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Socio-Demographic and Preoperative Clinical Factors Associated With 5-Year Weight Trajectories After Roux-en-Y Gastric Bypass and Sleeve Gastrectomy

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Objective: To determine whether socio-demographic and preoperative clinical factors contribute to the percent total body weight loss (%TBWL) after bariatric surgery (BS).

Background: BS is the most effective long-term treatment for medically complicated obesity. More information is needed about the factors that contribute to postoperative %TBWL in large and ethnically diverse cohorts.

Methods: This retrospective study conducted in the Kaiser Permanente Northern California region included 7698 patients who underwent Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy (SG) between January 2009 and March 2015. Trajectory analyses were conducted from 5-year follow-up data to assign patients to "low," "average," or "high" postoperative %TBWL groups. We then evaluated whether age, sex, race/ethnicity, neighborhood deprivation index and preoperative body mass index (BMI)/weight loss, diabetes, hypertension, and sleep apnea contributed to postoperative %TBWL using logistic regression models.

Results: Of 7698 patients (83.2% women), 48.6% underwent a RYGB and 51.4% underwent a SG. Postoperative %TBWL trajectories over 5 years were obtained in 6229 (81%) of 7698 eligible patients. About 27.8% and 29.3% of patients followed the "low" postoperative %TBWL trajectory, for RYGB and SG, respectively. Men, older patients, and Asian, Black, and Hispanic/Latino patients were more likely to be classified in the low postoperative %TBWL group. Patients showing lower postoperative %TBWL had a lower preoperative BMI (but lost less weight before surgery) and were more likely to have preoperative comorbidities.

Conclusions: This study confirms and extends prior findings of the effects of several demographic and preoperative clinical factors on postoperative weight loss. Findings could improve the support of patients to achieve desired surgical outcomes.

Keywords: bariatric surgery, gastric bypass, gender, health determinants, obesity, race/ethnicity, Roux-en-Y, sleeve gastrectomy, socio-demographics

INTRODUCTION

Bariatric surgery (BS) is currently the most effective long-term treatment for medically complicated obesity,[1] but the degree of weight loss after surgery is inconsistent, with an estimated 20% of patients failing to achieve or maintain greater than 50% loss of their excess body weight.[2–4] As the number of bariatric procedures performed in the United States rises,[5] it is essential to understand the factors that influence the efficacy of BS on weight loss.

Previous bariatric epidemiological observational studies[6–9] have suggested the moderating effects of several demographic and clinical factors on postoperative weight loss, such as age, sex, and preoperative body mass index (BMI). Most of these studies[6,7,10–13] have been limited in sample size (N < 500 patients) and were restricted to mainly White individuals, making their findings ungeneralizable. Important preoperative comorbidities associated with severe obesity such as diabetes, hypertension, and sleep apnea are under-investigated in regard to their contribution to long-term postoperative weight loss.[14] Further, most prior epidemiological studies have focused solely on one type of BS, the Roux-en-Y gastric bypass (RYGB). Though the RYGB was at the forefront of bariatric procedures for the past 2 decades, the sleeve gastrectomy (SG) has become the most performed BS in the United States.[5] Importantly, recent studies appear to indicate that long-term weight loss outcomes after SG may be inferior compared to those of the RYGB.[15–17] Thus, additional studies that consider both procedures performed in large and ethnically diverse cohorts are needed.

To address these gaps and limitations of previous studies, we conducted a retrospective longitudinal study on 7698 patients from a large and multiethnic BS cohort. We evaluated whether socio-demographic and preoperative clinical factors independently contribute to postoperative percent total body weight loss (%TBWL) using data from 5 years of follow-up. Our large and diverse longitudinal study serves to clarify and provide insight into the risk factors that affect postoperative weight loss.

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METHODS

Study Population

All patients were members of the Kaiser Permanente Medical Care Plan, Northern California region (KPNC), an integrated healthcare delivery system that includes ongoing longitudinal electronic health records (EHR). Patients who entered the BS program were part of the KPNC BS cohort, which comprises over 18,000 adult men and women patients, as of 2023, whose primary operation was performed between 2009 and 2023. Patients from the KPNC BS cohort were recruited at their preoperative BS clinic appointments, and health information, including preoperative comorbidities, operative records, and weight loss metrics were collected in a similar manner for each patient.

