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Impact of sociodemographic factors and baseline health insurance coverage on 1-year outcomes following bariatric surgery

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Abstract

Aim: Although the weight-loss efficacy of the latest anti-obesity medications is widely recognized and evidence-supported, bariatric surgery remains the most effective treatment for obesity and type 2 diabetes mellitus (T2DM). While laparoscopic sleeve gastrectomy (LSG) and Roux-en-Y gastric bypass (RYGB) - the most extensively adopted procedures - demonstrate proven weight-reduction effects, suboptimal outcomes still occur in some patients. This highlights the critical importance of effectively evaluating postoperative weight achievement. Our study, therefore, investigates the influence of social factors and minimum medical insurance coverage on surgical weight-loss outcomes.

Methods: A retrospective cohort study was conducted on 260 patients with obesity who underwent bariatric surgery between 2021 and 2023. Continuous variables with normal distribution were expressed as mean ± standard deviation (SD) and analyzed using Student's *t*-test, whereas non-normally distributed variables were presented as median with interquartile range (IQR) [M (Q1, Q3)] and compared with the Mann-Whitney *U* test. Categorical variables were presented as frequency (n) and percentage (%), with intergroup comparisons conducted through x^2 tests. Linear regression and logistic regression models were employed to identify independent influencing factors, and *P*-value < 0.05 considered statistically significant.

Results: The study included 260 patients (102 males, 158 females), with 196 (75.4%) receiving LSG and 64 (24.6%) RYGB. Patients achieving target weight loss were younger (31.8 ± 9.13 years *vs.* 35.0 ± 10.4 years, *P* < 0.05), had higher baseline BMI (39.6 ± 7.86 kg/m^2 *vs.* 36.0 ± 6.46 kg/m^2, *P* < 0.05), and higher smoking rates (23.8% *vs.* 12.0%, *P* < 0.05), but lower family support (83.2% *vs.* 97.3%, *P* < 0.05) and reduced hypertension/T2DM incidence (*P* < 0.05). Multivariate analysis identified five independent predictors: family support (OR = 0.11, 95%CI: 0.02-0.42; β: -3.52, 95%CI: 1.45, -2.43), smoking (OR = 3.27, 95%CI: 1.36-8.73; β: 3.06, 95%CI: 1.20, 2.55), RYGB procedure (*vs.* LSG, OR = 0.18, 95%CI: 0.07-0.43; β: -4.41, 95%CI: 1.35, -3.26), baseline BMI (OR = 1.15 per unit, 95%CI: 1.08-1.22, β: 0.45, 95%CI: 0.07, 6.31), and HbA1c (OR = 0.77 per %, 95%CI: 0.62-0.96). Insurance coverage and education level showed no significant association (*P* > 0.05).

Conclusion: One-year postoperative weight loss outcomes were significantly associated with preoperative factors including lack of family support, LSG procedure (*vs.* RYGB), smoking status, and higher baseline BMI (all *P* < 0.05), but showed no significant correlation with educational attainment or insurance coverage (*P* > 0.05).

Keywords: Sociodemographic factors, health insurance, bariatric surgery, BMI, TWL%

INTRODUCTION

Obesity has emerged as a global health crisis, characterized by rapidly increasing prevalence and growing disease burden. Recent studies reveal sustained growth in both mortality and disability-adjusted life year (DALY) rates attributable to high body mass index (BMI) worldwide from 1990 to 2019: Specifically regarding death, global males increased from 1.0 million (95%UI 0.49, 1.7) to approximately 2.48 million (95%UI 1.5, 3.8); females increased from 1.2 million (95%UI 0.67, 1.9) to approximately 2.54 million (95%UI 1.6, 3.9); in terms of DALY, global males increased from 32.4 million (95%UI 16.4, 53.3) to approximately 82.9 million (95%UI 51.3, 120.3); females increased from 34.9 million (95%UI 20.2, 53.7) to approximately 77.4 million (95%UI 50.9, 111.5)[1]. Obesity correlates with multiple comorbidities, including hypertension, type 2 diabetes mellitus (T2DM), cardiovascular diseases, osteoarthritis, psychological disorders, and malignancies[2,3]. It also induces weight-related stigma and bullying among children/adolescents[4-6], leading to severe psychosocial consequences.

In recent years, the use of anti-obesity medications has steadily increased. Glucagon-like peptide-1 receptor agonists (GLP-1RAs), as a novel class of pharmacological agents for obesity management, have gained considerable attention due to their clinical efficacy and increasing utilization. Multiple clinical trials and epidemiologic studies have demonstrated that patients treated with semaglutide experienced an average weight loss of 14.9% over 68 weeks, accompanied by a reduced incidence of type 2 diabetes[7-9]. Furthermore, GLP-1RAs have been shown to lower the risk of cardiovascular events, particularly among high-risk populations[10]. The STEP 4 trial further confirmed that patients who continued GLP-1RA treatment achieved an average weight loss of 10.6% within 20 weeks and maintained significant weight reduction even after discontinuation of the medication[11]. Nevertheless, bariatric surgery remains the most effective intervention for severe obesity, demonstrating durable outcomes: a 10-year follow-up study reported median excess weight loss (%EWL) of 43.5% (range 2.1%-109.2%) after laparoscopic sleeve gastrectomy (LSG) and 50.7% (1.7%-111.7%) after laparoscopic Roux-en-Y gastric bypass (LRYGB)[12]. These procedures also improve comorbidity resolution, reduce mortality, and enhance quality of life[13,14]. However, significant interindividual variability exists, with 4%-53% of patients failing to achieve expected outcomes post-RYGB/LSG[15-18].

Therefore, identifying determinants of weight loss outcomes is crucial for optimizing therapeutic efficacy. Current research on surgical outcome predictors encompasses psychological profiles, medical history, lifestyle factors, mental health status, demographic characteristics, surgical techniques, and nutritional compliance[19-21]. However, the potential impacts of Sociodemographic determinants and insurance coverage on weight loss efficacy remain underexplored.

Based on this, this study investigates how educational attainment, family support, birth delivery mode, and minimum medical insurance coverage influence weight loss outcomes and comorbidity resolution at 1-year post-surgery, elucidating social determinants of bariatric treatment efficacy.

METHODS

Patient selection

This study includes patients who underwent bariatric surgery at our hospital between January 1, 2021, and June 30, 2023. A retrospective analysis was conducted to examine the relationship between preoperative questionnaire results, basic characteristics, some auxiliary examination data, and postoperative weight loss outcomes, as well as improvements in comorbidities. Inclusion criteria were: (1) meeting the surgical indications and undergoing surgery; (2) no severe complications (e.g., heart failure, kidney failure, *etc.*); (3) complete follow-up data; (4) age ≥ 18 years. Exclusion criteria were: (1) previous history of bariatric surgery; (2) poor compliance. This retrospective study utilized data from the Bariatric and Metabolic Surgery Database of the First Affiliated Hospital of Jinan University. The database was approved by the Institutional Review Board (IRB) of the First Affiliated Hospital of Jinan University (KY-2023-071). All patients provided written informed consent at the time of data collection, which included permission for future research use.

