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The Effect of Gastric Bypass and Sleeve Gastrectomy Surgery on the Level of Vitamin A, Iron, Copper, Ferritin, Hemoglobin, Vitamin D, Vitamin B12, Zinc and Cardiometabolic Factors in Patients with Morbid Obesity

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ABSTRACT

Background: Obesity is a significant global health issue and bariatric surgery has emerged as a critical intervention for sustainable weight loss and metabolic improvement in individuals with severe obesity. Sleeve Gastrectomy (SG) and Roux-en-Y Gastric Bypass (RYGB) are the most commonly performed procedures, each with distinct mechanisms and outcomes. Comparative studies have highlighted varying outcomes between SG and RYGB, particularly in terms of weight loss, metabolic improvement, and postoperative complications. This study aimed to compare the baseline characteristics and subsequent outcomes of patients undergoing SG and RYGB.

Methods: Weight loss, metabolic parameters, and several micronutrient levels including biochemical factors, lipid profile, vitamin A, Iron, copper, ferritin, hemoglobin, vitamin D, vitamin B12 and zinc over a 12-month follow-up period were compared in both groups.

Results: Both SG as well as RYGB led to substantial weight loss and improvement in lipid profile and glycemic control over 12 months. RYGB showed superior reductions in LDL cholesterol and total cholesterol compared to SG, indicating potential additional benefits of RYGB.

Conclusion: Both SG and RYGB were effective for weight loss and metabolic improvement, with RYGB showing superior long-term benefits in lipid profile management.

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Introduction

Obesity is a global health crisis, with the World Health Organization estimating that over 650 million adults were obese in 2016, a figure that continues to rise (1). This epidemic is associated with a multitude of comorbidities, including type 2 diabetes mellitus (T2DM), cardiovascular diseases, and certain cancers, contributing significantly to increased morbidity and mortality rates worldwide (2-4). Bariatric surgery has emerged as a pivotal intervention for sustainable weight loss and metabolic improvement in individuals with severe obesity (5, 6). Among the various surgical options, Sleeve Gastrectomy (SG) and Roux-en-Y Gastric Bypass (RYGB) are the most commonly performed procedures, each with distinct mechanisms and outcomes (7, 8).

SG involves the removal of approximately 75-80% of the stomach, resulting in a tubular gastric remnant that restricts food intake and induces hormonal changes that favor weight loss and metabolic improvements (9, 10). RYGB, on the other hand, involves creating a small gastric pouch and rerouting the small intestine to this pouch, thereby combining restrictive and malabsorptive components. This procedure not only limits food intake but also alters gut hormones, contributing to significant weight loss and glycemic control (11).

Comparative studies have highlighted varying outcomes between SG and RYGB, particularly in terms of weight loss, metabolic improvements, and postoperative complications. However, inconsistencies in baseline characteristics of study populations and variations in follow-up durations have often led to conflicting results. For instance, a meta-analysis by Peterli *et al.* demonstrated that RYGB was more effective than SG in improving lipid profiles and achieving glycemic control, yet SG was associated with fewer nutritional deficiencies and complications (12). So the objective of this study was to comprehensively compare the baseline characteristics and subsequent outcomes of patients undergoing SG and RYGB, with a focus on weight loss, metabolic parameters, and micronutrient levels over a 12-month follow-up period. By providing a detailed analysis of these parameters, we aimed to elucidate the differential impacts of these surgical interventions and offer insights into optimizing patient-specific treatment strategies.

Materials and Methods

This study was designed as a retrospective cohort analysis aimed at comparing the outcomes of two bariatric procedures of SG and RYGB. Data were collected from patients who underwent either SG or RYGB at a Ghadir Mother and Child Hospital, Shiraz, Iran over the last 12 months. The study focused on evaluating various health parameters over a 12-month follow-up period. The study included 713 patients who had undergone either SG or RYGB. Inclusion criteria were (i) patients aged 18-65 years, (ii) patients with a body mass index (BMI)≥35 kg/m² with at least one obesity-related comorbidity or a BMI≥40 kg/m², and (iii) patients who had a minimum follow-up period of 12 months. Exclusion criteria were (i) previous bariatric surgery, (ii) significant gastrointestinal disorders and (iii) lack of follow-up data.

