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The Effect of Resected Specimen Weight on Weight Loss After Sleeve Gastrectomy

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ABSTRACT

Laparoscopic sleeve gastrectomy (LSG) is one of the most commonly performed bariatric procedures worldwide. While several studies have examined the relationship between gastric volume and weight loss, the correlation between resected gastric specimen weight and postoperative weight loss remains unclear. This study aimed to investigate the relationship between the weight of the resected gastric specimen and weight loss outcomes after LSG.
A total of 50 patients (39 women, 11 men; mean age 38.52±10.36 years) who underwent LSG were retrospectively analyzed. Preoperative and postoperative (3rd, 6th, and 12th months) weight and BMI values were recorded. The correlation between resected stomach weight (full and empty) and postoperative weight loss was assessed.
A statistically significant weight loss was observed in all patients up to the 12th month ($p<0.001$). The resected stomach weight was moderately correlated with patient weight at all follow-up points ($p<0.01$). However, the correlation between resected gastric specimen weight and percentage of excess weight loss was only significant in the early period (3rd month). No significant association was found in the 6th and 12th months. Additionally, patients with lower initial BMI values experienced greater early weight loss.
Resected gastric specimen weight may serve as a predictive factor for early postoperative weight loss following LSG. However, its predictive value for long-term weight loss remains limited. Larger prospective studies are needed to clarify its role in surgical planning and outcome prediction.

Keywords: Sleeve gastrectomy, bariatric surgery, gastric specimen weight, weight loss, obesity.

Introduction

Morbid obesity is one of the most significant public health problems worldwide. Excess body weight is recognized as the sixth leading risk factor contributing to the global burden of disease. Currently, approximately 1.1 billion adults and nearly 10% of children are classified as overweight or obese (1). Although several bariatric surgical procedures are available—such as Roux-en-Y gastric bypass, one-anastomosis gastric bypass (OAGB), biliopancreatic diversion (BPD), single-anastomosis duodeno-ileal bypass (SADI), and duodenal switch (DS)—**Laparoscopic Sleeve Gastrectomy (LSG)** has become the most commonly performed bariatric procedure worldwide (2).

The primary goal of bariatric surgery is to achieve sustainable long-term weight loss, improve obesity-related comorbidities, and prevent weight regain. As a standalone procedure, LSG has demonstrated favorable outcomes in terms of weight reduction and improvement in metabolic disorders, including type 2 diabetes mellitus, hypertension, and metabolic syndrome (3).

Sleeve gastrectomy involves longitudinal resection of the stomach by removing the fundus, corpus, and antrum, resulting in a narrow tubular gastric remnant along the lesser curvature (4). This procedure is technically less complex compared to bypass surgeries, does not require gastrointestinal anastomosis, preserves endoscopic access to the gastrointestinal tract, and is associated with a lower risk of micronutrient deficiencies.

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Additionally, in cases of insufficient weight loss or weight regain, revisional procedures such as re-sleeve gastrectomy, gastric bypass, or BPD/DS can still be performed (5,6).

Numerous studies have evaluated anatomical and volumetric parameters influencing postoperative weight loss after sleeve gastrectomy, including resected gastric volume, antral length, and gastric compliance. However, despite extensive research focusing on gastric volume and morphology, the relationship between resected gastric specimen weight and postoperative weight loss remains unclear in the literature (1,4).

Therefore, the aim of this study was to investigate whether a correlation exists between the weight of the resected gastric specimen and postoperative weight loss outcomes following laparoscopic sleeve gastrectomy.

Materials and Methods

Surgical Technique: All laparoscopic sleeve gastrectomy procedures were performed by the same surgical team using a standardized surgical technique. Pneumoperitoneum was established with an intra-abdominal pressure of 15 mmHg. Dissection was initiated along the curvatura major, approximately 3 cm proximal to the pylorus, using an advanced energy device.

The dissection proceeded close to the gastric wall, and the ligamenta gastrica were divided up to the incisura cardiaca. The crus sinistrum diaphragmatis was exposed to clearly identify the junction oesophagogastrica and to ensure complete mobilization and resection of the fundus. Adhesions located posterior to the stomach were carefully dissected to achieve full mobilization, particularly in the posterior fundic region.

A 40 French bougie was introduced along the lesser curvature to calibrate the gastric sleeve. Gastric transection was initiated approximately 5 cm proximal to the pylorus to preserve the antrum and maintain physiological gastric emptying. Particular attention was paid to avoid narrowing at the linea angularis. The staple line was inspected for bleeding, and a leak test was performed using methylene blue and saline administered through the gastric tube.

Following completion of the sleeve gastrectomy, the resected stomach specimen was first weighed on a precision scale while still containing its intragastric contents (ventriculus resectus cum contento) on the operating table. Subsequently, a longitudinal incision was made from the fundus to evacuate the contents, and the empty specimen (ventriculus resectus sine contento) was weighed again to determine the actual gastric tissue weight.