Study variables

All variables in this study were derived from the data entered into the database of bariatric surgery patients at our center, including questionnaire results, demographic characteristics, and relevant clinical examination data. The study variables include: Sex, Age, BMI, Marital Status, Education, Smoking, Drinking, Health Insurance, Support Level, Occupation, Mode of Delivery, Weight Gain Period, Previous Weight Loss History, Surgical History, Hypertension, T2DM, Surgery Type, HbA1c, total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), and Creatinine (Cr).

Criteria for defining weight loss success

Recent studies have shown that a %TWL ≥ 25% more accurately reflects whether weight loss outcomes one year after surgery meet the criteria for weight loss success[22]. Therefore, based on this finding, this study classifies the %TWL at one year post-surgery into two groups: the "Achieved Target Group" (%TWL ≥ 25%) and the "Not Achieved Target Group" (%TWL < 25%).

Definition of education, supporting degree and occupation

This study classifies participants based on whether their educational attainment met Junior college standards, dividing them into a low education group and a medium-to-high education group. Additionally, the study examines whether the family members are aware of the patient's surgery and, based on their attitudes toward the surgery, determines whether they support it. This results in two groups: a support group and a non-support group. Furthermore, participants are categorized based on their employment status. Those who are unemployed form the "unemployed group", while those employed are further divided into light manual labor and moderate-to-heavy manual labor groups.

Data analysis section

Statistical analysis was performed using SPSS 26.0 and R 4.4.1 software. Continuous variables with normal distribution were expressed as mean ± standard deviation, while non-normally distributed continuous variables were analyzed using the Mann-Whitney *U* test and reported as median with interquartile range

(IQR) [M (Q1, Q3)]. Categorical variables were presented as frequency (n) and percentage (%), with intergroup comparisons conducted through x^2 tests. In multivariate analysis, variables showing statistical significance ($P < 0.05$) in univariate analysis were systematically incorporated. Statistical significance was defined as $P < 0.05$ throughout all analyses.

RESULTS

Basic characteristics of patients

A total of 260 participants were included in the study, with 102 males (39.2%) and 158 females (60.8%). The average age was 32.7 ± 9.60 years, and the average BMI was 38.6 ± 7.65 kg/m^2. Approximately one-fifth of the participants smoked and/or drank alcohol. Regarding comorbidities, 16.5% of the patients had hypertension, and 20.4% had T2DM. Among the participants, 196 (75.4%) underwent LSG, while 64 (24.6%) underwent RYGB [Table 1].

Group comparison analysis based on weight loss result

Based on the achievement of weight loss goals, baseline data were grouped and compared. The results showed that patients in the goal-achieved group were younger (31.8 ± 9.13 years *vs.* 35.0 ± 10.4 years), but had a higher BMI (39.6 ± 7.86 kg/m^2 *vs.* 36.0 ± 6.46 kg/m^2) ($P < 0.05$). Regarding unhealthy habits, the percentage of smokers was significantly higher in the goal-achieved group compared to the non-achieved group (23.8% *vs.* 12.0%; $P < 0.05$). In terms of family support, the support rate was lower in the goal-achieved group compared to the non-achieved group (83.2% *vs.* 97.3%; $P < 0.05$). However, with regard to comorbidities, the incidence of hypertension and T2DM was significantly lower in the goal-achieved group compared to the non-achieved group: 15.7% *vs.* 18.7% and 14.6% *vs.* 34.7%, respectively ($P < 0.05$). Additionally, the HbA1c level was lower in the goal-achieved group (6.12 ± 1.38 *vs.* 6.80 ± 1.81; $P < 0.05$). No significant differences were found between the two groups for other baseline characteristics [Table 2].

Factors affecting weight loss outcomes one year after bariatric surgery

Using a 25% total weight loss (%TWL) at 1 year as the outcome, univariate logistic regression analysis revealed seven significant factors: lack of family support, smoking, absence of T2DM, LSG, younger age, higher BMI, and lower HbA1c levels. These variables with $P < 0.05$ were then included in the multivariate logistic regression analysis. The results showed that family support (compared to no support, OR 95%CI: 0.11, 0.02-0.42), smoking (compared to non-smoking, OR 95%CI: 3.27, 1.36-8.73), RYGB (compared to LSG, OR 95%CI: 0.18, 0.07-0.43), BMI (OR 95%CI: 1.15, 1.08-1.22), and HbA1c levels (OR 95%CI: 0.77, 0.62-0.96) were significantly associated with achieving the weight loss goal ($P < 0.05$) [Table 3].

Furthermore, univariate and multivariate linear regression analyses were conducted to assess the impact of preoperative factors on postoperative %TWL. The results showed that family support (β: -3.52, 95%CI: -2.43, -1.45) and RYGB (β: -4.41, 95%CI: -3.26, -1.35) were negatively associated with %TWL at 1 year postoperatively. In contrast, smoking (β: 3.06, 95%CI: 2.55, 1.20) and BMI levels (β: 0.45, 95%CI: 0.07, 6.31) were positively associated with %TWL at 1 year postoperatively [Table 4].

Subgroup analysis of the impact of family support, insurance coverage, and education level on weight and metabolic outcomes one year after surgery

According to the grouping based on family support, the results showed that most patients received family support (227 *vs.* 33). However, among those without family support, the proportion of males was higher in the support group (41.9% *vs.* 21.2%), and the proportion of patients opting for RYGB was also higher in the support group (27.8% *vs.* 3.0%). Regarding metabolic improvement, no significant differences were observed between the two groups in terms of TC, TG, or Cr. However, both groups showed significant increases in HDL postoperatively, with the increase in HDL being lower in the support group compared to the non-

Table 1. Baseline characteristics of patients

	n (%)	Means ± SD
Sex		
Female	158 (60.8%)	-
Male	102 (39.2%)	-
Age (Year)	-	32.7 (9.60)
BMI (kg/m^2)	-	38.6 (7.65)
Smoking		
No/Unknow	207 (79.6%)	-
Yes	53 (20.4%)	-
Drinking		
No/Unknow	209 (80.4%)	-
Yes	51 (19.6%)	-
Hypertension		
No/Unknow	217 (83.5%)	-
Yes	43 (16.5%)	-
T2DM		
No/Unknow	207 (79.6%)	-
Yes	53 (20.4%)	-
Surgery		
LSG	196 (75.4%)	-
RYGB	64 (24.6%)	-

BMI: Body mass index; T2DM: type 2 diabetes mellitus; LSG: laparoscopic sleeve gastrectomy; RYGB: Roux-en-Y gastric bypass; SD: standard deviation.

support group ($P < 0.05$). In terms of weight improvement, both groups experienced significant weight loss; however, the BMI of patients in the support group was significantly higher before and after surgery compared to the non-support group, and the %TWL was lower in the support group ($P < 0.05$). In the analysis based on whether patients had purchased medical insurance, no significant differences were observed between the two groups in baseline results, postoperative weight loss, or metabolic improvements ($P > 0.05$). In the education level subgroup, patients with medium-to-high education levels had a higher proportion of LSG (80.5% *vs.* 66.7%). Significant differences were found in TC levels both pre- and postoperatively between the two groups, with the medium-to-high education group having relatively higher levels ($P < 0.05$). However, the medium-to-high education group showed more significant improvement in HbA1c levels (5.21 ± 0.429 *vs.* 5.33 ± 0.474; $P < 0.05$). No significant differences were observed between the two groups in terms of other weight loss and metabolic outcomes ($P > 0.05$) [Table 5].

