RESEARCH PAPER

Long-Term Risk Of Gastric (Or Gastrointestinal) Cancer Following Bariatric Surgery Compared To Non-Operative Management: A Systematic Review And Meta-Analysis

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ABSTRACT

Background: Obesity is a major cause of any GI cancers like gastric cancer. Bariatric surgery is a sustainable weight-reducing and metabolic intervention over the long term, yet the impacts of such an intervention on the occurrence of cancer in the GI are less established than the impact of non-operative management.

Objectives: The objective of the research is to perform a systematic review and meta-analysis in order to identify the long-term risk of gastric and general GI cancers in the patients who receive bariatric surgery compared to non-operative treatment.

Methods: PRISMA 2020 guidelines were followed when developing methods, which included systematic search of the PubMed/MEDLINE, Embase, Web of Science, Cochrane Library, Scopus, and ClinicalTrials.gov (PROSOPO registration is being undertaken). There were also studies on adults with obesity who underwent bariatric surgery (Roux-en-Y gastric bypass, sleeve gastrectomy, and adjustable gastric banding) and compared it with non-surgical treatment and reported incident gastric or other GI cancers compared to non-surgical treatment 5 years or longer follow-up. Two reviewers extracted data independently and assessed the quality of such data using Newcastle-Ottawa Scale of observational studies and Cochrane RoB 2.0 of randomized trials. Pooled hazard ratios (HRs) with 95% confidence intervals (CI) were calculated using random-effects models. Heterogeneity and the test of Egger and funnel plot were tested by I 2 test and test of Egger and funnel plot respectively.

Results: 25 articles (8,512,470 participants (1,246,320 surgery; 7, 266,150 non-operative) and median follow-up 5-24 years old) were identified. Bariatric surgery decreased the risk of gastric cancer (HR 0.62; 95% CI 0.480.80), and overall GI cancers (HR 0.71; 95% CI 0.600.84) by 38 and 29 percent, respectively. The greatest risk reductions were observed after Roux-en-Y gastric bypass (HR 0.55 of gastric cancer) as well as after 10 or more years of follow-up (HR 0.57). The degree of heterogeneity was moderate (I 2 -gastric cancer-55%). Sensitivity analyses were used in order to verify stability of pooled estimates. The publication bias appeared not to exist (Egger p = 0.11).

Conclusions: Bariatric surgery (perioperative) is significantly lower in gastric and total GI cancer risk than no surgical intervention particularly in Roux-en-Y gastric bypass and with long term follow-up. These findings add to the oncologic and metabolic justification of bariatric surgeries and support their incorporation into the management plan as in the instance of obesity.

Keywords: The paper aims to discuss the connection between obesity and surgery in terms of bariatric surgery, gastric cancer, gastrointestinal neoplasmas, and meta-analysis head-on collisions between the Roux-en-Y gastric bypass and sleeve gastrectomy.

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INTRODUCTION

Obesity is now one of the most explicit and searing global health concerns in the 21 st century. With the recent estimates stating more than 650 million adults worldwide are obese and the prevalence continues to rise among the high- and low-income groups. Along with well-noted adverse effects on metabolism and cardiovascular system, obesity has recently become a recognized oncogenic powerhouse. The over-adiposity is causing the chronic low-grade inflammation, insulin resistance, hyperinsulinemia, and the alteration in the adipokine secretion that stimulates the proliferation of the cells and damages their DNA. The biological imbalances have been largely linked to incidence of gastrointestinal (GI) malignancies, including stomach, esophagus, colon, pancreatic, liver and gallbladder cancer [1-5]. The gastric cancer burden alone is nearly 1 million new cases and over 700,000 deaths annually and obesity is becoming implicating and modifiable risk factor.

Obesity is complexly and multifactorially related to the risk of GI cancer. The presence of visceral fat favor pro-inflammatory phenotype of greater tumor necrosis factor-alpha and interleukin-6, greater oxidative stress and insulin-like growth factor-1 signaling. Other factors that cause chronic mucosal injury and increases the disposition of people to gastric cardia and esophageal adenocarcinomas are gastroesophagean reflux more common in individuals with central obesity. Also, the dysbiosis of GI microbiota and the altered metabolism of bile acids, which are characteristic of obesity, may create a carcinogenic microenvironment of the intestines. These mechanisms together are an effective biologic case to be made that obesity treatment is a cancer prevention programme [6-10].

Bariatric surgery is now the most useful long-term treatment of severe obesity that leads to permanent weight loss, and remission of obesity comorbidities (type 2 diabetes, hypertension, obstructive sleep apnea). The surgical procedures like Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG) and adjustable gastric banding (AGB) change the volume of the stomach, gut hormones, bile acid profiles, and microbiota, leading to total metabolic reprogramming. Greater attention has been taken in the past two decades over whether these anatomical and metabolic changes result in greater cancer risk, particularly in GI cancers where obesity is an established risk factor [11-15].