Postoperatively, a liquid diet was initiated on the first day once the patient was clinically stable. In the absence of complications, patients were mobilized and discharged on postoperative day two. A liquid diet was maintained for two weeks, and all patients were followed by a multidisciplinary bariatric team for 12 months.

Body Mass Index (BMI) Calculation: BMI was calculated using the standard formula: BMI = weight (kg) / height² (m²). According to obesity severity, patients were divided into three groups: Group 1 (BMI < 40 kg/m²), Group 2 (BMI 40–49.9 kg/m²), and Group 3 (BMI ≥ 50 kg/m²).

Statistical Analysis: Statistical analyses were performed using SPSS software (IBM SPSS Statistics for Windows, Version 26.0; IBM Corp., Armonk, NY, USA). Normality of continuous variables was assessed using the Shapiro–Wilk test, and homogeneity of variances was evaluated using Levene's test.

Comparisons between sexes were conducted using the independent samples Student's t-test, while categorical variables were analyzed using the Chi-square test. Correlations between continuous variables were assessed using the Pearson correlation coefficient, with correlation direction explicitly reported. Changes in body weight over time were evaluated using repeated-measures ANOVA, followed by Bonferroni post-hoc correction. Comparisons among BMI groups were performed using one-way ANOVA with Bonferroni adjustment.

All statistical tests were two-tailed, and p-values were reported as exact values (e.g., $p = 0.001$). A p-value < 0.05 was considered statistically significant.

Sample Size and Power Consideration: This study was designed as a retrospective observational analysis; therefore, an a priori power calculation was not performed. However, a post hoc power analysis based on the observed correlation between empty resected stomach weight and third-month postoperative weight demonstrated a statistical power exceeding 80% at an alpha level of 0.05, indicating sufficient sample size for detecting moderate correlations in early postoperative outcomes.

Results

The study population consisted of 50 individuals (39 females and 11 males) with a mean age of 38.52 ± 10.36 years (range: 23–70 years) (Table 1). Female patients were similar to males in terms of age ($t = -1.38$, $df = 48$, $p = 0.176$) and preoperative weight ($t = -1.31$, $df = 48$, $p = 0.199$), but were significantly shorter in height ($t = -7.98$, $df = 48$, $p < 0.001$). Consequently, females had significantly higher BMI values compared to males ($t = 2.04$, $df = 48$, $p = 0.047$) (Table 1).

In terms of postoperative weight measurements, females and males were statistically similar at all follow-up points (all $p > 0.05$) (Table 2). As expected, the total resected stomach weight (162.31 ± 40.26 g) was greater than the empty stomach weight (142.18 ± 36.62 g). Repeated-measures ANOVA demonstrated a statistically significant reduction in body weight from the preoperative period to the 12th postoperative month ($F(3,147) = 412.6$, $p < 0.001$).

The total resected stomach weight showed moderate positive correlations with preoperative ($r = 0.430$, $p = 0.002$), third-month ($r = 0.456$, $p = 0.001$), sixth-month ($r = 0.487$, $p < 0.001$), and twelfth-month ($r = 0.417$, $p = 0.003$) body weights. Similarly, empty stomach weight demonstrated moderate positive correlations with preoperative ($r = 0.417$, $p = 0.003$), third-month ($r = 0.454$, $p = 0.001$), sixth-month ($r = 0.480$, $p < 0.001$), and twelfth-month ($r = 0.399$, $p = 0.004$) body weights. In addition, there was a very strong positive correlation between total and empty resected stomach weights ($r = 0.973$, $p < 0.001$) (Table 3).

Strong positive correlations were observed between preoperative body weight and body weight at the third ($r = 0.829$, $p < 0.001$), sixth ($r = 0.779$, $p < 0.001$), and twelfth ($r = 0.695$, $p < 0.001$) postoperative months.

Among female patients, six were classified in Group 1 (BMI < 40 kg/m², 15.4%), 27 in Group 2 (BMI 40–49.9 kg/m², 69.2%), and six in Group 3 (BMI ≥ 50 kg/m², 15.4%). Among male patients, five were in Group 1 (45.5%) and six were in Group 2 (54.5%). Analysis of BMI group distribution revealed no statistically significant association between sex and BMI category ($\chi^2 = 5.52$, $df = 2$, $p = 0.064$).

Neither total ($F(2,47) = 2.03$, $p = 0.142$) nor empty ($F(2,47) = 2.35$, $p = 0.106$) resected stomach weights were significantly associated with BMI group. Accordingly, resected stomach weights were statistically comparable between patients with BMI < 40 kg/m² and those with BMI ≥ 40 kg/m².

