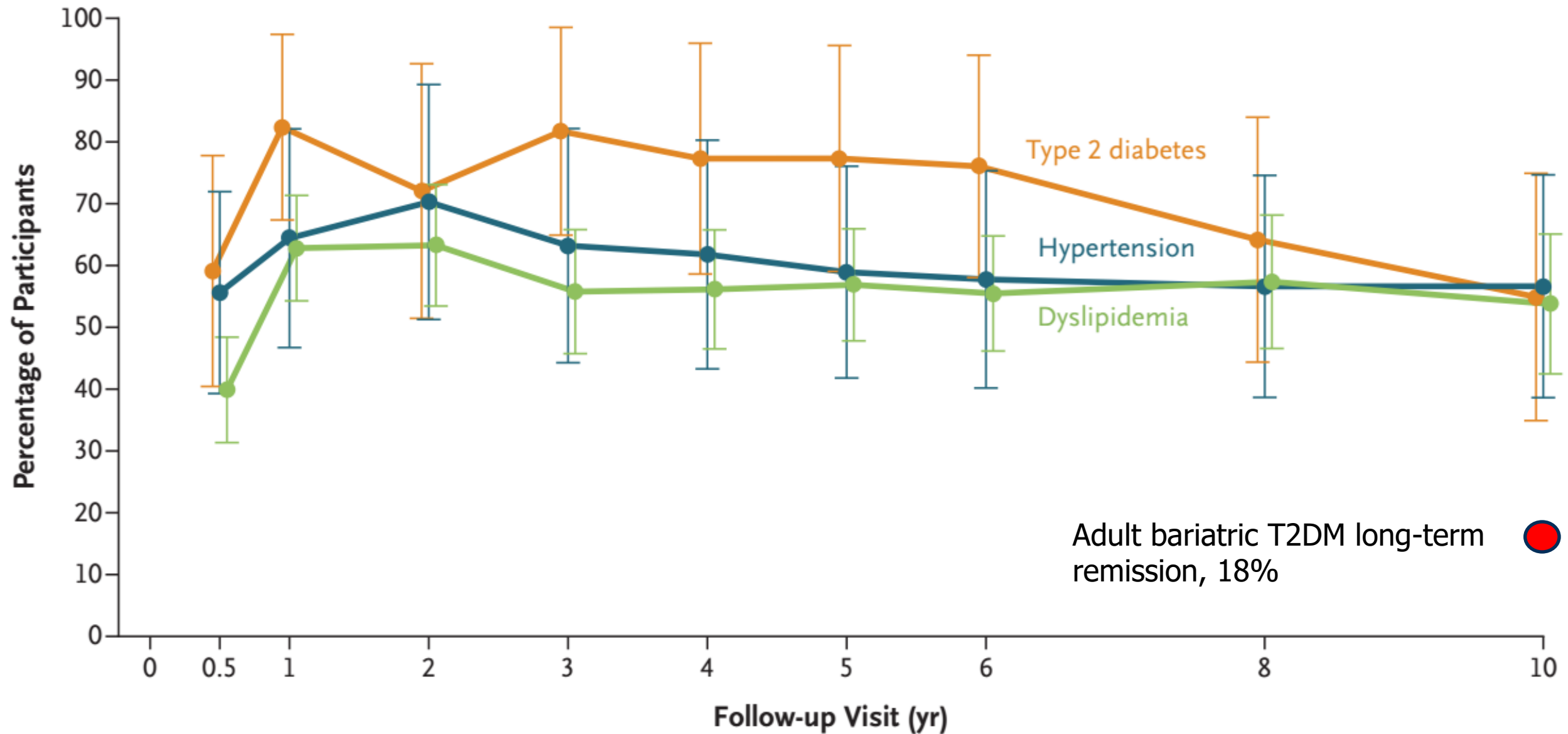
>80% retention is goal

A Changes in BMI from Baseline

10-year BMI outcomes



C Remission of Coexisting Conditions



Adult bariatric T2DM long-term remission, 18%

Next Questions:

What about long term nutritional risks?

Specific **micronutrient issues** to be expected?

What about the **BONES**?

Baseline vs 10-year Micronutrient Deficiencies

		Baseline	10yrs
		Prevalence	Incidence
Anemia	Low Ferritin		
	RYGB	1%	40%
	VSG	19%	40%
	High Transferrin		
	RYGB	0	34%
	VSG	0	13%
Bone Health	High PTH		
	RYGB	13%	32%
	VSG	8%	22%
	Low Vitamin D		
	RYGB	36%	45%
	VSG	35%	49%

