DOAJ DIRECTORY OF OPEN ACCESS JOURNALS
P-ISSN: 2548-5962
E-ISSN: 2548-981X
https://ojs.unud.ac.id/index.php/jbn

REVIEW ARTICLE

JBN Jurnal Bedah Nasional

Weight Regain Outcomes in Roux-en-Y Gastric Bypass vs Sleeve Gastrectomy Type of Bariatric Surgery: A Systematic Review and Meta-Analysis of 13591 Participants

Angeline Asti Shiela Permata[1*], Evelyne Naftali Halim[1], Juan Aditya[1], Jeanne Gabrielle Wibowo[1], Shantidewi[1], Manarul Iman Alfafa Rachman[1], Yunita Lestari Indrianto[1], Aries Budianto[2]

[1]Medical Faculty of Brawijaya University, Malang, Indonesia
[2]Digestive Surgery Division, Medical Faculty of Brawijaya University/Saiful Anwar General Hospital, Malang, Indonesia

*Corresponding author: asti.shiela@gmail.com.

ABSTRACT

Aim: This study aims to investigate weight regain (WR) outcomes following two of the most popular types of bariatric surgery: Roux-en-Y Gastric Bypass (RYGB) and Sleeve Gastrectomy (SG) following substantial weight loss with a minimum 1-year follow-up. **Methods:** We systematically searched English-language full-text literature from Pubmed, Cochrane, Wiley Library, Proquest, SpringerLink, and ScienceDirect databases from January 2013 to September 2023. This study was registered to PROSPERO (Registration ID: CRD42023468904). **Results:** A total of 6 eligible good-quality cohort studies of 13591 patients were included in this meta-analysis. Our findings indicate that RYGB type significantly has less WR events compared to SG type of bariatric surgery, revealing an OR of 0.47 (95% CI: 0.34, 0.65, $I^2 = 80\%$; $p < 0.0001$). This research may be considered when choosing the type of bariatric surgery. **Conclusion:** Our meta-analysis demonstrates that patients undergoing SG type of bariatric surgery are more prone to experience WR in comparison to RYGB type. Further research aimed at identifying associated risk factors would contribute significantly to advance our understanding in this domain.

Keywords: Bariatric surgery, meta-analysis, Roux-en-Y, Sleeve gastrectomy, Weight regain.

DOI: https://doi.org/10.24843/JBN.2025.v09.i01.p06

INTRODUCTION

Obesity, a global health challenge, affects over 1.9 billion adults worldwide, with 650 million classified as obese in 2016. At that time, 39% of adults aged 18 and over (39% of men and 40% of women) were struggling with excess weight. It's noteworthy that the prevalence of obesity across the world is becoming more commonplace worldwide.[1]

The abnormal or excessive accumulation of body fat is the hallmark of obesity, a chronic health issue. The Body Mass Index (BMI) is a regularly used metric to classify obesity. Underweight or normal weight is defined as having a BMI below 25 kg/m². Overweight is defined as having a BMI of 25 to less than 30 kg/m², moderate obesity as having a BMI of 30 to less than 35 kg/m², and severe obesity as having a BMI of 35 kg/m² or higher. Obesity increases the risk of metabolic diseases, such as Type 2 Diabetes Mellitus (T2DM) and cardiovascular disease (CVD), necessitating effective interventions.[2]

Bariatric surgery emerges as the most effective long-term solution for severe obesity and associated metabolic issues, surpassing alternatives like physical activity, dietary modification, pharmaceutical interventions, or management of gut microbiota.[2,3] It is recommended for individuals with BMI > 35 kg/m² (regardless of presence, absence, or severity of coexisting health issues) or for T2DM patients with BMI > 30 kg/m² who do not respond to non-surgical methods. Long term data affirm its safety, efficacy, and mortality risk reduction compared to non-surgical interventions.[4]

Among the various bariatric procedures available, Roux-en-Y Gastric Bypass (RYGB) and Sleeve Gastrectomy (SG) are the most widely performed due to their demonstrated efficacy in promoting substantial weight loss and improving metabolic outcomes.[5,6] These two procedures are favoured for their relatively lower complication rates and durability of weight loss compared to other options like adjustable gastric banding or biliopancreatic diversion However, they present unique challenges when it comes to weight regain (WR).[5,6]

