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

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KEY WORDS

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

ABSTRACT

INTRODUCTION Nissen sleeve gastrectomy (NSG) is a procedure that combines SG with an antireflux component. However, its impact on weight loss outcomes remains controversial. Comparative data between SG and NSG are limited.

AIM The aim of this study was to compare weight loss after NSG and SG at a minimum of 12 months postsurgery.

MATERIALS AND METHODS This retrospective matched-cohort study included patients who underwent NSG at a high-volume bariatric center between 2023 and 2025. The NSG patients were matched at a 1:2 ratio with individuals undergoing standard SG, using propensity score matching based on age, preoperative body mass index, 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 mo).

RESULTS A total of 25 patients undergoing NSG were matched with 50 SG patients. All study participants were women. At median (interquartile range) follow-up of 20.4 (16–23.1) months, SG was associated with significantly higher %TWL and %EWL, as compared with NSG (32.2% vs 29.3%; $P = 0.01$ and 87.3% vs 78.5%; $P = 0.02$, respectively). After stratification by follow-up duration, significant differences were observed only in the patients followed for less than 20 months, whereas weight loss outcomes were comparable between the procedures in the individuals followed for 20 months or longer. Operative time was significantly longer for NSG, while length of hospital stay was similar between the groups. One Clavien–Dindo grade III complication occurred in the NSG group.

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

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INTRODUCTION Obesity is a chronic, multifactorial disease that considerably increases the risk of cardiovascular disease, type 2 diabetes mellitus, and other obesity-related diseases.[1] Metabolic and 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 procedures worldwide.[3] Despite its effectiveness in weight reduction, standard SG is associated with the development or exacerbation of gastroesophageal reflux disease (GERD).[3,4] To address this concern, there have been surgical modifications that combine SG with an antireflux component, such as Nissen fundoplication, resulting in a procedure broadly referred to as Nissen sleeve gastrectomy (NSG). However, the impact of the antireflux component on weight loss outcomes remains debatable. While some studies report that NSG achieves weight loss outcomes comparable to standard SG, other studies suggest a trend toward

TABLE 1 Standardized 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	0.01

Abbreviations: BMI, body mass index; SMD, standardized mean difference

TABLE 2 Patient characteristics and outcomes

Variable	Nissen sleeve gastrectomy (n = 25)	Sleeve gastrectomy[a] (n = 25)	*P* value
Women	25 (100)	25 (100)	–
Age, y	42 (39–46)	41.5 (37.5–46.5)	0.55
Preoperative BMI, kg/m^2	37.9 (36.1–44.2)	38.1 (36.7–44.1)	0.41
Operative time, min	55 (50–60)	30 (25–32.5)	<0.001
Length of hospital stay, d	2 (2–2)	2 (2–2)	–
Follow-up, mo	20.2 (15.7–23)	20.4 (16–23.1)	0.98
%TWL	29.3 (22.5–31.7)	32.2 (28.3–34.8)	0.01
%EWL	78.5 (68–89.6)	87.3 (72.4–96)	0.02

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

a Mean value of 2 matched sleeve gastrectomy patients

Abbreviations: %EWL, percentage of excess weight loss; %TWL, percentage of total weight loss; others, see **TABLE 1**

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

Follow-up	Variable	Nissen sleeve gastrectomy (n = 25)	Sleeve gastrectomy[a] (n = 25)	*P* value
<20 mo (n = 12 pairs)	%EWL	79.9 (68–90)	92 (80.6–110.1)	0.01
	%TWL	30.2 (22.5–31.8)	34.5 (28.3–36.3)	0.01
≥20 mo (n = 13 pairs)	%EWL	71.2 (64.6–84.8)	75.9 (67.3–93.6)	0.38
	%TWL	28.9 (23.9–32.8)	28.8 (23.7–34.8)	0.27

Data are presented as median (interquartile range).

a Mean value of 2 matched sleeve gastrectomy patients

Abbreviations: see **TABLE 2**

slightly lower absolute weight loss in patients undergoing NSG.[5,6]

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

AIM The aim of this study was to compare weight loss outcomes after NSG and SG at a minimum of 12 months following surgery and to assess whether these outcomes were affected by the duration of postoperative follow-up.

MATERIALS AND METHODS **Study design** This was a retrospective cohort study including patients who underwent NSG at a high-volume bariatric center in Poland (Department of General, Minimally-Invasive, and Elderly Surgery, University of Warmia and Mazury, Olsztyn) between 2023 and 2025. The patients were matched at a 1:2 ratio with individuals who underwent standard SG during the same period. The inclusion criteria were eligibility for MBS and availability of data.[7] The exclusion criteria comprised unwillingness to participate in the study and a lack of follow-up data.

