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ORIGINAL PAPER

Weight loss outcomes after Nissen sleeve gastrectomy vs standard sleeve gastrectomy in female patients: a retrospective matched-cohort study

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Abstract

Introduction Nissen-sleeve gastrectomy (NSG) has been proposed as a modification combining SG with an anti-reflux component. However, its impact on weight-loss outcomes remains controversial. Comparative data between SG and NSG remain limited.

Aim The aim of the study was to compare weight loss after NSG and SG at a minimum of 12 months following surgery.

Materials and methods This retrospective matched cohort study included patients who underwent NSG at a high-volume bariatric center between 2023 and 2025. NSG patients were matched in a 1:2 ratio with patients undergoing standard SG using propensity score matching based on age, preoperative body mass index (BMI), and date of surgery. Weight-loss outcomes, including percentage of total weight loss (%TWL) and percentage of excess weight loss (%EWL), were assessed at a minimum follow-up of 12 months. Subgroup analyses were performed according to follow-up duration (<20 vs ≥20 months).

Results 25 patients undergoing NSG were matched with 50 SG patients. All patients were female. At a median follow-up of approximately 20 months, SG was associated with significantly higher %TWL and %EWL compared with NSG (32.2% vs 29.3%; $P = 0.012$ and 87.3% vs 78.5%; $P = 0.017$, respectively). After stratification by follow-up duration, significant differences were observed only in patients with follow-up <20 months, whereas weight-loss outcomes were comparable between procedures in patients followed for ≥20 months. Operative time was significantly longer for NSG, while length of hospital stay was similar. One Clavien–Dindo III complication occurred in the NSG group.

Conclusions SG was associated with greater early weight loss compared with NSG. However, these differences diminished with longer follow-up.

Key words

bariatric surgery, Nissen-sleeve gastrectomy, Nissen fundoplication, gastroesophageal reflux disease, sleeve gastrectomy

Introduction Obesity is a chronic, multifactorial disease that significantly increases the risk of cardiovascular disease, type 2 diabetes mellitus, and other obesity-related diseases [1]. Metabolic bariatric surgery (MBS) remains the most effective long-term treatment for obesity, resulting in substantial weight loss [2]. Among the available procedures, sleeve gastrectomy (SG) has become one of the most commonly performed bariatric operations worldwide [3]. Despite its effectiveness for weight reduction, standard SG is associated with the development or exacerbation of gastroesophageal reflux disease (GERD) [3,4]. To address this concern, surgical modifications have been developed that combine SG with an anti-reflux component, such as Nissen fundoplication, resulting in a procedure broadly referred to as Nissen-sleeve gastrectomy (NSG).

However, the impact of the anti-reflux component on weight-loss outcomes remains controversial. While some studies report that NSG achieves weight-loss outcomes comparable to standard SG in terms of weight loss, other studies suggest a trend toward slightly lower absolute weight loss in patients undergoing NSG [5,6].

Despite the growing interest in NSG, there is currently a limited amount of research directly comparing weight-loss outcomes between standard SG and NSG. This gap in literature underscores the need for comparative studies to clarify whether adding a fundoplication affects the effectiveness of weight loss.

Aim The aim of the study was to compare weight loss after NSG and SG at a minimum of 12 months following surgery. The secondary aim was to assess whether the duration of postoperative follow-up influenced weight loss outcomes.

Materials and methods

Study design This was a retrospective cohort study including patients who underwent NSG at a high-volume bariatric center in Poland between 2023 and 2025. These patients were matched in a 1:2 ratio with patients who underwent standard SG during the same period. Inclusion criteria were eligibility for MBS and availability of data [7]. Exclusion criteria included unwillingness to participate in the study and lack of follow-up data.

Patients were qualified for NSG if they presented with typical GERD symptoms before surgery and demonstrated objective endoscopic findings, defined as the presence of hiatal hernia and/or esophagitis of at least Los Angeles grade B. Patients without GERD symptoms and without pathological findings on gastroscopy were qualified for SG.

The database comprised baseline patient characteristics, including sex, age, preoperative body mass index (BMI), and date of surgery. Postoperative outcomes included current BMI, percentage of total weight loss (%TWL), and percentage of excess weight loss (%EWL). %TWL was calculated as (initial weight – current weight) / initial weight × 100, while %EWL was calculated as (initial weight – current weight) / (initial weight – ideal weight) × 100 [8]. Ideal body weight was calculated assuming a BMI of 25 kg/m². Due to the primary aim of the study and the qualification criteria for the respective surgical procedures, postoperative GERD evaluation was not analyzed in detail or directly compared between the groups.

Patients were matched using propensity score matching in a 1:2 ratio with nearest-neighbor matching without replacement, based on age, preoperative BMI, and date of surgery (±2 months).