In RYGB, the rerouting of the intestines and creation of a small gastric pouch leads to malabsorption and hormonal changes, but nutrient absorption may normalize over time, contributing to WR. SG removes the stomach's fundus, responsible for ghrelin production, thus promoting early satiety, though WR can occur as the remaining stomach expands postoperatively. As these two procedures dominate bariatric surgery, understanding their specific associations with WR is critical to improving long-term outcomes.[7–9]

RYGB involves creating a small gastric pouch and intestinal rerouting. During RYGB, the stomach is partitioned, forming a compact pouch of 20-30 ml volume, anastomosed with the mid-jejunum, redirecting nutrients to bypass a significant portion of the stomach, duodenum, and the proximal jejunum. SG entails removing 75% of the stomach, forming a tubular-shaped new stomach by transecting along the greater curvature and removing the fundus and body, therefore gastric contents can pass rapidly into the duodenum.[10,11]

While bariatric surgery has gained traction, the number of procedures and patient monitoring continues to rise. Weight regains has emerged as a significant concern for bariatric surgeons. The need for revisional surgery due to weight loss failure, is a challenging and risky procedure, which also increasing.[12] Reports suggest that 15% to 35% of bariatric surgery patients fail to achieve their weight loss goal.[3] Despite being the most effective approach for obesity, weight regain (WR) after surgery remains burdensome. In research involving 300 individuals who underwent Roux-en-Y gastric bypass (RYGB), it was found that 37% experienced substantial weight regain when assessed seven years later. Another analysis, through a systematic review, indicated that as many as 76% of Sleeve Gastrectomy (SG) patients encountered notable weight regain after a six-year follow-up period.[13]

Another research indicates significant variations in the occurrence of weight regain within the bariatric population. According to the Longitudinal Assessment of Bariatric Surgery study (LABS), the average weight regain is approximately 4% for individuals who undergo RYGB within 3 to 7 years post-surgery. Conversely, studies from Sweden and the Netherlands suggest higher figures, reporting that 20 to 24% of patients have gained more than 15% of their body weight five years after undergoing RYGB or SG.[14] The variability in WR rates can be partly attributed to the lack of consensus on the definition of WR, as it varies significantly between studies. This inconsistency in WR definitions, along with differences in study populations and follow-up durations, contributes to the challenges in assessing long-term outcomes of RYGB and SG.[5,6,15–18]

Although WR incidence following bariatric surgery has been thoroughly documented in recent years, few systematic reviews and meta-analyses focus specifically on RYGB and SG. Given the unique mechanisms and the high prevalence of these procedures, a comprehensive understanding of WR in this context is crucial. Therefore, this study aims to provide a thorough summary and ascertain WR outcomes in patients who undergo RYGB and SG after achieving sufficient weight loss, with a minimum of one year of follow-up.

METHODS

Protocol and Registration

Our study of systematic review and meta-analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, which offer a standardized framework for the systematic conduct and transparent reporting of studies (**Figure 1**).[19] Prior to the study starting, a meta-analysis protocol was created and prospectively registered in the PROSPERO international database of systematic reviews (Registration ID: CRD42023468904). PROSPERO registration reduces the possibility of reporting bias and improves transparency.[20]

Search Strategy

We systematically searched Pubmed, Cochrane, Wiley Library, Proquest, SpringerLink, and ScienceDirect databases from September 2013 up to September 2023 in English to identify potential research papers. Relevant articles were identified using the following terms: "weight regain" or "obesity relapse" or "obesity recrudescence" or "obesity recurrence" and "bariatric surgery" or "Roux-en-Y" or "gastrectomy" or "metabolic surgery" not "cancer". We supplemented this search with a hand search of a reference list of relevant articles.

