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Original Article

Bridging Clinical Success and Nutritional Risk: Public Health Challenges After Bariatric Surgery

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Abstrac

Background & rationale: Bariatric surgery has significantly improved weight loss and metabolic health, revolutionizing the treatment of morbid obesity and associated comorbidities. However, additional public health challenges are brought forward by its growing popularity, especially those linked to nutritional deficiencies following surgery

Aim: This study compares sleeve gastrectomy (SG) and Roux-en-Y gastric bypass (RYGB) with respect to micronutrient outcomes one year postoperatively and evaluates their implications for population health strategies.

Methods: A prospective, comparative study was conducted at Sohag University Hospital including 50 patients (25 SG, 25 RYGB). Participants were followed for one year postoperatively with serial monitoring of BMI, comorbidities, and key micronutrient levels

Results: Both procedures resulted in significant weight loss and improvement in hypertension, diabetes, and dyslipidemia. However, RYGB was associated with a higher incidence of vitamin B12, calcium, and iron deficiencies. SG showed better micronutrient retention, though both groups required supplementation

Conclusion: Despite both techniques showing marked reductions in BMI and chronic disease risk, RYGB patients demonstrated significantly greater deficiencies in vitamin B12, iron, and calcium. Our findings underscore the need to incorporate long-term nutritional monitoring into national obesity and surgical care protocols.

Public Health Implications: Postoperative micronutrient screening is mandatory at regular intervals.in addition to supplementation subsidies for vulnerable populations. Its highly recommended to train general practitioners in post-bariatric nutritional care and to Incorporate bariatric outcomes into national NCD surveillance program

Keywords: Bariatric surgery, Micronutrients deficiencies, Dyslipidemia, Vitamins

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Background and rational

Worldwide, obesity is regarded as a pan-endemic health issue. According to the National Institutes of Health, morbid obesity is defined as having a body mass index (BMI) of 40 kg/m2 or above when combined with other obesity-related conditions such type 2 diabetes, joint pain, obstructive sleep apnea, and hypertension (HTN). An average person's life expectancy is shortened by three years due to obesity, or ten years if they are extremely obese (BMI over 40). [(1)] Research demonstrates that bariatric surgery is superior to traditional treatment in managing obesity and its related comorbidities. [(2)] Based on current statistics, the most prevalent surgery worldwide for bariatric surgeries is sleeve gastrectomy (SG), accounting for 46% of all procedures. “Roux-En-Y Gastric bypass” (RYGB) is the next most widespread procedure. (40% of all procedures) .[(3)]
Despite many clinical advantages of bariatric surgeries, there is a chance of several surgical and gastrointestinal problems afterward. [(4)] Nutritional deficits are one of the potential problems that should be carefully considered. A multitude of clinical symptoms can be associated with nutritional deficiencies, contingent upon the particular nutrients or micronutrients implicated, the degree of insufficiency, and the length of the shortage. This is due to the possibility that they could seriously impair the patients' day-to-day activities and, in certain cases, lead to potentially fatal consequences. It is highly advised to have a nutritional examination both before and after surgery. [(5)]
The growing popularity of bariatric surgery necessitates a public health lens to evaluate its impact not only on obesity and comorbidities but also on nutritional status. Postoperative micronutrient deficiencies, if unmonitored, can exacerbate existing health inequalities, especially in low-resource settings where access to follow-up care and supplements may be limited. Integrating these findings into public health policy can help shape national guidelines for long-term post-bariatric care, improve quality of life, and reduce avoidable healthcare costs; Despite extensive evidence supporting the efficacy of bariatric surgery in weight reduction and comorbidity resolution, limited data exist on the comparative trajectory of micronutrient deficiencies between SG and RYGB in real-world clinical settings. This study addresses this gap by longitudinally evaluating and comparing postoperative nutritional outcomes and their public health implication. So the aim of this study is to compare postoperative micronutrient status (vitamin D, B12, calcium, iron, ferritin) among morbidly obese patients undergoing SG or RYGB and explore the public health implications of nutritional deficiencies in post-bariatric populations.

Methods

Study design & settings

A prospective cohort study was conducted at Sohag University Hospital general surgery department over a period of 18 months from January 2021 to mid-2022.

Study Population

A total of 50 adult patients with morbid obesity were enrolled and followed for a period of 12 months postoperatively (total coverage of patients that fulfill the inclusion criteria during the study period). Participants were allocated into two equal groups: 25 patients underwent RYGB and 25 underwent SG. The groups were matched for age and sex to ensure comparability.

Inclusion Criteria

- Adult males or females aged between 18 and 65 years
- BMI >40 kg/m², or BMI >30 kg/m² with one or more obesity-related comorbidities (e.g., type 2 diabetes mellitus [T2DM], hypertension [HTN])
- Documented failure of previous weight reduction attempts over a minimum period of two years
- Strong motivation and indication for surgical intervention

Exclusion Criteria

- Patients undergoing revisional bariatric procedures
- History of previous gastric surgery
- Endocrine disorders (excluding controlled hypothyroidism and diabetes mellitus)
- Diagnosed psychiatric illness
- Pregnancy
- Active malignancy

Data collection:

Preoperative Assessment

All patients underwent a standardized preoperative evaluation, which included:

- **Medical History:** Patient demographic data (name, age, sex, occupation, address), BMI, body weight, nutritional history, and presence of comorbid conditions (T2DM, HTN, dyslipidemia).
- **Clinical Examination:** General physical examination including vital signs (blood pressure, heart rate, respiratory rate, temperature) and signs of systemic illness (pallor, jaundice, cyanosis, lymphadenopathy). A focused abdominal examination was performed to exclude any gastrointestinal pathology.
- **Laboratory Investigations:** Complete blood count (CBC), renal and liver function tests, lipid profile, HbA1c, and baseline serum levels of key micronutrients (vitamin D, vitamin B12, iron, ferritin, and calcium).

