Predictors of insufficient weight loss after sleeve gastrectomy

Original Article

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ABSTRACT

Background: Laparoscopic sleeve gastrectomy is a restrictive procedure that excises the greater curvature leaving a small gastric tube. This procedure has been approved as an isolated bariatric procedure.

Aim: To assess and predict causes of insufficient weight loss (IWL) within 1 year after sleeve gastrectomy.

Patients and Methods: This randomized study was conducted on 80 patients with morbid obesity who presented for laparoscopic sleeve gastrectomy at Gastroenterology Surgical Center, Mansoura University. Retrospective study was conducted on 50 patients from January 2021 to July 2022 and prospective study was conducted on 30 patients from August 2022 to February 2023 and were followed-up till February 2024. The study was approved by the ethical committee at Mansoura Gastroenterology Surgical Center.

Results: Regarding 12 months follow-up results, there was a statistically significant relation between dietary conditions and insufficient weight loss. For sufficient weight loss; 37.8% Full bulk diet (as carbohydrates, fat, and protein diet), no sugars (sweets), 27% protein diet (as meat, chicken, fish and eggs), no sugars (sweets), 27% full bulk diet with increase sugars and 8.1% protein diet with increase sugars versus 100% of cases with IWL have full bulk diet with increase sugars. A statistically significant relation was detected also between physical activity and insufficient weight loss. For cases with sufficient weight loss; 24.3% do exercise and 31.1% walk versus 100% of cases with IWL are physically inactive. Between cases with sufficient and insufficient weight loss, there was a statistically significant difference as regards preoperative attempts of weight loss while there was no statistically significant difference as regards operative duration, amount of blood loss, and hospital stay per day.

Conclusion: IWL can be predicted by dietary conditions and physical activity. This can help surgeons direct surgical or medical interventions for patients at 3 months rather than at 1 year or beyond.

Key Words: Bariatric surgery, insufficient weight loss, laparoscopic sleeve gastrectomy, morbid obesity.

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INTRODUCTION

Obesity is an increasingly serious public health problem on a global level and is associated with increased mortality and a high burden of obesity-related morbidities such as diabetes mellitus, hypertension, osteoarthritis, and obstructive sleep apnea syndrome[1].

Bariatric surgery (BS) is currently the most efficient and durable intervention for morbid obesity. Unfortunately, some degree of weight regain is common after reaching nadir weight, where about 20–25% of patients struggle with considerable weight regain after BS[2]. Likewise, insufficient weight loss (IWL) [< 50% excess weight loss (EWL)] was the most common reason for revisional BS[3].

Bariatric surgical procedures reduce caloric intake by modifying the anatomy of the gastrointestinal tract. These operations are classified as restrictive, malabsorptive, or both. Restrictive procedures limit intake by creating a small gastric reservoir with a narrow outlet to delay emptying. Malabsorptive procedures bypass varying portions of the small intestine where nutrient absorption occurs[4] and Proliferation of the bacteria and its absorption in the bypassed limb leading to formation of circulating immune complexes causing diarrhea from fat malabsorption[5]. Weight loss after BS is due to the anatomical exclusion of the foregut. This leads to a hormonal upregulation of pancreatic peptide YY, glucagon-like peptide-1 (GLP-1), and gastric inhibitory polypeptide hormones which promote satiety and minimize hunger, as well as downregulation of ghrelin with subsequent decrease in food intake[6].

Laparoscopic sleeve gastrectomy (LSG) is a restrictive procedure that excises the greater curvature leaving a small gastric tube. This procedure has been approved as an isolated bariatric procedure[7].

Previous studies have shown that LSG beside its restrictive effect, it has an accelerated gastric emptying

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and hormonal effects, it decreases the level of ghrelin, an appetite-stimulating hormone by eliminating the gastric fundus, producing early satiety[8].

Nowadays, LSG is carried out more and more as a common isolated Bariatric procedure with promising short-term results. Its simple technique makes it more popular and the first line in the treatment of morbidly obese patients[9].

The aim of this study was to asses and predict causes of IWL within one year after sleeve gastrectomy.

PATIENTS AND METHODS:

This randomized study was conducted on 80 patients with morbid obesity who presented for laparoscopic sleeve gastrectomy in Gastroenterology Surgical Center, Mansoura University. A retrospective study was conducted on 50 patients from January 2021 to July 2022 and a prospective study was conducted on 30 patients from August 2022 to February 2023 and was followed-up till February 2024. The study was approved by the ethical committee at Mansoura Gastroenterology Surgical Center.