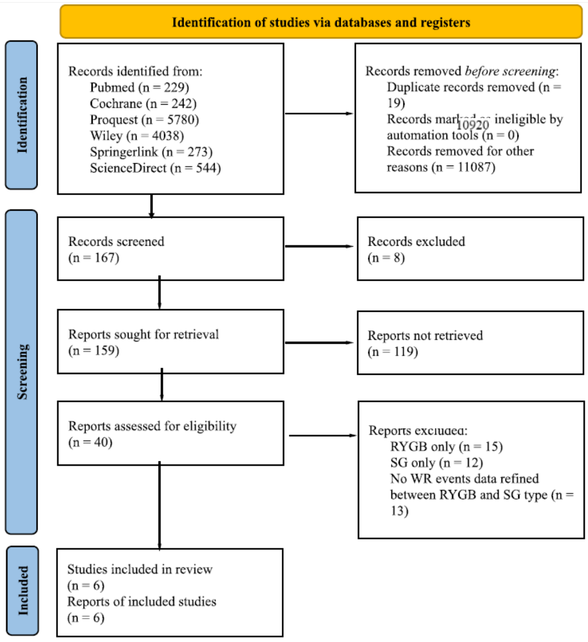

Figure 1. PRISMA flow chart.

Study Selection

Six reviewers (A.A.S.P., E.N.H., J.A., J.G.W., S., and Y.L.I.) independently assessed every study retrieved for inclusion, and disagreements were resolved through consensus. Studies would be included if they met the inclusion criteria as follows: (1) The participants were obese adult patients who received any type of bariatric surgery (minimum 1 year prior) (2) Randomized Controlled Trials (RCTs) and both prospective and retrospective observational studies. (3) Full-text versions accessible. (4) Studies published in English-language. (5) Studies published between January 2013 and September 2023. (6) Studies provide data regarding the events of WR or percentage data following RYGB and SG.

We excluded certain types of studies as follows: (1) Review articles, including systematic reviews, meta-analyses, scoping reviews, and literature reviews. (2) Case reports, protocols, retracted articles, gray literature, and letters to editors. (3) Studies lacking accessible full-text versions. (4) Research involving non-human subjects and pediatric participants is not within the scope of this analysis. (5) Studies that don't report data related to the events of WR post-RYGB and SG.

Initially, a total of 167 papers were retrieved through these sources. After eliminating duplicate entries and conducting a thorough review of titles and abstracts, 127 papers were excluded from further consideration based on predefined exclusion criteria.

Subsequently, 40 papers underwent a more detailed evaluation, during which we applied inclusion and exclusion criteria to assess their eligibility. Following this comprehensive assessment, we identified 6 studies that met the eligibility criteria and were included for synthesis in this study. These 6 studies collectively involved 13591 patients who participated in various studies conducted across five different countries (Netherlands, Saudi Arabia, India, Iran, and Spain). These studies aimed to investigate the events of WR after RYGB vs SG.

Furthermore, in a study with multiple definitions of WR, the author opted for the definition that exhibited the highest frequency of WR events. The selected definitions are described in **Table 1.**

Data Extraction

Five investigators (A.A.S.P., E.N.H., J.A., J.G.W., and S.) carried out the data extraction process independently using a standardized data collection form. The following items were extracted from each article: first author's name, year of publication, study design, country of study, number of samples in each surgery type, age, gender, surgery indication, type of primary surgery, WR definition in each study, WR outcome including the number or percentage of the population, percentage of the WR, post-operative follow-up time, mean BMI nadir, weight nadir, mean BMI follow-up, and mean weight follow-up.

Quality Assessment

Risk of bias assessment of cohort studies was carried out by two authors (J.G.W and A.A.S.P.) using the modified Newcastle-Ottawa Scale (NOS) and is visually presented in **Table 2.** Discrepancies were resolved through consensus. Using the star system of modified NOS (range 0-9 stars), six studies reviewed.[5,6,15–18] had seven or more stars and were categorized as good quality.

Statistical Analysis

Two investigators (A.A.S.P. and M.I.A.R.) conducted the meta-analysis using Cochrane Review Manager 5.4.1 software. For dichotomous variables, we assessed the outcomes by calculating odds ratios (ORs) along with 95% confidence intervals (CIs). A significance level of $P < 0.05$ was established for statistical significance. To assess heterogeneity among the included studies, we utilized the Tau^2 and Chi^2 heterogeneity test and quantified it using the I^2 statistic. When I^2 was found to be less than 50%, we considered the level of heterogeneity acceptable and applied the fixed-effect model for our analysis.