Surgical Procedures

All surgeries were performed laparoscopically by experienced bariatric surgeons following standard protocols. The choice between SG and RYGB was made based on patient preference, clinical indication, and surgical eligibility.

Postoperative Follow-Up

Patients were monitored at 3, 6, and 12 months postoperatively. Follow-up assessments included:

- Body weight and BMI
- Serum levels of vitamin D, vitamin B12, iron, ferritin, and calcium
- Evaluation of comorbidities (glycemic control in T2DM, blood pressure in HTN, lipid levels)

Patients were also evaluated for any clinical symptoms suggestive of nutritional deficiencies or surgical complications.

Outcome Measures

The primary outcomes included changes in BMI, weight loss, and serum micronutrient levels across the 12-month follow-up period.

Secondary outcomes included the resolution or improvement of obesity-related comorbidities (T2DM, HTN, dyslipidemia).

Comparative analyses between the SG and RYGB groups were conducted to determine the relative impact of each procedure on the nutritional and metabolic profile of the patients.

Data management and Statistical Analysis: Data collected over time, basic clinical examinations, laboratory investigations, and outcome measures were coded, processed, and analyzed with SPSS (statistical package for social science) version 25 (Armonk, NY: IBM Corp.). The data was checked for normality using the Shapiro-Wilk tests. Data presented as number and percentage; chi square test was used for comparison of qualitative variables. Data was normally distributed so Independent T- test was used for comparison quantitative variables. P value was considered significant if P was less than 0.05.

Results

A total of 50 patients were enrolled in the study, with 25 undergoing laparoscopic sleeve gastrectomy (LSG) and 25 undergoing laparoscopic Roux-en-Y gastric bypass (LRYGB). The two groups were comparable in baseline demographic characteristics, including age, sex, and body mass index (BMI), with no statistically significant differences observed ($P > 0.05$). patients saw a statistically significant reduction in hypertension and dyslipidemia relative to the preoperative group after 12 month follow up in both groups. The reduction in DM was more noticeable in the gastric bypass group, while the comparison between the two groups of surgery showed that it was not statistically significant. **Table 1**

Table 1. Baseline Demographics and Change in Comorbidities at 12 Months Postoperatively, n=50

Variable	Sleeve Gastrectomy (n = 25)	Gastric Bypass (n = 25)	p-value
Age (years)	42.2 ± 7.59	43.92 ± 7.12	0.413
Gender (M/F)	8 (32%) / 17 (68%)	9 (36%) / 16 (64%)	#0.765
Hypertension (%):			
Preoperative	13 (52%)	12 (48%)	#0.777
Postoperative	7 (28%)	6 (24%)	#0.747
Diabetes Mellitus (%):			
Preoperative	9 (36%)	8 (32%)	#0.765
Postoperative	5 (20%)	4 (16%)	#0.713
Dyslipidemia (%):			
Preoperative	25 (100%)	25 (100%)	#1.00
Postoperative	10 (40%)	10 (40%)	#1.00

P value was calculated by Independent T test or #Chi-square test whenever suitable

Considering the BMI, Both groups' body mass indexes (BMIs) were lower than they had been before surgery. However, when comparing the two groups' BMIs before and after surgery, there was no statistically significant difference unless after one year BMI was significantly lower in LRYGB group, p value =0.006.

Table 2& Figure 1 show the body mass index trend during the study period

Regarding Iron Deficiency Both groups experienced a **progressive decline** in serum iron levels postoperatively. However, the **gastric bypass group exhibited a significantly greater decline** at each postoperative time point. Also **Ferritin levels** significantly declined in the gastric bypass group over time, indicating progressive iron store depletion, while the sleeve gastrectomy group showed a paradoxical increase, likely due to reduced supplementation. These findings highlight the greater risk of iron deficiency with gastric bypass and the importance of differentiated postoperative nutritional strategies. **Table 2**

Calcium levels remained stable or slightly increased after sleeve gastrectomy, while gastric bypass patients showed a significant and progressive decline at 6 and 12 months, reflecting impaired calcium absorption due to bypass of the duodenum. These findings emphasize the need for vigilant calcium and vitamin D monitoring, particularly in gastric bypass patients. **Table 2**

Vitamin D Deficiency, When the patient results from each group were compared to those from the other before and after surgery, it was found that each group's vit D increased statistically significantly at 3, 6, and 12 months after surgery compared to preoperatively. However, when the 2 groups were compared, no difference was found to be statistically significant in vit D preoperatively, but the sleeve gastrectomy group's vit D increased statistically more than the gastric bypass groups at 3 and 6 months after surgery, and this difference became negligible at 12 months postoperatively **Table 2**

As regard Vitamin B12 ; At 12 months postoperatively, vitamin B12 was significantly higher in the LSG group (391.20 ± 22.23) compared to the LRYGB group (346.80 ± 20.36) (P = 0.002). **Table2**

Table 2. Comparison of BMI and Micronutrient Levels Between Sleeve Gastrectomy and Gastric Bypass Groups Over 12 Months, n=50