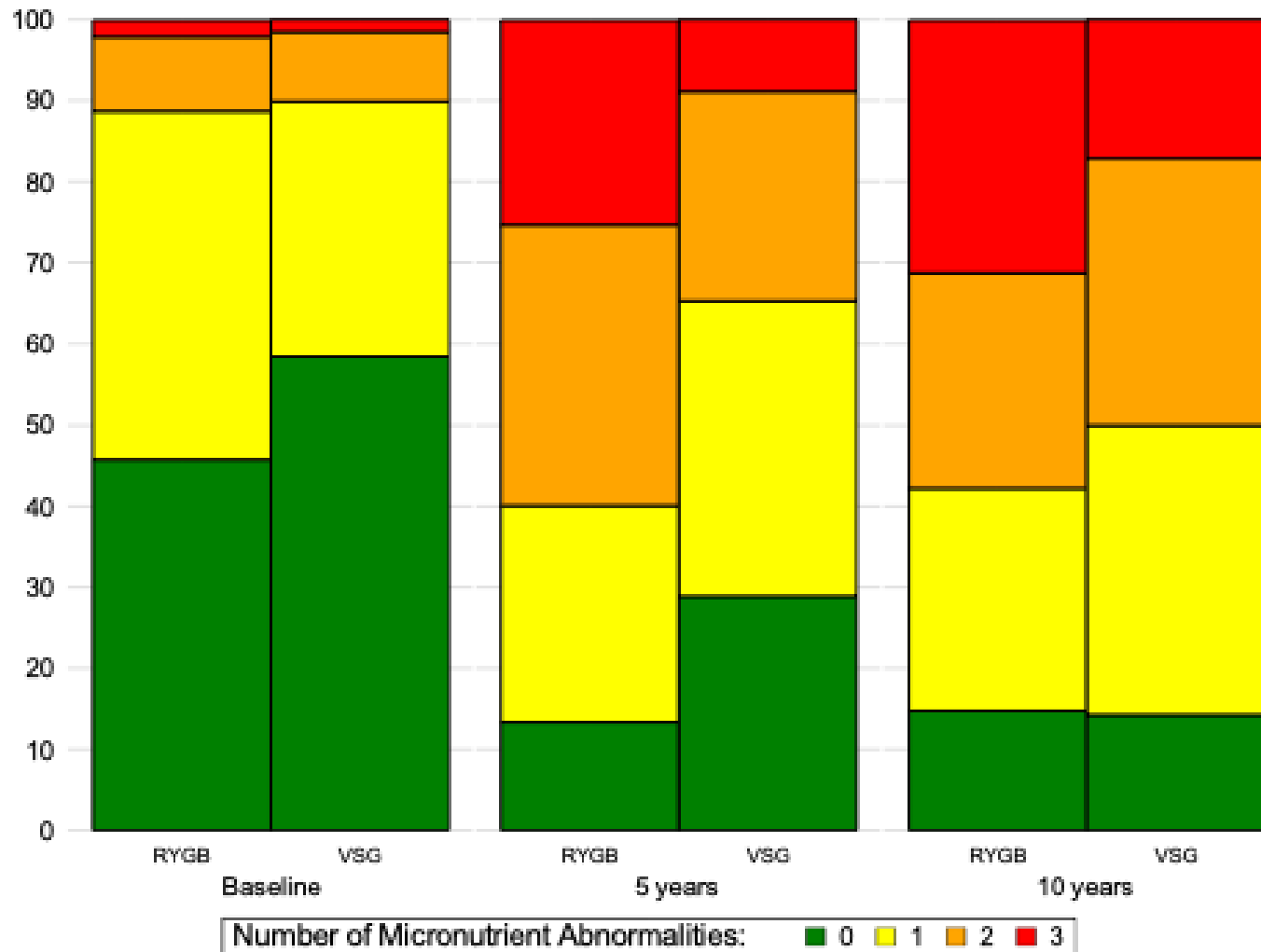


Baseline vs 10-year Micronutrient Deficiencies

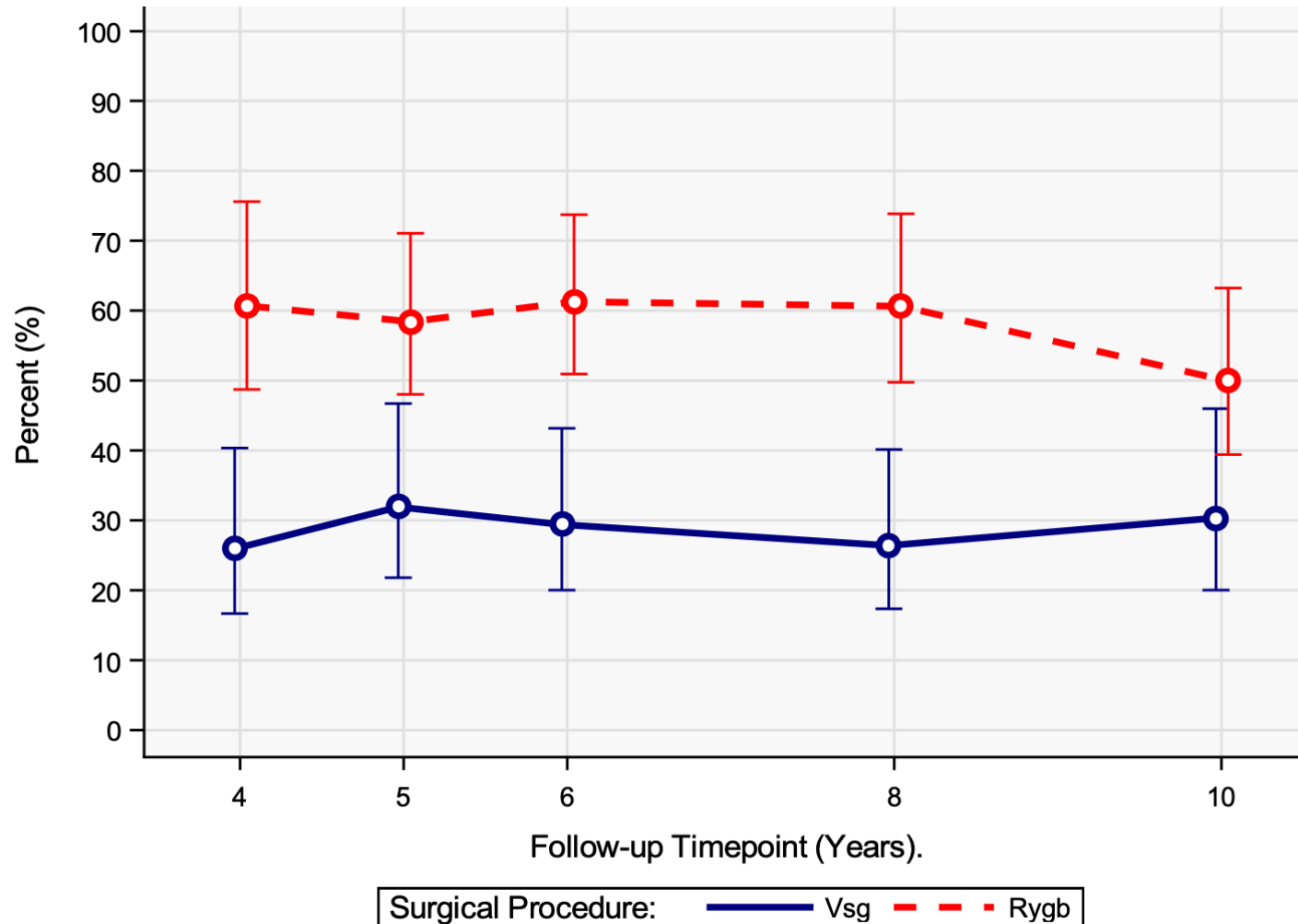
		Baseline	10yrs
		Prevalence	Incidence
B Vitamins	Low Vitamin B12		
	RYGB	0	0
	VSG	0	0
	Low Folate		
	RYGB	5%	4%
	VSG	6%	9%
Vit A	Low Vitamin A		
	RYGB	11%	8%
	VSG	4%	1%

