Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/23223
DOI URL: http://dx.doi.org/10.21474/IJAR01/23223

RESEARCH ARTICLE

COMPARATIVE EFFECTIVENESS OF CONTEMPORARY WEIGHT-LOSS INJECTIONS AND ESTABLISHED BARIATRIC PROCEDURES

Dvir Levin

Manuscript Info

Manuscript History
Received: 8 February 2026
Final Accepted: 10 March 2026
Published: April 2026

Key words:-
obesity; semaglutide; tirzepatide; liraglutide; bariatric surgery; sleeve gastrectomy; Roux-en-Y gastric bypass; narrative review; indirect comparison.

Abstract

Obesity management has shifted from a traditional lifestyle-versus-surgery framework to a broader continuum that now includes highly effective injectable anti-obesity medications. This revised narrative review compares established injectable therapies used in contemporary obesity care - liraglutide 3.0 mg, semaglutide 2.4 mg, and tirzepatide 5-15 mg - with major bariatric procedures, especially sleeve gastrectomy, Roux-en-Y gastric bypass, and selected duodenal switch procedures. In response to reviewer guidance, the methodology has been strengthened by adding a transparent literature-search strategy, explicit inclusion and exclusion criteria, a non-meta-analytic synthesis rationale, a formal ethical-clearance statement, and a critical-appraisal table of the principal evidence base. Across pivotal trials, mean total body-weight reduction was approximately 7.4% for liraglutide at 56 weeks, 14.9% for semaglutide at 68 weeks, and 20.9% for tirzepatide 15 mg at 72 weeks. In randomized or comparative bariatric literature, 5-year total weight loss was about 22.5% after sleeve gastrectomy and 26.0% after Roux-en-Y gastric bypass, while duodenal switch can exceed these results in selected high-BMI populations. Because medication and surgical estimates come from different trial designs, populations, follow-up durations, and outcome definitions, all comparisons are interpreted as indirect clinical benchmarks rather than exact head-to-head treatment effects. The main conclusion is that metabolic/bariatric surgery remains the most durable intervention for severe obesity, but modern injections have narrowed the efficacy gap and expanded individualized treatment options.

Introduction:-

Obesity is a chronic, relapsing, and multifactorial disease associated with cardiometabolic morbidity, mechanical complications, impaired quality of life, and increased healthcare utilisation. For many years, the clinical treatment pathway was framed as lifestyle intervention first, pharmacotherapy with modest expected benefit, and bariatric surgery for severe or refractory obesity. This structure has changed substantially with the development of incretin-based therapies capable of producing double-digit average weight loss in randomized trials.At the same time, bariatric surgery remains a mature and highly effective intervention with long-term data, established indications, and durable metabolic benefits. Contemporary clinical decision-making therefore requires a more nuanced comparison

Corresponding Author:- Dvir Levin

of efficacy, durability, cardiometabolic benefit, adverse effects, treatment burden, reversibility, access, and patient preference. The aim of this review is to synthesize the most clinically relevant evidence comparing injectable anti-obesity therapies with established bariatric procedures, while making clear that the evidence base is heterogeneous and mostly indirect.

Methodological approach:-

Review design:-

This article is a structured narrative review with an indirect comparative synthesis. It is not presented as a systematic review, and it does not claim to provide a formal meta-analysis. The purpose is clinically interpretive: to compare the magnitude, durability, safety profile, and practical role of leading injectable pharmacotherapies and established bariatric operations using high-quality pivotal trials, prescribing information, long-term follow-up studies, and professional guidelines.

Literature-search strategy:-

The literature was reviewed up to April 24, 2026. Searches were conducted in PubMed/MEDLINE, Google Scholar, ClinicalTrials.gov, official FDA prescribing-information pages, and professional-society guideline sources. The search combined terms for obesity and weight management with intervention-specific terms, including liraglutide, Saxenda, semaglutide, Wegovy, tirzepatide, Zepbound, GLP-1 receptor agonist, GIP/GLP-1 agonist, bariatric surgery, metabolic surgery, sleeve gastrectomy, Roux-en-Y gastric bypass, duodenal switch, weight regain, cardiovascular outcomes, adverse events, and long-term follow-up. Reference lists of pivotal publications and guidelines were also checked to identify major comparative or long-term sources.