All patients were asked to sign an informed consent after meeting the surgeon and explaining all the possible benefits and risks of the procedure and stressing on the importance of regular follow up visits.

Inclusion criteria: Patients who were considered eligible for inclusion in this study were those who had morbid obesity with a body mass index (BMI)greater than 40 kg/m^2 or BMI greater than 35 kg/m^2 when associated with at least one of comorbidities, such as type 2 diabetes. The included patients should have a history of obesity for more than 5 years and with failure of conservative means. The age was restricted to patients from 18 to 60 years old.

Exclusion criteria

Inflammatory disease or condition of the gastrointestinal tract, such as ulcers, severe esophagitis, or Crohn's disease, or severe heart or lung disease that makes you a poor candidate for any surgery, having a problem that could cause bleeding in the esophagus or stomach. That might include esophageal or gastric varices (a dilated vein). It might also be something such as congenital or acquired intestinal telangiectasia (dilation of a small blood vessel), portal hypertension, pregnancy, previous bariatric or gastric surgeries, major psychiatric illness, significant abdominal ventral hernia, age less than 18 or older than 60 years and on chronic, long-term steroid treatment.

Operative technique

The surgeon placed the patient in a modified lithotomy position, spreading his legs apart. The surgeon stood in between the patient's legs, with the assistant on the patient's left side and the camera holder to the right of the patient. The surgeon used the closed Veress needle technique to insufflate the abdomen via the umbilicus. Five ports were used. We introduced the first camera port (10 mm) slightly to the left of the midline, 20 cm below the xiphoid process, to avoid the falciform ligament. Under direct visualization, we introduced the remaining ports as follows:

Two 12 mm ports are at the right and left midclavicular lines and slightly above the camera port for the right and left hands of the surgeon. One 5 mm port is just below the xiphoid for liver retraction. One 5 mm port is at the left anterior axillary line for the assistant. We used an energy source (Harmonic Ace or Ligasure) to divide the vessels with greater curvature, starting 4–6 cm proximal to the pylorus (Figs 1 and 2). We proceeded with devascularization proximally until we fully mobilized the gastric fundus and visualized the angle of the right and left diaphragmatic crus (Fig. 3). The anesthetist trans-orally inserted a 36 French bougie and advanced it to the pylorus for gastric tube calibration. A 60 mm laparoscopic endo-stappler (endo-GIA Universal) was used to cut the stomach along the bougie (Fig. 4). Green loads were used for the antrum, and blue cartridges were used for the stomach's body and fundus. We examined the staple line for bleeding and leakage using methylene blue testing. We either used intermittent 10 mm clips or a continuous 3/0 absorbable suture to reinforce the staple line in cases of intraoperative hemorrhage. Reinforcement was not done routinely. We only performed suture reinforcement to control staple line bleeding or secure a doubtful staple line. We removed the resected part of the stomach and sent it for histopathology (Fig. 5). Finally, we left a tube drain along the staple line.

Fig. 1: Devascularization along greater curvature by harmonic.

Fig. 2: Devascularization along greater curvature by harmonic.

Fig. 3: Devascularization along greater curvature by harmonic.

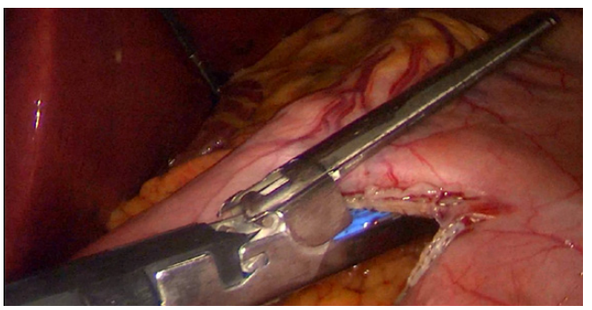

Fig. 4: Gastric resection by stapler.

Fig. 5: Gastric specimen.

Postoperative care

The study involved a prospective study of postoperative care for a patient with a surgical procedure. The parameters included operation time, blood loss, perioperative analgesic requirements, hospital stay, and complications. Post-operative care involved monitoring vital signs, urine output, drains, intravenous fluids, antibiotics, analgesics, PPI, and subcutaneous LMWH. Patients were encouraged to ambulate early. Oral gastrografin studies were conducted to assess pouch configuration and exclude leakage, obstruction, or twist. Patients were discharged if they were hemodynamically stable, pain-free, and without postoperative complications. They were then given a liquid diet for the first week, followed by a soft diet for another three weeks. A long-term, solid diet was maintained. Postoperative complications were evaluated using Clavian-Dindo Grading (GI = any deviation from normal postoperative course; GII = complication requiring medical treatment; GIIIa,b=complication requiring surgical, endoscopic, or radiological intervention; GIVa,b=organ failure; and GV = death)[10].