Parameter	Time Point	Sleeve Gastrectomy	Gastric Bypass	p-value
BMI (kg/m²)	Preoperative	45.65 ± 7.14	46.76 ± 5.19	0.534
	3 months	38.92 ± 6.44	38.97 ± 5.31	0.974
	6 months	33.10 ± 4.91	32.51 ± 4.00	0.647
	12 months	25.67 ± 4.01	22.73 ± 3.14	**0.006***
	Pre vs Post (All)	<0.001**	<0.001**	—
Vitamin D (ng/ml)	Preoperative	25.36 ± 5.50	24.48 ± 5.37	0.570
	3 months	29.36 ± 5.19	26.60 ± 4.15	**0.043***
	6 months	32.68 ± 4.09	29.24 ± 2.79	**<0.001****
	12 months	32.36 ± 2.98	30.80 ± 3.45	0.094
	Pre vs Post (All)	<0.001**	<0.001**	—
Iron (µg/dL)	Preoperative	92.32 ± 11.93	93.76 ± 10.17	0.648
	3 months	83.80 ± 10.10	77.44 ± 10.35	**0.033***
	6 months	78.04 ± 11.58	64.68 ± 6.79	**<0.001****
	12 months	72.48 ± 15.31	43.92 ± 5.31	**<0.001****
	Pre vs Post (All)	<0.001**	<0.001**	—
Ferritin (ng/ml)	Preoperative	163.60 ± 16.43	156.40 ± 14.97	0.894
	3 months	166.40 ± 14.97	129.20 ± 13.74	**0.014***
	6 months	185.56 ± 15.31	123.60 ± 22.25	**<0.001****
	12 months	190.64 ± 17.19	90.64 ± 17.19	**<0.001****
	Pre vs Post	0.520 / <0.001** / <0.001**	<0.001** (All)	—
Calcium (mg/dL)	Preoperative	10.12 ± 2.40	10.20 ± 1.76	0.787
	3 months	10.60 ± 1.63	9.36 ± 1.80	0.597
	6 months	10.76 ± 1.56	8.76 ± 1.61	**<0.001****
	12 months	10.88 ± 2.09	8.16 ± 1.49	**<0.001****
	Pre vs Post	0.056 / 0.069 / 0.147	0.003* / <0.001** / <0.001**	—
Vitamin B12 (ng/ml)	Preoperative	491.20 ± 22.23	493.60 ± 38.07	0.137
	3 months	431.20 ± 53.14	439.20 ± 53.14	0.913
	6 months	412.00 ± 29.72	369.20 ± 23.79	0.655
	12 months	391.20 ± 22.23	346.80 ± 20.36	**0.002***
	Pre vs Post (All)	<0.001**	<0.001**	—

*P < 0.05 (significant), **P < 0.001 (highly significant), p value was calculated by Independent T test or repeated measurements ANOVA test wherever suitable

"Trends in BMI and key micronutrients (iron, ferritin calcium, vitamin D and vitamin B12) over 12 months are illustrated in Figures 1–6.