Data were collected from electronic medical records and included demographic information, clinical parameters, laboratory results, and surgical outcomes. Baseline characteristics such as age, sex, BMI, fasting blood sugar (FBS), and vitamin D3 levels were recorded. Follow-up data were collected at 6 months and 12 months post-surgery. The primary variables analyzed in this study were (i) demographic and clinical characteristics including age, sex, height, weight, and BMI; (ii) metabolic parameters such as FBS, hemoglobin A1c (HbA1C) levels, lipid profile [low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol, total cholesterol, triglycerides (TG)]; (iii) micronutrient levels of vitamin D3, vitamin B12, zinc, copper, and vitamin A; and finally (iv) anthropometric measures including weight, body mass index (BMI), excess weight loss (EWL%), and total weight loss (TWL%).

Descriptive statistics were used to summarize the baseline characteristics of the participants. Continuous variables were expressed as mean±standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparisons between SG and RYGB groups were performed using independent t test for continuous variables and Chi-square test for categorical variables. Longitudinal changes in clinical and metabolic parameters were assessed using repeated measures and ANOVA to evaluate within-group differences over time. The correlation between EWL%, weight, fat mass, and atherosclerosis-related indicators was analyzed using Spearman's rho correlation coefficient. The study protocol was approved by the Ethics Committee of Shiraz University of Medical Sciences under grant no IR.SUMS.REC.1403.058. Informed consent was obtained from all participants prior to data collection. All data were anonymized to ensure patient confidentiality.

Results

The Baseline Characteristics of Participants in the Study

The baseline characteristics of participants in the study comparing SG and RYGB were presented in Table 1.

Table 1: Baseline characteristics of participants.

Variable	SG	RYGB	*P* value
Male (%)	24.7%	18.5%	0.045
Height (cm)	164.07±11.67	163.31±11.73	0.324
Weight	115.85±21.59	116.08±19.68	0.418
BMI (kg.m^{-2})	43.98±25.18	43.22±6.3	0.017
LDL (mg/dL)	111.95±31.74	109.51±32.90	0.422
FBS (mg/dL)	101.92±19.86	109.05±37.035	0.013
Vitamin D3	23.71±16.82	20.70±10.98	0.025
HDL (mg/dL)	46.13±13.48	45.85±21.20	0.871
TG (mg/dL)	161.12±84.32	154.77±77.84	0.701
Total cholesterolterol (mg/dL)	188.86±39.85	183.82±41.29	0.188
B12	328.57±166.77	299.98±209.32	0.211
Zinc	84.39±18.84	85.49±41.67	0.691
Cupper	115.12±36.35	114.5±31.23	0.885
Vitamin A	36.59±16.98	40.31±16.26	0.088
Hemoglubin	13.85±1.70	13.62±1.75	0.230
Ferritin	88.12±101.18	76.25±78.13	0.661
Iron	77.91±44.50	82.31±42.25	0.616
HBA1C	5.75±0.77	6.18±1.55	0.238

Data were presented as mean±standard deviation for quantitative variables and frequency (percent) for qualitative variables. ANOVA for quantitative variables, chi-square for qualitative variables. $p<0.017$ was considered statistically significant after the Bonferroni correction. [a]Significant difference between SG and RYGB. [b]Significant difference between SG and OAGB. [c]Significant difference between RYGB and OAGB. BMI: Body mass index, FBS: Fasting blood glucose, HDL: High density lipoprotein, RYGB: Roux-en-Y Gastric Bypass, SG: Sleeve Gastrectomy, TG: Triglyceride.