Teen Longitudinal Assessment of Bariatric Surgery
www.Teen-LABS.org

Prevalence of Multiple Deficiencies

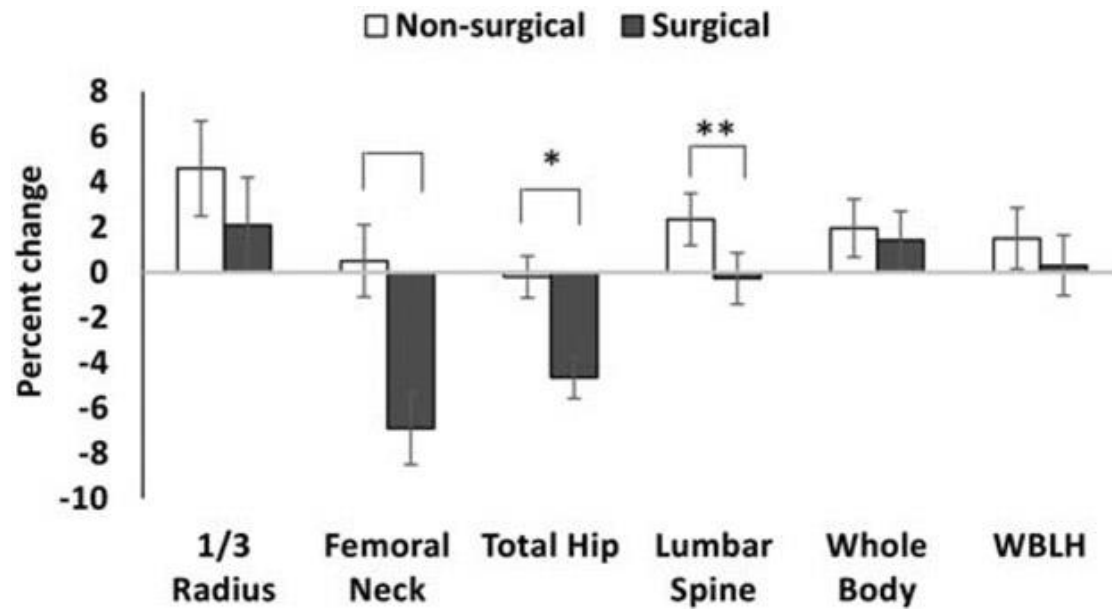


Hemoglobin-defined Anemia by Surgical Procedure & Visit



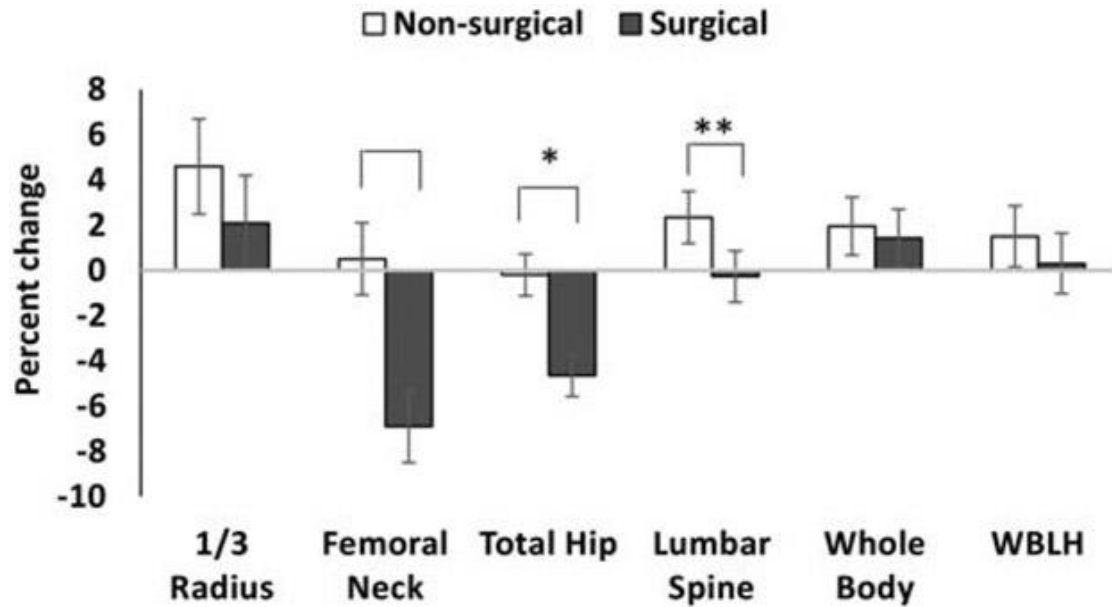
Lower Bone Mineral Density (BMD) after MBS in Adolescents

VSG
2yr



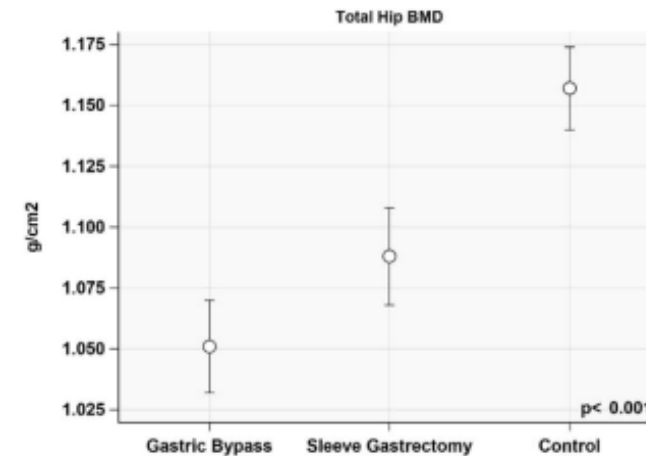
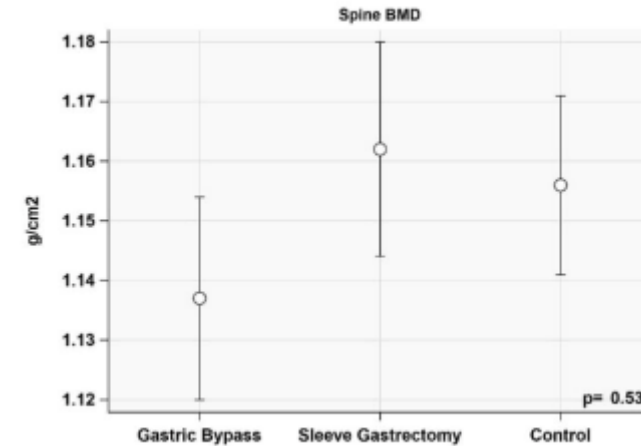
Lower Bone Mineral Density (BMD) after MBS in Adolescents (DEXA)