Surgical technique All patients underwent NSG according to the technique described by Nocca et al [9]. After dissection of the esophageal hiatus, the esophagus was mobilized from the mediastinum to obtain about 4–5 cm of intra-abdominal length. The hiatus was closed

with combined anterior and posterior cruroplasty using a continuous barbed suture over a 36-F nasogastric tube. The gastric fundus was fully mobilized and a 360 ° fundoplication was created around the distal esophagus using three interrupted sutures. Sleeve gastrectomy was then performed over a 36-F bougie. The last two staple firings were placed approximately 1 cm from the wrap to preserve blood supply. No mesh was used, and the wrap and esophagus were not fixed to the diaphragm or crura.

Statistical analysis A descriptive statistical analysis was conducted. All data were analyzed using Statistica software 13.PL (StatSoft Inc.). Propensity score matching was performed using a logistic regression model including age, preoperative body mass index, and date of surgery. Patients were matched in a 1:2 ratio using nearest-neighbor matching without replacement. Covariate balance was assessed using standardized mean differences. A standardized mean difference <0.1 was considered indicative of good covariate balance. The mean value of the matched SG controls was calculated to generate a single comparator for each NSG patient, enabling paired non-parametric comparisons between groups. Continuous values were presented as the median with interquartile range (IQR). Continuous outcomes were compared using the two-sided Wilcoxon signed-rank test.

Ethics The data were completely anonymized. The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its subsequent amendments. The study was approved by the Bioethics Committee of the University of Warmia and Mazury in Olsztyn (26/2025).

Results Of the 36 patients who underwent NSG and met the inclusion criteria, 1 could not be matched, 5 were lost to follow-up, and 4 were excluded due to pregnancy. During the same period, 584 patients underwent SG and constituted the pool of potential controls for matching. After propensity score matching, satisfactory covariate balance was achieved, as reflected by standardized mean differences (Table 1).

25 patients who underwent NSG were matched with 50 patients who underwent SG. Each NSG patient was matched to two SG patients. For analysis, the mean value of the 2 matched controls was used, resulting in 25 matched pairs. All 75 patients were female.

The NSG and SG patients did not differ in sex, age, preoperative BMI, length of stay and follow-up (Table 2). The median (IQR) operative time was 55 (50–60) minutes for NSG and 30 (25–32.5) minutes for SG.

When the matched cohort was stratified according to follow-up duration, 12 matched pairs had follow-up <20 months and 13 matched pairs had follow-up ≥20 months (Table 3). Significant differences in weight loss outcomes were observed only in patients with follow-up <20 months, with higher %EWL and %TWL in SG group than NSG group ($P = 0.012$ for %EWL; $P = 0.009$ for %TWL).

One Clavien–Dindo grade III complication occurred in the NSG group during follow-up. Two weeks after the surgery the patient was admitted to the hospital with symptoms and signs of perforation of gastrointestinal tract. During reoperation, no definite site of perforation was identified and only peritoneal drainage was performed. There was no Clavien–Dindo III complication in the follow-up time in SG group.

Discussion There are only a few studies comparing weight-loss outcomes between SG and NSG. Therefore, the strength of our study was addressing this literature gap. In our study, SG appeared to be superior to NSG in terms of weight loss, but the difference disappeared after 20 months of follow-up.

In the literature, weight loss after NSG is generally reported as satisfactory and comparable to that after SG. In recent meta-analyses, mean %EWL after NSG ranged from 59.1 to 67.8% in a short- to mid-term follow-up periods [5,10]. Moreover, Savvala et al[11], in their 5-year follow-up study, reported a mean TWL% of 22% and a mean EWL% was 59.4%. It can be considered relatively high for long-term outcomes. For comparison, in well-known

randomized controlled trials on SG and Roux-en-Y gastric bypass (RYGB), Salminem et al[12] demonstrated %EWL of 49% after 5 years following SG and 57% after RYGB, whereas Peterli et al[13] reported %EWL values of 61.1% after SG and 68.3% after RYGB. These data positioned NSG as a competitive option among bariatric procedures.

In our study, the median %TWL was 29.3 and the median %EWL was 78.5% after a median follow-up of 20 months. Comparable results have been reported in studies with similar follow-up durations [14,15]. However, consistent with the existing literature, we observed a gradual attenuation of weight-loss outcomes with longer follow-up duration.

In studies comparing SG with NSG, weight-loss outcomes were generally comparable [6,14,15]. In a meta-analysis by Loo et al[6] no significant differences in %EWL were observed between procedures. Although a statistically significant lower %TWL was reported after NSG compared with SG (mean difference, −2.75%). In a randomized trial by Maimaitiyusupu et al[14], %EWL was significantly higher after Nissen or fundoplication–augmented sleeve than after standard SG (71.9% vs 63.1% at 6–12 months; $P = 0.041$). Whereas Olmi et al[15], reported no difference in %TWL between SG and SG with fundoplication at 12 months. The observed differences between studies may result from the lack of standardization of NSG and the use of heterogeneous surgical techniques, which further underscores the need for additional studies specifically addressing and analyzing this issue.

