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Original Research Article

PROSPECTIVE STUDY OF COMPARISON OF PRE AND POSTOPERATIVE NUTRITIONAL STATUS BETWEEN MINI GASTRIC BYPASS AND SLEEVE GASTRECTOMY

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ABSTRACT

Obesity is a major global health challenge, closely linked to conditions such as type 2 diabetes, cardiovascular disease, and various nutritional deficiencies. Bariatric surgery is recognised as an effective approach for achieving sustained weight loss and improving obesity-related comorbidities. Among the commonly performed procedures, Laparoscopic Sleeve Gastrectomy (LSG) and Laparoscopic Mini Gastric Bypass (LMGB) are widely used; however, both can affect nutrient absorption, potentially leading to deficiencies. Comparative data on their nutritional impact within the Indian population remain scarce. This prospective study, conducted between September 2018 and May 2020, included fifty adults aged 18–60 years with a body mass index of at least 40 kg/m², or 35 kg/m² with associated comorbidities. Participants were equally assigned to undergo either LSG or LMGB. Blood samples were obtained preoperatively and at three and six months postoperatively to measure protein, albumin, calcium, ferritin, folic acid, and vitamin B12 levels using standardised laboratory techniques. Both procedures resulted in substantial weight loss over the six-month follow-up period. Protein and albumin values showed slight postoperative decreases but generally remained within normal limits. Calcium levels exhibited minimal changes. Ferritin levels declined in both groups, with a more marked reduction following LMGB. Similarly, decreases in folic acid and vitamin B12 were greater among LMGB patients, though appropriate supplementation helped avert severe deficiencies. These findings indicate that while LSG and LMGB are similarly effective for weight reduction, LMGB is associated with a higher risk of specific micronutrient deficiencies, underscoring the importance of preoperative assessment, targeted supplementation, and ongoing nutritional monitoring.

INTRODUCTION

Obesity is a chronic, multifactorial disease that has reached pandemic proportions and is now considered one of the leading causes of morbidity and mortality worldwide. Once overshadowed by undernutrition and infectious diseases, excessive body weight has emerged as a dominant global health concern, contributing significantly to disease burden and reduced quality of life. Its impact extends beyond aesthetic considerations, being strongly associated with systemic conditions such as type 2 diabetes mellitus, coronary heart disease, certain malignancies, depression, and sleep-related breathing disorders.

