Is Bariatric Surgery Still Relevant in the Era of GLP-1 Medications?

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Disclosure

Advisory Board: Boehringer Ingelheim; Currax; Lilly; Novo Nordisk

Consultant: Boehringer Ingelheim; Currax; Lilly; Novo Nordisk

Research Grant: Ethicon Endosurgery

Speaker's Bureau: Lilly; Novo Nordisk

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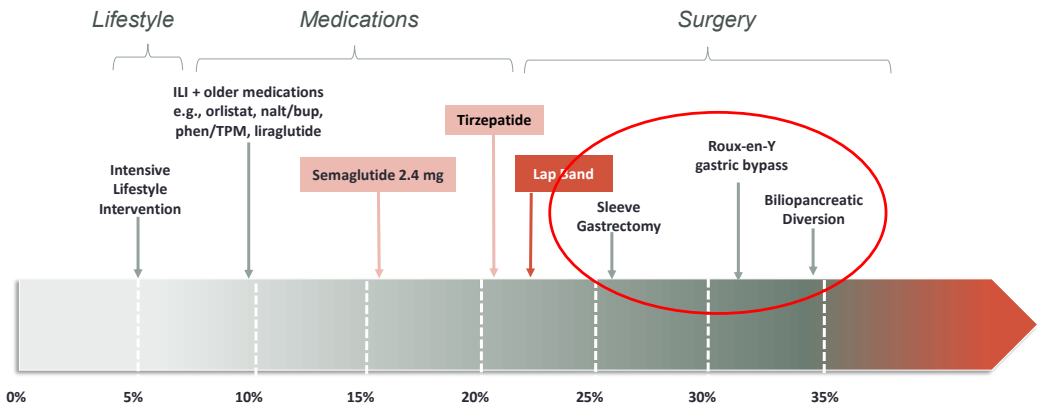
Objectives

- Describe the currently performed bariatric surgery procedures and their physiologic mechanisms of weight loss;
- Relate the safety and efficacy profiles of those surgeries;
- Discuss the barriers and challenges of bariatric surgery and the need for life-long macro and micronutrient monitoring;
- Identify areas to mitigate post-op weight recurrence which will likely encompass adjunctive pharmacotherapy for even longer term success

3

Weight Management Intensification Options



nal/bup, naltrexone/bupropion; phen/TPM, phentermine/topiramate

Allison DB, et al. *Obesity*. 2012;20(2):330-342. [EQUIP]; Gadde KM, et al. *Lancet*. 2011;37:1341-1352. [CONQER]; Greenway FL, et al. *Lancet*. 2010;376:595-605. [COR-I]; Apovian CM, et al. *Obesity*. 2013;21:935-943 [COR-II]; Wadden TA, et al. *Obesity*. 2011;19(1):110-120. [COR-BMOD]; Pi-Sunyer X, et al. *N Engl J Med*. 2015;373(1):11-22. [SCALE]; Wadden TA, et al. *In J Obes*. 2013;37:1443-1451. [SCALE MAIN]; Enebo LB, et al. Wilding JPH, et al. *N Engl J Med*. 2021;384(11):989. [STEP 1]; Wadden TA, et al. *JAMA*. 2021;325(14):1403-1413. [STEP 3]; Rubino D, et al. *JAMA*. 2021;325(14):1414-1425. [STEP 4]; Ryan D. *Lancet Diabetes Endocrinol*. 2021;9(5):252-254. [STEP]; Sjöström L, et al. *N Engl J Med*. 2007;357:741-52. [Surgery].

4

Considerations and Benefits for Surgical Treatment

Indicated for patients with[1]:

- BMI 35-39.9 kg/m^2 and ≥1 obesity-related comorbidity
- BMI ≥40 kg/m^2
- BMI 30-34.9 kg/m^2: can consider to treat T2DM[2]

- Complications rare when performed at a COE[3]
- Nutritional deficiencies are not uncommon[4]
- Long-term reduction in[1]:
  - Body weight
  - Cardiovascular biomarkers, events
  - Multiple weight-related complications
- **Need for ongoing support and intervention**

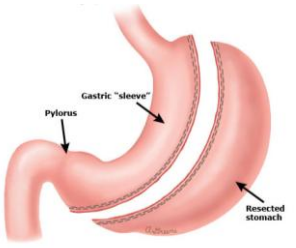
1. Jensen MD, et al. *Circulation*. 2014;129(25 Suppl 2):S102-S138. 2. American Diabetes Association. *Diabetes Care*. 2022;45(suppl 1): S113-S124. 3. Arterburn DE, et al. *Br Med J*. 2014;349:g3961. 4. Toh SY, et al. *Nutrition*. 2009;25(11-12):1150-1156.