VSG
2yr



Misra et. al, Bone 2020

RYGB and VSG
Cross-sectional ~9 yrs



Wasserman et al. Inge, Int J Obesity 2024

Bone mineral density in young adults 5 to 11 years after adolescent metabolic and bariatric surgery for severe obesity compared to peers

What Did the Study Show?

Trabecular Bone Outcomes (pQCT at 4% sites - radius & tibia)

- Significantly reduced trabecular bone density in both RYGB and VSG groups vs. controls:
 - Radius: ↓30% (RYGB), ↓15% (VSG)
 - Tibia: ↓26% (RYGB), ↓14% (VSG)
- **Implication:** Trabecular bone may be particularly vulnerable to the **catabolic effects** of bariatric surgery—especially following RYGB.

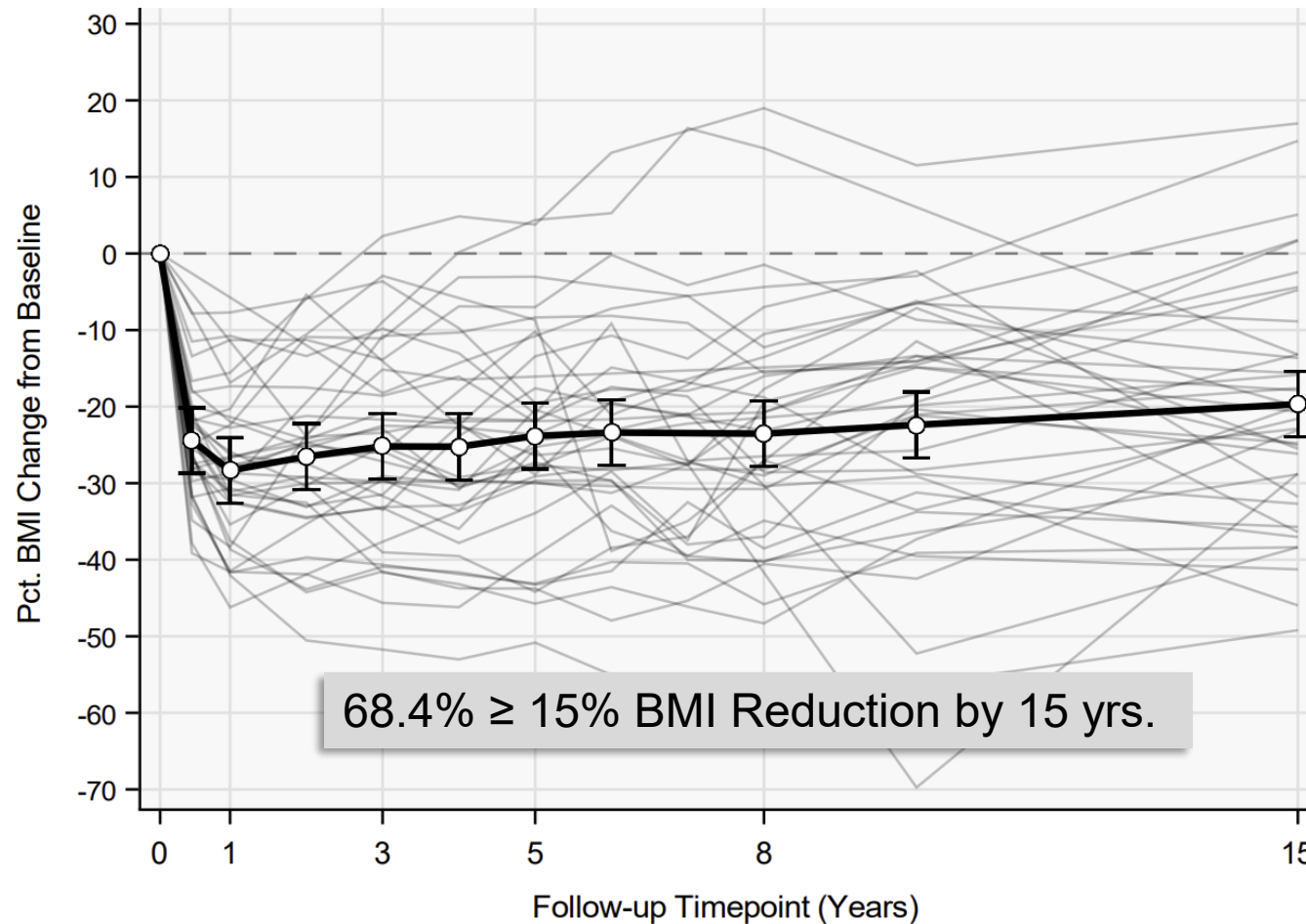
Cortical Bone Outcomes (30% sites - radius & tibia)

- No significant group differences in cortical thickness.
- However, **periosteal circumference** (bone outer diameter) was greater in surgical groups.
- **Strength-Strain Index (SSI)**—an estimate of mechanical strength—was **higher in the surgery group**, suggesting **compensatory modeling** to preserve load-bearing capacity.

Peripheral
Quantitative
CT

15 year outcomes in n=38 (of 40) with data (all RYGB)

	Baseline Mean (SD)	15 Yrs Mean (DS)	Mean Δ (%)	95% CI	P-value
BMI kg/m ²	55.8 (12.1)	44.2 (11.6)	-20.0%	-25.2 to -14/8	<0.001



Results

Outcome	Baseline Mean (SD)	15 Year Mean (SD)	Mean Change	95% CI	P-value
HDL Choles (n=26)	38.0 (10.0)	58.2 (16.8)	[+20.7 mg/dL]	+15.8 to +25.6	<0.001
Triglycerides (n=26)	156.8 (19.6)	114.2 (13.1)	[-42.5 mg/dL]	-72.3 to -12.6	0.007
Diabetes Meds	11/38 (28.9%)	1/38 (2.6%)	[-26.3 %]	—	0.004
Hypertension Meds	11/31 (35.5%)	2/31 (6.5%)	[-29.0%]	—	0.007

Final Nagging Question:

What causes the variability in long term wt loss?