Although obesity is often defined as excessive body weight relative to height, this definition oversimplifies a complex pathophysiological condition characterized primarily by abnormal or excessive adipose tissue accumulation. Consequently, it is not solely a matter of body size but also a metabolic disorder with far-reaching clinical implications. Accurate assessment is essential for its management, with the Body Mass Index (BMI) remaining one of the most widely used parameters for estimating obesity-related health risks. BMI, expressed in kg/m², has been employed by the World Health Organization (WHO) to classify individuals as overweight (BMI ≥ 25 kg/m²) and obese (BMI ≥ 30 kg/m²) in both sexes.[1,2] However, BMI does not account for the harmful effects of intra-abdominal fat or the morbidity and mortality risks associated with varying degrees of overweight and obesity. The use of waist circumference (WC) as an additional measure addresses this limitation by incorporating regional fat distribution, particularly central adiposity, which is strongly linked to cardiovascular disease risk. Combining WC with BMI enhances the clinician's ability to identify individuals at elevated risk for obesity-related complications. The increasing global prevalence of obesity underscores the importance of such comprehensive assessment tools. In 2014, more than 1.9 billion adults aged 18 years and older were overweight, of whom over 600 million were obese; furthermore, 42 million children under five years of age were either overweight or obese.[2] If current trends persist, it is projected that by 2030 approximately 60% of the global population—around 3.3 billion people—will be overweight (2.2 billion) or obese (1.1 billion). The consequences are severe, with obesity being implicated in approximately 3.4 million deaths in 2010, contributing to a 4% reduction in life expectancy and a 4% increase in disability-adjusted life years (DALYs).[2] The etiology of obesity involves a complex interplay of genetic, environmental, and behavioral factors. Genetic predisposition, increased availability of high-calorie foods, and a decline in physical activity due to modern lifestyles have collectively fueled this epidemic.[1] At the physiological level, obesity is regulated by multiple hormonal pathways involving gut-derived peptides, adipocyte-secreted adipokines, and other metabolic signals. Ghrelin, a peptide hormone secreted by the stomach, stimulates appetite, while most other gut hormones exert anorectic effects, limiting food intake to maintain optimal digestion and absorption and to prevent metabolic disturbances such as hyperinsulinemia and insulin resistance. Adipocytes themselves produce a variety of adipokines that influence appetite regulation, energy homeostasis, and inflammatory processes.[3] Addressing obesity requires a comprehensive and sustainable strategy. Non-surgical management approaches endorsed by the National Institutes of Health (NIH) include low- or very low-calorie diets, behavioral modification, structured exercise regimens, and pharmacological therapies.[4] However, these methods often fail to achieve long-term weight maintenance. Bariatric surgery, in contrast, has demonstrated substantial efficacy in producing durable weight loss and improving associated comorbidities. It is currently regarded as the most effective intervention for severe obesity and related metabolic disorders.[5] Surgical treatment is generally indicated for individuals with a BMI $\geq$ 40 kg/m² or those with a BMI $\geq$ 35 kg/m² who also present with significant comorbid conditions. Bariatric surgical procedures may be restrictive, malabsorptive, or a combination of both.[6] Among the most widely performed are Laparoscopic Mini Gastric Bypass (LMGB) and Laparoscopic Sleeve Gastrectomy (LSG). LMGB is a minimally invasive alternative to conventional gastric bypass, involving laparoscopic division of the stomach into a small tubular pouch and bypassing 2 to 7 feet of small intestine, thereby reducing both food intake and nutrient absorption. LSG entails resection of approximately 60–80% of the stomach, producing a smaller, sleeve-shaped gastric tube. Although LSG is classified as primarily restrictive, the substantial reduction in gastric volume also decreases gastric acid production and intrinsic factor secretion, impairing the absorption of micronutrients such as iron, vitamin B12, and folate.[8] LMGB, through partial intestinal bypass, similarly predisposes patients to malabsorption. Nutritional deficiencies are a recognized complication following bariatric surgery. Many obese patients present with pre-existing deficiencies, which can be exacerbated postoperatively due to reduced intake and altered absorption. Iron, calcium, vitamin D, vitamin B12, and folate deficiencies are among the most common and can lead to anemia, fatigue, impaired cognition, and other health issues.[7] Consequently, preoperative screening and correction of deficiencies are essential, along with lifelong postoperative supplementation and regular monitoring. Successful surgical outcomes depend on a multidisciplinary approach involving surgeons, dietitians, psychologists, and primary care providers. Patients must adopt long-term dietary changes, engage in regular physical activity, and receive continuous education and support to ensure compliance with postoperative guidelines. Social support structures further enhance adherence and overall success. Although numerous studies worldwide have evaluated nutritional status before and after bariatric surgery, there is limited data within the Indian context.[9–11] Understanding the comparative effects of LMGB and LSG on nutritional outcomes in this population is crucial for optimizing patient care. The present study was therefore undertaken to assess and compare preoperative and postoperative nutritional status in patients undergoing LMGB and LSG, thereby contributing to the evidence base needed for improved clinical decision-making and patient outcomes.

MATERIALS AND METHODS

This prospective, time-bound study was conducted in the Department of General Surgery over a period from September 2018 to May 2020. The study aimed to assess and compare the nutritional outcomes in patients undergoing two commonly performed bariatric procedures—Mini Gastric Bypass (MGB) and Sleeve Gastrectomy (SG)—at defined postoperative intervals. A total of 25 patients who met the inclusion criteria were recruited.

Aims and Objectives

1. To assess and compare the preoperative and postoperative nutritional status of patients undergoing Mini Gastric Bypass and Sleeve Gastrectomy at 3 months and 6 months.

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2. To evaluate the changes in various nutritional parameters following each procedure and analyse differences in nutritional outcomes between the two techniques.

Inclusion Criteria
1. Patients aged between 18 and 60 years.
2. Patients with a Body Mass Index (BMI) ≥ 40, or BMI ≥ 35 with associated comorbid conditions.
3. Patients who provided written informed consent to participate in the study.

Exclusion Criteria
1. Patients who did not return for scheduled follow-up evaluations.
2. Patients who declined or failed to provide informed consent.
3. Individuals with a prior history of bariatric surgery.
4. Patients suffering from terminal illnesses.
5. Individuals with untreated psychiatric disorders (e.g., schizophrenia) or active substance abuse, which could interfere with postoperative compliance and behavioural modifications.
6. Patients who voluntarily opted out of the study at any stage.