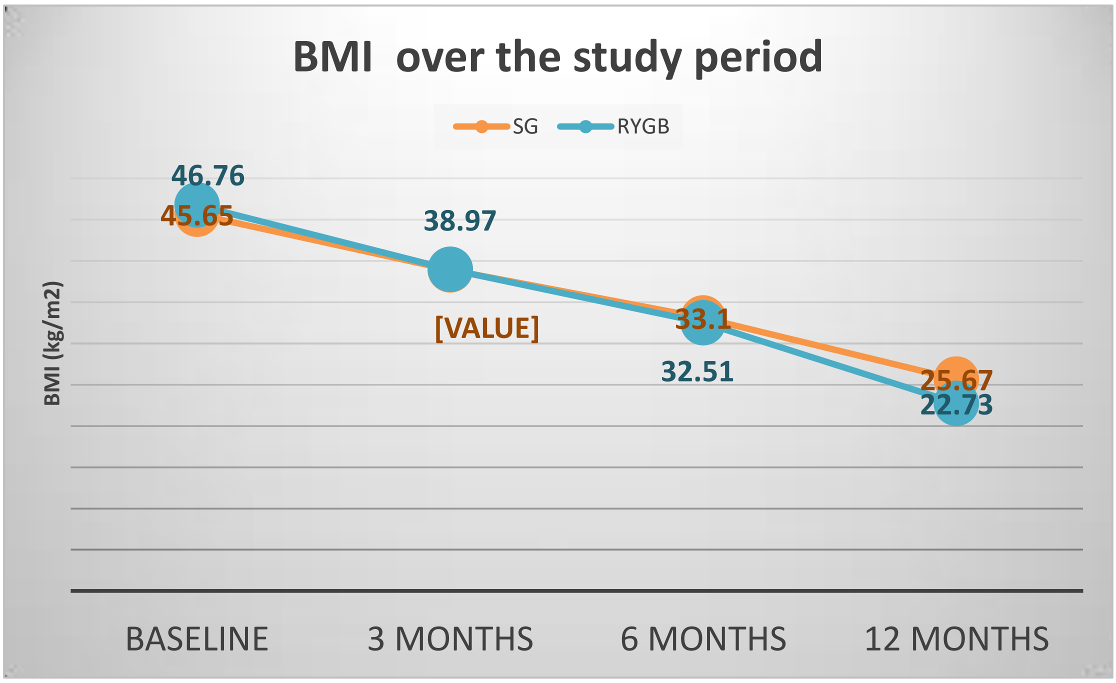

Figure 1 shows the body mass index trend during the study period

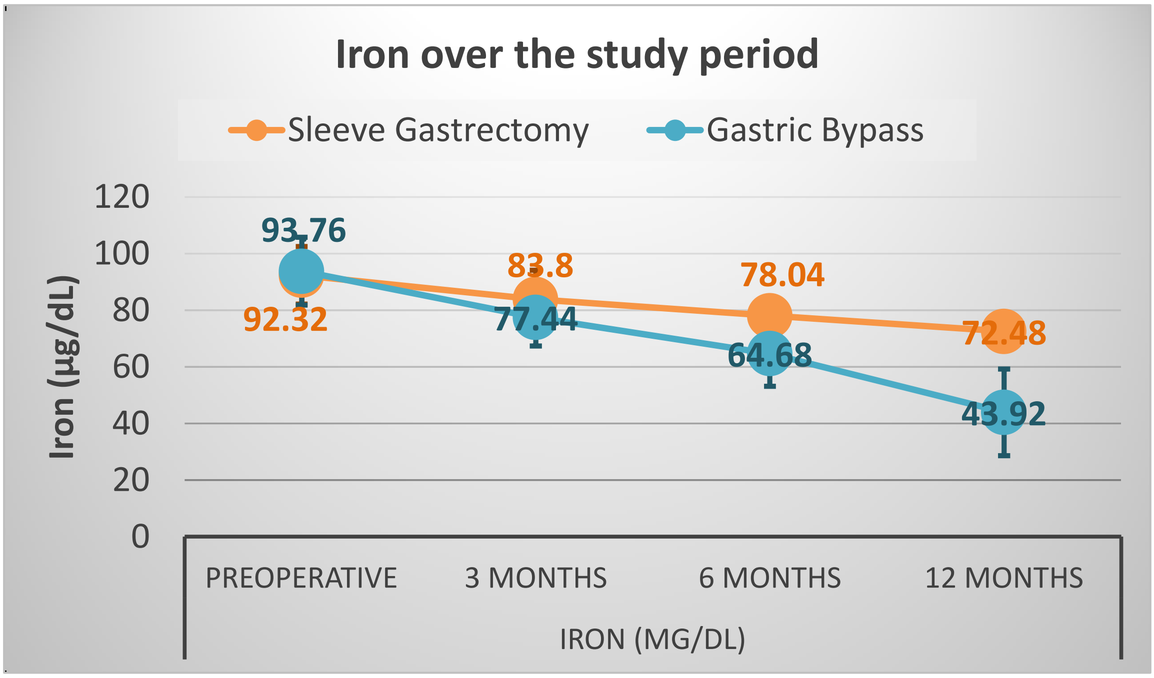

Figure 2 shows Iron trend during the study period

- Normal reference range for iron is 65–175 (men), 50–170 (women)µg/dL according to WHO .[14]

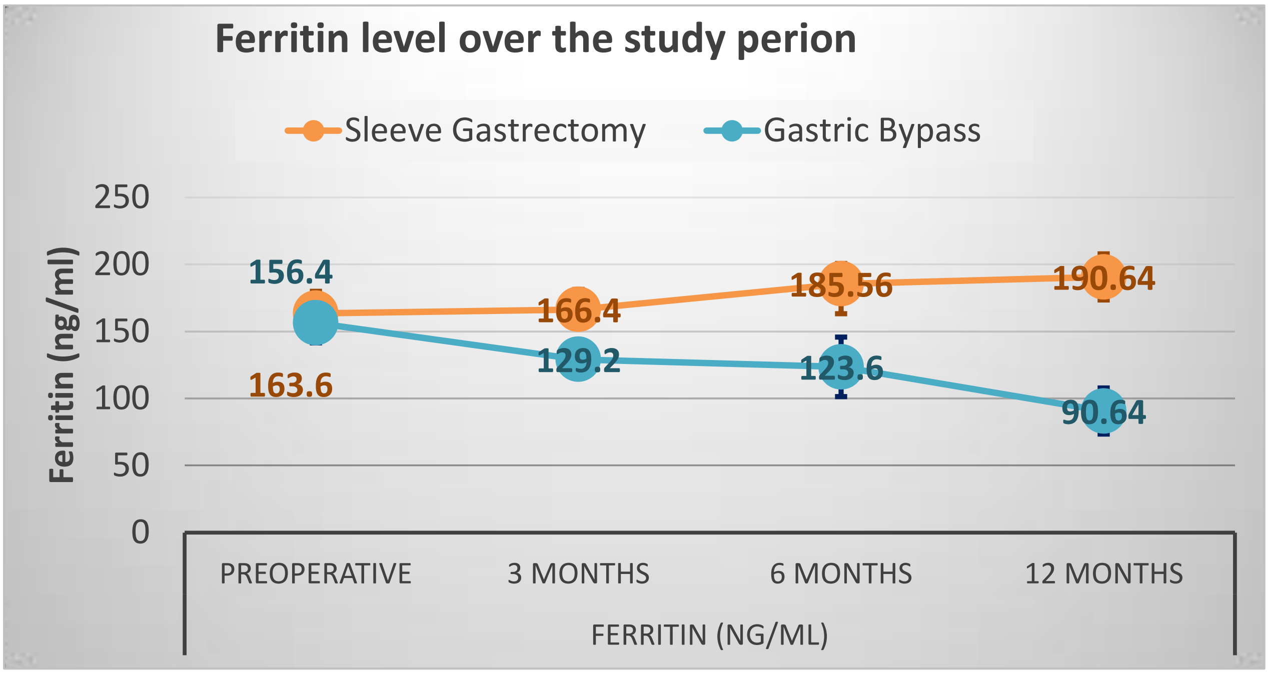

Figure 3 shows Ferritin trend during the study period

- Normal reference range for ferritin is 30–300 (men), 15–200 (women) ng/mL according to WHO. [15]