Search component	Operational approach used in the revised manuscript
Population	Adults with obesity or adults with overweight plus weight-related complications. Pediatric-only studies were not used as core comparators.
Interventions	Established injectable anti-obesity medicines with broad clinical uptake: liraglutide 3.0 mg, semaglutide 2.4 mg, and tirzepatide 5-15 mg. Newer semaglutide formats are noted but not used as the main comparator set because longer comparative experience remains limited.
Comparators	Established bariatric procedures: sleeve gastrectomy, Roux-en-Y gastric bypass, duodenal switch/biliopancreatic diversion variants, and adjustable gastric banding as a historical comparator.
Outcomes	Total body-weight reduction, milestone responder rates, durability, cardiometabolic outcomes, adverse events, treatment burden, and clinical positioning.
Evidence hierarchy	Randomized controlled trials, long-term extensions, FDA labels, professional guidelines, and robust comparative surgical studies were prioritized over commentary, promotional sources, and small uncontrolled reports.

Inclusion and exclusion criteria:-

Included literature	Excluded literature
Pivotal randomized trials of anti-obesity medications in adults with obesity or overweight plus complications.	Case reports, letters, promotional material, non-peer-reviewed claims, and unsupported media commentary.
Long-term extension studies or follow-up analyses relevant to weight maintenance, relapse, or durability.	Studies focused only on diabetes dosing without obesity-specific endpoints, unless needed for safety context.
FDA prescribing information and medication guides for safety, contraindications, and label-based adverse reactions.	Non-authoritative dosing or side-effect summaries when official label information was available.
Professional guidelines and consensus statements for bariatric-surgery indications and clinical positioning.	Bariatric procedures no longer widely used as main modern comparators, except where discussed

	historically.
Comparative surgical trials or large follow-up studies reporting weight-loss durability and procedure-specific risks.	Studies with unclear population, unclear intervention, very short follow-up, or insufficient reporting of outcomes.

Data extraction and synthesis:-
For each intervention, the review extracted mechanism, dosing or procedural category, pivotal efficacy outcomes, follow-up horizon, commonly reported adverse effects, clinically important risks, and practical limitations. Because drug trials and bariatric-surgery studies differ materially in baseline BMI, comorbidity load, follow-up completeness, behavioural support, endpoint definitions, and study design, the findings were synthesized descriptively. Numerical values are presented as clinically useful benchmarks, not as pooled estimates.

Rationale for not performing a meta-analysis:-
A formal statistical synthesis was not performed because the central comparison is not based on a homogeneous set of head-to-head randomized trials. Pooling liraglutide, semaglutide, tirzepatide, sleeve gastrectomy, Roux-en-Y gastric bypass, and duodenal switch outcomes into a single effect estimate would risk false precision. Differences in populations, intervention intensity, follow-up duration, adherence, attrition, endpoint definitions, and procedure selection make narrative synthesis more appropriate for this paper's clinical aim. This limitation is now stated explicitly to avoid overinterpretation.

Critical-appraisal approach:-
The evidence was appraised by considering study design, sample size, follow-up duration, endpoint relevance, generalisability, and risk of indirectness. Randomized drug trials provide strong short- to medium-term efficacy evidence but are limited by selected populations and adherence conditions. Surgical studies provide stronger durability information but often involve different baseline severity, centre expertise, and procedure-selection factors. The appraisal is summarized in Section 10.

Ethical clearance statement:-
Ethical approval was not required for this narrative review because no human participants were recruited, no intervention was performed, no identifiable patient data were used, and all information was drawn from published literature, professional guidelines, or publicly available regulatory documents.

Current injectable anti-obesity therapies:-
The core injectable therapies compared in this review are liraglutide 3.0 mg, semaglutide 2.4 mg, and tirzepatide 5-15 mg. Liraglutide is a daily GLP-1 receptor agonist and represents an earlier generation of incretin-based obesity pharmacotherapy. Semaglutide 2.4 mg is a weekly GLP-1 receptor agonist with substantially greater mean weight loss and direct cardiovascular-outcomes evidence in adults with overweight or obesity and established cardiovascular disease. Tirzepatide is a weekly dual GIP/GLP-1 receptor agonist that currently produces the largest mean weight reduction among the established injectable agents in pivotal obesity trials. Newer 2025-2026 semaglutide formats, including oral semaglutide tablets and higher-dose semaglutide injection, illustrate the rapidly evolving landscape; however, the present comparison remains centred on the established injectable evidence base.