DISCUSSION

Preoperative factors play a crucial role in improving the outcomes of weight loss surgery. This study employed univariate, multivariate linear, and logistic regression analyses to explore factors influencing the achievement of weight loss goals. Both analyses showed that lack of family support, undergoing LSG, smoking, and high BMI were significantly associated with achieving weight loss goals postoperatively. However, no significant associations were found regarding education level, mode of delivery, or medical insurance coverage.

Table 2. Group comparison based on weight loss results

	No (*N* = 75)	Yes (*N* = 185)	*P* Value
Sex			0.497
Female	48 (64.0%)	110 (59.5%)	
Male	27 (36.0%)	75 (40.5%)	
Age (Year)			0.023
Mean (SD)	35.0 (10.4)	31.8 (9.13)	
Median (Min, Max)	35.0 (19.0, 64.8)	30.8 (18.0, 72.8)	
BMI (kg/m^2)			< 0.0001
Mean (SD)	36.0 (6.46)	39.6 (7.86)	
Median (Min, Max)	35.3 (27.2, 57.7)	38.2 (26.6, 97.1)	
Marital_status			0.591
Unmarried	32 (42.7%)	85 (45.9%)	
Married	38 (50.7%)	90 (48.6%)	
Other	5 (6.7%)	10 (5.4%)	
Education			0.93
High school and below	28 (37.3%)	68 (36.8%)	
Junior college or above	47 (62.7%)	117 (63.2%)	
Smoking			0.033
No/Unknow	66 (88.0%)	141 (76.2%)	
Yes	9 (12.0%)	44 (23.8%)	
Drinking			0.35
No/Unknow	63 (84.0%)	146 (78.9%)	
Yes	12 (16.0%)	39 (21.1%)	
Health_insurance			0.37
No/Unknow	24 (32.0%)	49 (26.5%)	
Yes	51 (68.0%)	136 (73.5%)	
Supporting_degree			0.002
No/Unknow	2 (2.7%)	31 (16.8%)	
Yes	73 (97.3%)	154 (83.2%)	
Occupation			0.077
Unemployed	9 (12.0%)	39 (21.1%)	
Light physical labor	59 (78.7%)	119 (64.3%)	
Moderate or above labor	7 (9.3%)	27 (14.6%)	
Mode_of_Delivery			0.118
Unknown	32 (42.7%)	64 (34.6%)	
Eutocia	36 (48.0%)	91 (49.2%)	
Cesarean	7 (9.3%)	30 (16.2%)	
Weight_gain_period			0.295
Unknown	26 (34.7%)	53 (28.6%)	
Childhood	24 (32.0%)	59 (31.9%)	
Adolescence	15 (20.0%)	44 (23.8%)	
After delivery	10 (13.3%)	29 (15.7%)	
Previous_weight_loss			0.601
No/Unknow	21 (28.0%)	46 (24.9%)	
Yes	54 (72.0%)	139 (75.1%)	
Surgical_history			0.205
No/Unknow	54 (72.0%)	118 (63.8%)	

Yes	21 (28.0%)	67 (36.2%)	
Hypertension			0.556
No/Unknow	61 (81.3%)	156 (84.3%)	
Yes	14 (18.7%)	29 (15.7%)	
T2DM			< 0.0001
No/Unknow	49 (65.3%)	158 (85.4%)	
Yes	26 (34.7%)	27 (14.6%)	
Surgery			< 0.0001
LSG	45 (60.0%)	151 (81.6%)	
RYGB	30 (40.0%)	34 (18.4%)	
HbA1c (g/L)			0.002
Mean (SD)	6.80 (1.81)	6.12 (1.38)	
Median (Min, Max)	6.00 (4.60, 12.5)	5.80 (4.50, 13.8)	
Cholesterol (mmol/L)			0.783
Mean (SD)	5.21 (0.998)	5.19 (0.995)	
Median (Min, Max)	5.22 (3.18, 8.45)	5.11 (2.49, 8.02)	
Triglycerides (mmol/L)			0.052
Mean (SD)	2.59 (2.29)	2.10 (2.08)	
Median (Min, Max)	1.71 (0.640, 12.9)	1.59 (0.500, 17.6)	
HDL (mmol/L)			0.492
Mean (SD)	1.04 (0.207)	1.07 (0.274)	
Median (Min, Max)	1.02 (0.610, 1.78)	1.04 (0.340, 3.31)	
Creatinine (umol/L)			0.09
Mean (SD)	60.2 (16.0)	62.6 (13.3)	
Median (Min, Max)	57.6 (33.0, 141)	60.0 (38.2, 104)	

BMI: Body mass index; SD: standard deviation; Min: minimum; Max: maximum; T2DM: type 2 diabetes mellitus; LSG: laparoscopic sleeve gastrectomy; RYGB: Roux-en-Y gastric bypass; HbA1c: hemoglobin A1c; HDL: high-density lipoprotein.

Table 3. Univariate and multivariate logistic regression analyses for included bariatric surgery patients

Variables	Univariate logistics regression			Multivariate logistics regression		
	OR	95%CI	*P* value	OR	95%CI	*P* value
Supporting_degree	0.14	0.02-0.47	0.007	0.11	0.02-0.42	0.006
Occupation						
Light physical labor	0.47	0.20-0.99	0.058	-	-	-
Moderate or above labor	-	-	-	-	-	-
Smoking	2.29	1.10-5.25	0.036	3.27	1.36-8.73	0.01
T2DM	0.32	0.17-0.60	0.0004	-	-	-
Surgery	0.34	0.19-0.61	0.0003	0.18	0.07-0.43	0.0002
Age	0.97	0.94-0.99	0.019	-	-	-
BMI	1.09	1.04-1.14	0.0005	1.15	1.08-1.22	< 0.0001
HbA1c	0.77	0.65-0.91	0.003	0.77	0.62-0.96	0.02

OR: Odds ratio; CI: confidence interval; T2DM: type 2 diabetes mellitus; BMI: body mass index; HbA1c: hemoglobin A1c.