Dietary intake?

Physical activity?

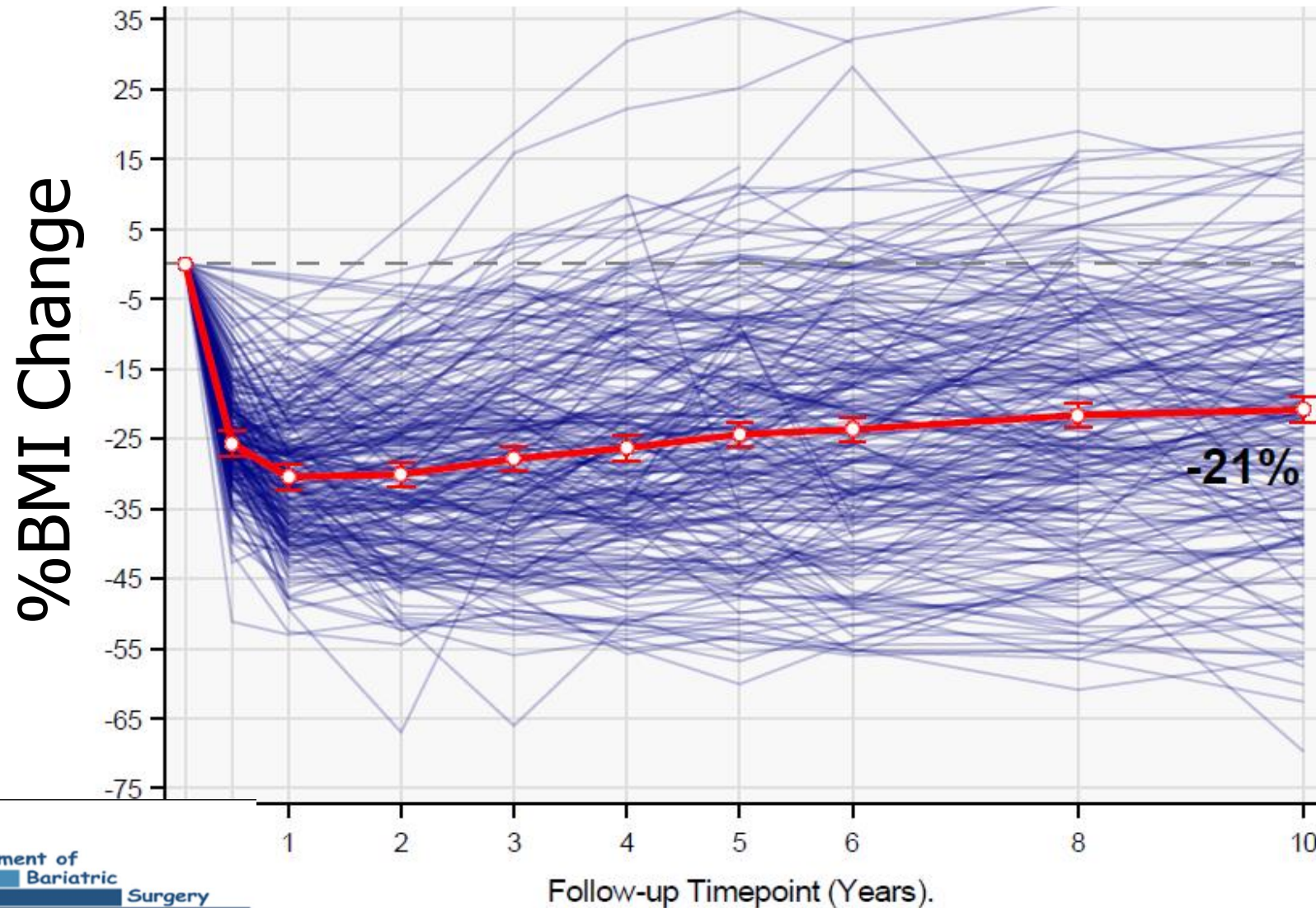
Other lifestyle features?

Genetics?

Metabolomic?

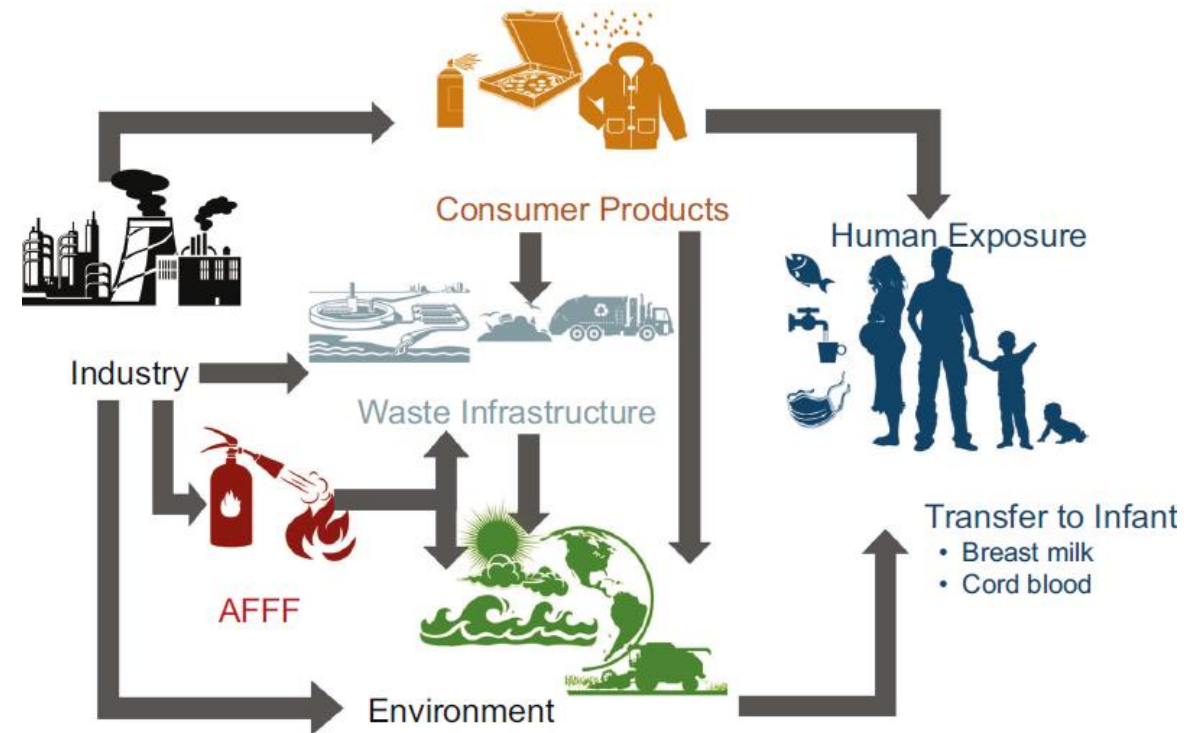
“Environment?”