Table 1. Main established injectable obesity therapies used as core comparators in this review.

Drug	Dosing	Mechanism	Pivotal efficacy horizon	Mean weight change	Interpretive note
Liraglutide 3.0 mg (Saxenda)	Daily subcutaneous injection	GLP-1 receptor agonist	56 weeks	-7.4%	Earlier broad-use obesity GLP-1; less convenient daily dosing and lower average weight loss than newer agents.
Semaglutide 2.4 mg (Wegovy)	Weekly subcutaneous injection	GLP-1 receptor agonist	68 weeks	-14.9%	High-quality weight-loss evidence;

					strongest hard cardiovascular-outcomes evidence among obesity injections.
Tirzepatide 5-15 mg (Zepbound)	Weekly subcutaneous injection	Dual GIP/GLP-1 receptor agonist	72 weeks	-15.0% to -20.9%	Highest average pivotal-trial weight loss among the established injectable comparators.

Established bariatric procedures:-

The main surgical comparators are sleeve gastrectomy and Roux-en-Y gastric bypass. Sleeve gastrectomy removes a large proportion of the stomach and combines restriction with hormonal effects while preserving intestinal continuity. Roux-en-Y gastric bypass creates a small gastric pouch and bypasses part of the proximal small bowel, combining restriction, hormonal effects, and modest malabsorption. Duodenal switch and related operations can produce greater weight loss in selected high-BMI populations, but they demand more intensive nutritional surveillance. Adjustable gastric banding is included only as a historical comparator because it is less favoured in contemporary practice.

Table 2. Major bariatric operations used in comparative practice.

Procedure	Core mechanism	Typical comparative efficacy	Durability	Main strengths	Main limitations
Sleeve gastrectomy (SG)	Restrictive + hormonal	~22.5% total weight loss at 5 years	Good	Technically simpler than bypass; strong efficacy; no intestinal bypass.	Reflux can worsen; weight regain can occur; less potent than RYGB on average.
Roux-en-Y gastric bypass (RYGB)	Restrictive + hormonal + mild malabsorption	~26.0% total weight loss at 5 years	Very good	Greater average weight loss; strong diabetes and reflux benefits.	More complex operation; micronutrient deficiency and dumping risks require follow-up.
Duodenal switch (DS/BPD-DS)	Restrictive + stronger malabsorption	Can exceed 30% total weight loss in selected cohorts	Excellent in selected patients	Most powerful weight-loss procedure for severe obesity.	Highest nutritional burden; not first-line for most patients.
Adjustable gastric banding	Restrictive	Inferior long-term performance	Variable	Reversible and less anatomically disruptive.	Higher revision/removal rates; now much less favoured.

Comparative efficacy: what the numbers show:-

The central pattern is consistent: each generation of injectable therapy has improved upon the previous one, but surgery still provides the largest and most durable mean weight reduction overall. Liraglutide produces clinically meaningful but comparatively modest average weight loss. Semaglutide nearly doubles the liraglutide benchmark in pivotal adult obesity data. Tirzepatide moves pharmacotherapy closer to the lower range of surgical outcomes,

especially sleeve gastrectomy. However, this statement requires caution: the comparison is indirect and should not be interpreted as proof that one treatment would outperform another in the same randomized population.