5

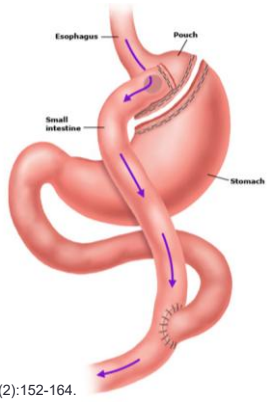
Most Common Bariatric Procedures

99% performed laparoscopically
Average length of stay: 1.2 days

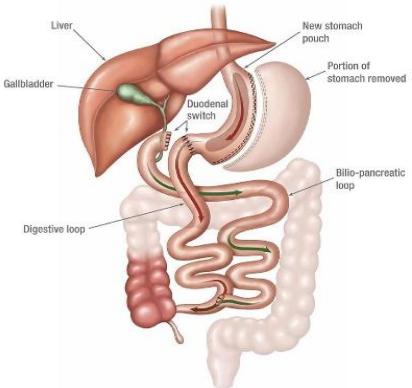
Sleeve Gastrectomy



Roux-en-Y Gastric Bypass



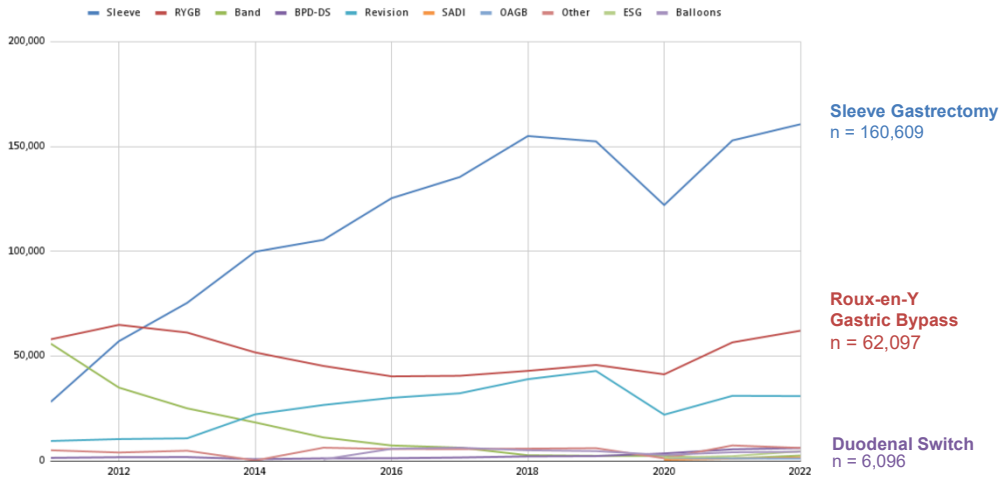
Duodenal Switch



Madsbad S, et al. *Lancet Diabetes Endocrinol*. 2014;2(2):152-164.
American Society of Metabolic and Bariatric Surgery. Accessed September 30, 2020. http://asmbs.org/resources/estimate-of-bariatric-surgery-numbers

6

Most Common Bariatric Procedures, 2011-2024



American Society for Metabolic and Bariatric Surgery. Estimate of Bariatric Surgery Numbers, 2011-2022. Accessed November 9, 2025. https://asmbs.org/resources/estimate-of-bariatric-surgery-numbers/

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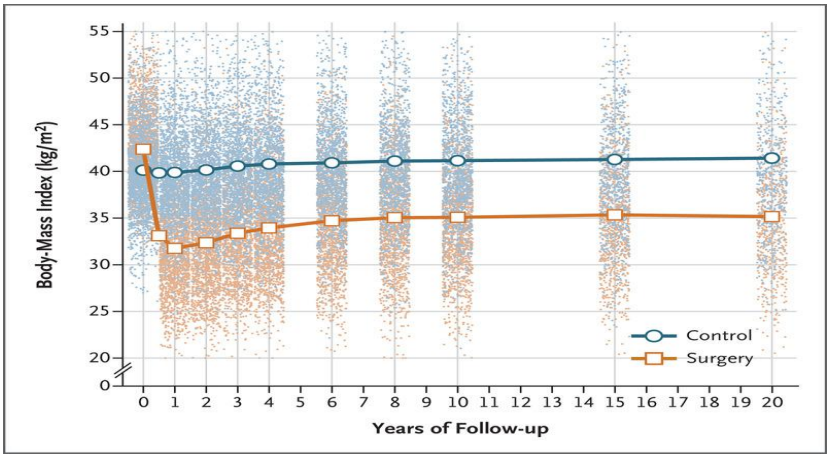
Long-Term Efficacy of Bariatric Surgery



Carlsson, Lena MS, et al. "Life expectancy after bariatric surgery in the Swedish obese subjects study." New England Journal of Medicine 383.16 (2020): 1535-1543

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Biological Changes Induced by Weight Loss

	Diet	Bariatric Surgery
Ghrelin	↑	↓
GLP-1	↓	↑
Bile acid secretion	=	↑
Perceived hunger	↑	↓
Perceived satiety	↓	↑
PYY 3-36	↓	↑
Leptin	↓	↓
Gut microbiota	↑ (with weight loss)	↑ (leaner)
Food preferences	Altered	Altered

GLP-1, glucagon-like peptide-1; PYY, peptide YY

Pucci A, et al. *J Endocrinol Invest.* 2019;42:117-128.

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Why Does Bariatric Surgery Work So Well?