For this study, we identified 7698 patients among the KPNC BS cohort who underwent either RYGB or SG between January 5, 2009 and March 1, 2015. RYGB and SG patients were identified by current procedural terminology (CPT) procedure codes (eg, 43644, 43645, 43846, 43847, 43775, and 43999) which were recorded in the EHR system. As the SG procedure received a unique CPT code in 2010, we identified patients who underwent SG before that based on having a BMI > 30 kg/m^2 and the partial gastrectomy CPT code. Further, these cases were done at KPNC medical centers performing BS and by surgeons identified as bariatric surgeons. This date range was chosen to ensure a follow-up period of 5 years and to avoid the potential influence of the COVID-19 pandemic on patient's lifestyle changes in weight. The Institutional Review Board of the Kaiser Foundation Research Institute approved all study procedures. Written informed consent was obtained from all participants.

Primary Outcome

Postoperative %TBWL is the gold standard for measuring the extent of weight loss after BS.[18–20] Postoperative %TBWL is calculated as follows: [(initial weight)–(postop weight)]/[(initial weight)] × 100.

Socio-Demographic Factors

Data on age at surgery, sex, and self-reported race/ethnicity were captured from the EHR for each patient. As an indicator of socio-economic status, we used a neighborhood deprivation index (NDI) based on the home address available in the EHR.

Preoperative Clinical Factors

Health information included preoperative BMI (assessed between the surgery date and 2 months prior), preoperative comorbidities (ie, diabetes, hypertension, and sleep apnea), and preoperative weight loss. Preoperative BMI and weight loss were obtained from the patients' EHR. Diagnoses for preoperative diabetes (type 1 or 2), hypertension, and sleep apnea were based on the International Classification of Disease, Ninth (ICD-9) or Tenth Revision (ICD-10) diagnosis codes recorded in the EHR system.

Postoperative Follow-Up of Weight Loss and Type of Surgery

Patients were scheduled for follow-up visits at 6 months and 12 months after BS and then yearly thereafter. Information on the type of surgery (ie, RYGB or SG) and weight loss after surgery for the selected period of 5 years (including 6 postoperative follow-up time points: 6, 12, 24, 36, 48, and 60 months) were captured in a database internal to the KPNC BS cohort.

Postoperative %TBWL Trajectory Group Analysis

According to postoperative %TBWL based on the 6 postoperative follow-up time points, patients were assigned to 3 trajectory groups [ie, low weight loss (LWL), average weight loss (AWL), and high weight loss (HWL)] by semiparametric trajectory analysis. This semiparametric trajectory-based methodology has been shown to be an accurate method to estimate weight loss over time and has been largely used to analyze longitudinal weight loss data.[2,6,9,21] Postoperative %TBWL trajectories were estimated for each patient by latent class growth analysis implemented using Proc Traj in SAS 9.4 (SAS Institute Inc.).[22,23] Proc Traj can handle data that are missing completely at random, yet at least 3 time points per patient was set as inclusion criteria. Furthermore, to minimize classification error, follow-up time points with less than 50% completeness were excluded from weight loss trajectory analysis, and patients showing a posterior probability of class assignment less than 0.7 were excluded, as previously done.[2,24] Consequently, we excluded 1469 patients from trajectory analyses due to follow-up attrition or posterior probability of class assignment <0.7. A total of 6229 patients were included in the trajectory analyses (Fig. 1), and the 6 follow-up time points (ie, 6, 12, 24, 36, 48, and 60 months) were further analyzed. Spaghetti plots showing the percentage of postoperative TBWL of the included patients over the 6 postoperative follow-up time points were generated in R (version 4.1.2) (https://www.R-project.org) using the

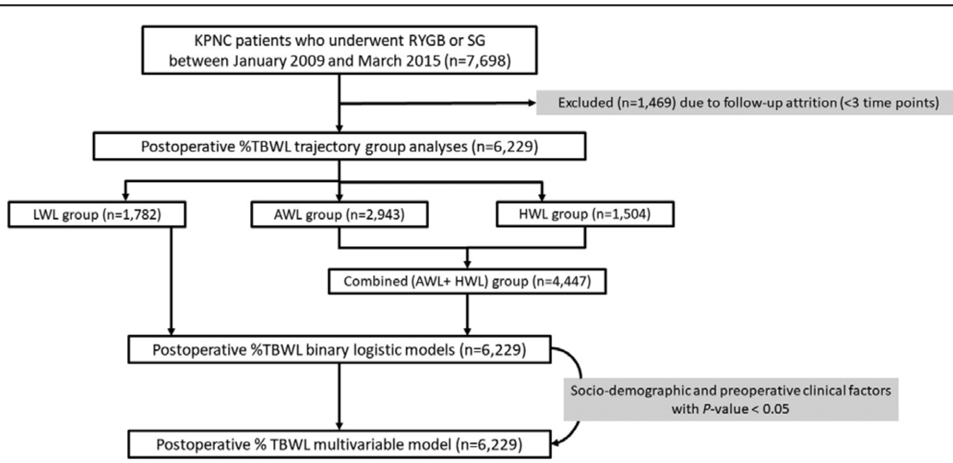

FIGURE 1. Flow diagram of the study design and study participants included in the analyses. %TBWL indicates percentage total body weight loss; AWL, average weight loss; HWL, high weight loss; KPNC, Kaiser Permanente Northern California; LWL, low weight loss.