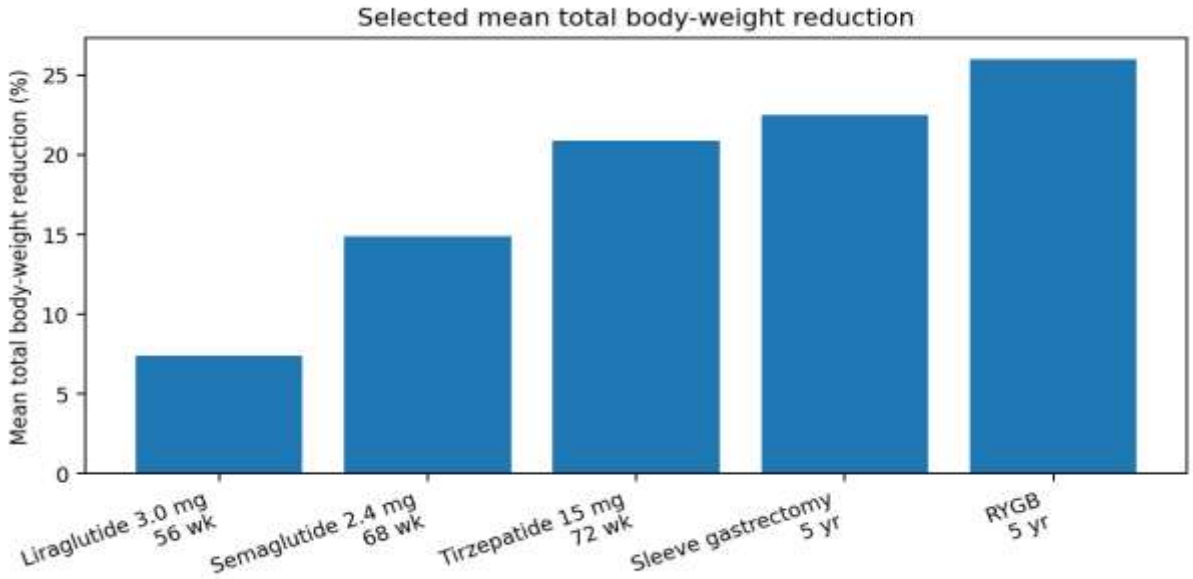

Figure 1. Selected mean total body-weight reduction. Values come from pivotal medication trials and major surgical comparative studies; they are benchmarks, not pooled head-to-head effects.

Milestone responders and clinical meaning:-

Average weight loss is useful but incomplete. Clinicians also need to know how many patients reach clinically meaningful thresholds. Many metabolic benefits begin around 5% body-weight reduction, while more substantial benefits for fatty liver disease, obstructive sleep apnoea, insulin resistance, and mechanical symptoms often become more likely as patients approach the 10-20% range. Milestone responder rates show that newer injections do not merely shift the mean but also move a larger proportion of patients into higher-response categories.

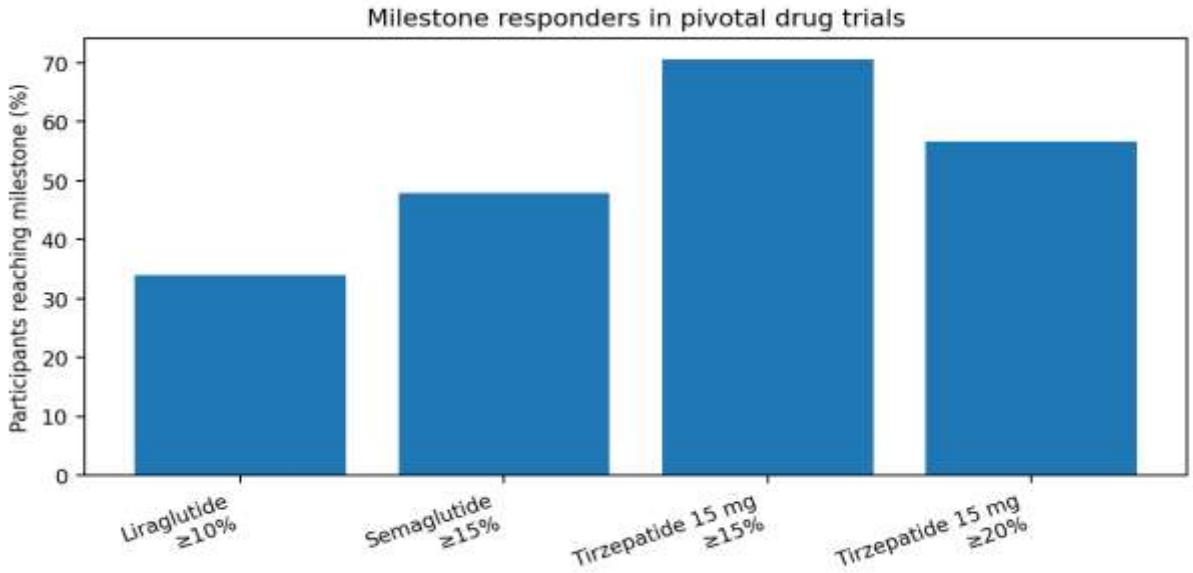

Figure 2. Milestone responders in pivotal drug trials. Different studies report different milestone thresholds; therefore, the figure is clinically illustrative rather than a strict like-for-like comparison.