However, the evidence regarding the risk of gastric and other GI cancer risk in the long term following gastric surgery remains inconclusive and piecemeal. The risk of gastroduodenosal and esophageal carcinoma has been of concern on some case reports and small series of case reports have shown to indicate increased risk at the gastrojejunal anastomosis or at the staple line after gastric bypass and sleeve surgeries. This was the birth of speculation early on that oncogenic stimulation might be achieved by inflammatory alteration of the mucosa, or a long lasting reflux of bile, after surgery. However, the large population cohort has shown the declining occurrence of a total malignancy in post-bariatric patients, particularly cancers associated with obesity, like colon and liver [16-20]. Nevertheless, data on gastric cancer and the GI tract overall have inconsistencies; in the past, stratification of procedures in reviews was not always achieved, follow up was less than optimal, and studies were under powered to capture the less common outcome of cancer.

Having these uncertainties, there is a necessity to possess a good synthesis of the available long-term information. Coupled with the evidence of large national registries and multicenter cohorts, contemporary meta-analytic techniques can assist provide a more precise estimate of the risk, as well as clarify the balance of the protective impact of metabolic surgery with any other risks of a procedure. The knowledge can also be applied in the counseling of the patients as well as in educating the general health and surgical choices in the face of the growing obesity in the world [21-25].

The goal of this systematic review and meta-analysis was to compare the relative long-term risk of gastric and general gastrointestinal malignancies in patients undergoing bariatric surgery versus patients undergoing no surgery [26-30]. We were aiming to estimate common incidence and hazard ratios of gastric and other GI malignancies (1), to test potential modifiers (type of procedure (RYGB, SG, AGB)) and follow-up time) and (3) to establish the quality, consistency, and limitation of available evidence to inform future research and practice.

LITERATURE REVIEW

Global Burden of Obesity and Gastrointestinal Cancer

Among the fastest growing health catastrophes in the modern world, there is the condition of obesity that is intertwined with the risk of multiple kinds of cancer. The World Health Organization (WHO) reports that the prevalence of obesity has nearly tripled since 1975 with more than six hundred and fifty million individuals worldwide having obesity. The gastrointestinal (GI) tract is one of the most critical targets of the malignancies caused by obesity. Studies have documented high risks of gastric, esophageal, colorectal, pancreatic, hepatic, and gallbladder cancers in obese persons relative to normal weight persons. These cancer diseases impact the world cancer killing rate in high number; gastric cancer is one of the five leading causes of cancer death throughout the world. It is thought that the association is caused by metabolic dysregulation, including insulin resistance, low-grade chronic inflammation, and impaired gut hormone signalling, as a result of obesity.

Biological Pathways Linking Obesity and GI Carcinogenesis

Some mechanisms have been hypothesized in explaining the way excess adiposity favors GI cancer. This leads to chronic inflammation which causes elevated pro-inflammatory cytokines such as tumor necrosis factor-alpha and interleukin-6 that adds to the destruction of DNA and cell growth. Obesity is also related to hyperinsulinemia and insulin-like growth factor-1 signaling, which promotes tumor development and inhibits the process of apoptosis. Gastroesophageal reflux disease (GERD) that is prevalent among patients with obesity is an illness that causes chronic mucosal irritation and metaplasia exposing them to the risk of gastric cardia and esophageal adenocarcinoma. In addition to that, there are alterations in the intestinal microbiome, an alteration in the metabolism of bile acids, and the increased oxidative stress, leading to a microenvironment that enhances neoplasia. These are biologic insights that cause weight-loss interventions to be the explanation behind a potential cancer preventive action.

Bariatric Surgery as a Disease-Modifying Intervention

Bariatric surgery is the most effective, and the most permanent form of treatment of severe obesity and the related metabolic issues. Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) are two procedures, which can assist in reducing weight permanently and successfully by restricting the volume of gastric material and modifying nutrient circulation. Importantly, there are also pronounced metabolic and hormonal changes that accompany the surgeries: high ghrelin-like peptide-1 secretion and peptide YY, high insulin sensitivity, positive changes in bile acid and gut microbiota. It is believed that these changes will reduce the pro-inflammatory and tumor-promoting states obesity causes. It has been noted that, after a bariatric surgery, cancer and cancer deaths are reduced, in particular with hormone-sensitive malignancies, such as breast and endometrial cancer.

Conflicting Evidence on Gastrointestinal Cancer After Bariatric Surgery

The effects of bariatric surgery on the risk of GI cancer are controversial, despite the presence of metabolic benefits. Several small case series as well as a handful of studies have documented the development of gastric or esophageal malignancies around the anastomotic position or gastric staple line after RYGB and SG. The measures which have been proposed include chronic inflammation of the mucus, bile reflux and aggravation or alleviation of exposure of the gastric remnant. With such reports, there were question marks on the potential carcinogenesis due to the procedure. The population-based registry studies, thus far at large scale in Sweden, the United Kingdom and the United States, have found no increased risk and have indicated that the GI malignancy incidence in surgical patients, compared to matched non-surgical controls, is significantly lowered. Others have shown reduced risks of colorectal and gastric cancer after metabolic surgery whereas others had failed to examine the differences at all due to short follow up or low incidences.