“ggplot2” package. A Wald statistical test was used to determine whether the trajectory groups were significantly different. Patients from the AWL and HWL groups were reassigned into a combined (HWL+AWL) group to compare them with patients from the LWL group. The different analyses conducted in this study are summarized in an overview diagram (Fig. 1).

Postoperative %TBWL Logistic Models

Based on postoperative %TBWL trajectory groups, a predictive model of weight loss response to the BS, including socio-demographic and clinical variables was assessed by multivariate logistic regression. Socio-demographic (ie, age, sex, race/ethnicity, and NDI), preoperative clinical variables (BMI, weight loss, diabetes, hypertension, and sleep apnea), and type of BS were tested independently and added to a multivariate model when showing statistical significance ($P < 0.05$).

Statistical Analyses

In addition to the overall analyses, with RYGB and SG data combined, we also conducted stratified analyses by BS type (ie, RYGB or SG analyzed separately). Sex-stratified and race/ethnicity-stratified analyses were also conducted. All tests were 2-sided, and $P < 0.05$ was considered significant. Both binary logistic and multivariate models were performed using R (version 4.1.2) glm function.

RESULTS

The KPNC Bariatric Surgery Cohort

Of the 7698 patients studied, around 48.6% of patients underwent a RYGB and around 51.4% underwent a SG (Table 1). The majority of individuals were female (83.2%), and the mean (SD) age at surgery was 44.5 (10.8) years. White patients accounted for the largest ethnic group (57.3%) followed by Hispanic/Latino (23.2%), Black (12.2%), and Asian (2.9%) individuals. Hypertension was the most prevalent preoperative comorbidity (51.4%), followed by sleep apnea (43.4%), and diabetes (28.5%). The average preoperative BMI was similar for individuals who underwent RYGB or SG. Although the mean preoperative %TBWL for patients who underwent RYGB was slightly higher (8.4%) than of those who underwent SG (7.8%), there was not a significant difference that was noted. Postoperative %TBWL data completeness varied from a maximum of 91.7% at 12 months to a minimum of 68.4% at 60 months after surgery (Table 1).

Interindividual Variability in Postoperative %TBWL

We detected significant interindividual variability in %TBWL after both RYGB and SG. We found that 27.8%, 48.0%, and 24.2% of RYGB patients were assigned to the LWL, AWL, and HWL group, respectively (Fig. 2) and that 29.3%, 46.6%, and 24.1% of SG patients were assigned to the LWL, AWL, and HWL group, respectively (Fig. 3). The average of %TBWL for each group (LWL, AWL, and HWL group) at 6, 12, 24, 36, 48, and 60 months after surgery are reported in Supplemental Tables 1 and 2, see http://links.lww.com/AOSO/A349. Using a Wald test, we confirmed that the 3 trajectory groups were significantly different ($\chi^2 = 3479.2$ and $P = 2.2\times10^{-16}$ for RYGB; $\chi^2 = 4870.9$ and $P = 2.2\times10^{-16}$ for SG). Because the type of surgery (RYGB vs SG) was not significantly associated with postoperative %TBWL trajectory group assignment (Table 2), the trajectory groups were combined across surgery types (eg, RYGB LWL+SG LWL) (Supplemental Figure 1, see http://links.lww.com/AOSO/A349). However, individual surgery type (ie, RYGB and SG) results from the binary logistic and multivariate models are reported in Supplemental Tables 3 and 4, see http://links.lww.com/AOSO/A349.

Socio-Demographic Factors Influence Weight Loss After BS

To determine which socio-demographic factors (ie, age at surgery, sex, race/ethnicity, and NDI) were specifically correlated with low postoperative %TBWL, patients from the LWL group

TABLE 1.