Notably, the proportion of male participants was significantly higher in the SG group (24.7%) when compared to the RYGB group (18.5%) (p=0.045). The BMI was also significantly higher in the SG group (43.98±25.18 kg/m²) in comparison to the RYGB group (43.22±6.3 kg/m²) (p=0.017). Additionally, FBS level was significantly lower in the SG group (101.92±19.86 mg/dL) compared to the RYGB group (109.05±37.035 mg/dL) (p=0.013). Vitamin D3 level was significantly higher in the SG group (23.71±16.82 ng/mL) in comparison to the RYGB group (20.70±10.98 ng/mL) (p=0.025).

Other variables such as height, weight, LDL, HDL, TG, total cholesterol, vitamin B12, zinc, copper, vitamin A, hemoglobin, ferritin, iron, and HbA1c did not show any statistically significant differences between the two groups.

The Changes Across Study Parameters Throughout the Study Duration

Table 2 illustrates the mean±SD values that represent various participant characteristics at baseline (0 months) and subsequent follow-up at 6 and 12 months. There was a substantial decrease in weight from 115.99±20.48 kg at the baseline to 85.55±15.10 kg at 6 months, and further to 76.70±13.15 kg at 12 months (p<0.001), that was accompanied by a significant reduction in BMI from 43.54±16.94 kg/m² to 32.34±5.75 kg/m² at 6 months and 28.74±5.10 kg/m² at 12 months (p<0.001).

The lipid profile parameters exhibited favorable trends, with LDL level decreasing significantly from 110.44±32.45 mg/dL at baseline to 96.15±27.79 mg/dL at 6 months and 88.71±28.05 mg/dL at 12 months (p<0.001). HDL level displayed a notable increase from 45.95±18.60 mg/dL at baseline to 47.18±10.08 mg/dL at 6 months and 49.61±13.04 mg/dL at 12 months (p<0.001), while total cholesterol decreased significantly from 185.90±39.91 mg/dL to 164.88±36.92 mg/dL and 158.36±36.96 mg/dL over the corresponding intervals (p<0.001). The FBS level exhibited a significant decrease from 106.53±34.97 mg/dL at baseline to 88.19±20.37 mg/dL at 6 months and 85.63±9.66 mg/dL at 12 months (p<0.001). Similarly, HbA1c level declined notably from 6.05±1.37% at baseline to 5.39±0.75% at 6 months and to 5.46±0.98% at 12 months (p<0.001). Vitamin B12 level demonstrated an initial increase from 314.94±194.04 pg/mL at baseline to 344.86±220.05 pg/mL at 6 months, followed by a decrease to 290.00±168.28 pg/mL at 12 months (p<0.001).

Although variables such as height, vitamin D3, zinc, TG, copper, vitamin A, hemoglobin, ferritin, iron, EWL%, and TWL% exhibited variations, but not all changes attained statistical significance. Height manifested a non-significant fluctuation, while some micronutrients displayed mixed trends.

Table 2: Mean±SD of variables from baseline to follow-up periods.

Variable	Time (month)			*P* value*
	0	6	12	
Weight	115.99±20.48	85.55±15.10	76.70±13.15	<0.001
Height	163.87±11.71	161.55±16.26	172.62±121.51	
BMI (kg.m^{-2})	43.54±16.94	32.34±5.75	28.74±5.10	<0.001
LDL	110.44±32.45	96.15±27.79	88.71±28.05	<0.001
HDL	45.95±18.60	47.18±10.08	49.61±13.04	<0.001
Total cholesterol	185.90±39.91	164.88±36.92	158.36±36.96	<0.001
Vitamin D3	21.81±13.20	29.96±11.50	32.13±16.74	
Vitamin B12	314.94±194.04	344.86±220.05	290.00±168.28	<0.001
FBS	106.53±34.97	88.19±20.37	85.63±9.66	<0.001
Zinc	85.11±35.53	82.55±20.78	79.31±16.76	
TG	157.73±80.33	102.16±32.56	91.83±40.07	
Vitamin B12	309.54±196.34	377.86±220.05	290.00±168.285	
Cupper	114.71±33.00	118.69±88.56	96.93±21.65	
Vitamin A	39.11±16.65	28.74±16.74	37.02±20.42	
Hemoglobin	13.71±1.74	13.34±1.63	13.01±1.35	
Ferritin	80.59±87.34	89.12±92.62	65.95±76.39	
Iron	80.35±43.10	81.98±34.94	93.95±48.47	
HBA1C	6.05±1.37	5.39±0.75	5.46±0.98	
EWL	-	63.71±18.84	80.02±22.98	
TWL	-	26.02±6.06	33.84±7.52	