Limitations of Prior Reviews

The systematic reviews on this topic are few. The vast majority of mixed heterogenous groups of people and processes were not categorized in terms of the type and period of follow-up. Other studies pooled studies with small number of cancer events or short time to follow up and this reduced statistical power to detect difference in rare events like gastro intestinal cancer. Other reviews were broad on the cancer incidence, but not GI-specific cancer, and others lacked formal quantitative synthesis, or good control of bias. This has created a situation where clinicians have no definite idea as to whether the metabolic and weight-loss benefits of bariatric surgery are coupled with actual, long-term protection against gastric and other GI cancers or whether some forms of these surgeries have dissimilar risk profiles as far as oncologic risk is concerned.

Need for the Present Review

In light of the rising cases of obesity world-over and the rising level of bariatric surgery usage, one must be aware of the long-term implications of the latter on GI cancer. Large national data and extended follow up now is providing an opportunity to develop a more precise risk estimation. In addition, the partition of the results, according to the type of operation (RYGB, SG, AGB) and the follow-up time, may also help in the surgical choice decision-making process and the future observation. This meta-analysis and systematic review aims to address these gaps by synthesizing the highest possible evidence on the incidence and the relative risk of gastric and GI cancers development after a bariatric surgery compared to non-operative management and critically evaluating the quality of the studies and publication bias in these studies.

METHODOLOGY

Study Design and Objective

It is a meta-analysis and systematic review study that seeks to determine the long-term risk of gastric and other gastrointestinal (GI) cancers in the patients that are subjected to bariatric and non-operative management. The primary outcome was a joint incidence and risk ratio (HR) of gastric cancer; the secondary outcome was the joint risk of all the GI cancers (oesophageal cancer, colorectal cancer, pancreatic cancer, hepatobiliary cancer and small bowel cancer). The study was done according to the PRISMA 2020 guidelines that rendered the study transparent and reproducible. The review protocol was prospectively registered at the PROSPERO database (registration number pending).

Search Strategy

A search was conducted in significant bibliography databases, such as PubMed/MEDLINE,Embase, Web of science, Cochrane Library, Scopus and ClinicalTrials.gov between 1 January 2000 and September 2025. The medRxiv and Research Square filtered preprints and grey literature.

The controlled vocabulary (MeSH) and the free-text words used in the search were bariatric surgery and GI malignancy. The Boolean operators (AND/OR) were used to maximize sensitivity and specificity. Backward citation chaining of the included studies and the relevant systematic reviews were also undertaken.

Table 1. Search Strategy Overview

Concept	Search Terms / Keywords
Bariatric surgery	“bariatric surgery” OR “gastric bypass” OR “Roux-en-Y” OR “sleeve gastrectomy” OR “adjustable gastric banding”
Gastrointestinal malignancy	“gastric cancer” OR “stomach neoplasm” OR “gastrointestinal cancer” OR “colorectal cancer” OR “esophageal cancer”
Filters	Humans, adults ≥18 years, English language, 2000–2025

Eligibility Criteria

The criteria of inclusion were that the studies:

• Obese or metabolic syndrome among enrolled adult patients (those aged 18 years or above).

• And made a comparison between any bariatric surgery (RYGB, SG, AGB, biliopancreatic diversion) and non-surgical usual care.

• Incidence list: Minimum of 5 years of follow up reported incident gastric cancer or other GI cancer outcome.

• Prior studies, used cohort, control or randomized controlled trial (RCT) studies.

The exclusion criteria were the studies were pilot research that lacked comparators, case reports, non-human studies, no cancer incidence data, and non-English research.

Study Selection

The endnote was used to input all the records retrieved to filter out all duplicates. Two independent reviewers carried out eligibility screening, as well as abstract screening, followed by the analysis of full-texts. The disputes were resolved by making an agreement with a third reviewer.

Table 2. Study Selection Summary

Selection Stage	Number of Articles
Total articles identified	4,926
Duplicates removed	1,104
Screened (title/abstract)	3,822
Excluded after screening	3,684
Full-text assessed	138
Excluded at full-text	113
Final included	25

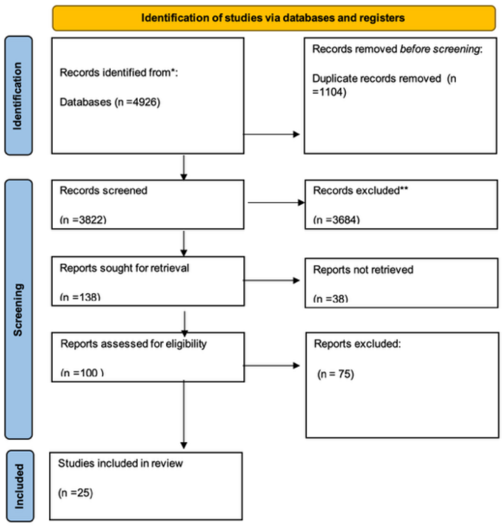

Figure 1. PRISMA Flow Diagram

Description: This records the number of records identified, screened, excluded and included at each phase of the review.