Food Intake

- Changes in hunger and fullness via enhanced satiety leading to decrease in calorie intake
- Mean caloric intake 600-700 one month postop to 1000-1800 after first year
- Average reduction of 1800 kcal per day from pre-op intake sustained for several years

Potential Mediators of Decreased Food Intake

- Increased transit of food into mid-gut through gastric pouch

Mediators for Food Preferences

- Taste function domains
- Sensory-discriminative *(stimulus identification)*
- Hedonic *(ingestive motivation) altered brain responsivity to high calorie food cues*
- Physiological *(digestive preparation)*

Hormonal

- GLP-1 and PYY increase
- Ghrelin decreases

Change in Gut Microbiota

- Short chain fatty acids – calorie extraction/signals

Energy Expenditure

- Increase/Decrease basal metabolic rate after bariatric surgery – in gut?

Food Preferences Change

- Dumping syndrome?
- Conditioned food avoidance?

Calorie Malabsorption

- Exclusion of 10% of the bowel after RYGB unlikely to result in malabsorption

Neural

- Vagal and partial vagal transection

Change in Bile Acids

- Partly responsible for intestinal hypertrophy, anorexigenic hormone secretion and alterations in gut microbiota; activation of FXR signaling

Madsbad S, et al. *Lancet Diabetes Endocrinol.* 2014:2:152-164.

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Metabolic Benefits of Bariatric (Metabolic) Surgery

Liao J et al. Forn Endocrinol Oct 2022, Wiggins T et al, PLOS 2020, Lassailly G et al, Gastroenterology Oct 2020, Aminian Ali et al, JAMA 2022.

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Weight Loss and CV Events

SOS (mean weight loss 16%) and Long-term Cardiovascular Events:

Bariatric Surgery is associated with a decrease in cardiovascular events.

Total CV events (MI or stroke):

- **Surgery: 199 events**
- **Control: 234 events**

- **Unadjusted hazard ratio 0.83; 95% CI 0.69-1.0; *P* <0.05**

CV, cardiovascular; MI, myocardial infarction; SOS, Swedish Obese Subjects

Sjöström L, et al. *JAMA*. 2012;307(1):56-65.

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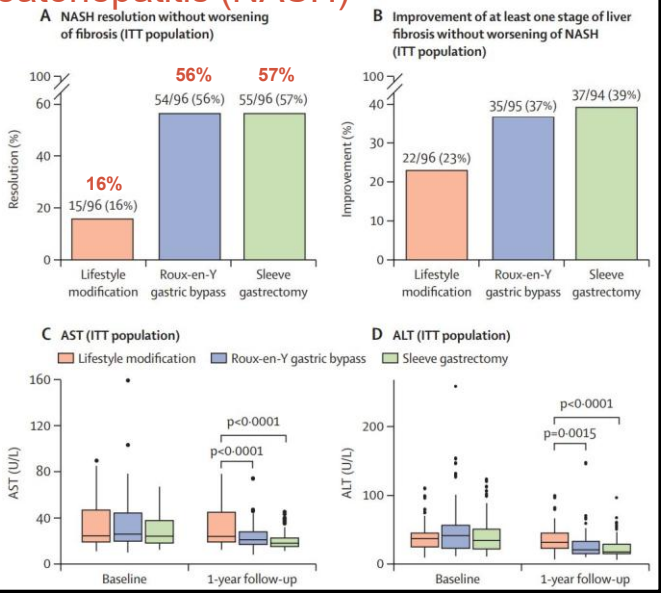
Bariatric Surgery vs Lifestyle Intervention Plus Best Medical Care in Non-alcoholic Steatohepatitis (NASH)

(BRAVES): Multicenter, Open-Label, Randomized Trial

Conclusion:
Bariatric-metabolic surgery is more effective than lifestyle interventions and optimized medical therapy in the treatment of NASH



ALT, alanine aminotransferase; AST, aspartate aminotransferase

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Association of Bariatric Surgery with Cancer Risk and Mortality in Adults with Obesity

- 30,318 patients, median age 46 years, mean BMI 45 kg/m^2
- Obesity-associated cancer at 10 years
  - **2.9%** in the bariatric surgery group; **4.9%** in the non-surgical control group
  - HR 0.68; 95% CI, 0.53-0.87; *P* = 0.002
- Cancer-related mortality at 10 years
  - **0.8%** in the bariatric surgery group; **1.4%** in the non-surgical control group
  - HR 0.52; 95% CI, 0.31-0.88; *P* = 0.01

Conclusion:
Surgery was associated with a significantly lower incidence of obesity-associated cancer and cancer-related mortality

Aminian A, et al. JAMA. 2022;327(24):2423-2433.

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Long-Term, All-Cause, and Cause-Specific Mortality for 4 Bariatric Surgery Procedures

- N = 21,837 matched pairs, surgery and non-surgery
- 40 years follow-up
- Incidences of malignant neoplasms, diabetes, and major CV diseases were significantly lower in the surgery groups across most age groups

Post-op mortality after surgery vs non-surgery decreased significantly by:

- **29% for CV disease**
- **43% for cancer**
- **72% for diabetes**

Adams TD, et al. *Obesity (Silver Spring)*. 2023;31(2):574-585.

