

Bariatric Surgery Patients Have Higher Rates of Diagnosed Nutritional Deficiencies Than GLP-1 and Other Weight-Loss Medication Patients at 15 Months

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- At 15 months post-treatment, 12.5% of bariatric surgery patients had a new diagnosis of nutritional or iron-deficiency anemia, compared to 4.6% of GLP-1 patients and 3.8% of patients on other weight-loss medications.
- At 15 months, 17.9% of bariatric patients, 13.9% of GLP-1 patients, and 12.9% of patients on other weight-loss medications had a new diagnosis of a vitamin deficiency.
- Among patients who lost more than 30% of body weight, vitamin deficiency rates climbed to 30.6% for bariatric surgery patients, 22.0% for other weight-loss medication patients, and 21.0% for GLP-1 patients.

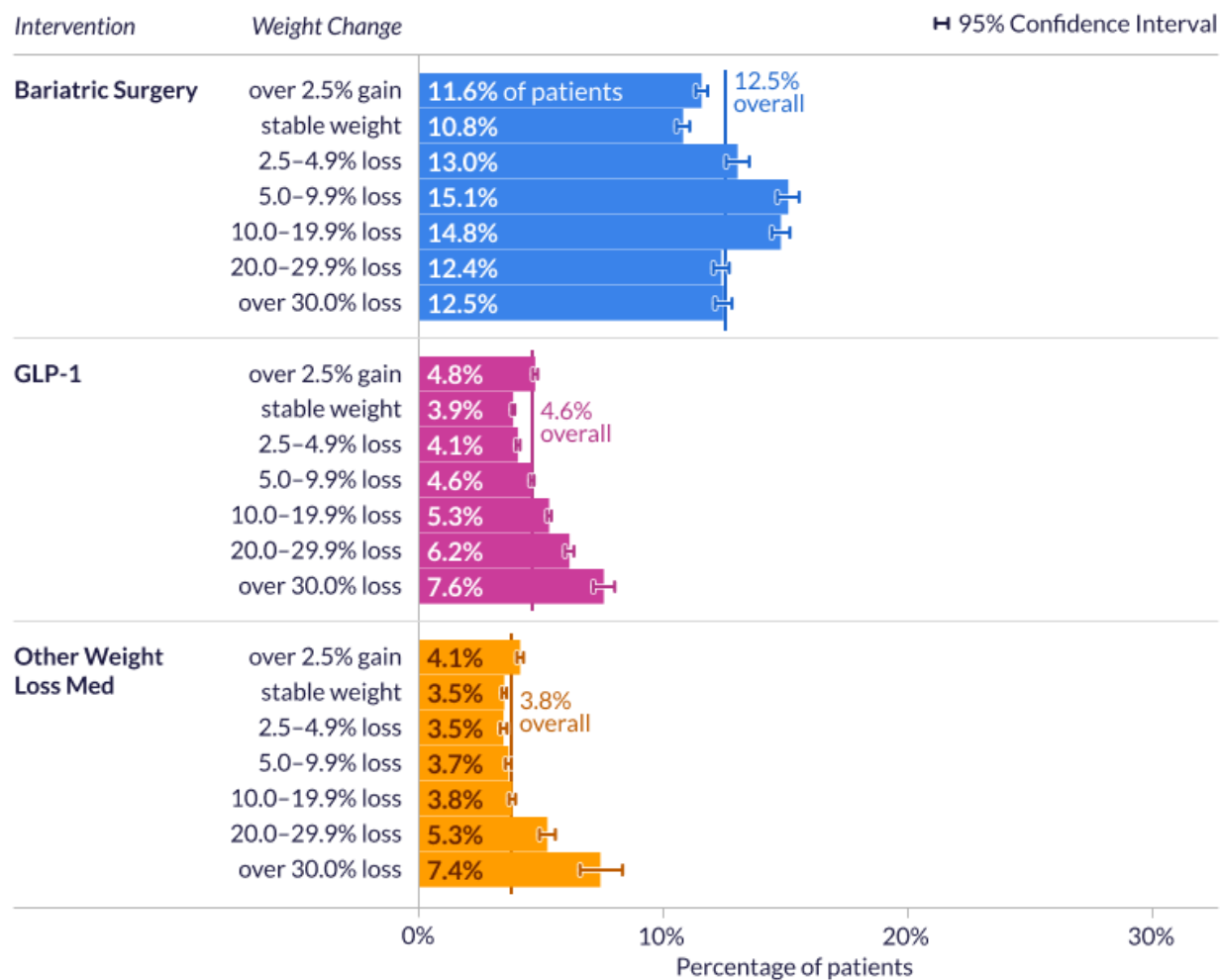
Glucagon-like peptide-1 receptor agonists (GLP-1s) are medications originally developed for type 2 diabetes that produce significant weight loss by reducing appetite and slowing how quickly the stomach empties. Their use for obesity has expanded rapidly: roughly 6% of U.S. adults reported current use in 2024, rising to 22% among adults who are overweight or obese.¹ Because GLP-1s reduce caloric intake by 16% to 39%, recent observational research has raised concern that long-term use could lead to deficiencies in vitamins, minerals, and protein, risks long recognized after bariatric (weight-loss) surgery where standard practice includes routine post-operative nutritional labs and supplementation.² One large claims-based study reported that more than 22% of patients newly prescribed a GLP-1 had a documented nutritional deficiency within one year of starting treatment,³ but how these rates compare to those seen after bariatric surgery or with other weight-loss medications across a similar follow-up window has been less clearly characterized in real-world data. Understanding how diagnosed malnutrition varies by intervention type and by amount of weight loss can help clinicians decide when nutritional screening is warranted and inform emerging guidance on monitoring patients during pharmacologic weight loss.