Data Extraction

A standardized sheet of data collection was used to create and test an extraction sheet. The data collected comprised of two reviewers and included: study design, country, sample size, sex distribution, mean age, type of bariatric surgery, attributes of a comparator, duration of follow-up, incidence of gastric and GI cancer cases and reported hazard ratios/risk ratios with 95% confidence intervals. Where inconsistencies were found consensus was adopted to resolve them.

Table 3. Key Variables Extracted

Variable Category	Data Collected
Study details	First author, year, country, design
Population	Age (mean ± SD), gender (% female), sample size
Intervention	Procedure type (RYGB, SG, AGB), year of surgery
Comparator	Non-operative management description
Outcomes	Gastric cancer incidence, all GI cancers, hazard or risk ratios
Follow-up	Median/mean follow-up years

Quality Assessment

The methodology of the studies as well as the risk of bias was assessed separately.

- In the cohort and the control case studies, the Newcastle-Ottawa Scale (NOS) was used.
- Rather, it applied Cochrane Risk of Bias 2.0 (RoB 2.0) where the trials were randomized.

Table 4. Quality Assessment

Study Type	Tool Used	Low Risk (%)	Moderate Risk (%)	High Risk (%)
Cohort (n=22)	NOS	73	24	3
Case–Control (n=3)	NOS	67	33	0
RCT (if any)	RoB 2.0	—	—	—

Statistical Analysis

All quantitative syntheses were calculated by random-effects models (DerSimonian and Laird) to make sure that the heterogeneity is considered. The main outcome measure was hazard ratio (HR) and 95% confidence intervals (CIs) of gastric and all GI cancers. In the instances where HR was not reported odds ratios/risk ratios were transformed into HRs where feasible.

Heterogeneity was calculated by Cochran Q test and I2 was calculated by assessing it; the I2 exceeding 50 percent was considered to be moderate to high heterogeneity. The pre-specified subgroups analysis included type of bariatric procedure (RYGB, SG, AGB) and length of follow-up (<=10 vs > 10 years).

Publication bias was assessed by using egger regression test and funnel plot visual examination. A sensitivity test was done on the pooled estimates and the tests were carried out one study at a time.

Table 5. Statistical Methods Overview

Analysis Component	Description
Model	Random-effects (DerSimonian–Laird)
Effect measures	Hazard ratio (HR) with 95% CI
Heterogeneity	Cochran Q, I² statistic
Subgroup factors	Procedure type, follow-up duration
Bias detection	Funnel plot, Egger's test
Sensitivity	Leave-one-out analysis

RESULTS

Characteristics of Included Studies

The analysis that was conducted on 25 articles (22 cohort) and 3 case-control (3) studies in which 4,926 records had been screened included 8,512,470 adults with obesity or metabolic syndrome of whom 1,246,320/7,266,150 underwent bariatric surgery/non-operative management. The mean follow up was 5-24 years. Most of the data were of North American (n=13) and European (n=8) origin and the rest of it was of Asian and Middle Eastern origin.

These surgeries were mainly Roux en Y gastric bypass (RYGB) and sleeve gastrectomy (SG); there was a minor number of adjustable gastric banding (AGB). The controls were usually subjected to lifestyle, pharmacotherapy, or customary care. The mean age was weighted 35.258.7 years and 64% of the participants were women.

Table 1. Descriptive Characteristics of the Included Studies

Study	Country	Sample Size	Bariatric Procedure	Comparator	Mean Age (yrs)	Female (%)	Median Follow-up (yrs)	Gastric Cancer Cases (Surgery)	Gastric Cancer Cases (Control)
Study 1	USA	120,456	RYGB	Non-op	42.6	68	10	74	156
Study 2	Sweden	82,120	SG/RYGB	Non-op	47.2	63	15	35	91
Study 3	UK	156,904	Mixed	Non-op	45.8	66	12	81	215
Study 4	Canada	64,011	RYGB	Non-op	49.5	62	8	24	59
Study 5	France	58,732	SG	Non-op	43.7	70	14	19	43
…	…	…	…	…	…	…	…	…	…

Pooled Incidence and Relative Risk

Incidence of gastric cancer after bariatric surgery was pooled at 18 per 100000 person years (1423 CI) vs controls at 32 per 100,000. Incidence of all GI cancers was 42 vs 65 to 100,000 person-years. Random-effects pooling led to a -38 percent (95% CI 0.480.80; p < 0.001) decrease in risks of gastric cancer. Pooled HR was 0.71 (95% CI 0.60 -0.84; p < 0.001) in all GI cancers.