Long term 10 year BMI outcomes



About the Environment---

- “Forever Chemicals” AKA “persistent environmental pollutants” may play a role
- > 10,000 chemicals widely used in **industrial applications** and **consumer products**
- **Resistant to degradation**
- **Detected in blood of almost everyone in the U.S.**



What are these chemicals exactly?

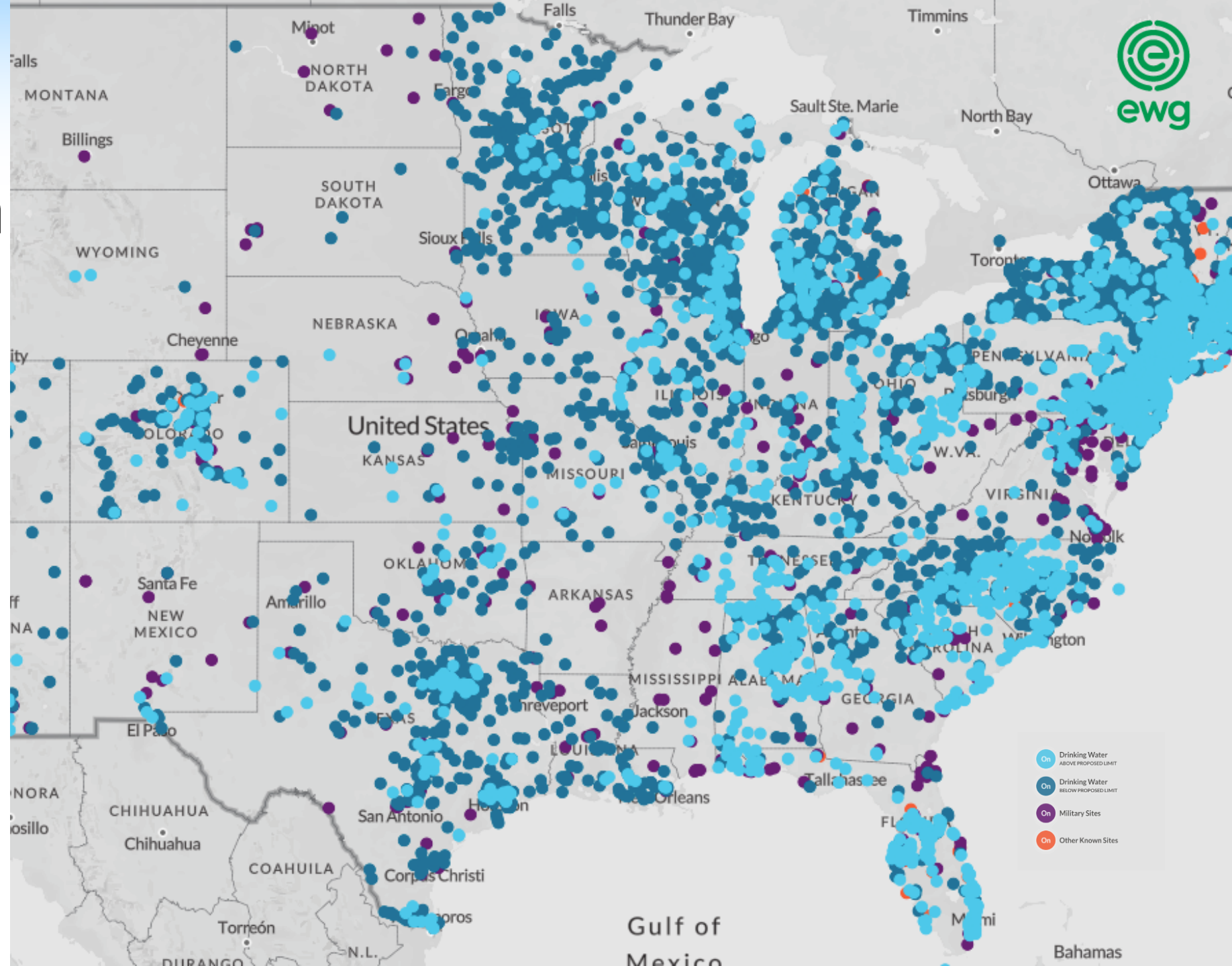
- Per- and polyfluoroalkyl substances (PFAS)
- PFAS are linked to metabolic dysfunction may influence weight regulation by disrupting endocrine and metabolic processes.
- Nothing is known about the impact of PFAS on weight trajectories after bariatric surgery.