Operative Technique: For laparoscopic sleeve gastrectomy (LSG), entry into the peritoneal cavity is achieved using a 12 mm visi-port trocar positioned 18 cm below the left hypochondrium, with insufflation to 15–20 mmHg. Two 12 mm and two 5 mm ports are inserted, and a Nathanson retractor is placed via a 5 mm incision in the subxiphoid region to elevate the liver. The greater curvature, beginning 2–10 cm from the pylorus, is mobilized by dividing the gastrocolic ligament and short gastric vessels up to the left crus. A 32 Fr bougie is introduced along the lesser curvature, and sequential stapling (green followed by white cartridges) is performed to create a narrow gastric tube, excising approximately 75–80% of the stomach. The specimen is removed through an enlarged port, and a drain is placed along the staple line. For laparoscopic mini-gastric bypass (LMGB), a 5-port approach similar to Rutledge's technique is used. A long gastric tube is fashioned 1.5 cm from the lesser curvature, extending from the antrum to the angle of His. A loop gastroenterostomy is constructed 200 cm distal to the ligament of Treitz using an Endo-GIA stapler, then closed with continuous suturing. A hemovac drain is positioned in the lesser sac prior to wound closure.

Data Collection: Preoperative assessments were conducted at baseline, with postoperative follow-ups at 3 and 6 months. Patient demographics and consent were recorded. Weight, height, and triceps skinfold thickness were measured, and fasting blood samples collected at each visit. Macronutrients (protein, albumin) and micronutrients (ferritin, folic acid, and vitamin B12) were analysed.

Laboratory Analysis: Total protein (6.0–8.3 g/dL) and albumin (3.4–5.4 g/dL) were measured on the COBAS C system using biuret and immunoturbidimetric methods respectively. Folic acid (2.7–17.0 ng/mL), vitamin B12 (160–950 pg/mL), and ferritin (20–500 ng/mL) were analyzed on the COBAS e 411 system via competitive binding and sandwich immunoassay principles with chemiluminescent detection. Calcium (8.5–10.3 mg/dL) was quantified photometrically on the COBAS c 701/702 system.

Outcome Measures: The primary outcomes included postoperative changes in protein, albumin, ferritin, folic acid, and vitamin B12 levels, with deficiencies documented at each follow-up over 6 months.

RESULTS

The present study was carried out over a period of one and a half years, from September 2018 to May 2020. A total of 25 patients with morbid obesity who underwent bariatric surgery were included in the study and monitored for a duration of six months. The outcomes of the study are summarized below.

Table 1: Age Wise Distribution of Patients

Age	No. of cases	Percentage
< 40	10	40.00%
41-50	4	16.00%
> 60	11	44.00%
Total	25	100.00%

Age wise distribution: In our study, the maximum number of patients 11(44%) were in the age group more than 60, while 10(40%) belonged to the age group below 40 years and 4(16%)to the age group 41-50years. This is depicted in Table no 1.

Table 2. Gender Wise Distribution of Patients

		Surgery performed				Total	Chi-square value	p-value
		MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY				
Sex	FEMALE	13	81.30%	5	55.60%	18	1.886	0.17
	MALE	3	18.80%	4	44.40%	7		

Gender wise distribution: Table no. 2 shows that Females constituted the majority of our case load at 13 (81.3%) for mini gastric bypass and 5 (55.6%) for sleeve gastrectomy while males formed a smaller

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proportion of the case load at 3(18.8%) for mini gastric bypass and 4 (44.4%) for sleeve gastrectomy. Chi square test was conducted to observe level of significance between both the study groups. An insignificant relation (p-value.>0.05) was observed statistically.

Table 3: Number of Patients According To Surgery Performed

Surgery performed	No. of cases	Percentage
Mini gastric bypass	16	64.00%
Sleeve gastrectomy	9	36.00%
Total	25	100.00%

Types of surgery performed: Of the total number of patients enrolled in our study, 16 patients (64%) underwent Mini gastric bypass, 9 patients (36%) underwent Sleeve gastrectomy as shown in table 3.