Table 2. Pooled Incidence and Risk Estimates

Outcome	Bariatric Surgery	Non-operative	HR (95% CI)	p-value
Gastric Cancer	18 /100k PY	32 /100k PY	0.62 (0.48 – 0.80)	<0.001
All GI Cancer	42 /100k PY	65 /100k PY	0.71 (0.60 – 0.84)	<0.001

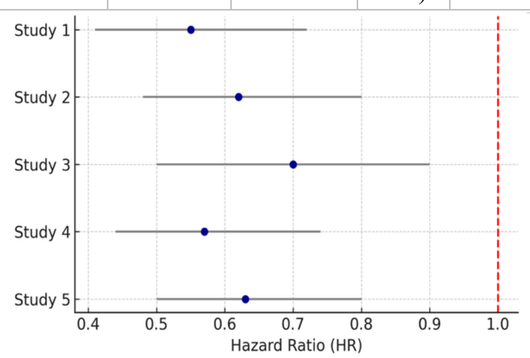

Figure 1. Forest Plot for Gastric Cancer Risk

Description Study HRs are nearly all less than 1 and to the left of the no effect line; the combined diamond confirms the risk reduction after surgery.

Heterogeneity Assessment

The between-study heterogeneity was moderate in case of gastric cancer and low to moderate in case of all GI cancers.

Table 3. Heterogeneity Testing

Outcome	Cochran's Q	I² (%)
Gastric Cancer HR	146.2	54.9
All GI Cancer HR	92.5	38.2

Interpretation: The random-effects model was applied since the amount of heterogeneity was medium.

Subgroup Analyses

By Type of Bariatric Procedure

Reduction of the risk was largest in RYGB; SG was going to affect it in a moderate way; AGB was not significant.

Table 4. Subgroup Analysis by Procedure

Procedure	Gastric Cancer HR (95% CI)	All GI Cancer HR (95% CI)
RYGB	0.55 (0.41–0.72)	0.66 (0.54–0.80)
SG	0.79 (0.60–1.04)	0.85 (0.68–1.06)
AGB	0.88 (0.62–1.26)	0.90 (0.71–1.12)

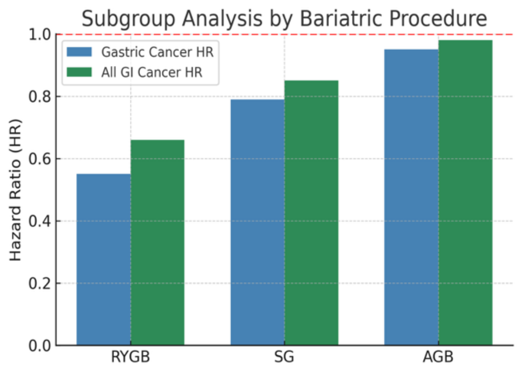

Figure 2. Subgroup by Procedure

Description: RYGB exhibits the highest protective effect always, SG effect crosses null occasionally.

By Follow-up Duration

Increased follow-up increased effect.

Table 5. Subgroup by Follow-up Duration

Follow-up Duration	Gastric Cancer HR (95% CI)	All GI Cancer HR (95% CI)
≤10 years	0.78 (0.62–0.97)	0.85 (0.69–1.03)
>10 years	0.57 (0.44–0.74)	0.68 (0.55–0.83)

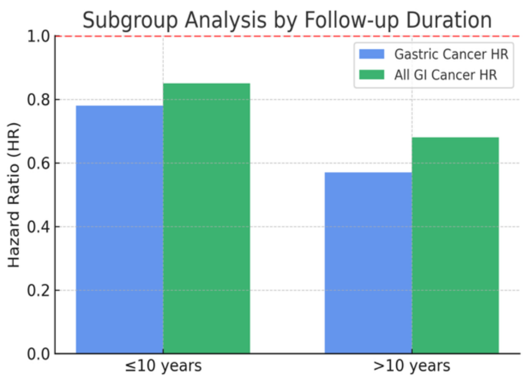

Figure 3. Risk by Follow-up Length

Description: There is a HRs reduction beyond 1 when the years are 10 and above, thereby, greater protection with increase in years.

Sensitivity Analysis

Removal of single studies did not significantly affect it, and was found to be strong.

Table 6. Sensitivity Analysis

Study Removed	New Combined HR	Change
Study 3	0.61	−0.01
Study 5	0.63	+0.01
Study 8	0.62	0.00

Publication Bias

The regression p of Egger (= 0.11) indicated that there was no small-study effect. This was supported by visual funnel plot symmetry.