Follow-up

Patient follow-up was scheduled at the 3rd, 6th, and 12th months, recording weight loss, nutritional parameters, and change in preoperative co-morbidities during every visit. After a year, patients' quality of life was assessed using the Gastrointestinal Quality of Life Index. All patients answered a questionnaire evaluating the quality of life after one year of follow up. Quality of life was measured by the Gastrointestinal Quality of Life Index, a 36-item questionnaire. In the analysis, the results of the questionnaire are divided into five domains: core symptoms (9 items), physical status (7 items), psychological emotions (6 items), social functioning (4 items), and disease-specific symptoms (10 items). Each item is quoted from 0 to 4 (from the worst to the best option). The maximum score is 144. This questionnaire had been verified in previous studies.

RESULTS:

This randomized study was conducted on 80 patients with morbid obesity who presented for laparoscopic sleeve gastrectomy in Gastroenterology Surgical Center, Mansoura University. A retrospective study was conducted on 50 patients from January 2021 to July 2022 and a prospective study was conducted on 30 patients from August 2022 to February 2023 and were followed-up till February 2024.

Our study revealed that there was no statistically significant relation between IWL and the following; age, sex, weight, height, and BMI (Table 1).

Table 1: Relation between demographic characteristics and insufficient weight loss among studied cases

	Weight loss		
	Sufficient *N*=74(%)	Insufficient *N*=6(%)	Test of significance
Age/years	38.0±10.59	46.0±10.94	t=1.78 *P*=0.08
Sex			
Male	16 (21.6)	1 (16.7)	χ^2=0.081
Female	58 (78.4)	5 (83.3)	*P*=0.775
Weight (kg)	141.20±25.62	156.17±31.39	t=1.35 *P*=0.180

Height (cm)	165.31±9.11	170±3.85	t=1.25 *P*=0.217
BMI (kg/m^2)	51.89±10.12	54.33±10.86	t=0.564 *P*=0.574

t: Student t test, χ2 : Chi-Square test.

Regarding operative data 47.5% of the studied cases need six cartridges, 42.5% of the studied cases need five cartridges, 6.2% need four cartridges and 3.8% need seven cartridges. 70% of cases use green and blue cartridges, 3.8% use blue cartridges, 17.5% use green and gold and blue cartridges, and 8.8% use green and gold cartridges. 17.5% of cases need re-enforcement (Figs 6), 2.5% of cases underwent lap plication. Suture material used was distributed as following; 50% vicryl 3/0, 21.4% Ethibond, 14.3% PDs 3/0, and 7.1% Proline and V lock (Fig. 7). Crural repair was done among 5 cases (Table 2).

Regarding laboratory findings there was no statistically significant relation between IWL and cholesterol and cortisol levels (Table 3).

We found that there is statistically significant difference between cases with sufficient and IWL as regard preoperative attempts of weight loss. For cases with sufficient weight loss; 50% depend on the diet, 47.3% depend on diet and medications, 1.4% depend on medical treatment only and 1.4% underwent intragastric ballon versus 16.7% of cases with IWL have no attempts of weight loss, 50% depend on diet and medications and 33.3% depend on a diet (Table 4).

Among studied cases there was no statistically significant relation between IWL and the following as operative duration, amount of blood loss, and hospital stay per days (Table 5).

After 12 months follow up there is a statistically significant relationship between dietary conditions and insufficient weight loss. For sufficient weight loss; 37.8% Full bulk diet, no sugars, 27% Protein diet, no sugars, 27% Full bulk diet, increase sugars, 8.1% Protein diet and Increase sugars versus 100% of cases with IWL have full bulk diet with increase sugars. A statistically significant relation was detected also between Physical activity and IWL. For cases with sufficient weight loss; 24.3% do exercise and 31.1% walking versus 100% of cases with IWL are physically inactive (Table 6) (Fig. 8).