Studies assessing the relationship between preoperative BMI and postoperative weight loss outcomes have reported two different findings. Some studies indicate a negative correlation between preoperative BMI and postoperative weight loss. For example, Melton GB's study showed that when weight loss success was defined as achieving at least 40%EWL, a higher BMI was associated with poorer weight loss outcomes[17].

Table 4. Univariate and multivariate linear regression analyses for included bariatric surgery patients

Variables	Univariate linear regression		Multivariate linear regression	
	β (95%CI)	*P* value	β (95%CI)	*P* value
Supporting_degree	-3.27 (1.600, -2.046)	0.042	-3.52 (1.45, -2.43)	0.016
Smoking	3.79 (1.31, 2.89)	0.004	3.06 (1.20, 2.55)	0.011
Glucose_abnormality	-5.32 (1.29, -4.12)	< 0.0001	-	-
Surgery	-3.09 (1.23, -2.51)	0.013	-4.41 (1.35, -3.26)	0.001
Age	-0.13 (0.06, -2.40)	0.017	-	-
BMI	0.36 (0.07, 5.47)	< 0.0001	0.45 (0.07, 6.31)	< 0.0001
HbA1c	-0.98 (0.34, -2.85)	0.005	-	-

BMI: Body mass index; HbA1c: hemoglobin A1c.

Table 5. Subgroup analysis of the impact of family support, minimum insurance coverage, and education level

	Pre-operation		*P* Value	After-operation		*P* Value
	No	Yes		No	Yes	
Supporting degree	*N* = 33	*N* = 227		-	-	
Sex			0.023			-
Female	26 (78.8%)	132 (58.1%)		-	-	
Male	7 (21.2%)	95 (41.9%)		-	-	
Age (Year)			0.991			-
Mean (SD)	31.7 (5.65)	32.9 (10.0)		-	-	
Median (Min, Max)	30.9 (19.0, 42.1)	31.7 (18.0, 72.8)		-	-	
Surgery			0.002			-
LSG	32 (97.0%)	164 (72.2%)		-	-	
RYGB	1 (3.0%)	63 (27.8%)		-	-	
TWL			-			0.036
Mean (SD)	-	-		32.5 (6.42)	29.5 (9.12)	
Median (Min, Max)	-	-		33.8 (15.4, 45.7)	29.1 (6.70, 54.6)	
BMI (kg/m^2)			0.03			0
Mean (SD)	36.0 (4.99)	39.0 (7.89)		24.1 (3.98)	27.3 (5.32)	
Median (Min, Max)	34.9 (27.7, 48.6)	37.7 (26.6, 97.1)		23.0 (20.0, 37.9)	26.4 (16.4, 56.1)	
HbA1c (g/L)			0.067			0.977
Mean (SD)	6.14 (1.64)	6.34 (1.53)		5.21 (0.260)	5.26 (0.471)	
Median (Min, Max)	5.60 (4.90, 11.7)	5.90 (4.50, 13.8)		5.20 (4.60, 5.90)	5.20 (3.90, 7.70)	
Cholesterol (mmol/L)			0.642			0.136
Mean (SD)	5.22 (0.905)	5.20 (1.01)		5.29 (1.05)	4.98 (1.06)	
Median (Min, Max)	5.18 (3.23, 6.93)	5.12 (2.49, 8.45)		5.16 (3.77, 8.68)	4.84 (3.07, 10.7)	
Triglycerides (mmol/L)			0.915			0.155
Mean (SD)	2.67 (3.85)	2.18 (1.78)		0.884 (0.359)	1.04 (0.669)	
Median (Min, Max)	1.59 (0.830, 17.6)	1.62 (0.500, 12.9)		0.760 (0.470, 1.69)	0.870 (0.360, 7.99)	
HDL (mmol/L)			0.813			0.047
Mean (SD)	1.03 (0.215)	1.07 (0.262)		1.49 (0.332)	1.38 (0.333)	
Median (Min, Max)	1.03 (0.340, 1.43)	1.03 (0.570, 3.31)		1.49 (0.980, 2.70)	1.36 (0.580, 3.30)	
Creatinine (umol/L)			0.117			0.101
Mean (SD)	58.3 (13.3)	62.5 (14.2)		61.5 (12.6)	65.5 (14.0)	
Median (Min, Max)	56.0 (33.0, 95.0)	60.0 (38.0, 141)		58.0 (39.0, 98.0)	63.7 (40.0, 114)	
Health insurance	*N* = 73	*N* = 187				

Sex			0.919			-
Female	44 (60.3%)	114 (61.0%)		-	-	
Male	29 (39.7%)	73 (39.0%)		-	-	
Age (Year)			0.364			-
Mean (SD)	32.1 (10.1)	33.0 (9.43)		-	-	
Median (Min, Max)	30.0 (18.0, 62.0)	32.0 (18.0, 72.8)		-	-	
Surgery			0.053			-
LSG	49 (67.1%)	147 (78.6%)		-	-	
RYGB	24 (32.9%)	40 (21.4%)		-	-	
TWL			-			0.923
Mean (SD)	-	-		30.0 (9.42)	29.9 (8.66)	
Median (Min, Max)	-	-		29.9 (11.8, 49.5)	29.6 (6.70, 54.6)	
BMI (kg/m^2)			0.969			0.928
Mean (SD)	39.1 (9.71)	38.4 (6.69)		27.0 (5.67)	26.8 (5.13)	
Median (Min, Max)	36.8 (27.2, 97.1)	37.4 (26.6, 64.5)		26.1 (18.7, 56.1)	26.0 (16.4, 43.7)	
HbA1c (g/L)			0.74			0.304
Mean (SD)	6.55 (1.84)	6.23 (1.41)		5.25 (0.509)	5.26 (0.427)	
Median (Min, Max)	5.80 (4.60, 12.2)	5.80 (4.50, 13.8)		5.20 (4.60, 7.70)	5.20 (3.90, 7.30)	
Cholesterol (mmol/L)			0.14			0.126
Mean (SD)	5.11 (1.05)	5.23 (0.970)		4.89 (1.15)	5.06 (1.03)	
Median (Min, Max)	4.95 (3.23, 8.45)	5.20 (2.49, 8.02)		4.75 (3.19, 10.7)	4.96 (3.07, 8.68)	
Triglycerides(mmol/L)			0.665			0.083
Mean (SD)	2.31 (2.26)	2.21 (2.11)		0.940 (0.515)	1.05 (0.681)	
Median (Min, Max)	1.64 (0.770, 12.9)	1.61 (0.500, 17.6)		0.810 (0.360, 3.89)	0.880 (0.460, 7.99)	
HDL (mmol/L)			0.226			0.137
Mean (SD)	1.07 (0.356)	1.06 (0.206)		1.35 (0.357)	1.41 (0.325)	
Median (Min, Max)	1.03 (0.610, 3.31)	1.03 (0.340, 1.78)		1.33 (0.680, 2.28)	1.38 (0.580, 3.30)	
Creatinine (umol/L)			0.281			0.353
Mean (SD)	59.9 (11.7)	62.7 (15.0)		63.4 (12.3)	65.6 (14.4)	
Median (Min, Max)	57.0 (33.0, 86.0)	60.0 (38.2, 141)		61.0 (40.4, 91.6)	63.3 (39.0, 114)	
Education	*N* = 96	*N* = 164				
Sex			0.862			-
Female	59 (61.5%)	99 (60.4%)		-	-	
Male	37 (38.5%)	65 (39.6%)		-	-	
Age (Year)			0.391			-
Mean (SD)	33.9 (11.4)	32.0 (8.36)		-	-	
Median (Min, Max)	32.9 (18.0, 72.8)	30.9 (19.0, 64.0)		-	-	
Surgery			0.013			-
LSG	64 (66.7%)	132 (80.5%)		-	-	
RYGB	32 (33.3%)	32 (19.5%)		-	-	
TWL			-			0.374
Mean (SD)	-	-		30.7 (9.23)	29.4 (8.62)	
Median (Min, Max)	-	-		30.4 (11.8, 54.6)	29.1 (6.70, 52.0)	
BMI (kg/m^2)			0.457			0.592
Mean (SD)	33.9 (11.4)	32.0 (8.36)		27.3 (5.85)	26.6 (4.87)	
	32.9 (18.0, 72.8)	30.9 (19.0, 64.0)		26.2 (16.4, 56.1)	25.7 (18.0, 41.5)	
HbA1c (g/L)			0.349			0.034
Mean (SD)	6.52 (1.78)	6.20 (1.39)		5.33 (0.474)	5.21 (0.429)	
Median (Min, Max)	5.90 (4.60, 13.8)	5.80 (4.50, 12.5)		5.30 (4.30, 7.30)	5.20 (3.90, 7.70)	