However, in cases where I^2 exceeded 50%, indicating a high degree of heterogeneity, we opted for the random-effects model to account for this variability. To assess the potential presence of publication bias, we visually represented the data through the utilization of a funnel plot. Funnel plot is a graphical method used to investigate the possibility of publication bias or other biases in the data. The funnel plot typically displays the effect size or standardized effect size (mean difference or odds ratio) of each study on the horizontal axis and a measure of study precision (standard error or sample size). In an ideal situation with no publication bias, the plot resembles a symmetrical inverted funnel shape. However, if publication bias or other biases are present, the funnel plot may show asymmetry. This asymmetry may manifest as a gap in the plot's lower part, where small studies with non-significant or negative results may be missing.[21]

RESULTS

Characteristics of Studies and Patients

Our search strategy identified 167 potential references. After applying the inclusion criteria, we included 6 cohorts in the meta-analysis, excluding 161 papers (**Table 1**). The eligible studies, spanning from 2015 to 2023, encompassed a total of 13,591 patients (RYGB/SG: 6,415/7,176), among whom 2,723 experienced weight regain events. The incidence rate from these 6 studies was calculated at 20.00% (2,723/13,591).

Participants' mean age at the time of follow-up was 40.53 ± 11.14 years.[5,6,15–18]. The follow-up period ranged from 48 to 84 months post-surgery for all participants.[5,6,15–18] Additionally, the mean pre-operative BMI across the 6 studies was 50.18 ± 8.78 kg/m^2.[5,6,15–18]

Outcomes

In the examination of weight regain events across six studies comparing the effects of RYGB and SG, a statistically significant discrepancy in the likelihood of weight regain emerges between these two surgical approaches. Our meta-analysis strongly favours RYGB over SG, with an odds ratio (OR) of 0.47 (95% CI: 0.34-0.65) (**Figure 2**). This outcome underscores the efficacy of RYGB in mitigating the risk of WR following bariatric surgery. This finding aligns with %WR in each included study despite varied WR definitions across studies, with %WR range of 14.16% to 41.98% in SG type and 8.47% to 35.95% in RYGB type (**Table 2**). But it is also crucial to acknowledge the substantial heterogeneity evident in our analysis, as indicated by an I² value of 81%.

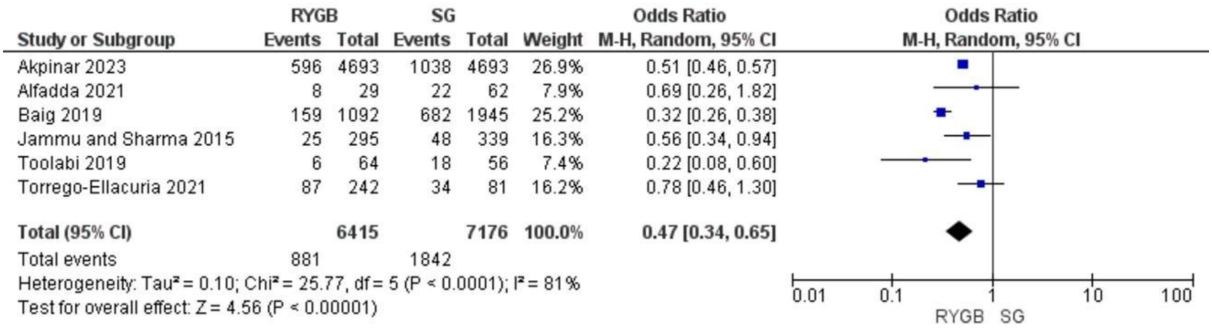

Figure 2. Subgroup analysis for WR on the comparison of RYGB and SG.

Table 1. Characteristics of the included studies.