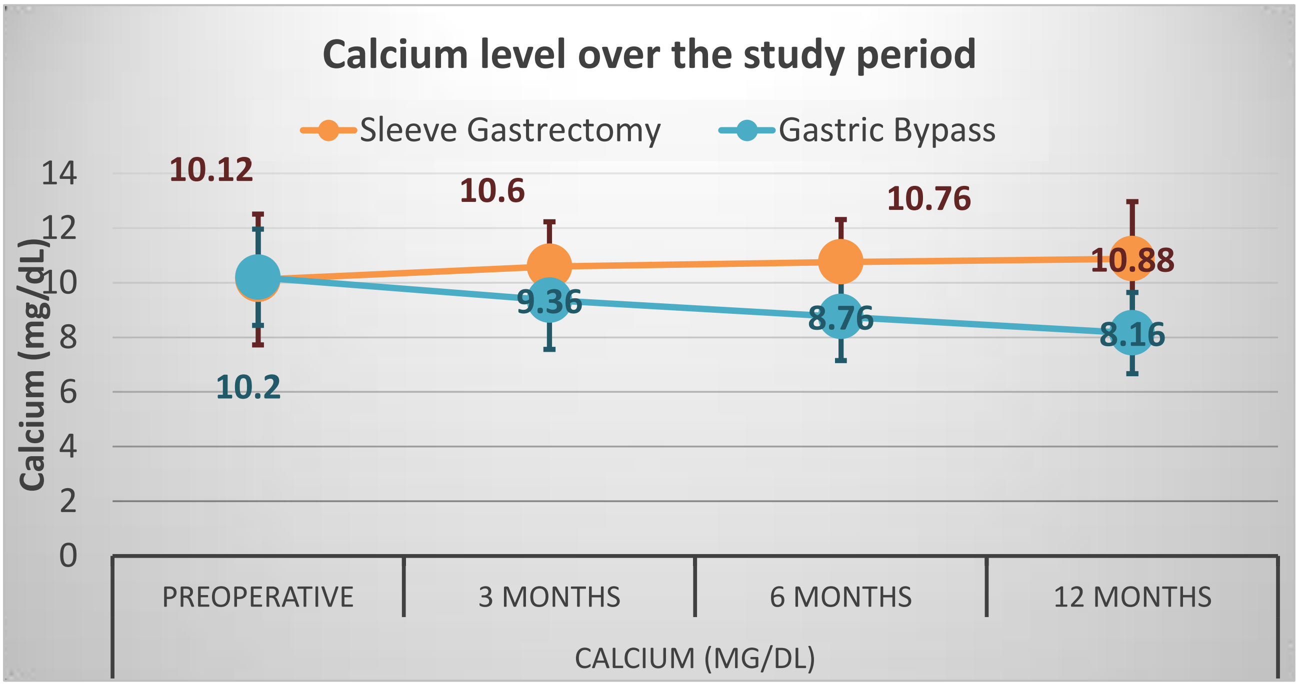

Figure 4 shows Calcium trend during the study period

- Normal reference range for Calcium is 8.4–10.5 mg/dL according to WHO. [16]

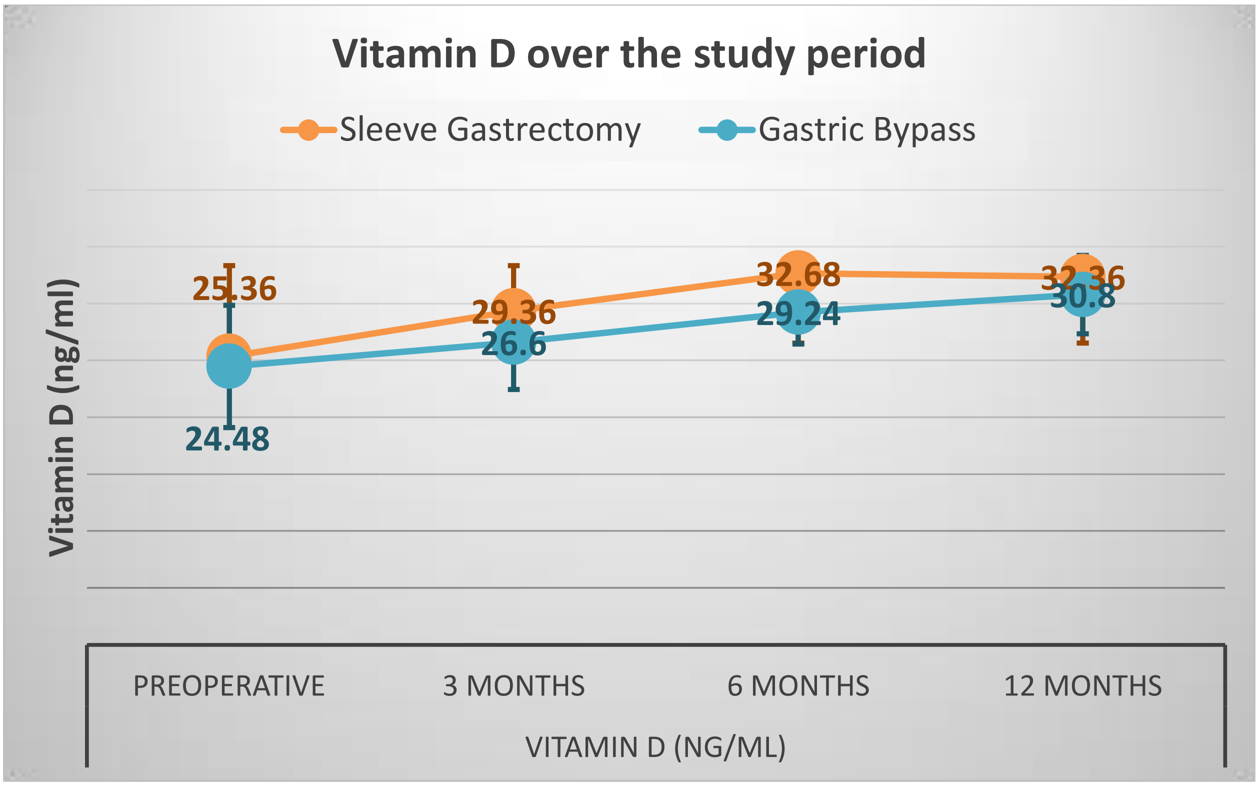

Figure 5 shows vitamin D trend during the study period

- Normal reference range for vitamin D is 20–50 ng/mL according to WHO [17]