We studied more than 2 million U.S. adults aged 18 and older who initiated a new weight-loss intervention between January 2018 and December 2025: a GLP-1 prescription, another type of weight-loss medication, or a bariatric surgical procedure. Patients were required to have a documented weight or BMI in the year before starting their intervention and to remain in active follow-up through 15 months post-intervention. We calculated the share of patients in each group who received a new diagnosis of nutritional or iron-deficiency anemia or any vitamin deficiency between 90 days and 15 months after starting treatment and stratified those rates by the percent change in body weight from baseline.

Bariatric surgery patients had higher rates of new nutritional or iron-deficiency anemia diagnoses than patients on either pharmacologic intervention, and this gap held across every level of weight change. Overall, 12.5% of bariatric surgery patients had a new anemia diagnosis at 15 months, compared to 4.6% of GLP-1 patients and 3.8% of patients on other weight-loss medications. Among patients using GLP-1 and other weight-loss medication, anemia rates rose modestly with greater weight loss, ranging from around

3.5% at stable weight to more than 7% among patients losing more than 30% of body weight. In contrast, bariatric surgery patients had anemia rates between 10.8% and 15.1% across all weight-change strata, including those who gained weight or were weight-stable. Because routine post-surgical nutritional monitoring is standard after metabolic and bariatric surgery but is largely absent in pharmacologic weight management,⁴ part of the observed difference between groups might reflect difference in surveillance and detection rather than differences in underlying deficiency.