Study (year)	**Country**	**Design**	**SG**				**RYGB**				**Total**				Follow-up (years)
			Patients (n)	Age (mean ± SD)	Pre-op BMI (kg/m^2 ± SD)	WR Event (n)	Patients (n)	Age (mean ± SD)	Pre-op BMI (kg/m^2 ± SD)	WR Event (n)	Patients (n)	Age (mean ± SD)	Pre-op BMI (kg/m^2 ± SD)	WR Event (n)	
Akpinar et al., [15]	Netherlands	Retrospective cohort	4693	42.11 ± 12.29	42.11 ± 12.29	1038	4693	42.46 ± 11.14	45.08 ± 5.61	596	9386	N/A	N/A	1634	5
Alfadda et al. [5]	Saudi Arabia	Prospective cohort	62	N/A	N/A	22	29	N/A	N/A	8	91	33.3 ± 9.7	49.7 ± 9.9	30	6
Baig et al. [6]	India	Prospective cohort	1945	40.62 ± 12.17	116.20 ± 24.82	682	1092	43.98 ± 11.65	120.79 ± 23.29	159	3037	N/A	N/A	841	5
Jammu and Sharma [16]	India	Retrospective cohort	339	23 (no SD data)	35 (no SD data)	48	295	38 (no SD data)	42.5 (no SD data)	25	634	N/A	N/A	73	7
Toolabi et al. [17]	Iran	Retrospective cohort	56	36.6 ± 10.9	40.0 ± 5.8	18	64	36.9 ± 11.5	47.0 ± 7.3	6	120	36.8 ± 11.3	43.2 ± 7.1	24	5
Torrego-Ellacuria et al. [18]	Spain	Retrospective cohort	81	40.36 ± 13.98	43.54 ± 6.88	34	242	45.15 ± 10.65	44.73 ± 6.30	87	323	44.78 ± 11.94	44.94 ± 6.88	121	4

SG = Sleeve Gastrectomy, RYGB = Roux-en-Y Gastric Bypass, BMI = Body Mass Index, SD = Standard Deviation

Table 2. Weight regain definitions.

Study	Weight Regain Definition	Calculation	%WR
Akpinar et al [10]	Increase of ≥ 10% of %WR from the nadir at 2 to 5 year follow-up	(EWL at nadir - EWL at min. FU2) ≥ 10	SG 22.12%; RYGB 12.70%; Total 17.41%
Alfadda et al [11]	Increase of ≥ 25% of %WR from the nadir at min. 1 year follow-up	(EWL at nadir - EWL at min. FU1) ≥ 25	SG 35.48%; RYGB 27.59%; Total 32.97%
Baig et al [12]	Increase of ≥ 25% of %WR from the nadir at 5 year follow-up	(EWL at nadir - EWL at FU5) > 25	SG 35.06%; RYGB 14.56%; Total 27.69%
Jammu and Sharma [13]	Any increase in EWL from nadir	(EWL at nadir - EWL at FU7) > 0	SG 14.16%; RYGB 8.47%; Total 11.51%
Toolabi et al [14]	(I) Increase of ≥ 25% of %WR from the nadir at 1 year post-op, or (II) Weight regain more than 10 kg from the weight at 1 year after surgery	(I) (EWL at nadir - EWL at min. FU1) > 25 (II) (Total body weight in kg at min. FU1 - Total body weight in kg at nadir) > 10	SG 32.14%; RYGB 9.38%; Total 20%
Torrego-ellacuri et al [15]	Any increase in kilograms from nadir	(Total body weight in kg at FU4 - Total body weight in kg at nadir) > 0	SG 41.98%; RYGB 35.95%; Total 37.46%
			Range %WR: SG: 14.16% - 41.98% RYGB: 8.47% - 35.95%

EWL = excess weight loss, %WR = percent weight regain, BMI = body mass index, nadir = lowest weight measured after surgery, FU = year follow-up

Publication Bias

To evaluate the possibility of publication bias (**Table 3**), we employed a funnel plot (**Figure 3**). Notably, the funnel plot exhibited asymmetry, which could suggest the presence of publication bias. Nevertheless, it is crucial to exercise caution in interpreting this finding, given that the analysis relies on a relatively limited number of studies, and several factors may contribute to the observed funnel plot asymmetry, including variations in study methodologies.

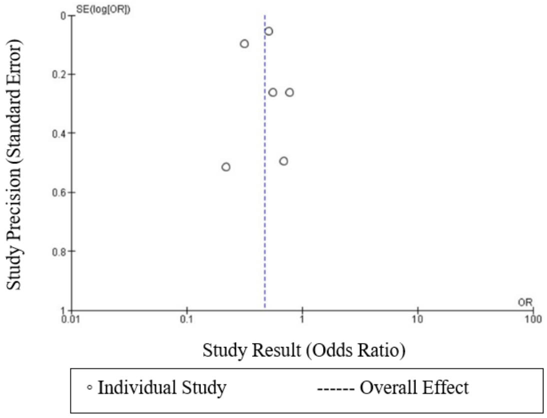

Figure 3. Funnel plots for the publication bias in the meta-analysis for WR on the comparison of RYGB and SG.