Durability, maintenance, and relapse:-

Durability remains the clearest domain in which bariatric surgery has a comparative advantage. Pharmacotherapy generally works while it is continued; weight regain after withdrawal is common. In contrast, surgery produces durable changes in anatomy, appetite regulation, eating tolerance, and, for bypass-type procedures, nutrient handling. Nevertheless, surgical durability is not absolute: weight regain, nutritional complications, and the need for revisional procedures remain clinically important. The strict interpretation is therefore not that surgery is always superior, but that durability, reversibility, treatment burden, and patient preference must be weighed together.

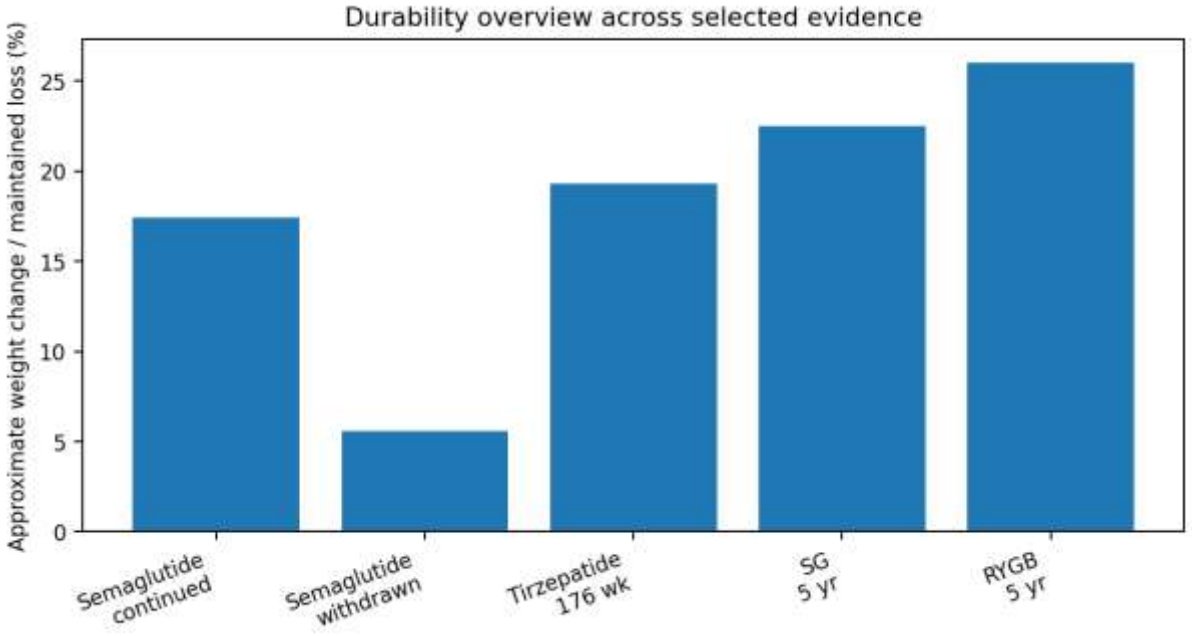

Figure 3. Durability overview across selected evidence. Horizons differ substantially, so the graph should be read as a durability overview rather than a ranked efficacy hierarchy.

Cardiometabolic outcomes beyond body weight:-

Weight reduction is not the only outcome that matters. Semaglutide 2.4 mg has unusually strong evidence for cardiovascular risk reduction in adults with overweight or obesity and established cardiovascular disease without diabetes. Tirzepatide has highly favourable glycaemic and diabetes-prevention signals, although its direct obesity-specific cardiovascular-outcomes evidence is less mature. Bariatric surgery has long-standing evidence for broad cardiometabolic benefit, particularly type 2 diabetes remission, obstructive sleep-apnoea improvement, blood-pressure improvement, dyslipidaemia improvement, and reduced mechanical burden. Consequently, the term effectiveness should be defined by the clinical target: maximal mean weight loss, long-term durability, cardiovascular-risk reduction, diabetes remission, safety, or patient acceptability.