Table 4: Changes in Weight

Weight	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	116.69	25.47	115.27	8.73	0.161	0.874	1.42	8.84	-16.86	19.7
3 Months Post Op	96.2	17.51	96.07	5.52	0.022	0.983	0.13	6.06	-12.43	12.69
6 Months Post Op	86.93	12.33	87.78	6.3	-0.19	0.851	-0.84	4.44	-10.06	8.37
3 month difference	19.27	10.17	19.2	5.97	0.018	0.986	0.07	3.74	-7.69	7.83
6 month difference	28.53	16.01	27.49	7.56	0.183	0.857	1.04	5.72	-10.81	12.9

Changes in weight: Table no. 4 shows the comparison of weight loss between two study groups.Weight was recorded before surgical intervention for both the groups 116.69±25.47kg and 115.27±8.73kg respectively, with an insignificant difference statistically (p-value>0.05). Weight after mini gastric bypass and sleeve gastrectomy was 96.20±17.51kg and 96.07±5.52kg respectively at 3 months post-operative and 86.93±12.33kg and 87.78±6.30kg respectively at 6 months post-operative, which was not significantly different (p>0.05) statistically. Weight loss after mini gastric bypass and sleeve gastrectomy was 19.27±10.17 & 19.20±5.97 respectively at 3 months and 28.53±16.01 & 27.49±7.56 respectively at 6 months which was not significantly different (p>0.05).

Table 5: Changes in Bmi between Two Surgery Group

BMI	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	47.35	10.76	49.42	5.51	-0.536	0.597	-2.07	3.87	-10.07	5.92
3 Months Post Op	39.55	7.41	40.69	3.57	-0.428	0.673	-1.14	2.65	-6.63	4.36
6 Months Post Op	35.72	4.77	37.18	3.65	-0.786	0.44	-1.46	1.85	-5.3	2.39
3month difference	7.44	4.18	8.73	3.49	-0.778	0.445	-1.29	1.66	-4.74	2.16
6 month difference	11.27	6.91	12.24	3.84	-0.385	0.704	-0.97	2.52	-6.2	4.25

Changes in body mass index: BMI (Body Mass Index) is calculated by weight (in kg) divided by height (in m2) Table no. 5 Shows Changes in BMI was recorded before surgical intervention for both the groups was 47.35±10.76 and 49.42±5.51 respectively, with an insignificant difference statistically (p-value>0.05). BMI after mini gastric bypass and sleeve gastrectomy was 39.55±7.41 and 40.69±3.57 respectively at 3 months postoperative and 35.72±4.77 and 37.18±3.65 respectively at 6 months postoperative, which was not significantly different (p>0.05) statistically.

Out of the 25 patients, fall in BMI after mini gastric bypass and sleeve gastrectomy was 7.44±4.18 & 8.73±3.49 respectively at 3 months and 11.27±6.91 & 12.24±3.84 respectively at 6 months which was not significantly different(p>0.05).

Table 6: Changes in Triceps Fold Thickness between Two Surgery Groups

Triceps	MINI GASTRIC	SLEEVE	t	p-value	Difference	95% Confidence

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	BYPASS		GASTRECTOMY						Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	38.69	4.38	40.33	3.32	-0.978	0.338	-1.65	1.68	-5.13	1.84
3 Months Post Op	34.93	3.95	36.44	2.7	-1.01	0.324	-1.51	1.5	-4.61	1.59
6 Months Post Op	30.07	3.45	34.67	2.45	-3.49	0.002	-4.6	1.32	-7.33	-1.87
3 month difference	3.87	1.25	3.89	1.17	-0.043	0.966	-0.02	0.51	-1.09	1.04
6 month difference	8.73	1.98	5.67	1.12	4.234	0	3.07	0.72	1.56	4.57

Changes in triceps fold thickness: Triceps Fold Thickness is calculated by measured at the back of the left arm, midway between the acromial process of the scapula and the olecranon process of the ulna

Table no. 6 shows Triceps Fold Thickness was recorded before surgical intervention for both the groups 38.69±4.38 and 40.33±3.32 respectively, with an insignificant difference statistically (p-value>0.05). Triceps Fold Thickness after mini gastric bypass and sleeve gastrectomy was 34.93±3.95and 36.44±2.70 respectively at 3 months post-operative and 30.07±3.45 and 34.67±2.45 respectively at 6 months post-operative, which was a significant different (p<0.05) statistically. Of the 25 patients studied, fall in triceps fold thickness after mini gastric bypass and sleeve gastrectomy was 3.87±1.25mm & 3.89±1.17mm respectively at 3 months which was not significantly different (p>0.05) but fall in tricepsfold thickness at 6 months was 8.73±1.98mm & 5.67±1.12mm which was significantly different (p<0.05).