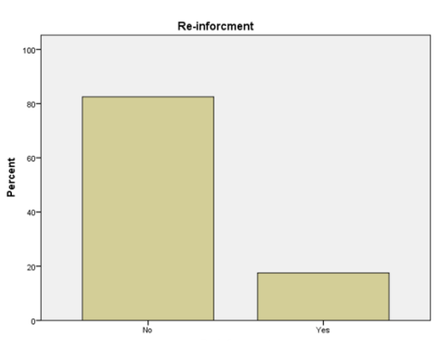

Fig. 6: Percentage of cases underwent staple line reinforcement.

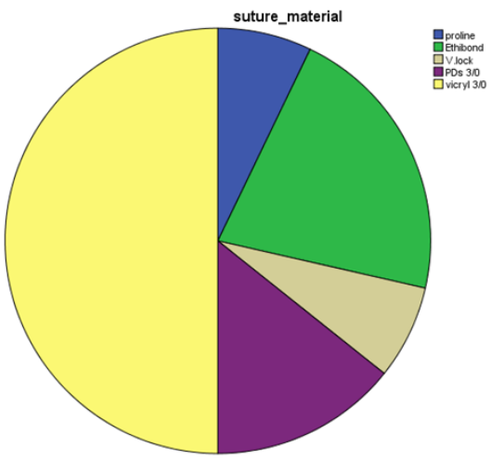

Fig. 7: Percentage of suture material used intraoperatively among studied cases.

Table 2: Operative data among studied cases

	N=80 (%)
Number of cartridges	
4	5 (6.2)
5	34 (42.5)
6	38 (47.5)
7	3 (3.8)
Type of cartridge	
Green+ blue	56 (70.0)
Blue	3 (3.8)
Green+gold+blue	14 (17.5)
Green+ gold	7 (8.8)
Re-enforcement	
No	66 (82.5)
Yes	14 (17.5)
Lap plication	
No	78 (97.5)
Yes	2 (2.5)
Suture material	
Proline	1 (7.1)
Ethibond	3 (21.4)
V.lock	1 (7.1)
PDs 3/0	2 (14.3)
Vicryl 3/0	7 (50.0)
Crural repair	
No	75 (93.8)
Yes	5 (6.3)

Table 3: Relation between laboratory findings and insufficient weight loss among studied cases.

	Weight loss		
	Sufficient *N*=74(%)	Insufficient *N*=6(%)	Test of significance
Cholesterol and cortisol			
Normal level	74 (100)	6 (100)	*P=1.0*
High level	0	0	

MC, Monte Carlo test.

Table 4: Relation between preoperative attempts of weight loss and insufficient weight loss among studied cases

	Weight loss		
	Sufficient *N*=74 (%)	Insufficient *N*=6 (%)	Test of significance
Attempts weight loss			
No	0	1(16.7)	
Diet	37 (50)	2 (33.3)	χ^{2MC}=12.82
Medical treatment	1 (1.4)	0	*P=0.01**
Diet+medical treatment	35 (47.3)	3 (50.0)	
Intragastric ballon	1 (1.4)	0	

MC, Monte Carlo test, *statistically significant.

Table 5: Relation between operative duration, blood loss, and hospital stay and insufficient weight loss among studied cases

	Weight loss		
	Sufficient *N*=74	Insufficient *N*=6	Test of significance
Operative duration (min)	119.93±39.31	111.67±29.94	t=0.50 *P=0.617*
Blood loss (ml^3)	99.32±38.37	91.67±58.45	t=0.451 *P=0.653*
Hospital stay (days)	1.73±0.764	1.67±0.516	t=0.198 *P=0.844*

t: Student t test, *statistically significant.

Table 6: Relation between 12 months follow-up results and insufficient weight loss among studied cases

	Weight loss		
12 months follow-up	Sufficient *N*=74 (%)	Insufficient *N*=6 (%)	Test of significance
Weight (kg)	88.01±16.98	124.33±22.68	t=4.92 *P<0.001**
BMI (kg/m^2)	32.39±6.98	43.42±8.21	t=3.68 *P<0.001**
EBWL (Excess body weight loss)	53.19±13.51	31.83±10.48	t=3.77 *P<0.001**
Dietary conditions			
Protien diet, no sugars	20 (27.0)	0	MC=13.47
Protien diet. Increase sugars	6 (8.1)	0	*P=0.004**
Full bulk diet, no sugars	28 (37.8)	0	
Full bulk diet, increase sugars	20 (27.0)	6 (100)	
Hormonal factors			
Normal thyroid function and cortisol level	74 (100)	6 (100)	*P=1.0*
Physical activity			
No	33 (44.6)	6 (100)	MC=6.82
Exercise	18 (24.3)	0	*P=0.03**
Walking	23 (31.1)	0	
Depression			
No	65 (87.8)	3 (50)	MC=9.84
Improved	2 (2.7)	0	*P=0.02**
Resolved	6 (8.1)	3 (50)	