DISCUSSION

Summary of Evidence

This meta-analysis compares weight regain (WR) in patients who have undergone Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG). Our findings indicate that WR is more likely after SG than RYGB. Each bariatric surgery type exhibits unique patterns contributing to WR. Gastric pouch dilatation, stomal dilatation, and gastro-gastric fistula are known causes of WR after RYGB. Similarly, gastric pouch dilatation also causes WR in SG.[7,22] However, WR is not solely due to surgical failure; lifestyle factors, mental health, and hormonal/ metabolic imbalance also play significant roles.

It seems that the incidence of weight regain is directly proportional to no remission of weight-related comorbidities. Akpinar et al[15] found that WR in SG was higher in the 5-year follow-up, with less often remission of hypertension (44.7% vs 29.4%), dyslipidemia (38.3% vs 19.3%), and obstructive sleep apnea syndrome (54% vs 20.3%) than RYGB. Meanwhile, patients who had WR after SG who managed to maintain ≥20% total weight loss (TWL) from starting weight, showed more comorbidity remission for hypertension (44.7% vs 29.4%), dyslipidemia (38.3% vs 19.3%), and obstructive sleep apnea syndrome (54% vs 20.3%) than those who did not maintain 20%TWL after SG. Whereas Torrego-ellacuri[18] reported a significant difference between type 2 diabetes in SG and RYGB (26.8% vs 29.3%) but no significant difference in hypertension (37.8% vs 48.3%).

Lifestyle factors contributing to WR include dietary non-adherence and physical inactivity. While bariatric surgery initially reduces caloric intake immediately due to the reduced gastric capacity, decreased hunger, and increased satiety; some patients experience a gradual increase in caloric intake leading to WR.[7,22] Intake of excessive calories, snacks, sweets, oils, and fatty food increases the risk of WR. A cross-sectional observational study by Beckman et al found a positive correlation between total energy, processed foods, and WR.[8] Dietary counselling and consistent nutritional follow-up are pivotal for the long-term success of bariatric surgery, alongside physical activity. The American Society for Metabolic and Bariatric Surgery (ASMBS) recommends at least 30 minutes daily physical activity post-bariatric surgery.[23]

Mental health conditions may be an underlying factor for the occurrence of WR in post-bariatric surgery patients, hindering motivation and dietary compliance.

Table 3. Risk of bias assessment.

Study (cohort)	**Selection (Maximum 4 stars)**				**Comparability (Maximum 2 stars)**	**Outcome (Maximum 3 stars)**			**Total**	
	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis controlled for con-founders	Assessment of outcome	Was follow-up long enough for outcomes to occur	Adequacy of follow-up of cohorts		
Akpinar et al., [15]	*	-	*	*	**	*	*	-	7	Good quality
Alfadda et al. [5]	*	-	*	*	*	*	*	*	8	Good quality
Baig et al. [6]	*	-	*	*	**	*	*	-	7	Good quality
Jammu and Sharma [16]	*	-	*	*	**	*	*	-	7	Good quality
Toolabi et al. [17]	*	-	*	*	**	*	*	*	8	Good quality
Torrego-Ellacuria et al. [18]	*	-	*	*	*	*	*	-	7	Good quality

There are other maladaptive eating behaviours commonly reported in bariatric surgery patients: grazing, loss of control, and night eating. Surgery doesn't alter the neuropsychiatric pathways.[9]

We observed that the hormonal and metabolic changes induced by bariatric surgery differ between RYGB and SG and contribute to WR outcomes. Specifically, RYGB significantly reduces circulating ghrelin levels by removing the stomach's fundus, which is rich in ghrelin-producing cells. In contrast, SG leads to a sustained but lesser reduction in acyl-ghrelin levels. These differences in ghrelin suppression between the two procedures may explain the higher WR observed in SG patients. Furthermore, RYGB is associated with greater increases in Peptide YY (PYY) and glucagon-like peptide 1 (GLP-1) due to anatomical changes, enhancing satiety and decreasing hunger more effectively than SG.[7,23]