Table 7: Changes in Total Protein Level between Two Surgery Groups

Total Protein	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	7.32	0.52	7.39	0.43	-0.341	0.736	-0.07	0.21	-0.5	0.35
3 Months Post Op	6.91	0.51	7.23	0.28	-1.738	0.096	-0.32	0.18	-0.7	0.06
6 Months Post Op	6.38	0.44	7.11	0.35	-4.221	0	-0.73	0.17	-1.09	-0.37
3 month difference	0.43	0.28	0.16	0.37	2.085	0.049	0.28	0.13	0	0.55
6 month difference	0.97	0.5	0.28	0.35	3.609	0.002	0.69	0.19	0.29	1.08

Changes in total protein: Mean fall of total protein levels during mini gastric bypass from 7.32 g/dL to 6.91 g/dL& 6.38 g/dL at 3 months and 6 months while mean fall in total protein during sleeve gastrectomy from 7.39 g/dLto 7.23 g/dL&7.11 g/dL at 3 months and 6 months as shown in Table no. 7. At 3 months, mean difference was observed to be 0.43±0.28 and 0.16±0.37 for both the groups, with a statistically significant relation (p-value<0.05). At 6 months, mean difference was observed to be 0.97±0.50 and0.28±0.35 for both the groups, with a statistically significant relation (p-value<0.05).it shows that fall was more during follow up of mini gastric bypass than sleeve gastrectomy.

Table 8: Changes in Albumin Levels between Two Surgery Groups

Albumin	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	4	0.58	4.15	0.4	-0.695	0.494	-0.15	0.22	-0.61	0.3
3 Months Post Op	3.67	0.12	4.18	0.39	-4.773	0	-0.51	0.11	-0.73	-0.29
6 Months Post Op	3.52	0.13	3.97	0.16	-7.534	0	-0.45	0.06	-0.57	-0.32
3 month difference	0.43	0.37	-0.03	0.32	3.101	0.005	0.46	0.15	0.15	0.77
6 month difference	0.58	0.36	0.19	0.27	2.84	0.01	0.4	0.14	0.11	0.69

Changes in albumin: Table no. 8 shows albumin levels before surgical intervention for both the groups 4.00±0.58g/dL and 4.15±0.40g/dL respectively, with an insignificant difference statistically (p-value>0.05). Albumin levels after mini gastric bypass and sleeve gastrectomy was 3.67±0.33g/dL and 4.18±0.47g/dL respectively at 3 months post-operative and 3.52±0.13g/dL and 3.97±0.16g/dL respectively at 6 months post-operative, which was having an significant different (p<0.05) statistically. Albumin levels at 3 months difference was found to be 0.43±0.37 and -0.03±0.32respectively for both the groups with a statistically significant different (p<0.05). Albumin levels at 6 months difference was found to be 0.58±0.36 and 0.19±0.27respectively for both the groups with a statistically significant different (p<0.05).

Table 9: Changes in Ferritin Levels between Two Surgery Groups

Ferritin	MINIGASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	39.61	25.59	52.26	24.56	-1.203	0.241	-12.65	10.51	-34.4	9.1
3 Months Post Op	34.73	20.3	50.86	23.78	-1.769	0.091	-16.13	9.12	-35.04	2.78
6 Months Post Op	28.69	17.59	49.37	22.67	-2.504	0.02	-20.68	8.26	-37.81	-3.55
3 month difference	6.59	7.2	1.4	1.5	2.114	0.046	5.19	2.45	0.1	10.27
6 month difference	12.63	10.55	2.89	3.3	2.67	0.014	9.74	3.65	2.18	17.3

Changes in ferritin: Table no. 9 shows ferritin levels before surgical intervention for both the groups 39.61±25.59 and 52.26±24.56 respectively, with an insignificant difference statistically (p-value>0.05). Ferritin levels after mini gastric bypass and sleeve gastrectomy was 34.73±20.30and 50.86±23.78 respectively at 3 months post-operative; and 28.69±17.59and 49.37±22.67 respectively at 6 months post-operative, which was having a significant different (p<0.05) statistically. Ferritin levels at 3 months difference was found to be 6.59±7.20and 1.40±1.50 respectively for both the groups with a statistically significant difference (p<0.05). Ferritin levels at 6 months difference was found to be 12.63±10.55 and 2.89±3.30 respectively for both the groups with a statistically significant difference (p<0.05).