The 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 grade B according to the Los Angeles classification. The 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/m^2. Due to the primary aim of the study and the qualification criteria for the respective surgical procedures, postoperative GERD prevalence was not analyzed in detail or directly compared between the groups.

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 36F nasogastric tube. The gastric fundus was fully mobilized, and 360° fundoplication was created around the distal esophagus using 3 interrupted sutures. SG was then performed over a 36F bougie. The last 2 staples 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, version 13.PL (TIBCO Software Inc., Palo Alto, California, United States). Propensity score matching was performed using a logistic regression model, including age, preoperative BMI, and date of surgery. The patients were matched at a 1:2 ratio using nearest-neighbor matching without replacement. Covariate balance was assessed using standardized mean differences (SMDs). An SMD below 0.1 was considered indicative of good covariate balance. Mean value of the matched SG controls was calculated

to generate a single comparator for each NSG patient, enabling paired nonparametric comparisons between the groups. Continuous values were presented as medians with interquartile ranges (IQRs). Continuous outcomes were compared using the 2-sided Wilcoxon signed-rank test. A *P* value below 0.05 was deemed significant.

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, and approved by the Bioethics Committee of the University of Warmia and Mazury in Olsztyn (26/2025).

RESULTS Of the 36 patients who underwent NSG, 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 SMDs (**TABLE 1**).

The 25 individuals who underwent NSG were matched with 50 individuals who underwent SG, so each NSG patient was matched with 2 SG patients. For analysis, the mean value of the 2 matched controls was used, resulting in 25 matched pairs. All 75 participants were women.

The NSG and SG patients did not differ in age, preoperative BMI, length of hospital stay, and follow-up duration (**TABLE 2**). 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 below 20 months and 13 pairs were followed for 20 months or longer (**TABLE 3**). Differences in weight loss outcomes were observed only in the patients with follow-up below 20 months, with higher %EWL and %TWL in the SG group than the NSG cohort ($P = 0.01$ for both %EWL and %TWL).

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

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

In the literature, weight loss after NSG is generally reported as satisfactory and comparable to that achieved after SG. In recent meta-analyses, mean %EWL after NSG ranged from 59.1% to 67.8% in short- and mid-term follow-ups.[5,10] Moreover, in their 5-year follow-up study, Savvala et al[11] reported mean %TWL of 22% and mean %EWL of 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% following SG and 57% post-RYGB 5 years after the procedure, whereas Peterli et al[13] reported %EWL values of 61.1% and 68.3% after SG and RYGB, respectively. These data positioned NSG as a competitive option among bariatric procedures.

In our study, in the NSG group, median (IQR) %TWL was 29.3% (22.5%–31.7%) and median (IQR) %EWL was 78.5% (68%–89.6%) after median follow-up of 20.2 (15.7–23) 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 as time passed.

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 differences in %EWL were observed between the 2 procedures, although a significantly lower %TWL was reported after NSG, as compared with SG (MD, 2.75%). In a randomized trial by Maimaitiyusupu et al,[14] %EWL was markedly higher after Nissen or fundoplication-augmented SG than standard SG (71.9% vs 63.1% at 6–12 mo; $P = 0.04$). However, 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 a lack of standardization of the NSG procedure and the use of heterogeneous surgical techniques, which further underscores the need for additional research specifically addressing this issue.

In our analysis, NSG was associated with markedly lower %TWL and %EWL, in comparison with SG, at median follow-up of approximately 20 months. However, stratification by follow-up duration showed that these differences were present only in the patients with shorter follow-up (<20 mo), whereas weight loss outcomes were comparable between the procedures in the individuals followed for 20 months or longer. This temporal pattern suggests that NSG may be associated with a slower early weight loss trajectory rather than impaired long-term efficacy.

NSG demonstrated longer operative times, reflecting the added complexity of hiatal dissection and fundoplication. In our study, 1 Clavien–Dindo grade III complication occurred in the NSG group. This finding aligns with larger cohort studies, indicating acceptable safety profiles of NSG, when performed by experienced surgeons.[11,15] Carandina et al[16] highlighted the learning curve–related risk of wrap-specific complications in early series. Using a national database, Afifi et al[17] reported no significant difference in 30-day readmission rates between patients undergoing SG or

NSG,[17] although length of hospital 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 the procedure is performed in experienced centers.

Limitations Our study has several limitations, the main ones being its retrospective design and a relatively small sample size, which may have limited 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 the cohorts. Additionally, as each NSG patient was matched with 2 SG controls, the mean value of the matched controls was used to enable paired comparisons. This approach may have reduced variability and influenced significance estimates. Moreover, all patients included in the analysis were women, 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 mo), the statistical power was limited. Therefore, the lack of significant differences in the group followed for 20 months or longer should not be interpreted as evidence of equivalence between the procedures, and our results should be interpreted with caution.

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

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