As expected, preoperative body weight differed significantly among BMI groups ($F(2,47) = 19.4$, $p < 0.001$), being highest in Group 3 and lowest in Group 1. At the third and sixth postoperative months, Group 1 patients had significantly lower body weights compared to Groups 2 and 3 ($p = 0.002$ and $p = 0.012$, respectively). By the twelfth postoperative month, body weights were statistically similar across all three BMI groups ($F(2,47) = 2.81$, $p = 0.069$) (Table 4). Thus, by the end of the first postoperative year, patients with BMI > 40 kg/m² achieved body weights comparable to those with BMI < 40 kg/m².

Discussion

Obesity is a growing global health concern, with environmental and lifestyle factors playing key roles in its etiology(7). Its incidence is higher among younger individuals and females(8). Similarly, our study population consisted of 50 individuals with a mean age of 38.52 ± 10.36 years (range: 23–70), including 39 females and 11 males [Table 1].

It is well known that many physiological, anthropometric, and social factors influence bariatric surgery outcomes. For example, individuals with a BMI over 50 kg/m² tend to have less favorable surgical outcomes compared to those with lower BMIs(9). Long-term follow-up studies have reported considerable rates of insufficient weight loss or weight regain after laparoscopic sleeve gastrectomy (LSG) (10,11). Failure rates following LSG are estimated to range between 10% and 30% (12). In our study, all patients successfully lost weight up to the 12-month follow-up. Consequently, recent research has focused on identifying predictive factors to improve postoperative weight loss outcomes (13). While there are several studies investigating the predictive value of resected gastric volume after LSG (1,6,9), the relationship between resected gastric weight and weight loss has received limited attention in the literature [Table 2].

A study by Salman et al. reported significant weight loss after LSG, especially during the first 3 months, which continued up to the 12th month (14). Similarly, our study observed rapid weight loss in the first 3 months, which remained effective through the 12th month. Additionally, both full and empty stomach weights

Table 1: Information For Patients

Demographic data			p value
Patient numbers	All	50 patients	
	Female	39 patients	
	Male	11 patients	
Age	All	38.52±10.36 years (23-70 years)	
	Female	37.46±10.78 years (23-70 years)	0.176
	Male	42.27±8.03 years (33-55 years)	
Height	All	166.04±6.96 cm (150-178 cm)	
	Female	163.46±5.26 cm (150-172 cm)	<0.001
	Male	175.18±3.79 cm (168-178 cm)	
Weight (pre-op)	All	121.96±14.64 kg (94-175 kg)	
	Female	120.54±15.21 kg (94-175 kg)	0.199
	Male	127±11.61 kg (110-145 kg)	
Body mass index (pre-op)	All	44.34±5.52 kg/m2 (35.49-62.70 kg/m2)	
	Female	45.15±5.63 kg/m2 (35.49-62.70 kg/m2)	0.047
	Male	41.43±4.15 kg/m2 (35.50-47.83 kg/m2)	

Table 2: Sex Comparison

Parameters	All	Females	Males	p value
full removed stomach weight (g)	162.31±40.26	158.15±37.73	177.05±47.20	0.172
empty removed stomach weight (g)	142.18±36.62	138.58±33.87	154.95±44.52	0.193
pre-op weight (kg)	121.96±14.64	120.54±15.21	127.00±11.61	0.199
weight at the third month (kg)	100.40±13.83	99.74±14.62	102.73±10.82	0.533
weight at the sixth month (kg)	88.92±12.25	88.21±12.89	91.45±9.74	0.443
weight at the twelfth month (kg)	77.96±10.35	76.95±10.61	81.55±8.90	0.197

Table 3: Correlations between weight measurements

	ERSW	pre-op weight	weight at 3m	weight at 6m	weight at 12m
FRSW	0.973**	0.430**	0.456**	0.487**	0.417**
	<0.001	0.002	0.001	<0.001	0.003
ERSW		0.417**	0.454**	0.480**	0.399**
		0.003	0.001	<0.001	0.004
pre-op weight			0.829**	0.779**	0.695**
			<0.001	<0.001	<0.001
weight at 3m				0.951**	0.767**
				<0.001	<0.001
weight at 6m					0.878**
					<0.001

FRSW: full removed stomach weight, ERSW: empty removed stomach weight, 3m: third month, 6m: sixth month, 12m: twelfth month

demonstrated moderate to strong correlations with patient weights at 3, 6, and 12 months (Table 3).

Deregowska et al., in a study based on early postoperative radiologic measurements, reported a negative correlation between gastric remnant volume and weight loss. However, they noted that the reliance on early radiologic assessments and a limited timeframe represented a study limitation (15).