KPNC Bariatric Surgery Cohort: Patients’ Characteristics

		Roux-en-Y Gastric Bypass		Sleeve Gastrectomy	
		N Ind.	%	N Ind.	%
Total		3741	100%	3957	100%
Sex	Female	3139	83.9%	3267	82.6%
	Male	602	16.1%	690	17.4%
Race/ethnicity	Asian	101	2.7%	126	3.2%
	Black	410	11.0%	529	13.4%
	Hispanic/Latino	919	24.6%	870	22.0%
	White	2140	57.2%	2269	57.3%
	Other*	171	4.6%	163	4.1%
Age (in years) at surgery, Mean ± SD		44.5 ± 10.8		44.4 ± 11.0	
BMI (in kg/m^2) at surgery, Mean ± SD		42.4 ± 6.3		42.0 ± 6.1	
Preoperative comorbidities	Diabetes	1294	34.6%	901	22.8%
	Hypertension	2009	53.7%	1949	49.3%
	Sleep apnea	1570	42.0%	1773	44.8%
Preoperative weight loss, Mean ± SD	TBWL (%)	8.4 ± 4.0		7.8 ± 3.5	
Follow-up after surgery	N months postsurgery	Mean ± SD	N Ind. (%)	Mean ± SD	N Ind. (%)
Postoperative TBWL (%)	6	32.0 ± 6.3	3086 (82.5%)	29.4 ± 6.6	3211 (81.1%)
	12	35.6 ± 7.9	3452 (92.3%)	31.4 ± 8.5	3605 (91.1%)
	24	34.9 ± 9.1	3009 (80.4%)	29.5 ± 9.8	3145 (79.5%)
	36	32.3 ± 9.7	2786 (74.5%)	26.3 ± 10.2	2936 (74.2%)
	48	30.2 ± 9.9	2689 (71.9%)	24.1 ± 10.4	2849 (72.0%)
	60	28.8 ± 10.3	2566 (68.6%)	22.6 ± 10.5	2705 (68.4%)

*“Other” race/ethnicity category included patients who self-reported “other” or “don’t know” or if patients self-selected multiethnic categories.

BMI indicates body mass index; Ind., individuals; N, number; SD, standard deviation; TBWL, total body weight loss.

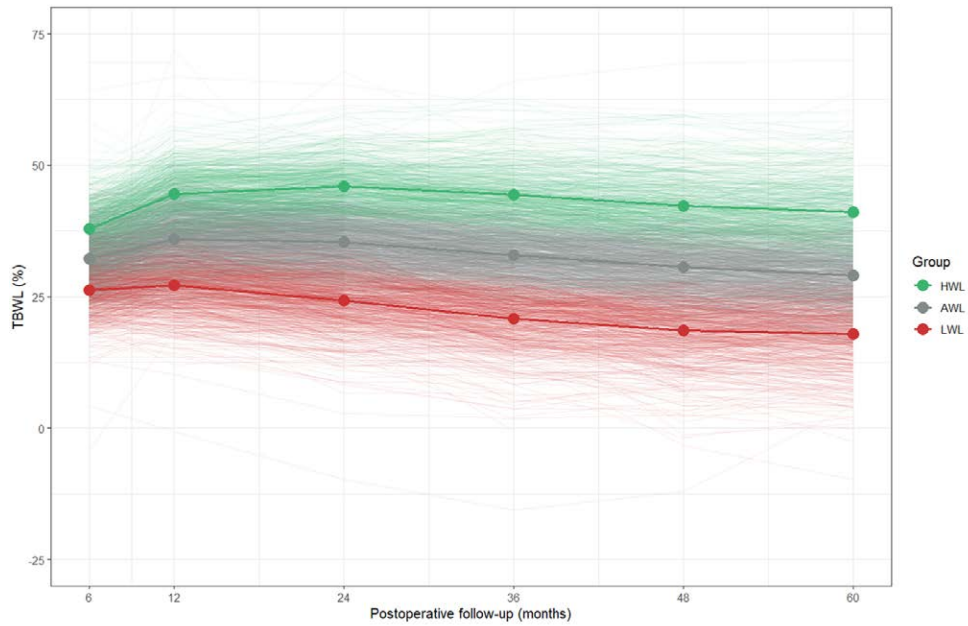

FIGURE 2. Roux-En-Y gastric bypass postoperative %TBWL trajectories. Spaghetti plots showing the percentage of postoperative %TBWL of the included 3021 patients (who underwent Roux-en-Y gastric bypass) over the 6 postoperative follow-up time points (6, 12, 24, 36, 48, and 60 months). The 3 trajectory groups [ie, low weight loss (LWL), average weight loss (AWL), and high weight loss (HWL)] were represented by different colors (ie, red for LWL, blue-gray for AWL, and green for HWL). Three thicker lines were added to report the average level of each group.