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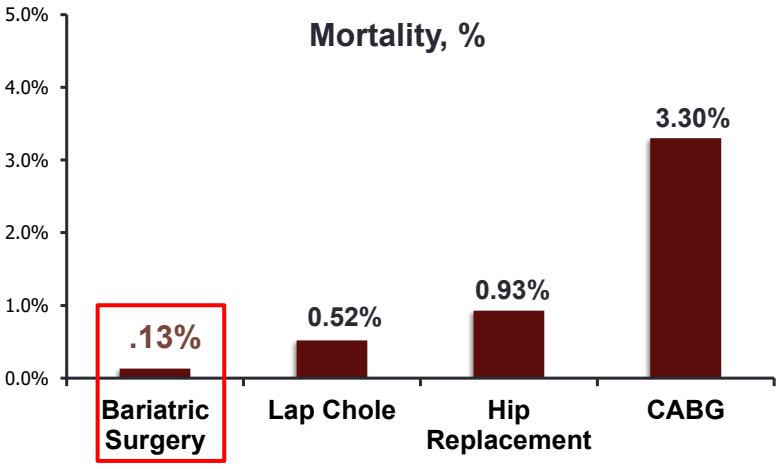
Bariatric Surgery: Low Mortality

0.13% Mortality; n=5365 Bariatric Surgery Patients From 2012–June 2016

When performed at a bariatric Surgery Center of Excellence



Obes Surg. 2008 Jun;18(6):660-7. doi: 10.1007/s11695-007-9357-y. Epub 2008 Apr 3.

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BUT……..

There Are Lifelong Consequences……

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General Recommendations for Bariatric Surgery Follow-up Care

Surgery Follow-up	☐ Monitor weight and evidence of complications
	☐ Assess adherence to lifestyle interventions
	☐ Assess cardiovascular fitness, sleep, mood, substance use, social engagement
	☐ Chemistry, CBC/platelets (complete blood count), lipids
	☐ Avoid NSAIDs (nonsteroidal anti-inflammatory drugs)
	☐ Adjust medications as needed (diabetes, HTN)
	☐ Vitamin, trace element supplementation
	☐ Consider support groups / long-term follow up

CBC, complete blood count; HTN, hypertension; NSAIDs, nonsteroidal anti-inflammatory drugs

Mechanick J, et al. *Endocr Pract.* 2019;25(Suppl 2):1-75.

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Nutritional and Deficiencies After Bariatric Surgery

Gastric Restrictive Procedures
- **Iron** deficiency 32%
- **Thiamine** deficiency

Roux-en-Y Gastric Bypass
- **Calcium** (50% - 60%)
- **Vitamin D** (20% - 60%)
- **Iron** 15% - 50% (49% - 52% with BMI >50)
  - Decreased acidification and proximal small bowel absorption
- **B12** 10% - 70%, 1 to 9 years after[a] (half-life 400 days)
  - Decreased liberation of B12 from protein foods
  - Decreased intrinsic factor production
  - Decreased ileal absorption
  - Requirement = 2 mcg/day; stores = 3000 to 5000 mcg
- **Thiamin** deficiency
- **Folic acid** 10% - 35% due to low intake and ↓ gastric acid
- **Protein** (<1% - 4.7%)[1]

[a]Earlier if B12 deficiency occurs preoperatively.
1.Faintuch J, et al. *Obes Surg.* 2004;14(2):175-181.
Kushner R, Still C. *Nutrition and Bariatric Surgery*. 2014; CRC Press. Boca Raton, FL.

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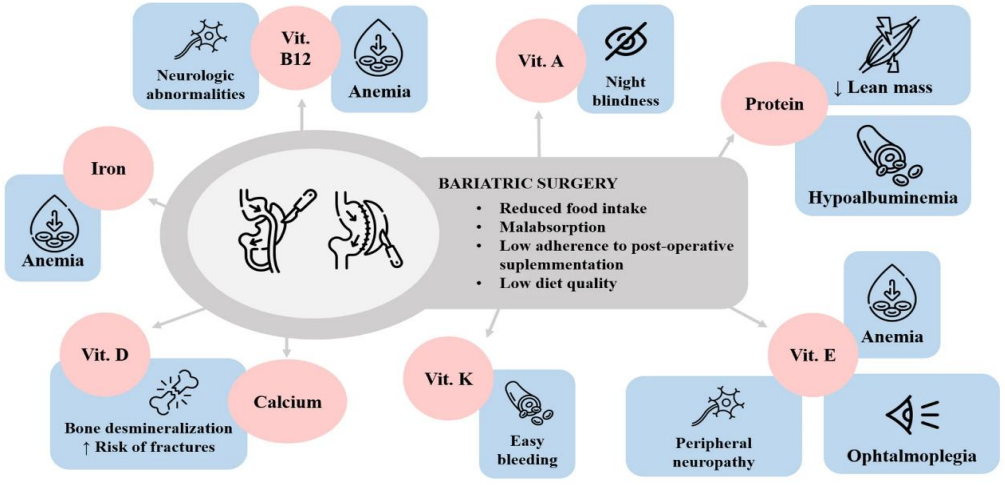
Clinical Manifestations of Nutrient Deficencies



Maite Aguas-Ayesa et al. Reviews in Endocrine and Metabolic disorders March 2023.