The increased nutrient exposure to L cells in the intestines post-RYGB further supports weight maintenance. These hormonal differences are directly related to our meta-analysis findings, which show that the greater metabolic impact of RYGB correlates with a lower incidence of WR compared to SG.[7,23]

Strength and Limitations

To the best of our knowledge, this is the first meta-analysis that reports the WR outcome among individuals following RYGB in comparison to SG type of bariatric surgery. Our study's strength included the large sample sizes from primary bariatric surgery cases (not revisional) in obese adults from diverse countries and backgrounds. This comprehensive approach allows us to provide meaningful insights into the clinical decision-making process regarding surgery type selection.

However, our analysis has several limitations. First, the variability in WR definitions among the included studies results in heterogeneous inclusion criteria, which may have impacted the overall WR event count. Secondly, the meta-analysis is influenced by various confounding factors, such as dietary habits, physical activity, supplements, mental health issues (e.g., binge eating, depression, anxiety), medication use, and the presence of obesity-related comorbidities. These factors may have affected the WR outcomes and contributed to the heterogeneity observed (I^2 = 80%).

We acknowledge that the high heterogeneity suggests variability in study designs, patient populations, and follow-up durations. Certain patient subgroups, such as those with pre-existing metabolic disorders or more significant weight-related comorbidities, may be more prone to WR and contribute to higher heterogeneity. The variability in study design, such as differing follow-up periods or criteria for defining WR, may also explain this heterogeneity. Although the use of a random-effects model accounts for these differences, it is important to note that this model cannot fully eliminate the uncertainty introduced by the variability. Therefore, while our results are valuable for guiding clinical decision-making, they should be interpreted with caution due to the inherent variability.

Recommendations for Clinical Practice

The findings of this investigation have important implications for clinical practice, especially for bariatric surgeons and patients selecting between RYGB and SG. Based on our findings, patients at higher risk of WR (e.g., those with poor dietary habits, low physical activity, or psychological challenges) may benefit more from RYGB due to its superior hormonal and metabolic effects in promoting long-term weight maintenance.

Clinicians should also emphasize the importance of post-surgical lifestyle modifications, including dietary counselling and physical activity, to mitigate WR risk. Patients should be thoroughly informed about the potential for WR, and individualized recommendations should be made based on patient-specific risk factors, such as pre-existing metabolic conditions or psychological health. Regular follow-up and monitoring of dietary habits, mental health, and physical activity post-surgery are crucial in minimizing the risk of WR and improving long-term outcomes.

Future Research Suggestion

Future studies should focus on more homogeneous patient subgroups, considering comorbidities, surgical techniques, and behavioural factors to better understand the mechanisms of WR post-bariatric surgery. Additionally, long-term studies comparing the hormonal and metabolic responses between RYGB and SG will be valuable in refining strategies to minimize WR. Further research should explore interventions targeting hormonal/metabolic pathways to prevent WR and improve long-term outcomes for bariatric patients.

CONCLUSION

In conclusion, our study demonstrates that patients undergoing RYGB bariatric surgery are more prone to experience WR compared to those undergoing SG. Investigating the associated risk factors would further enhance our study in the future.

ACKNOWLEDGEMENTS

The author would like to thank everyone that has helped during the process of writing this article.

DISCLOSURE

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors report no conflicts of interest. The authors are responsible for the content and writing of the paper.

REFERENCES

1. World Health Organisation. Obesity and Overweight. WHO. 2021.
2. Yang M, Liu S, Zhang C. The Related Metabolic Diseases and Treatments of Obesity. *Healthcare*. 2022;10(1616):1–21.
3. Cadena-obando D, Ramírez-rentería C, Ferreira-hermosillo A, et al. Are there really any predictive factors for a successful weight loss after bariatric surgery?. *BMC Endocr Disord*. 2020;4:1–8.
4. Eisenberg D, Shikora SA, Aarts E, et al. 2022 American Society of Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) Indications for Metabolic and Bariatric Surgery. *Obesity Surgery*. 2023;33:3–14.
5. Alfadda AA, Al-Naami MY, Masood A, et al. Long-term weight outcomes after bariatric surgery: A single center saudi arabian cohort experience. *J Clin Med*. 2021;10(21):4992
6. Baig SJ, Priya P, Mahawar KK, et al. Weight Regain After Bariatric Surgery—A Multicentre Study of 9617 Patients from Indian Bariatric Surgery Outcome Reporting Group. *Obes Surg*. 2019;29(5):1583–92.