Percent of Patients with New Anemia by Weight-Change Stratum at 15 Months



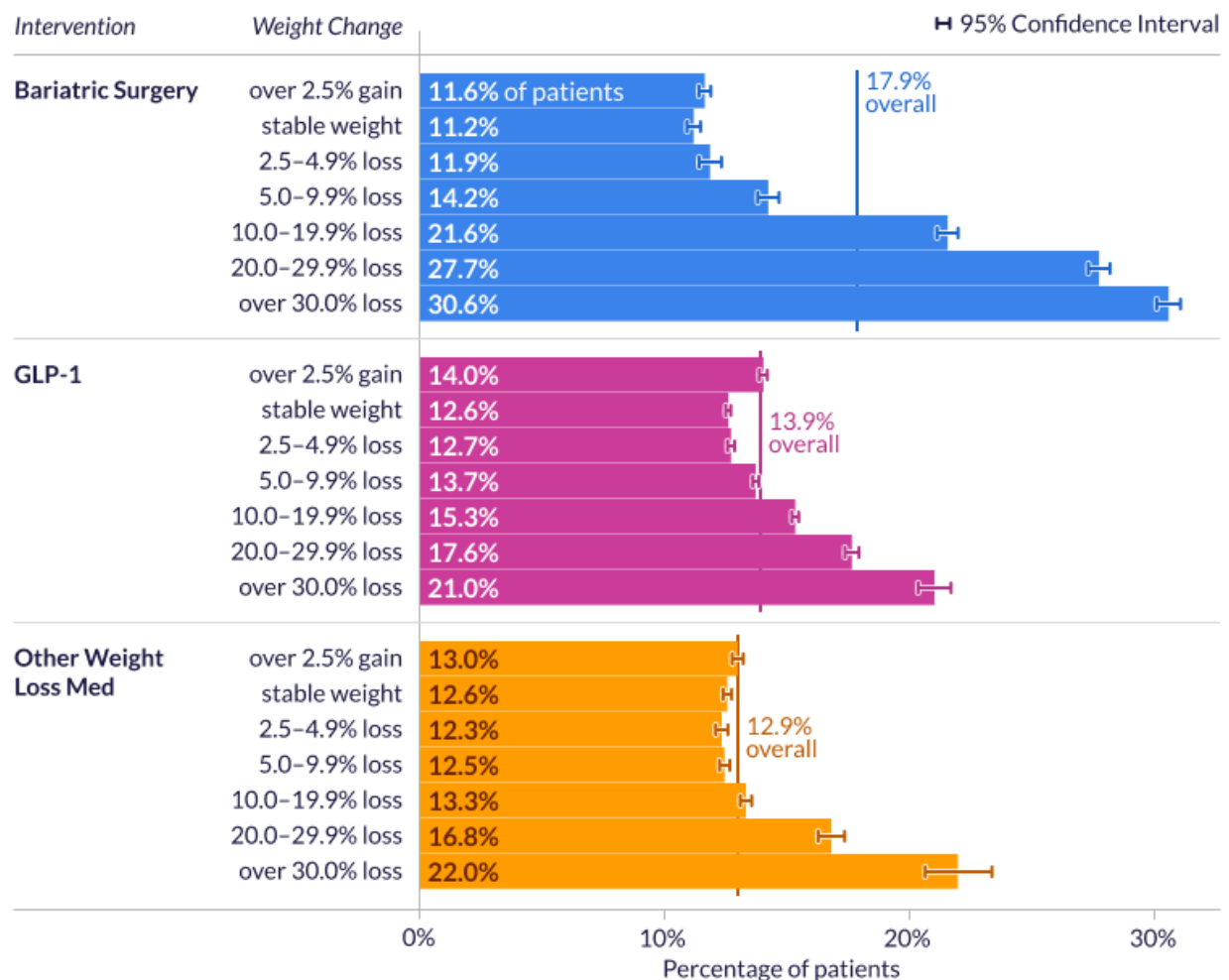
N=2,177,172 adults

"Percent of Patients with New Anemia by Weight-Change Stratum at 15 Months," 2026. EpicResearch.org

Figure 1. Percentage of patients in each treatment group with a new diagnosis of nutritional or iron-deficiency anemia between 90 days and 15 months after starting treatment, stratified by percent change in body weight from baseline.

Vitamin deficiency rates followed a different pattern than anemia. Overall, 17.9% of bariatric surgery patients, 13.9% of GLP-1 patients, and 12.9% of patients on other weight-loss medications had a new vitamin deficiency diagnosis at 15 months. However, the bariatric-medication gap emerged only at losses of 5% or more: among patients who gained weight or lost less than 5%, GLP-1 patients had slightly higher vitamin deficiency rates than bariatric patients (14.0% vs. 11.6% at a gain of 2.5% or more). At larger weight losses, bariatric rates climbed sharply: 30.6% of bariatric patients who lost more than 30% of body weight had a new diagnosis, compared to 21.0% of GLP-1 patients and 22.0% of patients on other weight-loss medications. This divergence at higher weight loss likely reflects both the more profound nutritional impact of surgery at that magnitude of loss and the routine post-surgical monitoring that increases detection.^{2,4}

Percent of Patients with New Vitamin Deficiency by Weight-Change Stratum at 15 Months



N=2,177,172 adults "Percent of Patients with New Vitamin Deficiency by Weight-Change Stratum at 15 Months," 2026. EpicResearch.org

Figure 2. Percentage of patients in each treatment group with a new diagnosis of any vitamin deficiency between 90 days and 15 months after starting treatment, stratified by percent change in body weight from baseline.

A sensitivity analysis accounting for BMI classification, history of conditions such as alcohol use disorder, depression, kidney disease, smoking status, and demographics had similar results.

These data come from Cosmos, a dataset created in collaboration with a community of Epic health systems representing more than 304 million patient records from 2,000 hospitals and more than 47,000 clinics from all 50 U.S. states, Canada, Lebanon, and Saudi Arabia. This study was completed by two teams that worked independently, each composed of a clinician and research scientist. The two teams came to similar conclusions. Graphics by Brian Olson.