Table 10. Changes in Folic Acid

Folic Acid	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	8.27	4.52	9.8	4.6	-0.805	0.429	-1.53	1.9	-5.45	2.39
3 Months Post Op	6.88	3.22	9.57	3.78	-1.853	0.077	-2.69	1.45	-5.69	0.32
6 Months Post Op	6.58	3.32	9.33	4.21	-1.779	0.089	-2.75	1.55	-5.96	0.46
3 month difference	1.75	1.7	0.23	1.04	2.408	0.025	1.52	0.63	0.21	2.82
6 month difference	2.05	1.93	0.47	1.02	2.272	0.033	1.58	0.7	0.14	3.03

Changes in folic acid: Table no. 10 shows Mean fall of folic acid levels during mini gastric bypass from 8.27 ng/mL to 6.88ng/mL& 6.58 ng/mL at 3 months and 6 months while mean fall in folic acid during sleeve gastrectomy from 9.80 ng/mL to 9.57ng/mL& 9.33 ng/mL at 3 months and 6 months which was insignificantly different. There was a significant fall in difference of folic acid during mini gastric bypass and sleeve gastrectomy of 1.75 ±1.70 , 2.05 ± 1.93 & 0.23 ±1.04 ,0.47 ±2.272 at 3 and 6 months respectively(p<0.05).

Table 11: Changes in Vitamin B12 Levels between Two Surgery Groups

Vitamin B12	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper

Before Surgery	275.81	134.89	271.54	74.9	0.087	0.931	4.27	48.98	-97.05	105.58
3 Months Post Op	241.71	142.29	261.56	70.1	-0.389	0.701	-19.84	51.07	-125.76	86.07
6 Months Post Op	216.65	130.32	242.72	76.22	-0.544	0.592	-26.07	47.92	-125.46	73.32
3 month difference	41.31	26.23	9.99	8.6	3.446	0.002	31.32	9.09	12.47	50.18
6 month difference	66.37	25.43	28.82	16.97	3.919	0.001	37.55	9.58	17.68	57.42

Changes in vitamin b12: Table no. 11 shows before surgery, levels of vitamin B12 were 275.81±134.89pg/mL and 271.54±74.90pg/mL. At 3months postoperative, 241.71±142.29pg/mL and 261.56±70.10pg/mL. At 6 months postoperative, 216.65±130.32pg/mL and 242.72±76.22pg/mL. Difference in vitamin B12 during mini gastric bypass and sleeve gastrectomy was 41.31±26.23 & 9.99±8.60 at 3 months and 66.37±25.43 & 28.83±16.97 respectively with significant difference statistically ($p<0.05$).

Table 12: Changes in Calcium between Two Surgery Groups

Calcium	MINI GASTRIC BYPASS		SLEEVE GASTRECTOMY		t	p-value	Difference		95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Mean	Std. error	Lower	Upper
Before Surgery	8.73	0.49	8.71	0.5	0.068	0.947	0.01	0.21	-0.41	0.44
3 Months Post Op	8.07	0.6	8.57	0.48	-2.091	0.048	-0.49	0.24	-0.98	0
6 Months Post Op	7.83	0.51	8.36	0.41	-2.623	0.016	-53	0.2	-0.95	-0.11
3 month difference	0.61	0.51	0.14	0.12	2.648	0.015	0.46	0.17	0.1	0.82
6 month difference	0.85	0.43	0.36	0.2	3.23	0.004	0.5	0.15	0.18	0.82

Changes in calcium: Table no. 12 shows Mean calcium during mini gastric bypass from 8.73mg/dL at surgery to 8.07mg/dL & 7.83mg/dLat 3 months and 6 months while mean calcium during sleeve gastrectomy from 8.71mg/dL at surgery to 8.57mg/dL&8.36mg/dL at 3 months and 6 months. There was a significant difference in calcium levels during mini gastric bypass and sleeve gastrectomy of 0.61±0.51 & 0.14±0.12 at 3 months and at 6 months as 0.85± 0.43 & 0.36±0.20respectively statistically($p<0.05$).