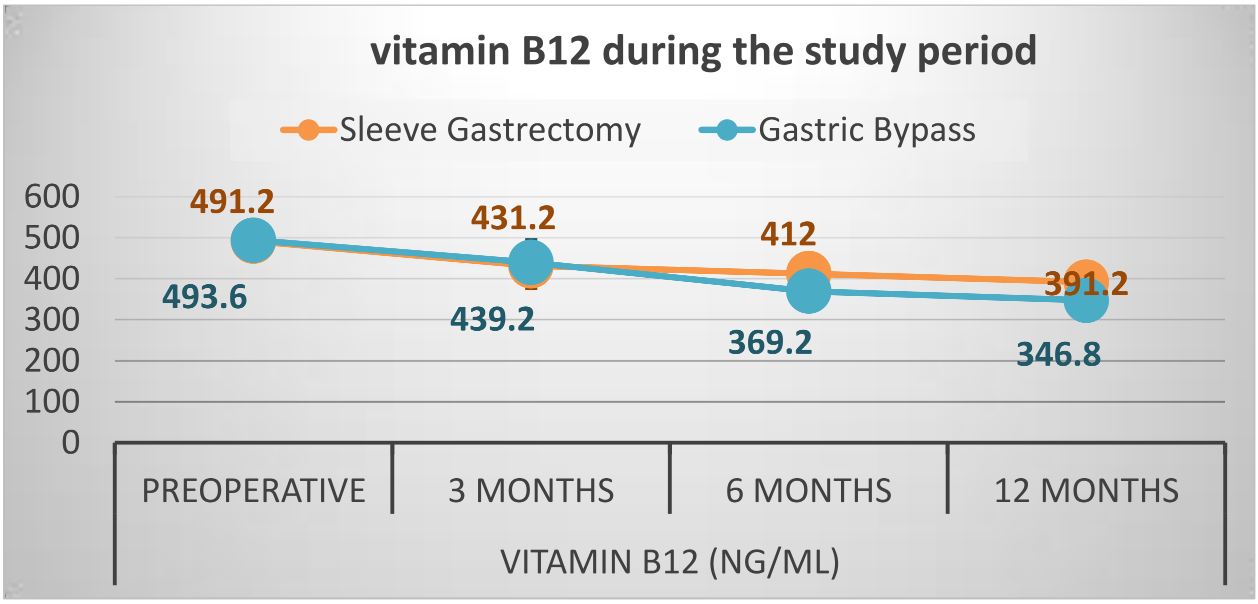

Figure 5 shows vitamin B12 trend during the study period

Normal reference range for vitamin B12 is 150–600 pg/mL according to WHO [18]
No significant differences were observed between groups regarding zinc or magnesium levels throughout the follow-up period (P > 0.05).

DISCUSSION

A health concern in both wealthy and developing nations is obesity. Severe obesity lowers life expectancy and causes problems that impact almost all organ systems.[6]

The only long-term effective treatment for extreme obesity that can lead to durable excess weight loss (EWL), comorbidity resolution or amelioration, quality of life enhancement, and lifespan extension is surgical therapy.[7]

The age range of the patients in our study, when comparing the two groups based on demographic data, was 29 to 56 years, with a mean ± SD of 42.20 ± 7.59 years in the sleeve gastrectomy group, and 25 to 56 years with a mean ± SD of 43.92 ± 7.12 years in the gastric bypass group.

There was no statistically significant difference in age, marital status, or gender when comparing the two groups.

These outcomes were consistent with those of Antoniewicz et al.[8], who found that women made up the majority of patients in both operation groups and that age and gender comparisons between the sleeve gastrectomy and gastric bypass groups were similar at baseline.

When patients' results from before and after surgery were compared for each group, it was found that each group's BMI decreased statistically more at 3, 6, and 12 months after surgery than it did preoperatively. Statistical analysis revealed no significant difference in preoperative BMI (45.65±7.14 vs. 46.76±5.19) or at 3, 6, and 12 months post-surgery between the two groups. However, the gastric bypass group did show a statistically significant reduction in BMI compared to the sleeve gastrectomy group at 12 months post-surgery (25.67±4.01 vs 22.73±3.14).

Our results were in line with de Brito E et al.[9] who found that during the In the first six months after surgery, the BMI significantly decreased compared to pre-operative values in both the RYGB (−7.9 ± 0.7 kg/m2, $p < 0.0001$) and SG (−7.5 ± 0.6 kg/m2, $p < 0.0001$) groups. After 7 to 18 months of follow-up, the RYGB group tended to have a higher decrease in BMI (−15.9 ± 1.1 kg/m2, p<0.0001) compared to the SG group (−12.6 ± 1.7 kg/m2, p = 0.0002). and the p-value is also 0.09. However, these changes were not significantly different between groups (p= 0.65) In our study, comparison between patients results after surgery with before surgery in each group showed that, there was statistically significant increase in vit D at 3, 6, and 12 months postoperatively in each group than preoperatively, Although the two groups did not differ statistically in terms of preoperative vitamin D levels, the sleeve gastrectomy group had significantly higher levels at 3 and 6 months postoperatively compared to the gastric bypass group; however, this difference became non-significant at 12 months postoperatively. This increase in vit D is explained by dietary supplements prescribed for patients after surgery.