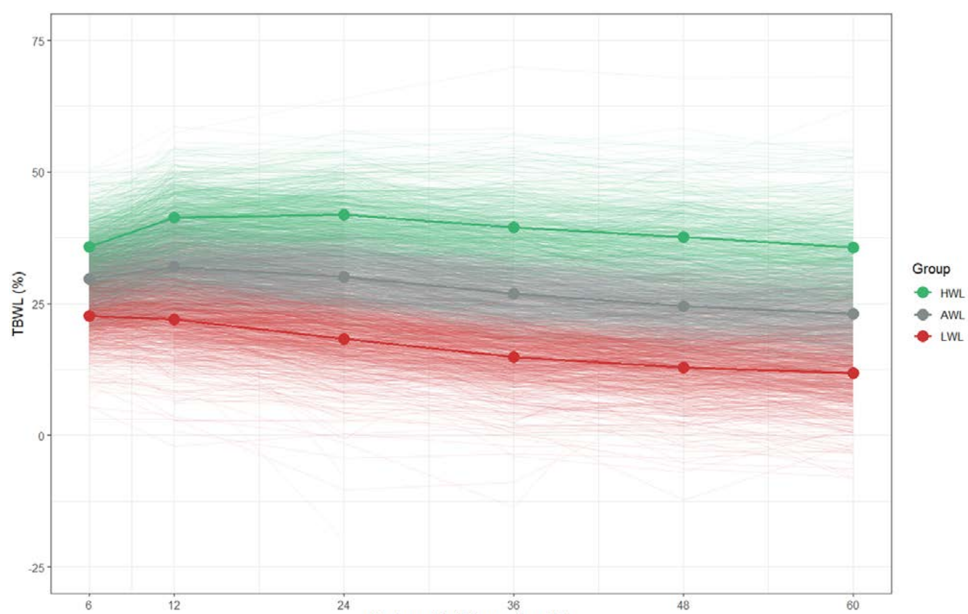

FIGURE 3. Sleeve gastrectomy postoperative %TBWL trajectories. Spaghetti plots showing the percentage of postoperative %TBWL of the included 3208 patients (who underwent sleeve gastrectomy) over the 6 postoperative follow-up time points (6, 12, 24, 36, 48, and 60 months). The 3 trajectory groups [ie, low weight loss (LWL), average weight loss (AWL), and high weight loss (HWL)] were represented by different colors (ie, red for LWL, blue-gray for AWL, and green for HWL). Three thicker lines were added to report the average level of each group.

were compared with patients from the AWL and HWL groups, who were reassigned into a combined (HWL+AWL) group. The results of the binary logistic regression are reported in Table 2. In the combined surgery type analysis, the probability of belonging to the LWL group was significantly higher in men [odds ratio (OR) = 1.32; 95% confidence interval (CI) = 1.14–1.53; $P < 0.001$], older patients (OR = 1.02; 95% CI = 1.02–1.03; $P < 0.001$), and nonwhite compared to White patients (OR = 1.95; 95% CI = 1.44–2.64; $P < 0.001$ for Asian patients; OR = 1.82; 95% CI = 1.55–2.14; $P < 0.001$ for Black patients; and OR = 1.23; 95% CI = 1.07–1.41; $P = 0.003$ for Hispanic/Latino patients) (Table 2). No significant association was found between socio-economic status (NDI) and %TBWL. Similar results were observed when RYGB and SG were analyzed separately (Supplemental Tables 3 and 4, see http://links.lww.com/AOSO/A349), except for sex, which was not a significant risk factor of postoperative %TBWL trajectory group assignment in the SG-specific-analysis.

TABLE 2.

Logistic Regression Analyses of Binary Postoperative %TBWL (LWL vs HWL+AWL)