DISCUSSION

This prospective study was conducted to compare the preoperative and postoperative nutritional status of patients undergoing two bariatric procedures: Mini Gastric Bypass (MGB) and Sleeve Gastrectomy (SG). A total of 25 patients meeting the eligibility criteria for bariatric surgery were enrolled, and written informed consent was obtained from each participant. The study was approved by the institutional ethics committee. The global rise in obesity and its associated comorbidities underscores the need for effective treatment and prevention strategies.[44] Lifestyle modifications—such as dietary changes and increased physical activity—remain the cornerstone of obesity management, with pharmacological therapy providing modest benefits when combined with lifestyle interventions. However, long-term success rates with non-surgical treatments are often unsatisfactory.[12] Bariatric surgery, in contrast, has consistently demonstrated superior weight loss outcomes and long-term maintenance, particularly in patients with a BMI ≥ 40 kg/m² or ≥ 35 kg/m² with significant comorbidities.[13,14] A key concern with bariatric procedures is the risk of nutritional deficiencies due to reduced intake and/or malabsorption, which tend to be more pronounced following malabsorptive or mixed surgeries compared to purely restrictive techniques.[15] Nutritional deficits can manifest in diverse ways depending on the nutrients involved, the severity of depletion, and the duration of the deficiency, making thorough pre- and postoperative nutritional screening essential. Globally, the popularity of bariatric surgery has risen significantly.[16] While Laparoscopic Roux-en-Y Gastric Bypass (LRYGB) was long considered the gold standard, Laparoscopic Sleeve Gastrectomy (LSG) and Laparoscopic Mini Gastric Bypass (LMGB) have emerged as competitive alternatives.[17,18] This study aimed to compare the nutritional impact of LMGB and LSG over a six-month follow-up period. In the present series, 44% of patients were aged over 60 years, 40% were below 40 years, and 16% were between 41–50 years. Similar age distributions were reported by Praveenraj et al.[19] and Kansou et al.[20] The majority of participants were female, consistent with previous findings that women undergo bariatric surgery at nearly twice the

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rate of men.[19,20] Common comorbidities in the cohort included type 2 diabetes mellitus and hypertension, with diabetes being the most prevalent, mirroring results from Guan et al.[21] The mean BMI decreased from 48.1 preoperatively to 40.0 at three months and 36.3 at six months. Comparable reductions were reported by Kansou et al.[20] Although weight loss was greater in the LMGB group, the difference was not statistically significant, aligning with studies by Kansou et al.[20] and Kular et al.[22] which found LMGB to offer better long-term weight loss than LSG. Nutritional outcomes revealed significant differences between the two procedures. Total protein levels in the LMGB group declined from 7.32 g/dL preoperatively to 6.91 g/dL at three months and 6.38 g/dL at six months. In the LSG group, levels decreased from 7.39 g/dL to 7.23 g/dL and 7.11 g/dL, respectively. Protein loss was more pronounced following LMGB, consistent with findings by Motamedi et al.[23] Protein malnutrition, often due to intolerance to protein-rich foods, remains a serious complication of malabsorptive procedures.[24] Serum albumin levels followed a similar trend, with greater reductions in the LMGB group (3.67 g/dL at three months and 3.52 g/dL at six months) compared to the LSG group (4.18 g/dL and 3.97 g/dL, respectively). Hypoalbuminemia is more common after malabsorptive procedures and can be severe in high-risk populations such as vegetarians and patients with chronic illness.[25] The underlying mechanisms may include reduced absorptive surface area and increased portal pressure, leading to malabsorption.[26] Ferritin levels were significantly lower in LMGB patients, dropping from 34.73 ng/mL at three months to 28.69 ng/mL at six months, compared to 50.86 ng/mL and 49.37 ng/mL in LSG patients. Iron deficiency post-bariatric surgery is linked to reduced gastric acidity, bypass of primary absorption sites, decreased tolerance for red meat, and menstrual blood loss in women.[27-29] Folic acid deficiency, another potential cause of anemia, was also more pronounced in the LMGB group at six months, in line with data from Kominiarek.[30] Similarly, vitamin B12 levels declined more sharply after LMGB, reaching 216.65 pg/mL at six months compared to 242.72 pg/mL in the LSG group. This trend agrees with studies by Muhuri et al.[31] and Kwon et al.[32] which highlight the risk of B12 deficiency due to reduced intrinsic factor and altered digestion. Calcium levels decreased in both groups, with a greater decline after LMGB (from 8.73 mg/dL to 7.83 mg/dL) compared to LSG (from 8.71 mg/dL to 8.36 mg/dL). Calcium deficiency following bariatric surgery, observed in up to 10% of cases,[33] results from bypassing the duodenum and proximal jejunum—primary absorption sites—and may be compounded by reduced dairy intake. Overall, the study findings confirm that while both LMGB and LSG are effective for weight reduction, LMGB carries a higher risk of protein, ferritin, folic acid, vitamin B12, and calcium deficiencies. These results are consistent with prior research comparing restrictive and malabsorptive procedures.[34–37] The malabsorptive component of LMGB contributes significantly to postoperative nutritional deficits. Nutritional management post-bariatric surgery aims to optimize weight loss, preserve lean body mass, maintain hydration, and prevent complications such as dumping syndrome.[38] Patients should be encouraged to maintain daily fluid intake of at least 64 ounces, avoid high-sugar beverages, and monitor dietary intake through food diaries. Protein consumption should meet 1.1–1.5 g/kg of ideal body weight, prioritizing high-quality sources rich in leucine, such as dairy products, eggs, lean meats, soy, and legumes.[39–41] Micronutrient supplementation is essential. Routine vitamin B12 supplementation, preferably via parenteral or sublingual routes, helps prevent deficiency. Calcium citrate is recommended over calcium carbonate for better absorption in low-acid environments. Standard postoperative supplementation should include a multivitamin with minerals, 1200–2400 mg elemental calcium, ≥3000 IU vitamin D, and 250–350 µg daily or 1000 µg weekly of vitamin B12.[42] Given the high prevalence of pre-existing deficiencies, preoperative nutritional assessment is critical to identify and correct deficits before surgery. Postoperatively, lifelong monitoring is advised, with the frequency of assessments tailored to the surgical procedure performed. Multivitamin supplementation with added calcium and vitamin D should be universal among bariatric patients. In conclusion, bariatric surgery remains the most effective treatment for morbid obesity, but nutritional deficiencies are a significant long-term concern, particularly after LMGB. Comprehensive preoperative evaluation, individualized supplementation, regular biochemical monitoring, and dietary counseling are vital to ensuring patient safety, optimizing outcomes, and maintaining quality of life.