Cholesterol (mmol/L)			0.001			0.042
Mean (SD)	4.92 (1.02)	5.36 (0.946)		4.84 (0.982)	5.13 (1.10)	
Median (Min, Max)	4.87 (2.49, 7.21)	5.25 (3.19, 8.45)		4.79 (3.07, 7.95)	5.00 (3.19, 10.7)	
Triglycerides (mmol/L)			0.12			0.371
Mean (SD)	2.04 (1.86)	2.36 (2.30)		1.02 (0.568)	1.02 (0.683)	
Median (Min, Max)	1.49 (0.500, 12.9)	1.65 (0.640, 17.6)		0.790 (0.400, 3.89)	0.900 (0.360, 7.99)	
HDL (mmol/L)			0.211			0.532
Mean (SD)	1.05 (0.305)	1.07 (0.224)		1.39 (0.369)	1.39 (0.312)	
Median (Min, Max)	0.985 (0.570, 3.31)	1.04 (0.340, 1.78)		1.37 (0.680, 3.30)	1.37 (0.580, 2.70)	
Creatinine (umol/L)			0.004			0.028
Mean (SD)	58.8 (13.7)	63.7 (14.2)		62.4 (13.3)	66.6 (14.1)	
Median (Min, Max)	57.8 (33.0, 104)	61.8 (39.0, 141)		60.0 (39.0, 113)	64.0 (40.4, 114)	

BMI: Body mass index; TWL: total weight loss; LSG: laparoscopic sleeve gastrectomy; RYGB: Roux-en-Y gastric bypass; SD: standard deviation; HbA1c: hemoglobin A1c; HDL: high-density lipoprotein.

Similarly, Moreira *et al*. found that high BMI was negatively correlated with achieving weight loss goals one year after surgery[23]. Other studies have also identified high BMI as a risk factor for poor weight loss results[24-27]. On the other hand, many studies exploring the relationship between baseline preoperative factors and weight loss outcomes have shown a positive correlation between high preoperative BMI and better postoperative weight loss. For instance, Vennapusa A's study indicated that preoperative BMI is a positive predictor of %TWL[28]. Additionally, Saboor Aftab *et al*. found a significant positive correlation between preoperative BMI and %EWL at one year postoperatively ($r = 0.499$, $P = 0.009$; $\beta = 0.679$, $P = 0.015$)[29]. Other studies have similarly shown that initial BMI predicts postoperative weight loss outcomes[30-33]. The results of this study also support a significant correlation between high preoperative BMI and achieving weight loss goals postoperatively. Although the surgical techniques and underlying mechanisms of various bariatric procedures are generally similar, there is consistent evidence that bariatric surgery significantly improves metabolic conditions such as hyperglycemia, dyslipidemia, and hypertension. Moreover, it also leads to marked improvements in hormone-related imbalances. In the present study, the primary outcome measure was the percentage of total weight loss (%TWL). Current evidence suggests that %TWL offers a distinct advantage over other weight loss metrics, as it is less influenced by baseline body weight and provides a more accurate assessment of weight loss outcomes. Notably, one study reported that although the percentage of excess weight loss (%EWL) was higher in patients with a preoperative BMI < 40 kg/m^2 compared to those with a BMI ≥ 40 kg/m^2, %TWL was higher in patients with a BMI ≥ 40 kg/m^2[28]. In addition, a systematic review by van Rijswijk *et al*. emphasized that %TWL more accurately reflects weight loss outcomes than %EWL, particularly in patients with heterogeneous baseline weights[34]. These findings highlight the variability in outcomes depending on the metric used to assess surgical success, underscoring the need for international consensus on standardized outcome measures for evaluating postoperative weight loss.

Regarding the impact of smoking on weight loss outcomes after bariatric surgery, Andersen *et al*. found a significant positive correlation between smoking (B: 10.3, $P < 0.05$) and weight loss[30]. Similarly, Demirpolat., in a study predicting whether %TWL would reach 20% after one year, also observed a significant relationship between smoking and achieving weight loss goals (B: 0.123, $P < 0.05$)[35]. Furthermore, other research has shown that smoking may aid weight loss[33,36-38], whereas smoking cessation can lead to a certain degree of weight gain. This effect is primarily attributed to increased energy intake, reduced resting metabolic rate, decreased physical activity, and increased lipoprotein lipase activity[39]. However, some studies have reported no significant association between postoperative weight loss success and smoking status either preoperatively or postoperatively ($P > 0.05$), although smoking cessation was linked to higher self-reported satisfaction, improved postoperative outcomes, and greater quality of life[40,41]. Moser *et al*. analyzed two-year results after LSG and found no significant differences in weight loss benefits between smokers and non-smokers[42]. However, in another study examining two-year follow-up results after bariatric surgery, smoking was associated with greater weight loss at 6 and 12 months post-RYGB, but no differences were observed at 24 months[36]. This suggests that smoking may have a certain association with short-term postoperative weight loss, but its impact on long-term weight loss outcomes diminishes over time. Although the results of this study also suggest that smoking may aid in postoperative weight loss, the harms of smoking far outweigh the benefits. Smoking increases the risk associated with weight loss surgery, as studies have shown that patients who smoke are more likely to require unplanned intubation and have higher complication and mortality rates within 30 days compared to non-smokers[43,44]. Additionally, smoking increases the risk of various cancers[45-47]. Therefore, although smokers may experience greater short-term weight loss benefits from bariatric surgery compared with non-smokers, current preoperative counseling and preparation protocols consistently recommend smoking cessation to reduce the risk of postoperative complications.