				Univariate Models		Multivariate Model†	
		LWL	HWL+AWL	OR (95% CI)	*P*	OR (95% CI)	*P*
Sex, %	Female	1447 (81.2%)	3784 (85.1%)	1	—	—	—
	Male	335 (18.8%)	663 (14.9%)	1.32 (1.14–1.53)	<0.001	1.19 (1.01–1.40)	0.04
Race/ethnicity, %	Asian	73 (4.1%)	111 (2.5%)	1.95 (1.44–2.64)	<0.001	1.62 (1.17–2.24)	0.003
	Black	298 (16.7%)	486 (10.9%)	1.82 (1.55–2.14)	<0.001	1.85 (1.56–2.21)	<0.001
	Hispanic	418 (23.5%)	1008 (22.7%)	1.23 (1.07–1.41)	0.003	1.22 (1.05–1.41)	0.01
	White	894 (50.2%)	2656 (59.7%)	1	—	—	—
	Other*	99 (5.6%)	186 (4.2%)	1.58 (1.22–2.04)	<0.001	1.35 (1.02–1.76)	0.03
Age (years) at surgery, Mean ± SD		46.8 ± 10.7	44.0 ± 10.9	1.02 (1.02–1.03)	<0.001	1.01 (1.00–1.02)	0.002
NDI	Mean ± SD	−0.040 (0.8)	−0.010 (0.8)	0.96 (0.90–1.02)	0.20	—	—
BMI (kg/m^2) at surgery	Mean ± SD	41.4 ± 6.1	42.54 ± 6.32	0.97 (0.97–0.98)	<0.001	0.98 (0.97–0.99)	0.002
Preoperative comorbidities, N (%)	Diabetes	760 (42.6%)	1047 (23.5%)	2.41 (2.15–2.71)	<0.001	2.02 (1.77–2.31)	<0.001
	Hypertension	1092 (61.3%)	2170 (48.8%)	1.66 (1.49–1.86)	<0.001	1.26 (1.10–1.44)	<0.001
	Sleep apnea	934 (52.4%)	1852 (41.6%)	1.54 (1.38–1.72)	<0.001	1.40 (1.24–1.59)	<0.001
Preoperative weight loss Mean ± SD	%TBWL	6.7 ± 3.3	8.6 ± 3.8	0.85 (0.84–0.87)	<0.001	0.85 (0.84–0.87)	<0.001
Surgery type, N (%)	RYGB	841 (47.2%)	2180 (49.0%)	0.96 (0.88–1.05)	0.19	—	—
	SG	941 (52.8%)	2267 (51.0%)	1	—	—	—

*"Other" race/ethnicity category included patients who self-reported "other" or "don't know" or if patients self-selected multiethnic categories.

†Multivariate analysis was not completed on sociod-emographic and clinical factors that did not show statistical significance on univariate analysis.

AWL indicates average weight loss; BMI, body mass index; CI, confidence interval; HWL, high weight loss; LWL, low weight loss; NDI, neighborhood deprivation index; OR, odds ratio; SD, standard deviation.

Preoperative Clinical Factors Influence Weight Loss After BS

We then conducted binary logistic regression to assess whether each preoperative clinical factor (ie, BMI at surgery, diabetes, hypertension, sleep apnea, and preoperative %TBWL) was associated with postoperative %TBWL trajectory group assignment. In the combined surgery type analysis, patients in the LWL group had a lower BMI at surgery (OR = 0.97; 95% CI = 0.97–0.98; $P < 0.001$), but lost less weight before surgery (OR = 0.85; 95% CI = 0.84–0.87; $P < 0.001$ for preoperative %TBWL) than those in the combined AWL and HWL group (Table 2). Furthermore, patients in the LWL group were more likely to have preoperative comorbidities than patients in the combined AWL and HWL group (OR = 2.41, 95% CI = 2.15–2.71, $P < 0.001$ for diabetes; OR = 1.66, 95% CI = 1.49–1.86, $P < 0.001$ for hypertension; and OR = 1.54, 95% CI = 1.38–1.72, $P < 0.001$ for sleep apnea). Associations persisted in the analyses stratified by type of BS (ie, RYGB or SG analyzed separately) (Supplemental Tables 3 and 4, see http://links.lww.com/AOSO/A349).

Multivariate Logistic Model for Postoperative %TBWL

In a multivariate analysis that included all risk factors of postoperative trajectory group assignment (LWL vs HWL plus AWL), age at surgery (OR = 1.01; 95% CI = 1.00–1.02; $P = 0.002$), male sex (OR = 1.19; 95% CI = 1.01–1.40; $P = 0.04$), race/ethnicity (OR = 1.62; 95% CI = 1.17–2.24; $P = 0.003$ for Asian patients; OR = 1.85; 95% CI = 1.56–2.21; $P < 0.001$ for Black patients; and OR = 1.22; 95% CI = 1.05–1.41; $P = 0.01$ for Hispanic/Latino patients), BMI at surgery (OR = 0.98; 95% CI = 0.97–0.99; $P = 0.002$), preoperative comorbidities (OR = 2.02; 95% CI = 1.77–2.31; $P < 0.001$ for diabetes, OR = 1.26; 95% CI = 1.10–1.44; $P < 0.001$ for hypertension, OR = 1.40; 95% CI = 1.24–1.59; $P < 0.001$ for sleep apnea), and preoperative %TBWL (OR = 0.85; 95% CI = 0.84–0.87; $P < 0.001$) remained associated with postoperative %TBWL trajectory group assignment (Table 2). This suggests that these factors are risk factors for a lower weight loss response to BS.