Unchanged	1 (1.4)	0	
DM			
No	64 (86.5)	4 (66.7)	MC=11.32
Improved	2 (2.7)	2 (33.3)	*P=0.003**
Resolved	8 (10.8)	0	
HTN			
No	52 (70.3)	4 (66.7)	MC=12.89
Improved	6 (8.1)	0 (0.0)	*P=0.005**
Resolved	16 (21.6)	1 (16.7)	
Unchanged	0	1 (16.70)	
OSAS (Obstructive sleep apnea syndrome)			
No	36 (48.6)	2 (33.3)	MC=25.30
Improved	0	2 (33.3)	*P<0.001**
Resolved	38 (51.4)	2 (33.3)	
Osteoarthritis			
No	27 (36.5)	0	MC=14.87
Improved	4 (5.4)	3 (50.0)	*P=0.001**
Resolved	43 (58.1)	3 (50.0)	
GERD			
No	44 (59.5)	3 (50.0)	MC=4.68
Improved	1 (1.4)	0	*P=0.321*
Resolved	11 (14.9)	1 (16.7)	
Unchanged	12 (16.2)	0	
Developed	6 (8.1)	2 (33.3)	
Hemoglobin	11.74±1.30	12.33±1.19	t=1.08 *P=0.286*
Albumin	3.60±0.28	4.17±0.38	t=1.91 *P=0.105*
Ca	NA	9.08±0.68	–
Vitamin D	NA	21.75±5.20	–
Serum iron	NA	74.97±28.52	–
Serum ferritin	NA	49.50±39.25	–
HbA1C	NA	6.90±0.0	–
HOMA IR (Homeostasis model assessment insulin resistance)	NA	6.55±0.07	–
Supplementation			
No	23 (31.1)	1 (16.7)	MC=1.32
Oral multivitamins	45 (60.8)	5 (83.3)	*P=0.724*
B12 injection	1 (1.4)	0	
both oral +injection vitamins	5 (6.8)	0	
Hair loss			
No	17 (23.0)	3 (50.0)	FET=2.16
Yes	57 (77.0)	3 (50.0)	*P=0.162*
OGG			
Not done	68 (91.9)	4 (66.8)	FET=3.17
Reflux	6 (8.1)	2 (33.3)	*P=0.08*

DM, diabetes mellitus; HTN, hypertension; Ca, calcium
χ^{2MC}, Monte Carlo test; FET, Fisher exact test *statistically significant.

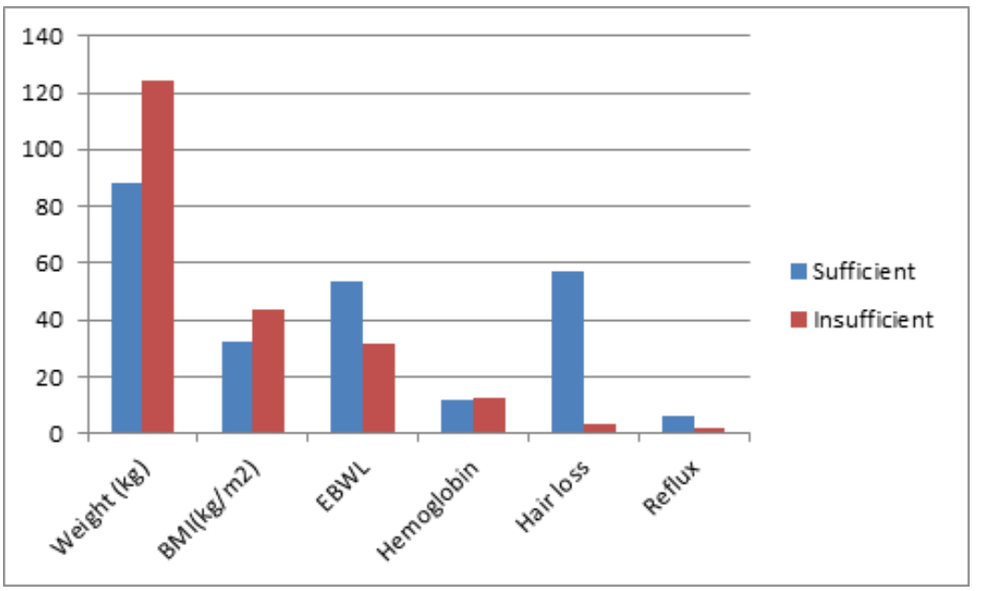

Fig. 8: Comparison between findings in cases with sufficient and insufficient weight loss after 12 months follow-up.