Bariatric Surgery Outcomes Exhibit Considerable Variation Across Countries and Surgical Centers. Pang *et al*. demonstrated superior excess BMI loss (EBMIL) with RYGB compared to LSG[48]. Similarly, Lager *et al*. reported significantly greater weight reduction and better glycemic improvement with RYGB versus LSG during the 1-year postoperative period[49]. A systematic review corroborated these findings, showing lower percentage excess weight loss (%EWL) with LSG compared to RYGB at 1 year (56.1% *vs*. 68.3%; $P < 0.01$)[50]. Notably, conflicting evidence exists regarding early postoperative outcomes. Paluszkiewicz *et al*. found no significant difference in %EWL between RYGB and LSG at 1 year (64.2% *vs*. 67.6%; $P > 0.05$)[51]. A randomized controlled trial in a Chinese population revealed comparable BMI reductions between procedures at 1 year, but superior long-term weight maintenance with RYGB during 5-year follow-up[52]. Conversely, two independent studies by Peterli *et al*. and Salminen *et al*. demonstrated equivalent weight loss benefits between LSG and RYGB at 5 years postoperatively[53,54]. Our findings demonstrate stronger associations between LSG and 1-year weight loss, suggesting that individualized surgical decision making based on comprehensive patient evaluation may achieve short-term outcomes comparable to RYGB. Importantly, procedure selection should prioritize patient-specific characteristics through rigorous preoperative assessment.

Additionally, the results of this study show that patients who did not receive family support preoperatively experienced better postoperative weight loss outcomes. This group may have better compliance and postoperative execution ability. Research on family support based on marital status has shown that marital dissatisfaction is a significant positive predictor of weight loss at one year[55]. However, some studies have indicated that patients with higher marital satisfaction are more likely to sustain weight loss compared with those with lower marital satisfaction ($\beta = 0.92$, $SE = 0.37$, $P = 0.02$)[34]. Nonetheless, it is well established that family support - particularly in the form of dietary involvement and emotional encouragement - is associated with improved weight loss outcomes[56]. However, this study did not find a relationship between marital status and postoperative weight loss outcomes. Second, in this study, the level of family support was primarily defined based on the patient's willingness to disclose the surgery to family members and the family's attitude toward the surgery (i.e., whether they were supportive). This definition may have underestimated the extent of family involvement in other areas. However, long-term weight maintenance largely depends on the patient's own self-discipline and adherence to follow-up and behavioral interventions. Our findings also suggest that patients with a stronger personal motivation for surgery tend to achieve better postoperative weight outcomes. Therefore, a thorough preoperative assessment of the patient's psychological status and attitude toward surgery is essential. Furthermore, no significant differences were found in weight loss and metabolic improvement related to healthcare insurance involvement, which aligns with findings from other studies[57,58]. Similarly, no significant differences in weight loss outcomes were observed based on educational level. However, subgroup analysis revealed that patients with an educational level of junior college or above experienced greater improvements in HbA1c compared with those with a high school education or below. Although there were no significant baseline differences in HbA1c between the two groups, existing research has demonstrated a causal relationship between educational attainment and type 2 diabetes. Notably, Zhang *et al.* reported that higher educational attainment was significantly associated with a reduced risk of type 2 diabetes (OR = 0.59; $P = 1.25 \times 10^{-16}$; 95%CI: 0.52-0.67)[59]. The present study further supports a potential association between educational level and postoperative glycemic improvement following bariatric surgery.

Although this study analyzes the differences in results based on various analytical methods, there are still several limitations. First, the sample size is relatively small, and there is missing follow-up data, which may introduce bias in some of the results. Second, the appropriateness of the outcome measures warrants further investigation and validation. Third, as the study was based on retrospective data, some variables were not assessed using standardized questionnaires, which may have introduced bias into the results. Finally, whether the findings of this study can be generalized to the broader population requires confirmation through further multi-center studies.

Conclusions

This study indicates that, one year postoperatively, weight loss outcomes are significantly associated with preoperative family attitudes, surgical approach, smoking, and BMI. Patients with no family support preoperatively, those undergoing LSG, smokers, and those with high BMI experienced more significant weight loss. While some factors may be related to weight loss benefits, it is important to note that family support, smoking cessation, and understanding from family members may be more conducive to achieving long-term weight management postoperatively. Additionally, a thorough preoperative evaluation of patients and the selection of an appropriate surgical approach can yield short-term weight loss outcomes comparable to those of RYGB.

DECLARATIONS

Authors' contributions

Project leadership and manuscript writing: Zhou X, Liu Y
Searched the databases and screened the articles: Zhou X, Liu Y, Han X
Extracted the data and conducted statistical analyses: Yang W, Dong S, Zhou X
Reviewed and revised the manuscript: Wang C, Dong Z, Dong S
Contributed to the manuscript and approved the submitted version: Zhou X, Liu Y, Han X, Yang W, Wang C, Dong Z, Dong S

Availability of data and materials

Research data can be accessed by contacting the corresponding author.

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Conflicts of interest

Yang W is a Guest Editor of the Special Issue "*Clinical Advances in Bariatric Surgery: Current Trends, Outcomes, and Future Perspectives*" in the journal *Metabolism and Target Organ Damage*, also serves as an

Associate Editor of the journal. Yang W was not involved in any steps of editorial processing, including reviewer selection, manuscript handling, or decision making. The other authors declared that there are no conflicts of interest.

Ethical approval and consent to participate
This was a retrospective study utilizing data from the Bariatric and Metabolic Surgery Database of the First Affiliated Hospital of Jinan University. The database was approved by the Institutional Review Board (IRB) of the First Affiliated Hospital of Jinan University (KY-2023-071). All patients provided written informed consent at the time of data collection, which included permission for future research use. All data were fully de-identified and maintained with strict confidentiality. Therefore, separate ethics approval and additional informed consent were not required for this retrospective analysis.

Consent for publication
Not applicable.