Sex-Specific Analyses

Sex-specific binary and multivariate analyses were conducted to determine differences in risk factors of poor postoperative weight loss according to sex (Supplemental Tables 5 and 6, see http://links.lww.com/AOSO/A349). In analyses among women (N = 5231 patients), we found very similar results (Supplemental Table 5, see http://links.lww.com/AOSO/A349) to those for the overall cohort, except surgery type was significantly associated with postoperative %TBWL group assignment. Specifically, women who underwent SG were more likely to belong to the LWL group compared to women who underwent RYGB. The association of surgery type with trajectory group outcome persisted in the multivariate model, along with race/ethnicity, age and BMI at surgery, preoperative diabetes, hypertension, sleep apnea, and preoperative weight loss. In analyses among men (N = 998 patients), findings (Supplemental Table 6, see http://links.lww.com/AOSO/A349) differed compared to the overall cohort results, likely due to the more limited sample size. Specifically, we did not detect significant differences in postoperative %TBWL trajectory group assignment for Asian and Hispanic/Latino men compared to White men. Further, sleep apnea was not associated with postoperative %TBWL outcome in men, and the association of diabetes was not significant in the multivariate model. Finally, men who underwent a RYGB were more likely to belong to the LWL group compared to men who underwent SG.

Race/Ethnicity-Specific Analyses

Race/ethnicity-specific binary and multivariate analyses were conducted to evaluate differences in risk factors for lower weight loss after BS according to race/ethnicity (Supplemental Tables 7–10, see http://links.lww.com/AOSO/A349). On the Asian population binary analyses (N = 184 patients), sex, age, preoperative hypertension, and sleep apnea were not associated with postoperative %TBWL outcomes. On multivariate analysis of Asian patients, only lower preoperative BMI (OR = 0.94; 95% CI = 0.88–0.99; $P = 0.04$), smaller preoperative weight loss (OR = 0.84; 95% CI = 0.75–0.92; $P = 0.001$), and preoperative diabetes (OR = 2.80; 95% CI = 1.46–5.49; $P = 0.002$) were independent risk factors for belonging to the LWL group (Supplemental Table 7, see http://links.lww.com/AOSO/A349). On binary analyses of Black individuals (N = 784 patients) (Supplemental Table 8, see http://links.lww.com/AOSO/A349), preoperative BMI and hypertension were not associated with postoperative %TBWL outcome. In the Hispanic/Latino population binary analyses (N = 1426 patients), male sex was not associated with postoperative %TBWL outcome. Moreover, on multivariate analysis of Hispanic/Latino patients, age (OR = 1.01; 95% CI = 0.99–1.02; *P* = 0.45), and preoperative hypertension (OR = 1.22; 95% CI = 0.94–1.60; *P* = 0.14) were no longer associated with postoperative %TBWL trajectory group assignment (Supplemental Table 9, see http://links.lww.com/AOSO/A349). On binary analyses of White individuals (N = 3550 patients), similar results were observed compared to the overall cohort findings, except for NDI, which was a significant risk factor for LWL in White patients. On multivariate analysis of White individuals, male sex (OR = 1.13; 95% CI = 0.91–1.40; *P* = 0.27) and age at surgery (OR = 1.01; 95% CI = 1.00–1.02; *P* = 0.05) were no longer statistically significantly associated with postoperative %TBWL trajectory group assignment (Supplemental Table 10, see http://links.lww.com/AOSO/A349).

DISCUSSION

The present study addressed several knowledge gaps about the effects of socio-demographic factors and preoperative clinical factors on postoperative weight loss after BS in a large and multiethnic cohort. We found that 28.6% of KPNC patients experienced lower-than-expected weight loss after BS. Further, we reported variability in postoperative %TBWL according to race/ethnicity with 39.7%, 38.0%, 29.3%, and 25.2% of patients assigned to the LWL group, for Asian, Black, Hispanic/Latino, and White individuals, respectively. Our combined surgery type analysis revealed several demographic and preoperative clinical factors that influenced postoperative %TBWL. Men, older patients, and patients who are Black, Asian, or Hispanic/Latino were more likely to be in the LWL group. These results indicate that sex, age, race/ethnicity influence weight loss after BS. Additionally, patients in the LWL group had a higher prevalence of preoperative diabetes, hypertension, and sleep apnea when compared to those in the AWL and HWL groups. Finally, lower BMI at surgery and losing less weight before surgery were independent risk factors of lower postoperative %TBWL. Those associations remained when stratified by type of BS (i.e., RYGB or SG analyzed separately).