7. El Ansari W, Elhag W. Weight Regain and Insufficient Weight Loss After Bariatric Surgery: Definitions, Prevalence, Mechanisms, Predictors, Prevention and Management Strategies, and Knowledge Gaps—a Scoping Review. *Obes Surg*. 2021;31(4):1755.
8. Beckman RM, Costa AJRB, Caetano N, et al. Food Consumption and Weight Recurrence in Patients Undergoing Bariatric Surgery with a Minimum of 2 Years Post-surgery. *Obes Surg*. 2023;33(10):3223-3229.
9. Furtado TDA, Girundi MG, Campolina CDOC, et al. Depressive and Eating Disorders in Patients Post-Bariatric Surgery with Weight Regain: A Descriptive Observational Study. *Arquivos Brasileiros de Cirurgia Digestiva*.2023;36:e1725.
10. Sherman V, Coulter SA. Bariatric Surgery. *Texas Heart Institute Journal*. 2013;40(3):296.
11. Pucci A, Batterham RL. Mechanisms underlying the weight loss effects of RYGB and SG: similar, yet different. *Journal of Endocrinological Investigation*. 2019;42:117–28.
12. Kim EY. Definition, Mechanisms and Predictors of Weight Loss Failure After Bariatric Surgery. *J Metab Bariatr Surg*. 2023;11(2):39–48.
13. Noria SF, Shelby RD, Atkins KD, et al. Weight Regain After Bariatric Surgery: Scope of the Problem, Causes, Prevention, and Treatment. *Current Diabetes Reports*. 2023;23(3):31–42.
14. Tolvanen L, Christenson A, Surkan PJ, et al. Patients' Experiences of Weight Regain After Bariatric Surgery. *Obesity Surgery*. 2022;32(5):1498–507.
15. Akpinar EO, Liem RSL, Nienhuijs SW, et al. Weight recurrence after Sleeve Gastrectomy versus Roux-en-Y gastric bypass: a propensity score matched nationwide analysis. *Surgical Endoscopy*. 2023;37(6):4351–9.
16. Jammu GS, Sharma R. A 7-Year Clinical Audit of 1107 Cases Comparing Sleeve Gastrectomy, Roux-En-Y Gastric Bypass, and Mini-Gastric Bypass, to Determine an Effective and Safe Bariatric and Metabolic Procedure. *Obesity Surgery*. 2015;26(5):926–32.
17. Toolabi K, Sarkardeh M, Vasigh M, et al. Comparison of Laparoscopic Roux-en-Y Gastric Bypass and Laparoscopic Sleeve Gastrectomy on Weight Loss, Weight Regain, and Remission of Comorbidities: A 5 Years of Follow-up Study. *Obesity Surgery*. 2019;30(2):440–5.
18. Torrego-Ellacuría M, Barabash A, Larrad-Sainz A, et al. Weight Regain Outcomes After Bariatric Surgery in the Long-term Follow-up: Role of Preoperative Factors. *Obesity Surgery*. 2021;31(9):3947-3955.
19. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Journal of clinical epidemiology*. 2009; 62(10):1006–12.
20. Chien P, Khan K, Siassakos D. The pros and pros of registration on PROSPERO. *BJOG*. 2012;119:904–5.
21. Sterne JAC, Sutton AJ, Ioannidis JPA, et al. Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ*. 2011;343:d4002.
22. Firat O. Weight regain after bariatric surgery. Annals of Laparoscopic and *Endoscopic Surgery*. 2021;6(0):50–50.
23. Maleckas A, Gudaityte R, Petereit R, et al. Weight regain after gastric bypass: etiology and treatment options. *Gland Surgery*. 2016;5(6):61724–61624.