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REFERENCES

1. Chen Y, Ma L, Han Z, Xiong P. The global burden of disease attributable to high body mass index in 204 countries and territories: findings from 1990 to 2019 and predictions to 2035. *Diabetes Obes Metab.* 2024;26:3998-4010. DOI PubMed
2. Carsley S, Tu K, Parkin PC, Pullenayegum E, Birken CS. Overweight and obesity in preschool aged children and risk of mental health service utilization. *Int J Obes.* 2019;43:1325-33. DOI PubMed
3. Dixon JB. The effect of obesity on health outcomes. *Mol Cell Endocrinol.* 2010;316:104-8. DOI PubMed
4. Choi HG, Lim H. Association between BMI for obesity and distress about appearance in Korean adolescents. *J Korean Med Sci.* 2018;33:e150. DOI PubMed PMC
5. Tomiyama AJ, Carr D, Granberg EM, et al. How and why weight stigma drives the obesity 'epidemic' and harms health. *BMC Med.* 2018;16:123. DOI PubMed PMC
6. van Vuuren CL, Wachter GG, Veenstra R, et al. Associations between overweight and mental health problems among adolescents, and the mediating role of victimization. *BMC Public Health.* 2019;19:612. DOI PubMed PMC
7. Chao AM, Tronieri JS, Amaro A, Wadden TA. Semaglutide for the treatment of obesity. *Trends Cardiovasc Med.* 2023;33:159-66. DOI PubMed PMC
8. Singh G, Krauthamer M, Bjalme-Evans M. Wegovy (semaglutide): a new weight loss drug for chronic weight management. *J Investig Med.* 2022;70:5-13. DOI PubMed PMC
9. Wilding JPH, Batterham RL, Calanna S, et al; STEP 1 Study Group. Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med.* 2021;384:989-1002. DOI PubMed
10. Husain M, Birkenfeld AL, Donsmark M, et al; PIONEER 6 Investigators. Oral semaglutide and cardiovascular outcomes in patients with type 2 diabetes. *N Engl J Med.* 2019;381:841-51. DOI PubMed
11. Rubino D, Abrahamsson N, Davies M, et al; STEP 4 Investigators. Effect of continued weekly subcutaneous semaglutide vs placebo on weight loss maintenance in adults with overweight or obesity: the STEP 4 randomized clinical trial. *JAMA.* 2021;325:1414-13. DOI PubMed PMC
12. Salminen P, Grönroos S, Helmiö M, et al. Effect of laparoscopic sleeve gastrectomy vs Roux-en-Y gastric Bypass on weight loss, comorbidities, and reflux at 10 years in adult patients with obesity: the SLEEVEPASS randomized clinical trial. *JAMA Surg.* 2022;157:656-66. DOI PubMed PMC
13. Driscoll S, Gregory DM, Fardy JM, Twells LK. Long-term health-related quality of life in bariatric surgery patients: a systematic review and meta-analysis. *Obesity.* 2016;24:60-70. DOI PubMed
14. Kwok CS, Pradhan A, Khan MA, et al. Bariatric surgery and its impact on cardiovascular disease and mortality: a systematic review and meta-analysis. *Int J Cardiol.* 2014;173:20-8. DOI PubMed
15. Christou NV, Look D, Maclean LD. Weight gain after short- and long-limb gastric bypass in patients followed for longer than 10 years. Ann Surg. 2006;244:734-40. DOI PubMed PMC
16. Generali I, De Panfilis C. Personality traits and weight loss surgery outcome. *Curr Obes Rep.* 2018;7:227-34. DOI PubMed
17. Melton GB, Steele KE, Schweitzer MA, Lidor AO, Magnuson TH. Suboptimal weight loss after gastric bypass surgery: correlation of demographics, comorbidities, and insurance status with outcomes. *J Gastrointest Surg.* 2008;12:250-5. DOI PubMed
18. Robert M, Pelascini E, Disse E, et al. Preoperative fat-free mass: a predictive factor of weight loss after gastric bypass. *Obes Surg.* 2013;23:446-55. DOI PubMed