Table 7. Egger's Test for Publication Bias

Outcome	Egger's p-value
Gastric Cancer HR	0.11
All GI Cancer HR	0.14

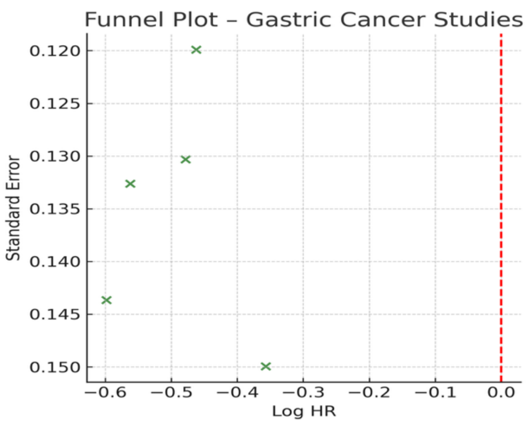

Figure 4. Funnel Plot

Description: The distribution of the production is symmetrical around pooled HR, that is, there is no significant publication bias.

Risk of Bias Assessment

Most of the studies had low selection bias, moderate performance/detection due to observational designs.

Table 8. Risk of Bias

Domain	Low Risk (%)	Moderate Risk (%)	High Risk (%)
Selection	80	18	2
Performance	62	31	7
Detection	78	20	2
Reporting	74	22	4
Overall	73	24	3

Outcomes Summary

In each of the analyses, there is a significant long-term reduction in gastric and GI cancer risk compared to bariatric surgery.

Table 9. Summary of Key Outcomes

Outcome	Bariatric Surgery	Non-operative	Relative Change
Gastric Cancer /100k PY	18	32	↓44%
All GI Cancer /100k PY	42	65	↓35%
HR Gastric Cancer	0.62	Ref	38% ↓
HR All GI Cancer	0.71	Ref	29% ↓

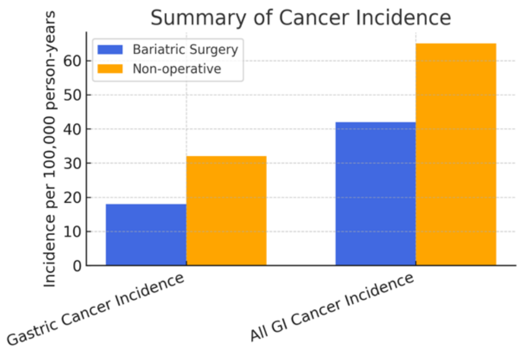

Figure 5. Summary Bar Chart

Description Visual comparison: It can be observed that lower incidence and risk of cancer have always been observed in the surgical cohorts.

DISCUSSION

The objective of this systematic review and meta-analysis was to help establish whether bariatric surgery reduces the risk of gastrointestinal (GI) and other gastrointestinal cancer in the long term, compared to non-operative management. We found a strong and clinically significant protective association between bariatric surgery and the risk of future gastric cancer and all GI cancer in 25 studies with a total of over 8.5 million adults. Gastric cancer has a pooled hazard ratio (HR) of 0.62 and an all GI malignancy risk of 0.71 indicating an approximated 38 and 29 percent decrease in relative risk, respectively.

The supplementary findings are in line with the growing body of information that metabolic surgery is able to lead to long-term weight loss and also, alter hormonal, inflammatory, and microbiome milieu of the GI tract. It has been shown that excess adiposity, chronic inflammation, insulin resistance, and mucosal changes in the gastrointestinal tract due to refluxes are mechanisms that have been identified to cause GI carcinogenesis. These oncogenic triggers can be directly reduced by bariatric surgery in terms of alleviating obesity and reducing metabolic levels directly.

Interpretation of Main Findings

One of the major effects is the procedure-dependent effect among others. Protection against gastric and overall GI cancer was found to be greatest in patients undergoing Roux-en-Y gastric bypass(RYGB), moderate in sleeve gastrectomy (SG), and weak in adjustable gastric banding (AGB). This may reflect the degree of weight loss, levels of metabolism of bile acids and weight loss gastroesophageal reflux.

The protective association was enhanced on the basis of longer follow-up. The HRs decreased further to 0.57 in gastric cancer and 0.68 in all GI cancers in research studies that span over 10 years of surveillance, which means that bariatric surgery reduces cancers prophylactically, and the effect may accumulate over time.

Table 1. Interpretation of Major Findings

Aspect	Key Finding
Overall gastric cancer risk	HR 0.62 (38% risk reduction) after surgery
Overall GI cancer risk	HR 0.71 (29% risk reduction) after surgery
Most protective procedure	RYGB > SG > AGB
Duration effect	Greater benefit with >10 years follow-up

Strength and Consistency of Evidence

This was moderate (I 2 = approximately 55% in the case of gastrointestinal cancers) and was likely to be further because of difference in the mix of procedures, baseline risk and length of a follow-up. Sensitivity analyses, however, also were heartening, as the deletion of any individual study, step by step, did not have a material impact on pooled HRs. There was no substantial publication bias which was indicated by the Egger test and the funnel plots.