References

1. Faruqi A, Stoner SC. GLP-1 receptor agonists – good for body weight, bad for micronutrient status? *Nutrients*. 2025;17(24):3923. doi:10.3390/nu17243923

2. Brown A, Mellor D, Makaronidis J, et al. Bridging the nutrition guidance gap for GLP-1 receptor agonist therapy assisted weight loss: lessons from bariatric surgery. *Int J Obes (Lond)*. Published online November 15, 2025. doi:10.1038/s41366-025-01952-w
3. Butsch WS, Sulo S, Chang AT, et al. Nutritional deficiencies and muscle loss in adults with type 2 diabetes using GLP-1 receptor agonists: a retrospective observational study. *Obes Pillars*. 2025;7:100237. doi:10.1016/j.obpill.2025.100237
4. Mechanick JI, Apovian C, Brethauer S, et al. Clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures – 2019 update. *Surg Obes Relat Dis*. 2020;16(2):175-247. doi:10.1016/j.soard.2019.10.025

Data Definitions

Term	Definition
Study period	1/1/2018 to 12/31/2025
Index date	Date of first qualifying treatment exposure during the study period : <ul style="list-style-type: none"> • GLP-1: first prescription or administration with at least three orders or dispenses that indicate coverage for 90 days • Other weight-loss medication: first prescription or administration with at least two orders or dispenses that indicate coverage for 90 days • Bariatric surgery: date of qualifying surgical procedure
Study population: inclusion	Patients who: <ul style="list-style-type: none"> • Were aged 18 or older at index • Had a residence in the U.S. • Had at least one face-to-face encounter in the two years prior to index date • Had at least one documented weight or BMI in the year prior to index date • Had a GLP-1, bariatric surgery, or other weight-loss medication exposure in the study period • Remained in active follow-up through 15 months post-index
Study population: exclusion	Diagnosis of any outcome condition in the year prior to index date Diagnosis in the 5 years prior to index date : <ul style="list-style-type: none"> • Cancer (ICD-10-CM C00*–C96* or SNOMED 363346000) • Malabsorptive conditions (ICD-10-CM K90.0, K50*, K91.2; SNOMED 396331005, 34000006, 190753003) • End-stage renal disease (ICD-10-CM N18.6 or SNOMED 46177005, 433146000) • Eating disorder (ICD-10-CM F50* or SNOMED 72366004) Pregnancy (ICD-10-CM Z33* or O*) at any point from one year prior to index date through end of follow-up Cross-arm exclusions: <ul style="list-style-type: none"> • Bariatric surgery patients with GLP-1 or other weight-loss medication within 2 years of surgery • GLP-1 patients with any prior bariatric surgery or other weight-loss medication within 2 years of index date • Other weight-loss medication patients with any prior bariatric surgery or GLP-1 use within 2 years of index date
Exposures	GLP-1, bariatric surgery, or other weight-loss medication

Outcomes	<p>New diagnosis between 90 days and 15 months after index date of:</p> <ul style="list-style-type: none"> Nutritional or iron-deficiency anemia: ICD-10-CM D50*-D53*, E61.1, or SNOMED 35240004 or 66612000 Any vitamin deficiency: ICD-10-CM E54, E51*, E53*, E55*, E56*, or SNOMED 85670002
GLP-1	<p>Medication order with simple generic name containing semaglutide, liraglutide, tirzepatide, dulaglutide, lixisenatide, or exenatide</p> <p>Subcutaneous formulations only</p> <p>Persistence: at least 90 days of refill coverage from initial prescription</p> <p>Order modes: prescription or medication administration</p>
Bariatric surgery	<p>A procedure with CPT code 43644, 43645, 43659, 43770, 43771, 43772, 43773, 43774, 43775, 43845, 43846, 43847, 43848, 43886, 43887, 43888, 43842, or 43843, or ICD-10-PCS code 0DB6*, 0DV6*, 0D16*, or 0D19*</p>
Other weight-loss medication	<p>Order with one of the following pharmaceutical classes and not associated with any GLP-1: “ANTI-OBESITY SEROTONIN 2C RECEPTOR AGONISTS,” “ANTI-OBESITY-OPIOID ANTAG-NOREPI,DOPAMINE RU INHIB,” “ANTI-OBESITY – ANOREXIC AGENTS,” or “ANTI-OBESITY – MELANOCORTIN 4 RECEPTOR AGONISTS”</p> <p>Persistence: at least 90 days of refill coverage from initial prescription</p>
Face-to-face encounter	<p>An encounter of type Office Visit, Hospital Encounter, Emergency, Urgent Care, Walk-in, Telemedicine, Surgery, Procedure Visit, Infusion, Follow-up, Consult, Surgical Consult, Transplant Evaluation, Transplant Follow Up, Procedural Consult, Evaluation, Well Child, Postpartum Visit, Initial Prenatal, Routine Prenatal, Home Care Visit, Hospice F2F Visit, Hospital, Nursing Home, Multidisciplinary Visit, or Oncology Survivorship</p>
Stratifications	<p>Weight change from baseline to 15 months post-index, classified as:</p> <ul style="list-style-type: none"> 2.5% or greater gain 2.4% gain to 2.4% loss (stable weight) 2.5% to 4.9% loss 5.0% to 9.9% loss 10.0% to 19.9% loss 20.0% to 29.9% loss 30.0% or greater loss <p>Weight at the end of the observation window is the most recent weight measurement within 183 days of the observation date</p>
Model specifications	<p>Descriptive statistics. Raw event rates and 95% confidence intervals are reported for each outcome within each weight-change stratum and treatment cohort.</p>
Limitations	<p>Bariatric surgery patients receive routine post-operative nutritional monitoring, which likely improves detection of deficiencies relative to GLP-1 and other weight-loss medication patients and may explain part of the observed difference in diagnosis rates.</p> <p>Subclinical deficiencies that do not lead to a documented diagnosis are not captured.</p> <p>Unmapped bariatric procedures are not included.</p> <p>The 90-day persistence requirement may exclude patients who discontinued therapy early due to adverse effects.</p>