Our study findings are consistent with previous studies[8–13,25,26] that reported demographic and preoperative clinical factors associated with lower weight loss after RYGB, including male sex, older age, Black and Hispanic populations, preoperative weight loss, and preoperative diabetes. Especially, a large study conducted in the KP Southern California bariatric registry reported that non-Hispanic White RYGB patients had a higher percent excess weight loss than non-Hispanic Black and Hispanic RYGB patients.[26] In contrast to some previous studies,[8,27,28] but consistent with a recent study,[29] we found that a lower BMI at surgery was associated with less postoperative TBWL. Our study also reinforces well-established associations between preoperative hypertension and sleep apnea with lower postoperative weight loss,[27,30] although the mechanisms underlying those associations remain unclear.

Our study builds upon previous literature[8–13,25,26] by looking at risk factors of lower weight loss after BS among women and men, separately. Surgery type was differently associated with postoperative %TBWL in sex-stratified analyses; RYGB was associated with higher weight loss trajectories in women and, SG was associated with higher weight loss trajectories in men. However, in multivariate analyses stratified by sex, a number of risk factors other than surgery type were no longer associated with postoperative weight loss in men, likely due to the limited sample size (N = ~998 men) and representation of some risk factors in this subgroup analysis, resulting in being underpowered to detect some effects with statistical significance. Thus, further large studies are needed to confirm these male-specific findings.

Similarly, our study builds upon previous literature[8–13,25,26] by looking at risk factors of lower weight loss after BS across race/ethnicity groups. First, we found that NDI was a risk factor for unfavorable weight loss after surgery trajectories in White patients, but not in Hispanic/Latino, Black, and Asian populations. This result is consistent with a previous study, including mostly Black or Hispanic individuals, that reported no significant associations between census tract-level NDI score and weight loss at either follow-up time point after BS.[31] Further, we found that age and sex were independent risk factors of postoperative %TBWL outcome only in Black patients, but not in White, Hispanic/Latino, or Asian patients. Moreover, for Asian, Black, and Hispanic/Latino patients, hypertension was not a significant contributor to lower weight loss after surgery. This finding is consistent with previous work from the OneFlorida Clinical Research Consortium that reported no difference in postoperative %TBWL between patients with or without preoperative hypertension.[29] Finally, while Black patients were the only racial group for which preoperative BMI was not a risk factor of postoperative %TBWL, Asian individuals were the sole racial group for which preoperative sleep apnea did not affect postoperative weight loss. However, we note that the Asian race/ethnicity group (N = 184) is the smallest in our study, and we may have been underpowered to detect effects with statistical significance. These nuanced findings underscore the importance of conducting race/ethnicity-stratified analyses when evaluating risk factors that contribute to weight loss after BS. Future large and ethnically studies will confirm how each of these risk factors correlates with weight loss after surgery.

There are several strengths of the current study. This study benefits from a large cohort of ethnically diverse patients based in a single integrated delivery system (KPNC) with a comprehensive EHR, facilitating a standardized bariatric program, standardized data collection, and standardized procedures. When compared to earlier studies investigating risk factors for weight loss following BS,[6,7,10–13] the current study includes a larger number of patients with greater ethnic diversity. Furthermore, the extended follow-up period allows for a comprehensive assessment of long-term postoperative %TBWL outcomes. There are, however, certain limitations to consider when reviewing this study. First, while postoperative %TBWL is considered the gold standard for measurement of weight loss after surgery,[18–20] it may not capture all aspects of successful surgery and long, disease-free life. Future investigations should consider a wider range of outcomes that are important for overall health status, such as postoperative comorbidities improvements, surgery complications, reoperations, and modifications in gut microbiota composition. Second, the limited sample size in some subgroup analyses (eg, men only, N = 998; Asian and Black race/ethnicity groups, N = 184 and 784, respectively) could be considered as a study limitation. Lastly, our study focused on the main preoperative comorbidities associated with obesity (ie, diabetes, hypertension, and sleep apnea), but future studies might consider additional potential perioperative comorbidities such as cardiovascular disease, and psychiatric disorders.

In summary, our study highlights key socio-demographic and clinical factors that contribute to variation in %TBWL outcome after BS. These findings emphasize the importance of considering individual characteristics when evaluating which patients may be at a higher risk of experiencing LWL postoperatively. Future research could focus on understanding the underlying mechanisms behind the observed associations and developing tailored interventions to optimize weight loss outcomes. The identification of these risk factors could help clinicians personalize treatment approaches and set realistic expectations for patients based on their individual characteristics.

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