Safety, burden, and trade-offs:-

The safety comparison must distinguish front-loaded procedural risk from chronic medication burden. Modern bariatric surgery is safer than older public perceptions suggest, but it still carries operative risks including leak, bleeding, venous thromboembolism, bowel obstruction, strictures, and procedure-specific nutritional complications. Injectable therapy avoids anaesthesia and operative recovery, but it introduces long-term adherence demands, cost and access barriers, gastrointestinal adverse effects, gallbladder-related risks, pancreatitis warnings or precautions, dehydration-related renal injury concerns, and contraindications in patients with a personal or family history of medullary thyroid carcinoma or multiple endocrine neoplasia syndrome type 2. Figure 4 presents the same gastrointestinal adverse-event categories for each injectable medication, so the visual comparison is medication-specific and avoids mixing isolated adverse events from different sources into a single non-comparable ranking.

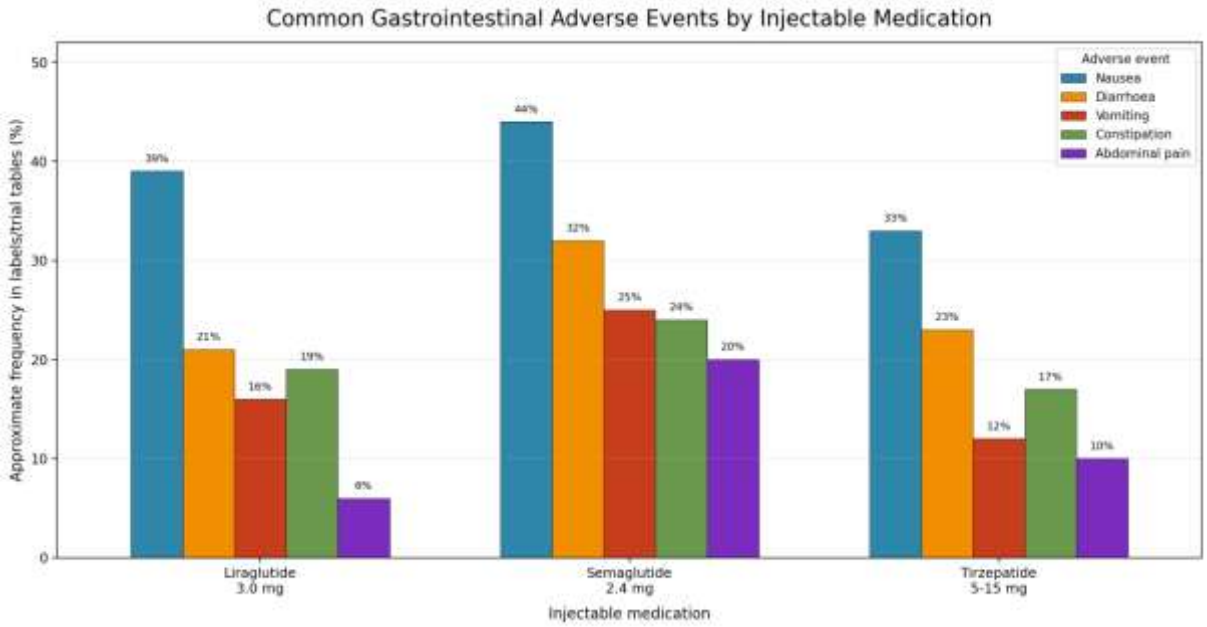

Figure 4. Common gastrointestinal adverse events by injectable medication. The same adverse-event categories are displayed for liraglutide, semaglutide, and tirzepatide. Frequencies vary by study, dose, label version, and population; therefore, the graph is descriptive and is not a head-to-head safety comparison.

Table 3. Side-effect and risk profile by intervention.