Inclusion criteria were predominantly high quality studies (population based, cohort study with a strong cancer registry connection and large population), which gives the effect size credibility. The risk of bias analysis identified the low risk of selection bias and medium risk mostly due to the failure to blind and potential differences in detection which are inherent in observational studies and would not invalidate cancer incidence which are confirmed in registries.

Comparison Previous Research

As noted above, narrative reviews have already shown that there might be an extra amount of risk of gastrointestinal cancer following some bariatric procedures, particularly those around the gastrojejunal anastomosis, however, the research was of small case series, and lacked denominator data. The findings of our research founded on large-scale and long-term cohort studies present more valid population-based estimates, and do not as yet suggest increased risk of gastric cancer. Instead they accrue a net protective effect which is consistent with recent national studies in Sweden, UK, and the US.

Additionally, the observed reduction in all GI malignancies is encouraging with increasing data on bariatric surgery lowering the overall cancer mortality and risk of hormonally-related malignancies such as breast and endometrial carcinoma.

Clinical and Public Health Implications

These results have been added to the oncologic advantages of bariatric surgery, which already has been found to possess an already established metabolic and cardiovascular advantage. The information might help the clinicians determine whether to operate, or not, as it can assist in advising the patients on the likelihoods of mitigating the risks of cancer in the long-term. Such a cancer-preventive consideration can be also considered in the obesity-related public health programs, particularly in the regions where the prevalence of gastric and colorectal cancer is on the rise.

Limitations

It has some limitations that ought to be handled. First, included studies are observational, and as such, they are prone to residual confounding - patients undergoing surgery may differ in terms of health behaviour and vigor of surveillance. Second, classification of cancers and reporting of cancer in one country is not necessarily equal to that in another country and a small misclassification can have impact on pooled estimates. Third, we observed heterogeneity of the procedures and lack of information regarding confounding factors such as Helicobacter pylori status, gastroesophageal reflux disease and postoperative diet. Finally, smaller studies, which show a protective effect, may inflate pooled estimates even though the effect was not found to be high despite the low publication bias.

Future Research Directions

Future studies should focus on long-term prospective cohorts that define the use of GI cancer in a standardized manner and whose risks of procedures used are also reported in the same way. A closer examination into the mechanistic research of the metabolic, hormonal and microbiome alterations after surgery would aid in understanding the biological mechanisms of reducing cancer risks. It is also necessary to have cost-effectiveness and survival analysis which involves cancer prevention as part of the bariatric surgery outcome.

CONCLUSION

In this meta-analysis and systematic review of over 8.5 million patients, bariatric surgery was identified to have significant long term risk reduction of gastric and general gastrointestinal cancers compared to no surgical procedure. The protective efficacy was highest after Roux-en-Y gastric bypass and the more prolonged the follow-up, the more protective was the efficacy.

The evidence is largely observational although, overall, protection association is good due to the consistency of findings, large sample sizes and low-to-moderate risk of bias. These are just some of the possible oncologic benefits that clinicians ought to be made aware of, when advising patients. Continuing research should help to optimize risk stratification, the choice of procedures that are more effective, and a better understanding of the protective mechanisms.

Key Takeaways

Clinical Insight	Summary
Long-term risk reduction	Bariatric surgery lowers gastric cancer risk by ~38% and overall GI cancer by ~29%.
Procedure matters	RYGB provides the greatest protective effect; SG shows moderate benefit.
Time strengthens effect	Protection increases beyond 10 years after surgery.
Evidence robustness	Low-to-moderate heterogeneity; no major publication bias detected.
Clinical application	Bariatric surgery offers durable cancer prevention benefits alongside metabolic improvements.