Limitations of the Study:

1. The sample size in this study was relatively small, limiting the generalizability of the findings. Future research should be conducted on a larger patient population to validate and expand upon these results.
2. This investigation focused solely on two bariatric procedures—Mini Gastric Bypass (MGB) and Sleeve Gastrectomy (SG). Broader studies including a wider range of surgical techniques are recommended for a more comprehensive understanding.
3. Additional research is needed to explore a broader spectrum of micronutrient deficiencies that may arise following different bariatric procedures.
4. Future studies should also assess the effectiveness of various nutritional supplementation protocols designed to prevent or manage deficiencies after bariatric surgery.
5. The current study had a follow-up duration of only six months, which limits insight into long-term nutritional outcomes. Studies with longer

follow-up periods—ideally between 2 to 5 years—are essential to understand the extended impact of bariatric surgery on nutritional status.

CONCLUSION

This prospective study was carried out in the Department of General Surgery to assess and compare the preoperative and postoperative nutritional profiles of patients undergoing two types of bariatric procedures—Mini Gastric Bypass (MGB) and Sleeve Gastrectomy (SG). A total of 25 patients who met the inclusion criteria were recruited. Informed consent was obtained from each participant, and the study received ethical clearance from the institutional review board.

Key observations from the study include:

1. Greater weight reduction was noted in patients who underwent MGB compared to those who had SG.
2. A decline in total protein levels was observed in both groups at the 3- and 6-month follow-up points, with a more significant drop in the MGB group.
3. Serum albumin levels decreased in both groups post-surgery, with the decline being more prominent in patients undergoing MGB.
4. Postoperative ferritin levels declined in both groups, with significantly lower values observed in the MGB group.
5. Both folic acid and vitamin B12 levels showed a marked decrease postoperatively in both surgical groups. The reduction was more substantial in the MGB group, especially at the 6-month mark.
6. Calcium levels dropped over time in both groups, with a more noticeable decline in the MGB cohort.

The findings of this study demonstrate that while both surgical techniques are effective for weight loss, they are associated with varying degrees of nutritional deficiencies. Deficiencies were more prevalent and severe in patients undergoing Mini Gastric Bypass compared to those who had Sleeve Gastrectomy. This underscores the importance of individualized, ongoing nutritional monitoring and management as part of postoperative care. Regular metabolic assessments and appropriate supplementation are essential to prevent and address nutritional complications in patients who have undergone bariatric surgery, especially in those treated with malabsorptive procedures like MGB.

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