Intervention	Common side effects	Important/serious risks	Clinical notes
Liraglutide 3.0 mg	Nausea, vomiting, diarrhoea, constipation, abdominal discomfort, decreased appetite.	Gallbladder disease, pancreatitis warning, dehydration/renal injury, thyroid C-cell tumour warning.	Daily injections may worsen treatment fatigue; slower titration can improve tolerance.
Semaglutide 2.4 mg	Nausea, vomiting, diarrhoea, constipation, abdominal pain, headache, fatigue.	Gallbladder disease, pancreatitis warning, dehydration/renal injury, thyroid C-cell tumour warning.	Weekly dosing is convenient; long-term adherence remains central to effectiveness.
Tirzepatide 5-15 mg	Nausea, diarrhoea, vomiting, constipation, abdominal pain, dyspepsia.	Gallbladder disease, pancreatitis warning, dehydration/renal injury, thyroid C-cell tumour warning.	Highest drug efficacy but tolerability can limit dose escalation in some patients.
Sleeve gastrectomy	Postoperative pain, nausea, vomiting, reduced intake, reflux symptoms.	Staple-line leak, bleeding, VTE,dehydration, micronutrient deficiencies, worsening GERD.	Requires lifelong follow-up; reflux risk is a major differentiator.
Roux-en-Y gastric bypass	Postoperative pain, nausea,dumping symptoms, altered food tolerance.	Leak, bleeding, internal hernia, bowel obstruction, VTE,micronutrient deficiencies, hypoglycaemia.	Often stronger metabolic effect than sleeve, but nutritional surveillance is more demanding.
Duodenal switch	Frequent stools or steatorrhoea, altered tolerance, postoperative GI symptoms.	Highest nutritional deficiency burden, protein malnutrition, fat-soluble vitamin deficiency, surgical complications.	Reserved for selected patients and experienced centres.

Critical appraisal of key evidence:-

A stricter reading of the evidence requires acknowledging the strengths and limitations of the major sources rather than presenting efficacy numbers alone. Table 4 therefore summarizes the key appraisal points used in interpreting this review.

Table 4. Critical appraisal of individual evidence sources used in the review.

Evidence source/type	Main strength	Main limitation	Implication for interpretation
Pivotal liraglutide trials	Randomized evidence for clinically meaningful GLP-1-based weight loss.	Lower efficacy than newer incretin therapies and daily injection burden.	Useful historical and current comparator, but not the pharmacologic ceiling.
STEP semaglutide trials	Large randomized evidence with strong mean weight-loss and responder outcomes.	Selected trial populations; effectiveness depends on continuation and adherence.	Strong evidence for injectable pharmacotherapy, but not a surgical head-to-head comparator.
SURMOUNT tirzepatide trials	Largest mean weight loss among established injectable therapies.	Long-term and cardiovascular-outcomes evidence is still maturing relative to semaglutide and surgery.	Supports tirzepatide as the most potent established injectable comparator.
SELECT semaglutide outcomes trial	Hard cardiovascular-outcomes evidence in overweight/obesity without diabetes.	Population restricted to established cardiovascular disease; not designed as a surgery comparison.	Strengthens semaglutide beyond weight-loss endpoints.
ASMBS/IFSO guidelines	Professional consensus based on broad surgical evidence and modern indications.	Guidelines synthesize evidence but do not supply single comparative effect sizes.	Supports surgery as a standard evidence-based option for selected patients.
Surgical comparative trials/cohorts	Longer durability horizons and direct procedure comparisons.	Different baseline BMI, centre expertise, and follow-up patterns from medication trials.	Best source for surgical durability but indirect against medications.
FDA prescribing information	Authoritative source for indications, warnings, contraindications, and adverse reactions.	Labels are not designed as comparative-effectiveness studies.	Best used for safety and regulatory context, not for efficacy ranking alone.

Clinical decision-making implications:-

For many patients, the best pathway is not an either-or choice. Injectable therapies can be first-line pharmacologic options, bridge therapy before surgery, relapse-management tools after surgery, or alternatives for patients who decline or are not suitable for surgery. Surgery remains especially relevant for severe obesity, major metabolic disease, or situations where durable weight reduction is the priority. The strongest clinical approach is individualized, shared decision-making that considers baseline BMI, comorbidities, medication access, surgical risk, treatment goals, previous weight-loss attempts, psychological readiness, nutritional follow-up capacity, and patient preference.

Limitations:-

This review has several limitations. First, it is a narrative review rather than a systematic review, although the revised manuscript now provides a transparent search strategy and explicit eligibility criteria. Second, the comparison between injections and surgery is indirect and should not be interpreted as a pooled head-to-head estimate. Third, follow-up duration differs substantially across evidence sources: drug trials commonly report 56-176 week outcomes, while bariatric literature often includes 5-year or longer horizons. Fourth, real-world adherence, affordability, insurance coverage, surgical centre expertise, and patient selection may substantially alter outcomes.