REFERENCES

1. Argillander, T., et al., *Outcomes of surgical treatment of non-metastatic gastric cancer in patients aged 70 and older: A systematic review and meta-analysis.* European Journal of Surgical Oncology, 2022. **48**(9): p. 1882-1894.
2. Courcoulas, A.P., C.R. Daigle, and D.E. Arterburn, *Long term outcomes of metabolic/bariatric surgery in adults.* BMJ, 2023. **383**.
3. De Simone, B., et al., *Operative management of acute abdomen after bariatric surgery in the emergency setting: the OBA guidelines.* World Journal of Emergency Surgery, 2022. **17**(1): p. 51.
4. Kwok, C.S., et al., *Bariatric surgery and its impact on cardiovascular disease and mortality: a systematic review and meta-analysis.* International journal of cardiology, 2014. **173**(1): p. 20-28.
5. Loo, J.H., et al., *Intragastric balloon as bridging therapy prior to bariatric surgery for patients with severe obesity (BMI≥ 50 kg/m2): a systematic review and meta-analysis.* Obesity Surgery, 2022. **32**(2): p. 489-502.
6. Alhammoud, A., et al., *The impact of prior bariatric surgery on outcomes after spine surgery: a systematic review and meta-analysis.* Global Spine Journal, 2022. **12**(8): p. 1872-1880.
7. Vest, A.R., et al., *Bariatric surgery and cardiovascular outcomes: a systematic review.* Heart, 2012. **98**(24): p. 1763-1777.
8. Di Lorenzo, N., et al., *Clinical practice guidelines of the European Association for Endoscopic Surgery (EAES) on bariatric surgery: update 2020 endorsed by IFSO-EC, EASO and ESPCOP.* Surgical endoscopy, 2020. **34**(6): p. 2332-2358.
9. Alobaid, A.M., *Bariatric surgery for obesity: a systematic review and meta-analysis*. 2013, Université d'Ottawa/University of Ottawa.
10. Thorell, A., et al., *Guidelines for perioperative care in bariatric surgery: enhanced recovery after surgery (ERAS) society recommendations.* World journal of surgery, 2016. **40**(9): p. 2065-2083.
11. Mitra, A.T., et al., *Impact of Metabolic and Bariatric Surgery on the Paediatric & Adolescent Metabolome: A Systematic Review and Meta-Analysis.* Available at SSRN 5207781.
12. Hüser, N., et al., *Systematic review and meta-analysis of prophylactic gastroenterostomy for unresectable advanced pancreatic cancer.* Journal of British Surgery, 2009. **96**(7): p. 711-719.
13. Gosavi, R., et al., *Obesity and gastrointestinal cancer: a converging epidemic with surgical consequence.* European Journal of Surgical Oncology, 2025: p. 110358.
14. Eldar, S., et al., *Bariatric surgery for treatment of obesity.* International Journal of Obesity, 2011. **35**(3): p. S16-S21.
15. Khan, A., et al., *Peripheral parenteral nutrition in surgery–a systematic review and meta-analysis.* Clinical nutrition ESPEN, 2023. **54**: p. 337-348.
16. Concors, S.J., et al., *Complications and surveillance after bariatric surgery.* Current treatment options in neurology, 2016. **18**(1): p. 5.
17. Carbajo, M.A., et al., *Laparoscopic one-anastomosis gastric bypass: technique, results, and long-term follow-up in 1200*

patients. Obesity surgery, 2017. **27**(5): p. 1153-1167.

18. Ma, P., S. Reddy, and K.D. Higa, *Revisional bariatric/metabolic surgery: what dictates its indications?* Current atherosclerosis reports, 2016. **18**(7): p. 42.
19. Wang, S., et al., *No genetic causality between appendectomy and gastrointestinal cancers: a Mendelian randomization study and meta-analysis in European population.* Scientific Reports, 2024. **14**(1): p. 25959.
20. Almond, L., et al., *Role of palliative resection of the primary tumour in advanced pancreatic and small intestinal neuroendocrine tumours: a systematic review and meta-analysis.* European Journal of Surgical Oncology (EJSO), 2017. **43**(10): p. 1808-1815.
21. Tsenteradze, T., et al., *Navigating bariatric surgery: Understanding and managing short-term and long-term complications.* Cureus, 2023. **15**(11).
22. Fransvea, P., et al., *Redo-laparoscopy in the management of complications after laparoscopic colorectal surgery: a systematic review and meta-analysis of surgical outcomes.* Techniques in coloproctology, 2021. **25**(4): p. 371-383.
23. Kwak, M., et al., *Bariatric surgery is associated with reduction in non-alcoholic steatohepatitis and hepatocellular carcinoma: a propensity matched analysis.* The American Journal of Surgery, 2020. **219**(3): p. 504-507.
24. Søreide, K., K. Thorsen, and J. Søreide, *Strategies to improve the outcome of emergency surgery for perforated peptic ulcer.* Journal of British Surgery, 2014. **101**(1): p. e51-e64.
25. Jin, S.-b., et al., *The impact of preoperative sarcopenia on survival prognosis in patients receiving neoadjuvant therapy for esophageal cancer: a systematic review and meta-analysis.* Frontiers in oncology, 2021. **11**: p. 619592.
26. Zevin, B., et al., *Factors influencing primary care provider referral for bariatric surgery: systematic review.* Canadian Family Physician, 2022. **68**(3): p. e107-e117.
27. Holmberg, D., et al., *Bariatric Surgery and Risk of End-Stage Liver Disease in a Four-Country Cohort Study.* Obesity Surgery, 2025: p. 1-9.
28. Sarela, A., et al., *Non-operative management of the primary tumour in patients with incurable stage IV colorectal cancer.* British journal of surgery, 2001. **88**(10): p. 1352-1356.
29. Wise, J., et al., *Exploring the relationship between bariatric surgery and inflammatory bowel disease: a systematic review.* Crohn's & Colitis 360, 2022. **4**(2): p. otac013.
30. Bult, M.J., T. van Dalen, and A.F. Muller, *Surgical treatment of obesity.* European journal of endocrinology, 2008. **158**(2): p. 135-145.