In our analysis, NSG was associated with significantly lower %TWL and %EWL compared with SG at a median follow-up of approximately 20 months. However, stratification by follow-up duration revealed that these differences were present only in patients with shorter follow-up (<20 months). Whereas weight-loss outcomes were comparable between procedures in patients followed for ≥20 months. This temporal pattern suggests that NSG may

be associated with a slower early weight-loss trajectory rather than impaired long-term efficacy.

NSG was associated with a longer operative time, reflecting the added complexity of hiatal dissection and fundoplication. In our study, one Clavien–Dindo III complication occurred in the NSG group. This finding aligns with larger cohort studies indicating acceptable safety profiles for NSG when performed in experienced centers [11,15]. Carandina et al[16] highlighted the learning-curve–related risk of wrap-specific complications in early series. Afifi et al[17] using a national database demonstrated no significant difference in 30-day readmission rates between patients undergoing SG or NSG. Although length of stay and total hospital charges were higher in the fundoplication group. These findings are consistent with reports showing that even newly established bariatric programs can achieve safe and favorable outcomes with appropriate training and multidisciplinary care [18]. Taken together, these findings suggest that while NSG may be associated with specific early complications related to the fundoplication component, overall short-term safety appears acceptable when performed in experienced centers.

The study has several limitations. The main limitation is retrospective design and relatively small sample size, which may limit statistical power. However, a 1:2 matching strategy with careful selection of patients based on age, preoperative BMI, sex, and date of surgery was applied to minimize selection bias and improve comparability between cohorts. Additionally, because each NSG patient was matched to two SG controls, the mean value of the matched controls was used to enable paired comparisons. This approach may have reduced variability and influenced statistical significance estimates. Moreover, all patients included in the analysis were female, which limits the generalizability of the findings to male populations. In addition, weight-loss outcomes were assessed at variable follow-up durations, and although stratified analyses were performed, longer and uniform follow-up would be required to

confirm the durability of the observed trends. Due to the small number of matched pairs in the stratified follow-up analysis (<20 vs ≥20 months), the statistical power was limited. Therefore, the lack of statistically significant differences in the ≥20-month group should not be interpreted as evidence of equivalence between procedures. These results should therefore be interpreted with caution.

Conclusions SG was associated with greater early weight loss compared with NSG. However, these differences were no longer observed after 20 months of follow-up. Further prospective studies with standardized surgical techniques and longer follow-up are warranted to better define the role of NSG among bariatric procedures.

Article information

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Contribution statement ND-G conceived the main idea of the study, performed the statistical analysis, and wrote the manuscript. MM contributed to drafting the manuscript. MM and PL were responsible for data collection. All authors reviewed and approved the final version of the manuscript prior to submission.

Conflict of interest None declared.

AI statement Artificial intelligence was not used in the preparation of this manuscript.

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Table 1 Standard mean difference before and after matching		
Variable	**SMD before matching**	**SMD after matching**
Age	0.258	0.031
Preoperative BMI	0.494	0.049
Date of surgery	0.415	0.010
Abbreviations: BMI, body mass index; SMD, standard mean difference		

Table 2 Patient characteristics and outcomes

Variable	**NSG**	**SG[a]**	***P* value**
Women	25 (100)	25 (100)	–
Age, y	42 (39–46)	41.5 (37.5–46.5)	0.546
Preoperative BMI, kg/m^2	37.9 (36.1–44.2)	38.1 (36.7–44.1)	0.411
Operative time, min	55 (50–60)	30 (25–32.5)	<0.001
Length of stay, d	2 (2–2)	2 (2–2)	–
Follow-up, mo	20.2 (15.7–23)	20.4 (16–23.1)	0.979
%TWL	29.3 (22.5–31.7)	32.2 (28.3–34.8)	0.012
%EWL	78.5 (68–89.6)	87.3 (72.4–96)	0.017

Data are presented as number (percentage) or median (interquartile range).

a Mean value of two matched SG patients

Abbreviations: %EWL, percentage of excess weight loss; NSG, Nissen-sleeve gastrectomy; SG, sleeve gastrectomy; %TWL, percentage of total weight loss; others, see Table 1

Table 3 Percentage of excess and total weight loss in the matched cohort according to follow-up duration

Follow-up	**Variable**	**NSG**	**SG[a]**	***P* value**
<20 months (n = 12 pairs)	%EWL	79.9 (68–90)	92 (80.6–110.1)	0.012
	%TWL	30.2 (22.5–31.8)	34.5 (28.3–36.3)	0.009
≥20 months (n =13 pairs)	%EWL	71.2 (64.6–84.8)	75.9 (67.3–93.6)	0.376
	%TWL	28.9 (23.9–32.8)	28.8 (23.7–34.8)	0.273

Data are presented as median (interquartile range).

a Mean value of two matched SG patients

Short title: Weight loss after Nissen sleeve vs standard sleeve gastrectomy in women