Fifth, the obesity-treatment field is evolving quickly, especially after recent semaglutide label expansions and oral GLP-1 development; therefore, periodic updating is required.

Conclusion:-

Modern injectable anti-obesity therapies have transformed obesity care and have narrowed the efficacy gap with bariatric surgery, particularly with tirzepatide and semaglutide. Nevertheless, bariatric surgery remains the most durable established intervention for severe obesity, especially when long-term weight loss and broad metabolic benefit are the main goals. The revised evidence synthesis supports a careful, patient-centred interpretation: medication trials and surgical studies provide complementary but not directly interchangeable evidence. Clinicians should use the available data as comparative benchmarks, not as a rigid ranking, and should individualize treatment decisions according to efficacy, durability, safety, access, and patient values.

Ethical clearance:-Ethical approval was not required for this narrative review, as no human participants were recruited, no individual patient data were accessed, and no animal experiments were conducted.

Data availability:-No new primary dataset was generated. The review is based on published literature, professional guidelines, and publicly available prescribing information.

Conflict of interest:-The author declares no conflict of interest.

Key takeaways:-

1. Tirzepatide currently produces the largest mean weight loss among established broad-indication injectable anti-obesity medicines, followed by semaglutide and liraglutide.
2. Roux-en-Y gastric bypass generally yields greater long-term mean weight loss than sleeve gastrectomy, while duodenal switch can be more potent but carries a higher nutritional burden.
3. The medication-surgery comparison is clinically informative but indirect; it must not be read as a pooled meta-analysis or a randomized head-to-head ranking.
4. The revised manuscript now includes explicit eligibility criteria, a transparent search strategy, an ethical statement, and a structured critical appraisal of key evidence.

References:-

1. American Society for Metabolic and Bariatric Surgery and International Federation for the Surgery of Obesity and Metabolic Disorders. (2022). 2022 ASMBS/IFSO indications for metabolic and bariatric surgery. Surgery for Obesity and Related Diseases, 18(12), 1345-1356.
2. U.S. Food and Drug Administration. (2026). Wegovy (semaglutide) prescribing information: injection and tablets. FDA Access Data.
3. U.S. Food and Drug Administration. (2026). FDA approves higher-dose semaglutide for chronic weight management. FDA News Release, March 19, 2026.
4. U.S. Food and Drug Administration. (2026). Zepbound (tirzepatide) prescribing information. FDA Access Data.
5. U.S. Food and Drug Administration. (2025). Saxenda (liraglutide) prescribing information. FDA Access Data.
6. Jastreboff, A. M., Aronne, L. J., Ahmad, N. N., Wharton, S., Connery, L., Alves, B., et al. (2022). Tirzepatide once weekly for the treatment of obesity. New England Journal of Medicine, 387(3), 205-216.
7. Lincoff, A. M., Brown-Frandsen, K., Colhoun, H. M., Deanfield, J., Emerson, S. S., Esbjerg, S., et al. (2023). Semaglutide and cardiovascular outcomes in obesity without diabetes. New England Journal of Medicine, 389(24), 2221-2232.
8. Wilding, J. P. H., Batterham, R. L., Calanna, S., Davies, M., Van Gaal, L. F., Lingvay, I., et al. (2021). Once-weekly semaglutide in adults with overweight or obesity. New England Journal of Medicine, 384(11), 989-1002.
9. Wölnerhanssen, B. K., Peterli, R., Hurme, S., Bueter, M., Helmiö, M., Juuti, A., et al. (2021). Laparoscopic Roux-en-Y gastric bypass versus laparoscopic sleeve gastrectomy: 5-year outcomes of merged data from two randomized clinical trials. British Journal of Surgery, 108(1), 49-57.
10. Rubino, D., Abrahamsson, N., Davies, M., Hesse, D., Greenway, F. L., Jensen, C., et al. (2021). Effect of continued weekly subcutaneous semaglutide vs placebo on weight loss maintenance in adults with overweight or obesity: The STEP 4 randomized clinical trial. JAMA, 325(14), 1414-1425.