There was no difference in the prevalence of vitamin D deficiency between the groups in the de Brito E et al.[9] investigation before and after surgery.

Additionally, Zhang et al.'s study[10] found that while about one-third of patients had a 25-OH-vitamin D shortage before surgery, 25-OH-vitamin D levels increased 12 months after surgery. Following surgery, patients in the SG groups had higher postoperative levels of the 25-OH vitamin.

The present study employed a comparison of patient outcomes between preoperative and postoperative periods in each group. The results indicated a statistically significant decrease in Hb, Iron, and ferritin at 3, 6, and 12 months postoperatively in each group compared to preoperative values. Additionally, a comparison between the two groups revealed a statistically significant decrease in the postoperative sleeve gastrectomy group compared to the gastric bypass group.

In terms of anemia, Souza et al.[11] found that there were no statistically significant differences between patients in either surgical approach at any of the evaluation periods (3, 6 and 12 months). In terms of iron deficiency, it was found that patients who had the RYGB had a greater prevalence of deficit at three months (p=0.003). When it came to ferritin levels, the group that underwent the

RYGB had a higher frequency of deficiency. (p=0.006).

Comparing the patient outcomes in each group before and after surgery revealed that, At 3, 6, and 12 months post-surgery, the gastric bypass group's calcium levels decreased significantly, whereas the sleeve gastrectomy group's levels did not differ significantly from pre-surgery levels at any of these time points. When we compared the two groups, however, we discovered that the sleeve gastrectomy group's calcium levels were statistically significantly higher than those of the gastric bypass group in terms of calcium at 6, and 12 months after surgery.

In a comparison of nutritional status one year following a sleeve gastrectomy and a Roux-en-Y gastric bypass, Coupaye et al. [12] discovered that the GBP group's urine calcium level was considerably lower at one year than the SG groups.

Comparing the patient outcomes in each group before and after surgery in this study revealed a statistically significant decrease in vitamin B12 at 3, 6, and 12 months postoperatively compared to preoperatively; however, when comparing the two groups, there was no statistically significant difference in preoperative vitamin B12 at 3 and 6 months postoperatively, but at 12 months postoperatively, the sleeve gastrectomy group's vitamin B12 levels were significantly higher than those of the gastric bypass group.

As per our findings, Grönroos S et al. [13] conducted a randomized clinical trial comparing laparoscopic sleeve gastrectomy to laparoscopic Roux-en-Y gastric bypass for patients with BMI less than 50 kg/m2. They discovered that vitamin B12 deficiency was more severe following LRYGB.

Study strengths: It is a Prospective design with matched patient groups include serial biochemical follow-up at 3, 6, and 12 months. Conducted in a real-world clinical setting, reflecting public hospital practices.

Study limitations: small sample size may limit external validity. One-year follow-up limits insight into long-term outcomes. Lack of dietary intake tracking and adherence to supplementation protocols.

PUBLIC HEALTH IMPLICATIONS

- Standardized micronutrient screening must be part of post-bariatric care.
- Government subsidies for micronutrient supplementation may be needed.
- Primary care providers should be trained in post-bariatric nutritional monitoring.
- Include bariatric outcomes in national NCD surveillance systems

CONCLUSION

To sum up, both LSG and LGB surgeries are useful in treating chronic conditions like dyslipidemia, T2DM, and HTN. However, LGB was more successful in reducing weight than LSG, and micronutritional deficiencies were more common in LGB than LSG.

AUTHORS' CONTRIBUTIONS

TM contributed substantially to the transformation of the thesis into a publishable manuscript, finalizing the study design, constructing and critically reviewing the methodology, and contributing to data analysis and interpretation. provided in-depth conceptual input, extracted key implications based on the findings, and authored the final draft of the results section, including graphical representation of data. Additionally, conducted comprehensive paraphrasing, enhanced the scientific clarity of the manuscript, and synthesized the discussion, emphasizing the strengths, limitations, and public health implications of the study and the corresponding author, overseeing the submission and revision process in alignment with journal requirements. **FS** created the survey, participated in its distribution, and handled the statistical analysis of the information. **ER** penned the paper. In the distribution of the questionnaire, **AG** shared. **SA** gave the final manuscript a review.

REFERENCES

1. Milone M, Lupoli R, Maietta P, Di Minno A, Bianco P, Ambrosino P, Coretti G, Milone F, Di Minno MN, Musella M. Lipid profile changes in patients undergoing bariatric surgery: a comparative study between sleeve gastrectomy and mini-gastric bypass. Int J Surg. 2015 Feb;14:28-

32. doi: 10.1016/j.ijsu.2014.12.025. Epub 2015 Jan 7. PMID: 25576760.

2. Ribaric G, Buchwald JN, McGlennon TW. Diabetes and weight in comparative studies of bariatric surgery vs conventional medical therapy: a systematic review and meta-analysis. Obes Surg. 2014 Mar;24(3):437-55. doi: 10.1007/s11695-013-1160-3. PMID: 24374842; PMCID: PMC3916703.