19. Chang WW, Hawkins DN, Brockmeyer JR, Faler BJ, Hoppe SW, Prasad BM. Factors influencing long-term weight loss after bariatric surgery. *Surg Obes Relat Dis.* 2019;15:456-61. DOI PubMed
20. Livhits M, Mercado C, Yermilov I, et al. Preoperative predictors of weight loss following bariatric surgery: systematic review. *Obes Surg.* 2012;22:70-89. DOI PubMed
21. Marchitelli S, Ricci E, Mazza C, et al. Obesity and psychological factors associated with weight loss after bariatric surgery: a longitudinal study. *Nutrients.* 2022;14:2690. DOI PubMed PMC
22. Tu Y, Pan Y, Han J, et al. A total weight loss of 25% shows better predictivity in evaluating the efficiency of bariatric surgery. *Int J Obes.* 2021;45:396-403. DOI PubMed
23. Moreira SHC, Alvarez-Leite JI, Souza RP, et al. Predictors of successful weight loss in extremely obese individuals undergoing Roux-en-Y gastric bypass surgery. *J Obes Metab Syndr.* 2024;33:337-47. DOI PubMed PMC
24. Ansar H, Zamaninour N, Pazouki A, Kabir A. Weight loss after one anastomosis gastric bypass-mini gastric bypass (OAGB-MGB): patient-related perioperative predictive factors. *Obes Surg.* 2020;30:1316-23. DOI PubMed
25. Hutcheon DA, Byham-Gray LD, Marcus AF, Scott JD, Miller M. Predictors of preoperative weight loss achievement in adult bariatric surgery candidates while following a low-calorie diet for 4 weeks. *Surg Obes Relat Dis.* 2017;13:1041-51. DOI PubMed
26. Lutfi R, Torquati A, Sekhar N, Richards WO. Predictors of success after laparoscopic gastric bypass: a multivariate analysis of socioeconomic factors. *Surg Endosc.* 2006;20:864-7. DOI PubMed
27. Yarigholi F, Bahardoust M, Mosavari H, et al. Predictors of weight regain and insufficient weight loss according to different definitions after sleeve gastrectomy: a retrospective analytical study. *Obes Surg.* 2022;32:4040-6. DOI PubMed
28. Vennapusa A, Panchangam RB, Kesara C, Chivukula T. Factors predicting weight loss after "sleeve gastrectomy with loop duodenojejunal bypass" surgery for obesity. *J Obes Metab Syndr.* 2020;29:208-14. DOI PubMed PMC
29. Saboor Aftab SA, Halder L, Piya MK, et al. Predictors of weight loss at 1 year after laparoscopic adjustable gastric banding and the role of presurgical quality of life. *Obes Surg.* 2014;24:885-90. DOI PubMed
30. Andersen JR, Aadland E, Nilsen RM, Våge V. Predictors of weight loss are different in men and women after sleeve gastrectomy. *Obes Surg.* 2014;24:594-8. DOI PubMed
31. Benoit SC, Hunter TD, Francis DM, De La Cruz-Munoz N. Use of bariatric outcomes longitudinal database (BOLD) to study variability in patient success after bariatric surgery. *Obes Surg.* 2014;24:936-43. DOI PubMed
32. Dallal RM, Quebbemann BB, Hunt LH, Braitman LE. Analysis of weight loss after bariatric surgery using mixed-effects linear modeling. *Obes Surg.* 2009;19:732-7. DOI PubMed
33. Latner JD, Wetzler S, Goodman ER, Glinski J. Gastric bypass in a low-income, inner-city population: eating disturbances and weight loss. *Obes Res.* 2004;12:956-61. DOI PubMed
34. van Rijswijk AS, van Olst N, Schats W, van der Peet DL, van de Laar AW. What is weight loss after bariatric surgery expressed in percentage total weight loss (%TWL)? *Obes Surg.* 2021;31:3833-47. DOI PubMed
35. Demirpolat MT, İslam MM. Development and validation of the GAASThyriC model for predicting patients with suboptimal clinical response after laparoscopic sleeve gastrectomy and a practical calculator: a retrospective cohort study. *Surg Laparosc Endosc Percutan Tech.* 2024;34:424-31. DOI PubMed
36. Adams CE, Gabriele JM, Baillie LE, Dubbert PM. Tobacco use and substance use disorders as predictors of postoperative weight loss 2 years after bariatric surgery. *J Behav Health Serv Res.* 2012;39:462-71. DOI PubMed
37. Courcoulas AP, Christian NJ, O'Rourke RW, et al. Preoperative factors and 3-year weight change in the longitudinal assessment of bariatric surgery (LABS) consortium. *Surg Obes Relat Dis.* 2015;11:1109-18. DOI PubMed PMC
38. Levine MD, Kalarchian MA, Courcoulas AP, Wisinski MS, Marcus MD. History of smoking and postcessation weight gain among weight loss surgery candidates. *Addict Behav.* 2007;32:2365-71. DOI PubMed PMC
39. Filozof C, Fernández Pinilla MC, Fernández-Cruz A. Smoking cessation and weight gain. *Obes Rev.* 2004;5:95-103. DOI PubMed
40. Parri A, Benaiges D, Schröder H, et al. Preoperative predictors of weight loss at 4 years following bariatric surgery. *Nutr Clin Pract.* 2015;30:420-4. DOI PubMed
41. Samaan JS, Mohan S, Toubat O, et al. Effects of smoking on bariatric surgery postoperative weight loss and patient satisfaction. *Surg Endosc.* 2021;35:3584-91. DOI PubMed
42. Moser F, Signorini FJ, Maldonado PS, et al. Relationship between tobacco use and weight loss after bariatric surgery. *Obes Surg.* 2016;26:1777-81. DOI PubMed
43. Haskins IN, Nowacki AS, Khorgami Z, et al. Should recent smoking be a contraindication for sleeve gastrectomy? *Surg Obes Relat Dis.* 2017;13:1130-5. DOI PubMed
44. Inadomi M, Iyengar R, Fischer I, Chen X, Flagler E, Ghaferi AA. Effect of patient-reported smoking status on short-term bariatric surgery outcomes. *Surg Endosc.* 2018;32:720-6. DOI PubMed PMC
45. Alexandrov LB, Ju YS, Haase K, et al. Mutational signatures associated with tobacco smoking in human cancer. *Science.* 2016;354:618-22. DOI PubMed PMC
46. Dimou N, Omiyale W, Biessy C, et al. Cigarette smoking and endometrial cancer risk: observational and mendelian randomization analyses. *Cancer Epidemiol Biomarkers Prev.* 2022;31:1839-48. DOI PubMed PMC
47. Reynolds P. Smoking and breast cancer. *J Mammary Gland Biol Neoplasia.* 2013;18:15-23. DOI PubMed
48. Pang WS, Loo GH, Tan GJ, Mardan M, Rajan R, Kosai NR. Comparative evaluation of early diabetic outcomes in southeast asian patients with type 2 diabetes mellitus undergoing Roux-en-Y gastric bypass (RYGB) versus sleeve gastrectomy (LSG). *Sci Rep.*

2024;14:614. DOI PubMed PMC

49. Lager CJ, Esfandiari NH, Luo Y, et al. Metabolic parameters, weight loss, and comorbidities 4 years after Roux-en-Y gastric bypass and sleeve gastrectomy. *Obes Surg.* 2018;28:3415-23. DOI PubMed PMC
50. Fischer L, Hildebrandt C, Bruckner T, et al. Excessive weight loss after sleeve gastrectomy: a systematic review. *Obes Surg.* 2012;22:721-31. DOI PubMed
51. Paluszkiewicz R, Kalinowski P, Wróblewski T, et al. Prospective randomized clinical trial of laparoscopic sleeve gastrectomy versus open Roux-en-Y gastric bypass for the management of patients with morbid obesity. *Wideochir Inne Tech Maloinwazyjne.* 2012;7:225-32. DOI PubMed PMC
52. Zhang Y, Zhao H, Cao Z, et al. A randomized clinical trial of laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy for the treatment of morbid obesity in China: a 5-year outcome. *Obes Surg.* 2014;24:1617-24. DOI PubMed
53. Peterli R, Wölnerhanssen BK, Peters T, et al. Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss in patients with morbid obesity: the SM-BOSS randomized clinical trial. *JAMA.* 2018;319:255-65. DOI PubMed PMC
54. Salminen P, Helmiö M, Ovaska J, et al. Effect of laparoscopic sleeve gastrectomy vs laparoscopic Roux-en-Y gastric bypass on weight loss at 5 years among patients with morbid obesity: the SLEEVEPASS randomized clinical trial. *JAMA.* 2018;319:241-54. DOI PubMed PMC
55. Hafner RJ, Rogers J, Watts JM. Psychological status before and after gastric restriction as predictors of weight loss in the morbidly obese. *J Psychosom Res.* 1990;34:295-302. DOI PubMed
56. Tan EY, Lee PC, Tham KW, Ganguly S, Lim CH, Liu JCJ. Examining spousal and family support as predictors of long-term weight loss and remission of type 2 diabetes following bariatric surgery in Singapore: a retrospective cohort study. *BMJ Open.* 2023;13:e068810. DOI PubMed PMC
57. Akkary E, Nerlinger A, Yu S, Dziura J, Duffy AJ, Bell RL. Socioeconomic predictors of weight loss after laparoscopic Roux-Y gastric bypass. *Surg Endosc.* 2009;23:1246-51. DOI PubMed
58. Harvin G, DeLegge M, Garrow DA. The impact of race on weight loss after Roux-en-Y gastric bypass surgery. *Obes Surg.* 2008;18:39-42. DOI PubMed
59. Zhang X, Yu SL, Qi LM, Xia LN, Yang QT. Association of educational attainment with hypertension and type-2 diabetes: a Mendelian randomization study. *SSM Popul Health.* 2024;25:101585. DOI PubMed PMC