DISCUSSION

There was no statistically significant relation between IWL and the following; age, sex, weight, height, and BMI.

Similarly, our study is in agreement with Cadena-Obando and colleagues who revealed that there was no statistically significant relation between IWL and sex, weight , height, and BMI[11].

Our study demonstrates that 93.8% of the studied cases have no intraoperative difficulty, 3.8% have technical difficulty and 2.5% have large left lobe. For intraoperative disasters; 96.2% have no disasters, 2.5% Injury to the liver, and 1.2% show staple line bleeding. The mean operative duration is 119.31±38.59 min ranging from 60 to 240 min, The mean blood loss is 98.75±39.76 ml3 ranging from 50 to 200 ml3, the median hospital stay is 2 days ranging from 1 to 5 days. There was no statistically significant relation between IWL and the following; operative duration, amount of blood loss and hospital stay per days.

Our study in consistent with Santos and colleagues who demonstrated that 12.5% of cases had disasters, 2.1% of their cases had staple line bleeding and the mean length of hospital stay among their studied cases was 5.92±9.44 days[12].

Similarly, our findings are in line with Abd Ellatif and colleagues who reported that 35 (2.5%) patients had staple line bleeding, one patient had large left liver lobe, the mean operative time was 113±29 min ranging from 79 to 139 min and the mean hospital stay was 3.9±1.7 days ranging from 2.1 to 35 days[13].

There was no statistically significant relation between IWL and cholesterol and cortisol level.

Our results are in consistent with Scovazzo, who revealed that there was no statistically significant relation between IWL and cholesterol level[14].

There is a statistically significant difference between cases with sufficient and IWL as regard preoperative attempts of weight loss. For cases with sufficient weight loss; 50% depend on the diet, 47.3% depend on diet and medications, 1.4% depend on medical treatment only and 1.4% underwent intragastric ballon versus 16.7% of cases with IWL have no attempts of weight loss, 50% depend on diet and medications, 33.3% depend on diet and all of them have no exercise.

Our findings are in line with McNickle and Bonomo, who reported that was statistically significant relation between %EWL and the preoperative diet after laparoscopic sleeve gastrectomy[15].

our results agreed with Ruiz-Tovar and colleagues who revealed that there was statistically significant difference between cases with sufficient and IWL as regards preoperative attempts of weight loss[16].

Regarding 12 months follow-up results, there was a statistically significant relation between dietary conditions and insufficient weight loss. For sufficient weight loss; 37.8% full bulk diet, no sugars, 27% protein diet, no sugars, 27% full bulk diet, increase sugars, 8.1% protein diet and increased sugars versus 100% of cases with IWL have full bulk diet with increase sugars. A statistically significant relation was

detected also between physical activity and insufficient weight loss. For cases with sufficient weight loss; 24.3% do exercise and 31.1% walking versus 100% of cases with IWL are physically inactive.

The current study can be supported by Ruiz-Tovar and colleagues who reported that there was statistically significant relation between eating patterns after 12 months and IWL as patients who, in addition to being binge eaters, were also snackers, sweet-eaters or 'diet' soda drinkers lost less weight. They revealed that 12 months after surgery, the mean EWL in snacker patients was 84.6 versus 89.8% in nonsnackers (*P=0.037*). In patients who often ate sweets, EWL at 12 months was 80.8 versus 92.3% in patients without this eating habit (*P=.013*)[16].

Our findings are in line with Amundsen *et al*., who revealed that there was statistically significant relation between lower physical activity levels and IWL[17].

Our findings revealed that six (7.5%) patients had less than 50% EWL 1 year after LSG.

Similarly, our findings are in line with de Raaff *et al*., who reported that 149 (19.7%) patients had less than 50% EWL 1 year after BS[18].

CONCLUSION

There was a significant relation between dietary conditions and physical activity and insufficient weight loss. The study showed that dietary noncompliance and physical inactivity were associated with IWL. We concluded that IWL can be predicted by dietary conditions and physical activity. This can help surgeons direct surgical or medical interventions for patients at 3 months rather than at 1 year or beyond.

Larger longitudinal studies with long-term follow-up are needed to further understand predictors of IWL after sleeve gastrectomy.

CONFLICT OF INTEREST

There are no conflicts of interest.

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