Other weight-loss medications include a heterogeneous set of agents, which may mask differences across drug classes.

Table 1. Percent of Patients with New Anemia by Weight-Change Stratum at 15 Months

Cohort	Weight Change	Rate	Lower CI	Upper CI
Other weight loss med	Gain Over 2.5%	4.15	4.01	4.28
	No Change Within (-2.4)-2.4%	3.49	3.40	3.59
	Loss 2.5-4.9%	3.46	3.33	3.61
	Loss 5.0-9.9%	3.67	3.55	3.79
	Loss 10.0-19.9%	3.82	3.69	3.95
	Loss 20.0-29.9%	5.25	4.94	5.58
	Loss Over 30.0%	7.43	6.59	8.33
Bariatric	Gain Over 2.5%	11.57	11.33	11.81
	No Change Within (-2.4)-2.4%	10.80	10.54	11.07
	Loss 2.5-4.9%	13.03	12.56	13.51
	Loss 5.0-9.9%	15.10	14.66	15.55
	Loss 10.0-19.9%	14.80	14.43	15.17
	Loss 20.0-29.9%	12.37	12.04	12.69
	Loss Over 30.0%	12.45	12.11	12.80
GLP-1	Gain Over 2.5%	4.76	4.66	4.86

	No Change Within (-2.4)-2.4%	3.86	3.80	3.92
	Loss 2.5-4.9%	4.05	3.97	4.14
	Loss 5.0-9.9%	4.63	4.56	4.71
	Loss 10.0-19.9%	5.33	5.24	5.42
	Loss 20.0-29.9%	6.16	5.98	6.34
	Loss Over 30.0%	7.57	7.14	8.01

Table 2. Percent of Patients with New Vitamin Deficiency by Weight-Change Stratum at 15 Months

Cohort	Weight Change	Rate	Lower CI	Upper CI
Other weight loss med	Gain Over 2.5%	12.99	12.77	13.21
	No Change Within (-2.4)-2.4%	12.57	12.39	12.74
	Loss 2.5-4.9%	12.34	12.09	12.59
	Loss 5.0-9.9%	12.45	12.25	12.66
	Loss 10.0-19.9%	13.33	13.10	13.56
	Loss 20.0-29.9%	16.81	16.28	17.35
	Loss Over 30.0%	21.98	20.64	23.36
Bariatric	Gain Over 2.5%	11.65	11.41	11.89
	No Change Within (-2.4)-2.4%	11.19	10.92	11.47
	Loss 2.5-4.9%	11.86	11.41	12.32
	Loss 5.0-9.9%	14.24	13.81	14.67
	Loss 10.0-19.9%	21.55	21.13	21.98
	Loss 20.0-29.9%	27.74	27.30	28.18
	Loss Over 30.0%	30.57	30.09	31.06
GLP-1	Gain Over 2.5%	14.03	13.87	14.20
	No Change Within (-2.4)-2.4%	12.60	12.50	12.71
	Loss 2.5-4.9%	12.72	12.58	12.86
	Loss 5.0-9.9%	13.72	13.60	13.85
	Loss 10.0-19.9%	15.34	15.20	15.48
	Loss 20.0-29.9%	17.65	17.37	17.94
	Loss Over 30.0%	21.02	20.36	21.69