*One-way repeated measure ANOVA was used to compare differences of variables by the three time points. BMI: Body mass index, FBS: Fasting blood glucose, HDL: High density lipoprotein, LDL: Low density lipoprotein, RYGB: Roux-en-Y Gastric Bypass, SG: Sleeve Gastrectomy, TG: Triglyceride. EWL: Excess weight loss, TWL: Total weight loss

The Comparison between SG and RYGB

Table 3 illustrate the comparison between SG and RYGB over a 12-month follow-up period. In terms of weight, both procedures resulted in a reduction, with SG showing a mean weight loss of 37.22 kg when compared to 40.63 kg for RYGB, though not statistically significant (p=0.134). However, RYGB demonstrated significantly lower level of LDL and total cholesterol in comparison to SG across all time intervals (p<0.001 for 0-6 months, p=0.003 for 0-12 months). Similarly, RYGB exhibited superior outcome in terms of total cholesterol, with a significant difference observed at all intervals (p<0.001 for 0-6 months, p=0.001 for 0-12 months).

The FBS level at 0-6 months was significantly lower in SG when compared to RYGB (p=0.026). However, no significant difference was found for HBA1C level between the two procedures. The comparison of other variables such as vitamin A, hemoglobin, ferritin, and iron did not reveal any statistically significant differences between SG and RYGB. These findings suggest that while both SG and RYGB are effective in promoting weight loss, RYGB may offer additional benefits in terms of lipid profile improvement when compared to SG.

The Correlation Analysis between %EWL and Atherosclerosis-related Indicators

Table 4 illustrate the correlation analysis between %EWL, weight, fat mass, and atherosclerosis-related indicators over a 12-month follow-up period. Vitamin D showed a positive correlation with BMI (r=0.181, p<0.001) and HDL cholesterol (r=0.116, p=0.015). Zinc also exhibited a positive correlation with BMI (r=0.389, p=0.007) and LDL cholesterol (r=0.403, p=0.002).

The EWL% demonstrated a negative correlation with BMI (r=-0.406, p<0.001), indicating that as excess weight loss increased, BMI decreased. Moreover, EWL% showed a negative correlation with FBS level (r=-0.390, p<0.001), suggesting an improvement in glycemic control with weight loss. However, no significant correlation was found between EWL% and vitamin B12, vitamin A, total cholesterol.

Discussion

The study presents a comprehensive analysis of the baseline characteristics and subsequent outcomes of participants undergoing SG and RYGB. Our findings revealed critical insights into the differential impacts of these bariatric procedures on various health parameters over a 12-month follow-up period. The demographic and clinical profiles at baseline were illustrated in Table 1, indicating significant differences between the SG and RYGB groups. Notably, the SG group had a higher proportion of male participants compared to the RYGB group.

Table 3: Comparison between SG and RYGB variables during 12-months follow-up.