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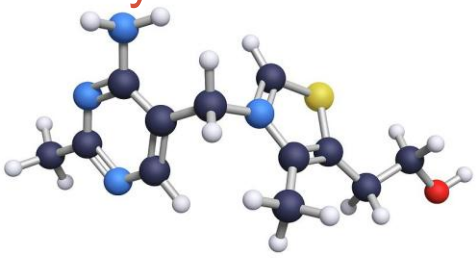
Thiamine Deficiency

- Stores last 3 to 6 weeks
- Decreased gastric acid production
- Altered gastrointestinal anatomy
- Decreased food intake
- Frequent vomiting
- Dextrose infusion



Vitamin B_1
$[C_{12}H_{17}N_4OS]^+$
thiamine

WHEN YOU THINK OF IT:
GIVE IT

Kushner R, Still C. Nutrition and Bariatric Surgery. 2014; CRC Press. Boca Raton, FL.

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Routine Vitamin and Mineral Supplementation for RYGB Patients

Supplement	Dosage
Multivitamin	1 to 2 daily
Calcium citrate with vitamin D	1200 to 2000 mg/day + 3000 U/day vitamin D
Elemental iron	40 to 65 mg/day
Vitamin B12	5000 µg/day orally *OR* 1000 µg/month IM *OR* 500 µg weekly intranasal

Kushner R, Still C. Nutrition and Bariatric Surgery. 2014; CRC Press. Boca Raton, FL.

22

Mental Health Adverse Outcomes
Review of 32 Studies

Post-bariatric surgery patients had higher self-harm/suicide attempt risk compared to age-, sex-, and BMI-matched controls."

Castaneda D, et al. *Obes Surg*. 2019 Jan;29(1):322-333.

23

METABOLIC SURGERY IN THE ERA OF GLP-1'S

Summary of Nature Medicine Review (Dec 2025)

Kohlwes, J., & Brett, A. S. (2025). *Metabolic Surgery in the Era of GLP-1 Receptor Agonists* (Review of Nature Medicine article). NEJM Clinician, 2025.

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Study Overview

- Observational study, 2010–2017.
- 1,700 surgical patients (RYGB or sleeve gastrectomy).
- 2,300 GLP-1 RA patients (primarily liraglutide, dulaglutide).
- Baseline differences adjusted statistically.

Key Results

- 10-year mortality: 9% surgery vs. 12% GLP-1 RAs.
- MACE: 24% surgery vs. 34% GLP-1 RAs.
- Microvascular complications ~50% lower with surgery.

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Interpretation & Limitations

- Newer GLP-1s (e.g., semaglutide, tirzepatide) not represented.
- GLP-1 group used intermediate-potency agents.
- Residual confounding is possible.
- Surgery remains strong option for long-term risk reduction.

Clinical Takeaways

- Metabolic surgery showed lower 10-year mortality than GLP-1 RAs.
- Stronger reductions in cardiovascular and microvascular complications.

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BARIATRIC SURGERY VS GLP-1'S

Body Composition Outcomes – JAMA (2026)

Wang Z, Wang L, Zhang X, Lowery BD, Shaffer LL, Chen Y, et al. Body composition changes after bariatric surgery or GLP-1 receptor agonist treatment. *JAMA Netw Open.* 2026 Jan 9;9(1):e2553323

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Study Overview

- Retrospective cohort (VUMC), n = 3,066
- Bariatric surgery: 1,257 patients
- GLP-1RA (semaglutide/tirzepatide): 1,809 patients
- Follow-up: 24 months
- Outcomes: Fat mass (FM), Fat-free mass (FFM)

Baseline Characteristics

- Surgery group higher baseline BMI (46.8 vs 41.0)
- GLP-1RA group more hypertension/dyslipidemia
- Surgery group had more diabetes

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Fat Mass Reduction

Surgery:
- 42.4% at 6 months
- 49.7% at 12 and 24 months

GLP-1RAs:
- 10.3% at 6 months
- 17.3% at 12 months
- 18.0% at 24 months

Fat **Free** Mass Reduction

Surgery:
- 7.8% at 6 months
- 10.6% at 12 months
- 11.7% at 24 months

GLP-1RAs:
- 1.8% at 6 months
- 3.0% at 12 months
- 3.3% at 24 months

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Sex Differences

- Men preserved FFM better than women
- Women had greater %FFM loss after both treatments
- Ratio improvements seen in both sexes

Conclusions

- Both treatments reduced FM and FFM
- Surgery produced larger reductions in both compartments
- GLP-1RAs showed milder but favorable shifts in composition

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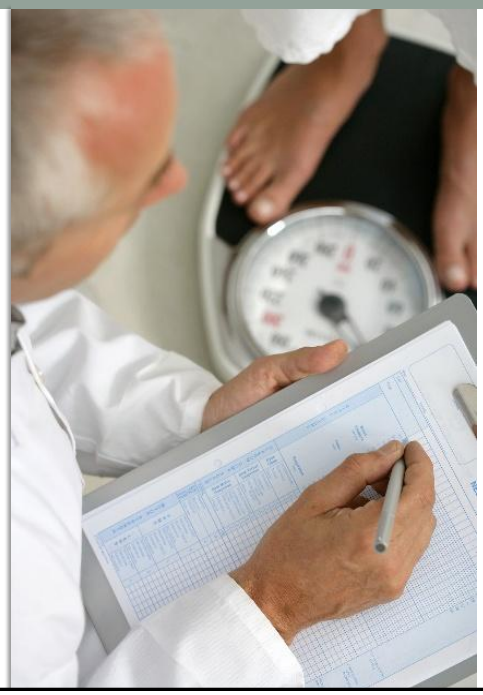