Water Contamination in the United States

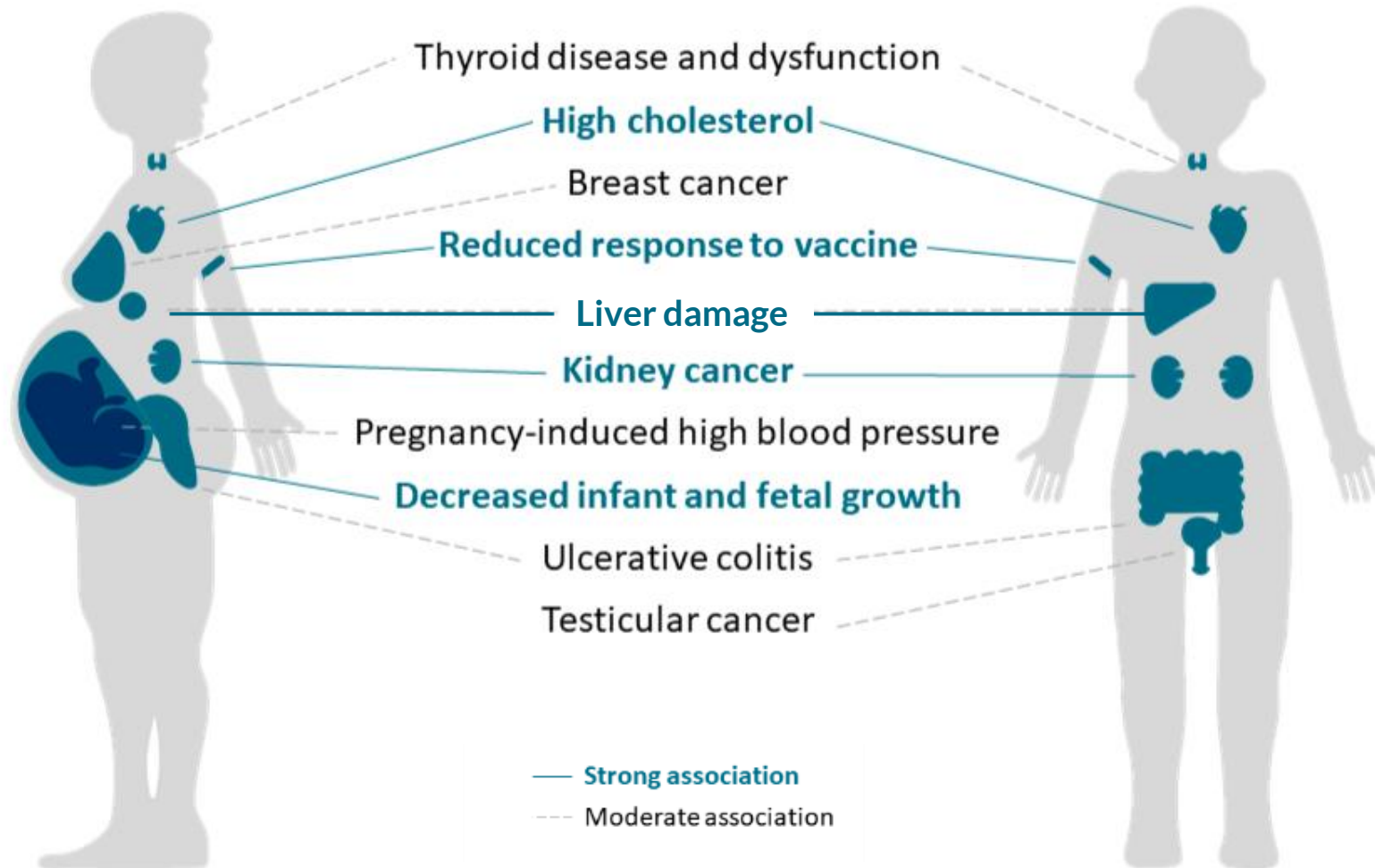
March 24, 2025

8,900 known PFAS contamination sites in the US

143 million people in communities throughout the US have drinking water with detected PFAS concentrations

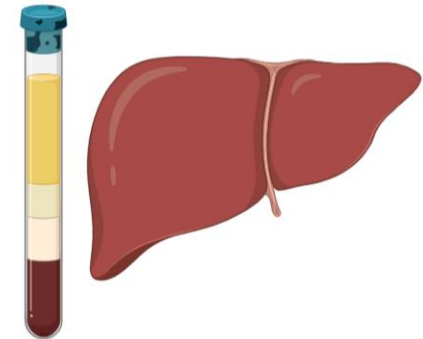


PFAS EXPOSURE



Study Design

- Participants: 186 adolescents from the Teen-LABS (Longitudinal Assessment of Bariatric Surgery) cohort undergoing bariatric surgery (2007–2012).
- Clinical data collected at baseline, 6-, 12-, 36-, and 60-months post-surgery.
- Plasma PFAS measured pre-surgery using LC-MS/MS.