Variable	Time	SG	RYGB	SG vs. RYGB	*P* Value (SG vs. RYGB)
Weight	0-6	29.72±10.69	30.67±8.72	30.33±9.46	0.474
	6-12	7.48±7.78	8.58±5.70	8.22±6.44	0.438
	0-12	37.22±12.10	40.63±12.07	39.65±12.13	0.134
BMI (kg.m^{-2})	0-6	10.75±6.56	11.57±3.66	11.28±4.88	0.234
	6-12	3.96±8.11	3.90±4.39	3.92±5.84	0.371
	0-12	14.02±4.48	15.47±5.70	15.05±5.40	0.153
LDL	0-6	3.00±30.5	24.03±32.48	15.90±34.15	<0.001
	6-12	6.25±18.33	9.92±22.72	8.89±21.48	0.566
	0-12	3.56±23.14	28.98±36.93	21.28±35.22	0.003
HDL	0-6	2.76±10.94	3.10±11.80	3.00±11.51	0.872
	6-12	1.76±7.31	3.95±15.48	2.30±13.82	0.152
	0-12	5.08±14.04	7.07±19.28	6.46±17.77	0.651
TG	0-6	3.00±30.53	24.03±32.48	47.27±57.37	0.464
	6-12	5.29±21.59	11.55±35.03	9.83±31.87	0.495
	0-12	48.21±54.55	60.58±53.15	56.93±53.51	0.356
Total cholesterol	0-6	6.27±44.58	27.01±41.20	17.57±44.64	<0.001
	6-12	13.50±17.94	0.76±31.08	4.47±28.90	0.139
	0-12	3.27±30.05	31.92±40.82	21.45±41.06	0.001
FBS	0-6	7.71±28.03	18.94±27.73	15.50±28.21	0.026
	6-12	0.93±9.77	1.72±11.50	1.51±10.99	0.808
	0-12	21.73±73.16	19.24±58.98	19.89±62.45	0.882
Vitamin D3	0-6	6.16±20.48	8.48±14.55	7.89±16.03	0.443
	6-12	0.80±12.18	2.84±18.34	2.34±16.96	0.688
	0-12	7.70±14.16	14.94±21.34	12.9±19.79	0.165
Vitamin B12	0-6	38.00±168.32	59.81±295.88	53.71±265.72	0.714
	6-12	26.46±225.21	22.48±319.01	10.70±297.89	0.601
	0-12	47.92±130.43	18.25±237.57	26.09±213.71	0.660
Zinc	0-6	2.22±28.25	1.60±27.49	0.46±27.66	0.494
	6-12	2.54±15.01	6.04±25.82	4.23±24.08	0.298
	0-12	2.88±18.53	6.44±24.85	3.77±23.46	0.155
Cupper	0-6	1.11±37.18	6.72±37.70	4.11±37.36	0.473
	6-12	22.66±23.86	78.68±213.89	69.84±196.54	0.663
	0-12	225.50±20.12	12.83±38.17	15.36±35.38	0.443
Vitamin A	0-6	1.52±15.56	6.38±16.54	4.10±1653	2.858
	6-12	2.66±7.55	3.37±8.66	3.18±8.20	0.031
	0-12	1.00±7.69	0.8±21.07	0.41±18.69	0.811
Hemoglobin	0-6	0.03±1.07	0.36±1.77	0.26±1.59	1.448
	6-12	0.77±0.87	0.07±1.25	0.25±1.20	4.813
	0-12	0.65±0.93	0.65±1.51	0.65±1.35	0.000
Ferritin	0-6	12.33±89.53	5.82±88.45	7.83±88.50	0.156
	6-12	2.82±52.34	23.97±54.31	17.88±54.17	1.873
	0-12	29.85±44.44	6.22±83.78	13.31±74.66	1.483
Iron	0-6	4.4±32.10	1.80±23.32	0.26±25.56	0.185
	6-12	28.33±50.08	10.40±13.50	4.12±34.96	2.937
	0-12	6.00±21.21	11.00±17.92	0.33±17.92	0.428
HbA1C	0-6	0.83±1.29	0.88±1.31	0.83±1.29	0.524
	6-12	0.6±1.51	0.75±1.70	0.60±1.51	0.154
	0-12	0.66±0.57	1.00±1.22	0.87±0.99	0.188

Data were presented as mean±standard deviation. *ANOVA was used to compare changes between groups. $p<0.017$ was considered statistically significant after the Bonferroni correction. [a]Significant difference between SG and RYGB. [b]Significant difference between SG and OAGB. [c]Significant difference between RYGB and OAGB. BMI: Body mass index, EWL: Excess weight loss, FBS: Fasting blood glucose, HDL: High density lipoprotein, LCI: lipoprotein combine index, LDL: Low density lipoprotein, RYGB: Roux-en-Y Gastric Bypass, SG: Sleeve Gastrectomy, TG: Triglyceride. TWL: Total weight loss.