Weight Recurrence Is Common

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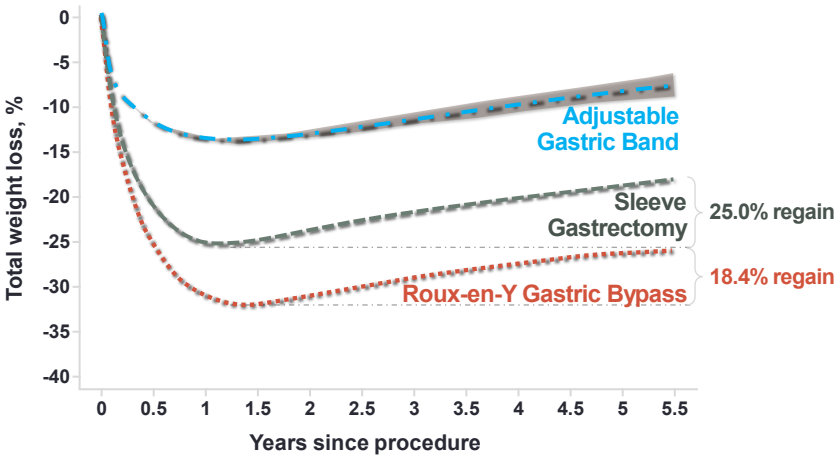
Comparative Effectiveness and Weight Regain Between Bariatric Surgery Procedures

[A PCORnet Cohort Study] N=44,978



Arterburn, et al. *Ann Intern Med.* 2018;169(11):741-750.

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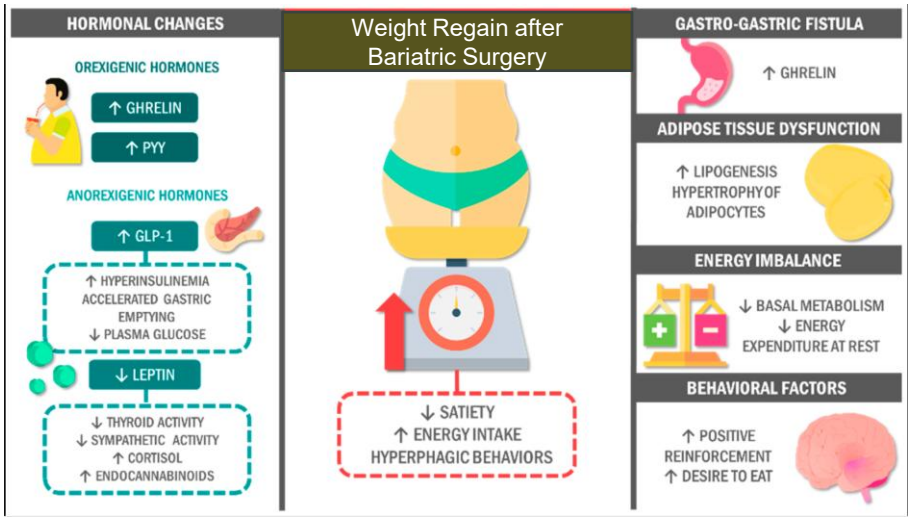
Biology of Weight Regain After Bariatric Surgery



Juan Salazar et al. J Clin Med 2024.

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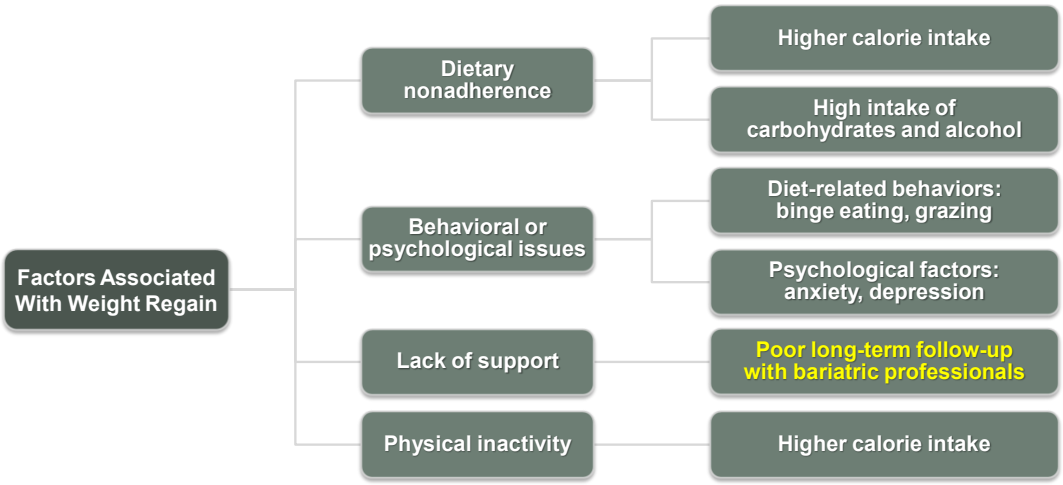
Factors Associated with Weight Regain After Bariatric Surgery: A Scoping Review



Kaouk, et al. *F1000 Research.* 2020;8:615..