3. Welbourn R, Hollyman M, Kinsman R, Dixon J, Liem R, Ottosson J, Ramos A, Våge V, Al-Sabah S, Brown W, Cohen R, Walton P, Himpens J. Bariatric Surgery Worldwide: Baseline Demographic Description and One-Year Outcomes from the Fourth IFSO Global Registry Report 2018. Obes Surg. 2019 Mar;29(3):782-795. doi: 10.1007/s11695-018-3593-1. Epub 2018 Nov 12. PMID: 30421326.

4. Courcoulas AP, Christian NJ, O'Rourke RW, Dakin G, Patchen Dellinger E, Flum DR, Melissa Kalarchian PD, Mitchell JE, Patterson E, Pomp A, Pories WJ, Spaniolas K, Steffen K, Wolfe BM, Belle SH. Preoperative factors and 3-year weight change in the Longitudinal Assessment of Bariatric Surgery (LABS) consortium. Surg Obes Relat Dis. 2015 Sep-Oct;11(5):1109-18.

5. doi: 10.1016/j.soard.2015.01.011. Epub 2015 Jan 23. PMID: 25824474; PMCID: PMC4512927.

6. Lupoli R, Lembo E, Saldalamacchia G, Avola CK, Angrisani L, Capaldo B. Bariatric surgery and long-term nutritional issues. World J Diabetes. 2017 Nov 15;8(11):464-474. doi: 10.4239/wjd.v8.i11.464. PMID: 29204255; PMCID: PMC5700383.

7. Bhurosy T, Jeewon R. Overweight and obesity epidemic in developing countries: a problem with diet, physical activity, or socioeconomic status? ScientificWorldJournal. 2014;2014:964236.

8. doi: 10.1155/2014/964236. Epub 2014 Oct 14. PMID: 25379554; PMCID: PMC4212551.

9. Arterburn DE, Telem DA, Kushner RF, Courcoulas AP. Benefits and Risks of Bariatric Surgery in Adults: A Review. JAMA. 2020 Sep 1;324(9):879-887. doi: 10.1001/jama.2020.12567. PMID: 32870301.

10. Antoniewicz A, Kalinowski P, Kotulecka KJ, Kocoń P, Paluszkiewicz R, Remiszewski P, Zieniewicz K. Nutritional Deficiencies in Patients after Roux-en-Y Gastric Bypass and Sleeve Gastrectomy during 12-Month Follow-Up. Obes Surg. 2019 Oct;29(10):3277-3284. doi: 10.1007/s11695-019-03985-3. PMID: 31201694.

11. de Brito E, Silva MB, Tustumi F, de Miranda Neto AA, Dantas ACB, Santo MA, Cecconello I. Gastric Bypass Compared with Sleeve Gastrectomy for Nonalcoholic Fatty Liver Disease: a Systematic Review and Meta-analysis. Obes Surg. 2021 Jun;31(6):2762-2772. doi: 10.1007/s11695-021-05412-y. Epub 2021 Apr 13. PMID: 33846949.

12. Zhang C, Chen X, Liu S, Liu W, Zhu D, Li X, Qu S, Zhu Z, Zhang J, Zhou Z. Nutritional Status in Chinese Patients with Obesity Following Sleeve Gastrectomy/Roux-en-Y Gastric Bypass: A Retrospective Multicenter Cohort Study. Nutrients. 2022 May 5;14(9):1932. doi: 10.3390/nu14091932. PMID: 35565899; PMCID: PMC9101375..

13. Souza NMM, Santos ACO, Santa-Cruz F, Guimarães H, Silva LML, de-Lima DSC, Ferraz ÁAB, Kreimer F. Nutritional impact of bariatric surgery: a comparative study of Roux-en-Y Gastric Bypass and Sleeve gastrectomy between patients from the public and private health systems. Rev Col Bras Cir. 2020 Jun 15;47:e20202404. Portuguese, English. doi: 10.1590/0100-6991e-20202404. PMID: 32555963.

14. Coupaye M, Rivière P, Breuil MC, Castel B, Bogard C, Dupré T, Flamant M, Msika S, Ledoux S. Comparison of nutritional status during the first year after sleeve gastrectomy and Roux-en-Y gastric bypass. Obes Surg. 2014 Feb;24(2):276-83. doi: 10.1007/s11695-013-1089-6. PMID: 24122661. Kehagias, I., Karamanakos, S. N., Argentou, M., Kalfarentzos, F. (2011).

15. Grönroos S, Helmiö M, Juuti A, Tiusanen R, Hurme S, Löyttyniemi E, Ovaska J, Leivonen M, Peromaa-Haavisto P, Mäklin S, Sintonen H, Sammalkorpi H, Nuutila P, Salminen P. Effect of Laparoscopic Sleeve Gastrectomy vs Roux-en-Y Gastric Bypass on Weight Loss and Quality of Life at 7 Years in Patients With Morbid Obesity: The SLEEVEPASS Randomized Clinical Trial. JAMA Surg. 2021 Feb 1;156(2):137-146. doi: 10.1001/jamasurg.2020.5666. PMID: 33295955; PMCID: PMC7726698.

16. World Health Organization. Serum ferritin concentrations for the assessment of iron status and iron deficiency in populations. Geneva: World Health Organization; 2011.

17. WHO/CDC. Assessing the iron status of populations. 2nd ed. Geneva: World Health Organization; 2007.

18. World Health Organization. Nutritional anaemias: tools for effective prevention and control. Geneva: World Health Organization; 2017.

19. World Health Organization. Vitamin D supplementation in populations. Geneva: World Health Organization; 2020.

20. World Health Organization. Serum vitamin B12 concentrations for determining deficiency in populations. Geneva: World Health Organization; 2008. Available from: https://www.who.int/vmnis/indicators/vitaminb12.pdf