Table 4: Correlation between EWL%, weight, fat mass and atherosclerosis-related factors during 12 months follow-up.

Variable	Vitamin B12		Vitamin D		Zinc		EWL%	
	r	*P* value	r	*P* value	r	*P* value	r	*P* value
Weight	-0.009	0.957	0.156	0.001	0.049	0.755	-0390	0.000
BMI	-0.228	0.151	0.181	<0.001	0.389	0.007	-0.406	0.000
FBS	0.052	0.749	0.086	0.070	0.278	0.046	0.000	0.998
LDL	-0.015	0.921	0.065	0.172	0.403	0.002	0.003	0.984
HDL	0.255	0.087	0.116	0.015	0.051	0.711	0.105	0.429
TG	0.250	0.094	0.116	0.014	0.127	0.350	0.039	0.766
Total cholesterol	-0.050	0.755	0.181	<0.001	0.156	0.248	-0.133	0.322
Vitamin A	0.142	0.471	-0.118	0.512	0.282	0.146	-0.178	0.601
Cupper	-0.392	0.053	0.204	0.278	-0.097	0.638	0.524	0.183
HbA1C	0.621	0.188	0.488	0.326	0.501	0.252	-	-
Iron	-	-	1.000	-	1.000	-	-	-
Ferritin	-0.77	0.641	0.090	0.467	0.108	0.454	0.231	0.408

This gender disparity may influence comparative outcomes, as male and female patients can respond differently to bariatric surgery due to physiological and hormonal differences (13, 14). The SG group also exhibited a significantly higher than the RYGB group This finding suggests that individuals with higher BMI might be more inclined towards SG, as it is an effective and safe procedure (15, 16) and potentially due to perceived differences in procedure risk profiles and outcomes (17). Furthermore, the SG group had a lower FBS level compared to the RYGB group. This improved glycemic index in SG patients had a positive influence on post-operative cardiometabolic outcome (18).

Additionally, the SG group demonstrated significantly higher vitamin D3 level when compared to the RYGB group. Given the role of vitamin D in cardiometabolic processes (19) and immune function (20), these differences might contribute to varying recovery and health trajectories post-surgery (21, 22). Table 2 illustrates substantial weight reduction and BMI decrease in both SG and RYGB groups over the 12-month follow-up. Both procedures resulted in significant weight loss. While both surgical interventions were effective in reducing weight and BMI, no significant difference in weight loss was observed between SG and RYGB groups, suggesting both procedures to be comparably effective for weight management in obese patients (23, 24).

Improvement in lipid profile was observed in both SG and RYGB groups, with significant reductions in LDL, HDL and total cholesterol levels. RYGB demonstrated superior outcomes in LDL and total cholesterol reductions compared to SG, with significant differences observed at all intervals. These findings align with previous studies suggesting RYGB's greater efficacy in improving lipid profile due to its malabsorptive component, which reduces total cholesterol absorption in addition to promoting weight loss (25, 26). Glycemic control, as indicated by FBS and HbA1c levels, improved significantly in both groups. FBS level decreased markedly and was significantly lower in the SG group at 0-6 months compared to RYGB (p=0.026), suggesting an initial glycemic advantage with SG. However, no significant difference was observed in HbA1c level between the two procedures, indicating comparable long-term glycemic control (24).