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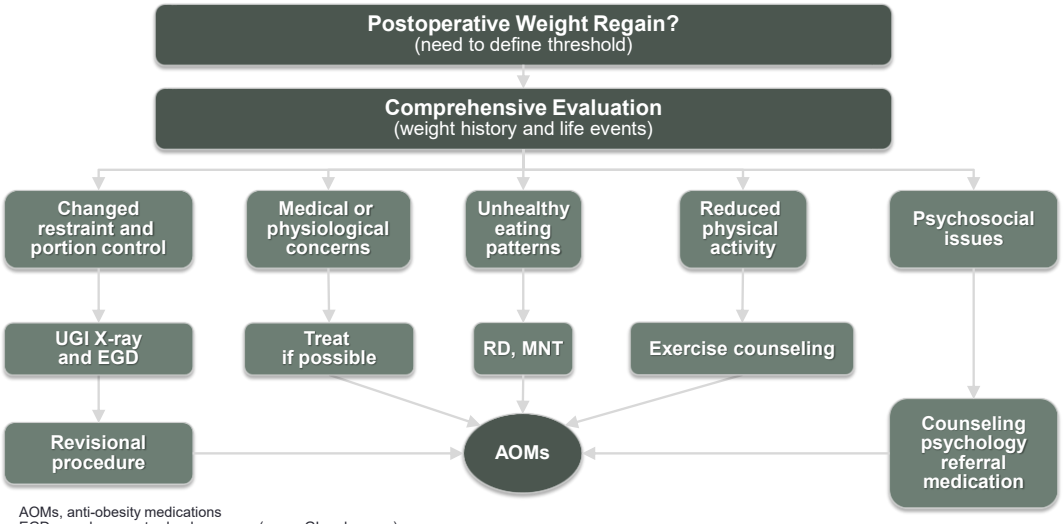
Treatment Pathway



AOMs, anti-obesity medications
EGD, esophagogastroduodenoscopy (upper GI endoscopy)
MNT, medical nutrition therapy
RD, registered dietitian
UGI, upper gastrointestinal.

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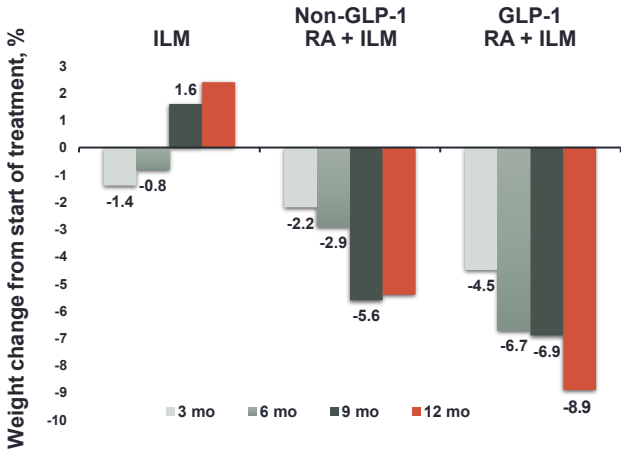
Real-World Outcomes of Treatment Strategies for Weight Regain Post–Bariatric Surgery (Mean Weight Regain >40%)



- N=207 post–bariatric surgery patients
- Retrospective study:
  - Intensive lifestyle modification (ILM)
  - Non-GLP-1 RA-based weight-loss pharmacotherapy + ILM
  - GLP-1 RA-based weight loss pharmacotherapy + ILM
- **Significantly more patients in the GLP-1 RA + ILM group achieved ≥5% weight loss**
- Treatment group (not surgery type) was the only significant predictor of weight regain

Gazda, et al. *Obesity (Silver Spring)*. 2021;29(5):829-836.

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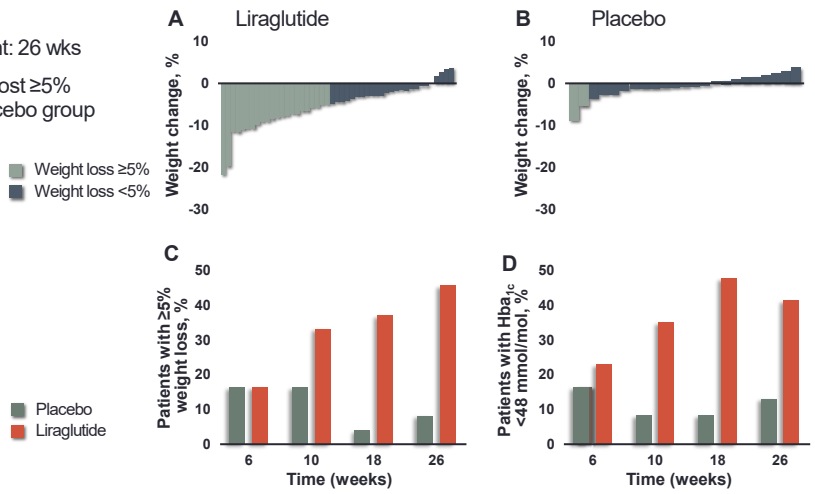
Use of Liraglutide 1.8 mg/d After Metabolic Surgery for Weight Regain and Recurrent T2DM: Randomized, Double-Blind, Placebo-Controlled Trial (GRAVITAS)

n=80

≥1 year post-op treatment: 26 wks

46% of liraglutide group lost ≥5% weight vs 9% lost by placebo group



Miras, et al. *Lancet Diabetes Endocrinol*. 2019;7(7):549-559.