Table 4: Changes in Weight Measurements According to pre-op BMI Groups

Parameters	Group 1 (N=11)	Group 2 (N=33)	Group 3 (N=6)	p value
FRSW	141.25±29.63	168.82±42.69	165.12±34.72	0.142
ERSW	122.24±23.86	149.12±38.99	140.55±32.82	0.106
pre-op weight	108.18±9.80a,b	123.18±10.39b	140.50±19.42	<0.001
weight at 3m	89.73±9.95a,b	101.85±12.55	112.00±15.53	0.002
weight at 6m	80.64±8.69a,b	90.09±12.12	97.67±11.34	0.012
weight at 12m	73.18±8.64	78.24±10.46	85.17±9.37	0.069

FRSW: full removed stomach weight, ERSW: empty removed stomach weight, 3m: third month, 6m: sixth month, 12m: twelfth month, a: comparison to group 2, b: comparison to group 3

Fig. 1. Full Removed Stomach Weight Measurement

Fig. 2. Empty removed stomach weight measurement

Patients with lower preoperative BMI values experienced more rapid weight loss in the early period. Findings from previous literature also support a negative relationship between preoperative BMI and postoperative weight loss, indicating that higher BMI values are associated with reduced weight loss (16).

In our study, no significant correlation was found between the resected stomach weight and the percentage of excess weight loss. Although higher specimen weights may suggest greater preoperative gastric capacity and calorie intake—potentially resulting in more substantial postoperative weight loss—this hypothesis was not confirmed. Group 1 patients showed more rapid weight loss, while Group 3 patients did not exhibit a significantly greater percentage of weight loss compared to the other groups. A study published in 2015 examining resected gastric specimen weight reported a similar correlation in the early postoperative period (3 months) but did not observe this relationship at 6 and 12 months (17). Consistently, in our study, gastric specimen weight was significantly associated with early weight loss (3rd month) but not at later follow-ups (6th and 12th months)[Table 4].

In the study conducted by Sobutay and colleagues, resected gastric weight was found to be associated with patient characteristics but was not a reliable predictor of weight loss during the first year after

LSG(18). In our study, a positive correlation was observed between resected gastric weight and early weight loss in the low BMI group; however, no statistically significant relationship was found between resected gastric weight and weight loss at the end of the 12th month.

A study by Toro et al. suggested that in order to achieve effective weight loss, resected stomach weights should exceed 120 grams for women and 160 grams for men(19). In our study, the mean full stomach weight was approximately 158 g for females and 177 g for males, while the mean empty stomach weight was 138 g for females and 154 g for males. As reported in the aforementioned study, increased specimen weight is associated with enhanced satiety and early fullness, resulting in more effective and rapid weight loss. In our findings, resected specimen weights for both females and males were within the recommended range, and early weight loss outcomes were statistically significant and consistent with the literature.

In this study, the weight of the resected gastric specimen in individuals who underwent sleeve gastrectomy was found to be associated with early weight loss (at the 3rd month); however, this relationship was not statistically significant at the 6th and 12th months. The gastric specimen weights removed from both female and male patients were consistent with the threshold values reported in the literature, which was associated with effective early weight loss. Nevertheless, no significant correlation was observed between gastric specimen weight and long-term weight loss. These findings suggest that gastric specimen weight may serve as a potential predictive parameter for early weight loss. However, to better understand its role in long-term outcomes, larger-scale and long-term prospective studies are warranted.

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Authors' contributions: In the development of this manuscript, multiple authors made significant and complementary contributions. The initial conception and establishment of the hypothesis were carried out by SB and FA, laying the groundwork for the study. The design and planning of the methodology were primarily managed by BB and OB, who structured the research approach. GB and AÖ took on the role of supervision, overseeing the research process and assuming responsibility for the project's progression. Critical providing of necessary personnel, financial, and environmental support, as well as tools and instruments, was facilitated by İE. Materials, including biological reagents and essential substances, were supplied by İÇ, ensuring smooth experimental procedures. The data collection and processing, involving execution of experiments and data handling, was performed by ÖY and RK, who also contributed to the analysis and interpretation of results. A comprehensive literature review was conducted by SB, supporting the theoretical foundation of the study. Article writing responsibilities were led by FA and BB, who drafted and structured the manuscript. Finally, OB and GB conducted a critical review, offering revisions and insights before the submission of the article.

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Data Availability: The data generated and analyzed during the current study is not publicly

available but is available from the corresponding author on reasonable

request.

Declarations

Human Ethics and Consent to Participate Declarations: Ethical approval for this study was granted by the Ethics Committee of Van Yüzüncü Yıl üniversity (Approval No. 2025/02-04 Date: 28/02/2025).

The research adhered to the ethical principles outlined in the Declaration

of Helsinki. The requirement for informed consent was waived by the Ethics

Committee of Van Yüzüncü Yıl Üniversity due to the retrospective

nature of the study. To ensure confidentiality, all patient data were

anonymized, and no personal identifying details were collected or recorded.

Clinical trial Number: Not applicable.

Consent for Publication: The final manuscript has been read and approved for final submission by all

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