Micronutrient levels, including vitamin B12, vitamin D3, zinc, copper, and vitamin A, displayed mixed trends. Vitamin B12 level showed an initial increase that was later followed by a decrease in both groups, with no significant differences between SG and RYGB groups. Vitamin D3 level was initially higher in the SG group, but overall trend was not significantly different between the groups during the follow-up. Zinc level remained relatively stable, with no significant intergroup difference. These findings highlight the necessity for vigilant monitoring of micronutrient levels post-surgery to prevent deficiencies and associated complications, particularly considering the potential for malabsorption in bariatric patients (27, 28). Both procedures could effectively promote weight loss, while RYGB demonstrated a superior outcome in terms of lipid profile improvement, with significantly greater reductions in LDL and TOTAL CHOLESTEROL levels compared to SG. These results may be attributed to the distinct mechanisms of action between the procedures, where RYGB's combination of restriction and malabsorption can lead to more pronounced metabolic benefits (29, 30).

Interestingly, SG exhibited a transient glycemic advantage with significantly lower FBS level at 0-6 months when compared to RYGB, although long-term glycemic control, as indicated by HbA1c level was comparable between the two procedures. This finding suggests that while SG may offer initial benefits in glycemic control, RYGB's effects on overall metabolic health might be more robust and sustained (23). The correlation analysis between EWL%, weight, fat mass, and atherosclerosis-related indicators further elucidates the interplay between weight loss and metabolic health. A negative correlation between EWL% and BMI underscores the effectiveness of both procedures in reducing BMI with weight loss. Additionally, the negative correlation between EWL% and FBS level indicates an improved glycemic control with greater weight loss, aligning with the observed reductions in FBS and HbA1c levels (31).

Vitamin D showed a positive correlation with BMI and HDL cholesterol, suggesting its potential role in lipid metabolism and cardiovascular health. Similarly, zinc exhibited a positive correlation with and LDL cholesterol, indicating its involvement in metabolic processes related to body weight and lipid levels. These correlations highlight the complex relationships between micronutrients, weight loss, and metabolic health, warranting further investigation. The findings from this study have significant clinical implications for the management of obesity and related metabolic disorders. The comparative analysis of SG and RYGB provides valuable insights for clinicians in tailoring bariatric interventions to individual patient profiles. For instance, patients with higher baseline BMI and lower glycemic control might benefit more from SG initially, while those with dyslipidemia could derive greater benefit from RYGB. Moreover, the importance of micronutrient monitoring post-bariatric surgery cannot be overstated. Given the observed trends in vitamin B12, vitamin D3, and other micronutrients, regular assessment and supplementation are crucial to prevent deficiencies and ensure optimal patient outcomes (32, 33).

Despite the comprehensive nature of this study, several limitations warrant consideration. The observational design and the inherent differences in baseline characteristics between the SG and RYGB groups may introduce biases that could affect the generalizability of the findings. Additionally, the follow-up period of 12 months, while providing valuable short-term insights, may not capture the long-term outcomes and complications associated with each procedure.

Future research should focus on randomized controlled trials with longer follow-up durations to validate these findings and explore the long-term sustainability of weight loss and metabolic improvements post-SG and RYGB. Furthermore, investigations into the mechanisms underlying the differential impacts of these procedures on lipid profile and glycemic control could elucidate the pathways through which bariatric surgery exerts its beneficial effects.

Conclusion

Both SG and RYGB were effective bariatric procedures for weight loss and metabolic improvement. While SG offers initial advantages in glycemic control, RYGB demonstrated superior long-term benefits in lipid profile management. This study underscored the need for individualized patient assessment and tailored surgical interventions to optimize outcomes. Additionally, the importance of micronutrient monitoring and supplementation post-surgery is highlighted to prevent deficiencies and support overall health. Future research should aim to address the limitations of the current study and provide further insights into the long-term efficacy and safety of these bariatric procedures.

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Authors' Contribution

GM and NH designed the study and its protocol. MM, SMH, FS, RG and FA gathered the data. BZ and MA provided the draft and MA approved the manuscript.

Conflict of Interest

The authors have no conflict of interest to declare.

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