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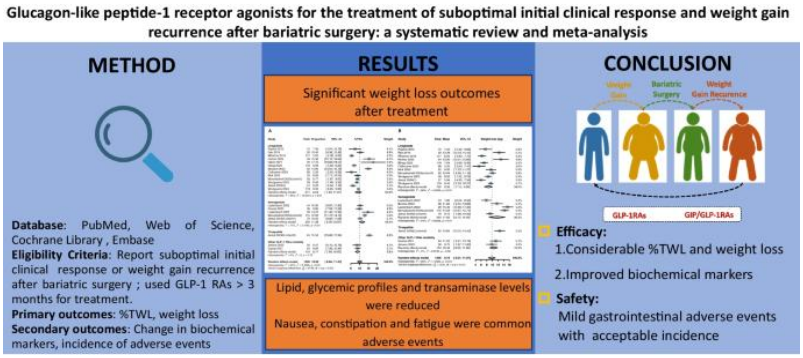
Glucagon-Like Peptide-1 Receptor Agonists for the Treatment of Suboptimal Initial Clinical Response and Weight Gain Recurrence After Bariatric Surgery: A Systematic Review and Meta-analysis



Nie Y, Zhang Y, Liu B, Meng H. Glucagon-Like Peptide-1 Receptor Agonists for the Treatment of Suboptimal Initial Clinical Response and Weight Gain Recurrence After Bariatric Surgery: a Systematic Review and Meta-analysis. **Obes Surg. 2025 Mar;35(3):808-822.**

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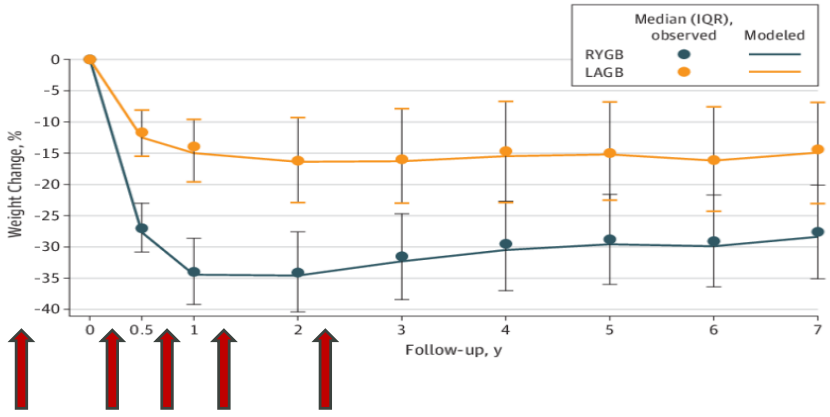
What Is the Optimal Timing of Adding AOM's Post MBS?



Courcoulas et al. JAMA Surgery 2017.

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Continued Accountability Is Key for Longterm Success

Patient establishes care with weight loss provider in clinic. Started on OMMs and/or referred to surgery

Patient establishes care with bariatric surgeon. Undergoes surgery if meeting criteria.

Continues to follow up in clinic with the same team to monitor weight loss and also close follow up with Registered dietician.

Close follow up allows for early intervention

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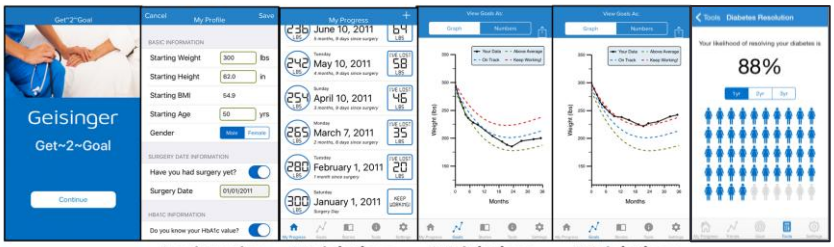
FREE App for Patient Accountability and Follow-up

A Patient-Centered Electronic Tool for Weight Loss Outcomes after Roux-en-Y Gastric Bypass

G. Craig Wood,[1] Peter Benotti,[1] Glenn S. Gerhard,[2] Elaina K. Miller,[3] Yushan Zhang,[3] Richard J. Zaccone,[3] George A. Argyropoulos,[1,4] Anthony T. Petrick,[5] and Christopher D. Still[1,6]



Registration page | Weight loss diary | Weight loss Above average | Weight loss Keep working | DiaRem

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Summary

- Three most common bariatric procedures:
  - Sleeve gastrectomy
  - Roux-en-Y Gastric Bypass
  - Duodenal Switch
- MBS Provides long-term reduction in:
  - Body weight
  - Cardiovascular biomarkers, events
  - Multiple weight-related complications
  - Reduction in some cancers and all cause mortality
- Nutritional deficiencies are not uncommon
- Weight regain is common
  - Continued accountability and early intervention with AOM's is key for long-term success
  - Often times no fault of the patient

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