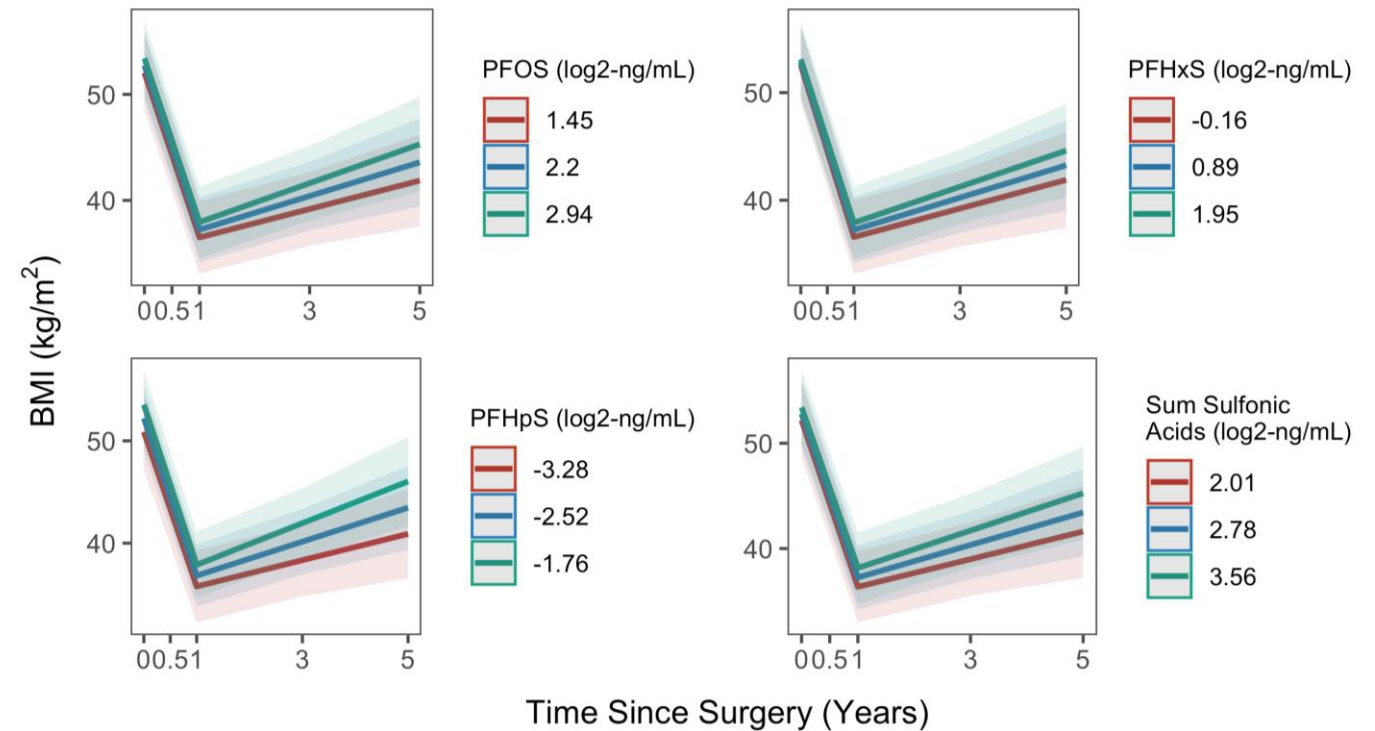


Statistical Analysis

- Linear mixed-effects models which included PFASxTime interaction term, spline at one-year post-surgery, and random intercept for each participant were used to assess PFAS-by-time associations with:
 - BMI (kg/m²)
 - Percent weight loss
 - Waist circumference
- Quantile g-computation to assess effects of PFAS mixtures (total, PFCAs, PFSAAs).
- Adjusted for: age, sex, race, income, and study site.

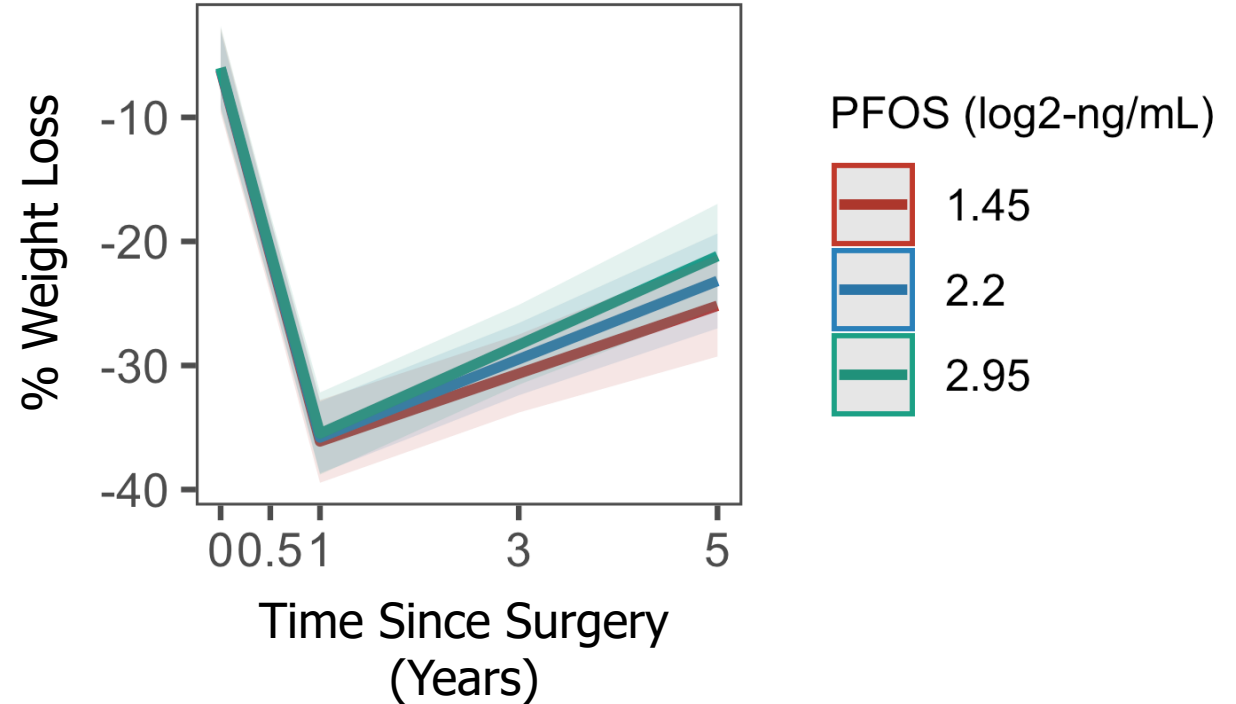
Higher sulfonic acid PFAS concentrations associated with greater BMI regain from 1–5 years post-surgery

- **PFHxS:** At low levels (0.90 ng/mL) BMI regained at rate of 1.33 kg/m² per year. At higher levels (3.86 ng/mL), the rate rose to 1.50 kg/m² per year—a 13% increase.
- **PFHpS:** At low levels (0.10 ng/mL), rate of BMI regain was 1.29 kg/m² per year, at higher levels (0.30 ng/mL) regain was 2.04 kg/m² per year—a 58% increase



Higher sulfonic acid PFAS congeners concentrations associated with less sustained weight loss during the 1–5-year period post bariatric surgery.

- Example: at low PFOS concentrations adolescent with a baseline body weight of 149 kg would, on average, regain about 2.7% (or 4.07 kg) per year, or regain **16.3 kg (36lbs) over four years**
- But at high PFOS concentrations regain increases to 3.5% per year or **21.3 kg (46.9 lbs) over 4 years**
- These findings highlight the **hidden role for PFAS exposure to undermine long-term surgical outcomes**, and contribute to BMI variability
- Emphasizes need for environmental health considerations in obesity treatment.



Conclusions

- Adolescent severe obesity prevalence is increasing, as are comorbidities.
- Bariatric surgery is an effective, underutilized intervention
- Early intervention is particularly important for optimal reversal of T2DM and HTN
- Adverse nutritional impact is modest at best, treatable, and may be less with VSG compared to RYGB
- Variability in weight regain is complex, but we should NOT blame the patient as hidden factors are likely in play



May 3rd-7th

“NO ONE LEFT BEHIND”