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Exploring racial disparity in perioperative outcomes following revisional bariatric surgery: A case-control matched analysis

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ABSTRACT

Introduction: Bariatric surgery is associated with 20–30% weight recidivism. As a result, revisional bariatric operation is increasingly performed. Disparity in bariatric outcomes remains controversial and very little is known about revisional bariatric surgery outcomes in ethnic cohorts.
Methods: Revisional bariatric cases were identified from the 2015 and 2016 Bariatric Surgery Accreditation and Quality Improvement Program Participant Use Data File. 1:1 case-control matching was performed and perioperative outcomes compared between racial cohorts.
Results: 24,197 cases were analyzed, including 20.78% Black patients. At baseline, there were differences in demographics and pre-existing conditions between racial cohorts. Matched analysis compared 7,286 Black and White patients. Operative duration ($p = 0.008$) and length of stay ($p = 0.0003$) were longer in Black patients. Readmission (6.8% vs. 5.4%, $p = 0.009$) was higher in Black patients. Bleeding (0.82% vs. 0.38%, $p = 0.02$) and surgical site infection (SSI) (2.6% vs. 1.8%, $p = 0.01$) were higher in White patients.
Conclusion: Revisional bariatric surgery is safe. Apart from a higher rate of bleeding, SSI and readmission, outcomes were not mediated by race.

Introduction

Obesity (body mass index (BMI) $\geq$ 30kg/m2) is an increasing pandemic that has been linked to a multitude of chronic diseases including diabetes mellitus (DM), hypertension, dyslipidemia, coronary artery disease, stroke (CVA), obstructive sleep apnea, degenerative joint disease, biliary disease, chronic kidney disease and certain types of cancer.[1,2] Severe obesity (BMI $\geq$ 40kg/m2) affects 7.6% of adults in the United States.[2,3] Even though obesity and severe obesity has increased among all racial/ethnic groups and socioeconomic demographics, obesity-related health conditions disproportionately affect Black patients and in particular, Black women.[4] Current rates of severe obesity among adults in the United States are 12.1% and 5.6% among Black and White patients, respectively,[5] with a significant upward projection over the next two to three decades.

Metabolic and Bariatric Surgery (MBS) remains a safe and effective treatment for severe obesity, resulting is sustained weight loss, improvement in comorbid conditions, reduction in primary cancer risk, increased longevity, and overall improved quality of life.[6,7] Despite this safety profile, approximately 20–30% of bariatric patients do not experience long-term success,[7,8] and may have significant weight regain and recurrence of comorbid conditions. As a result, revisional bariatric surgery is increasingly performed, and now represents the third most commonly performed weight loss procedure with an annual incidence of 14%.[9] While there are no consensus guidelines about the ideal patient for whom revisional surgery should be recommended, overall, revisional bariatric surgery has been shown to be a safe and effective treatment option.[10,11] Due to current trends in MBS, revisional surgery will likely continue to represent an increasing proportion of bariatric operations performed.

Disparities in outcome following MBS remain a controversial topic. Some studies have reported no differences in outcomes among ethnic groups, while others have reported more adverse

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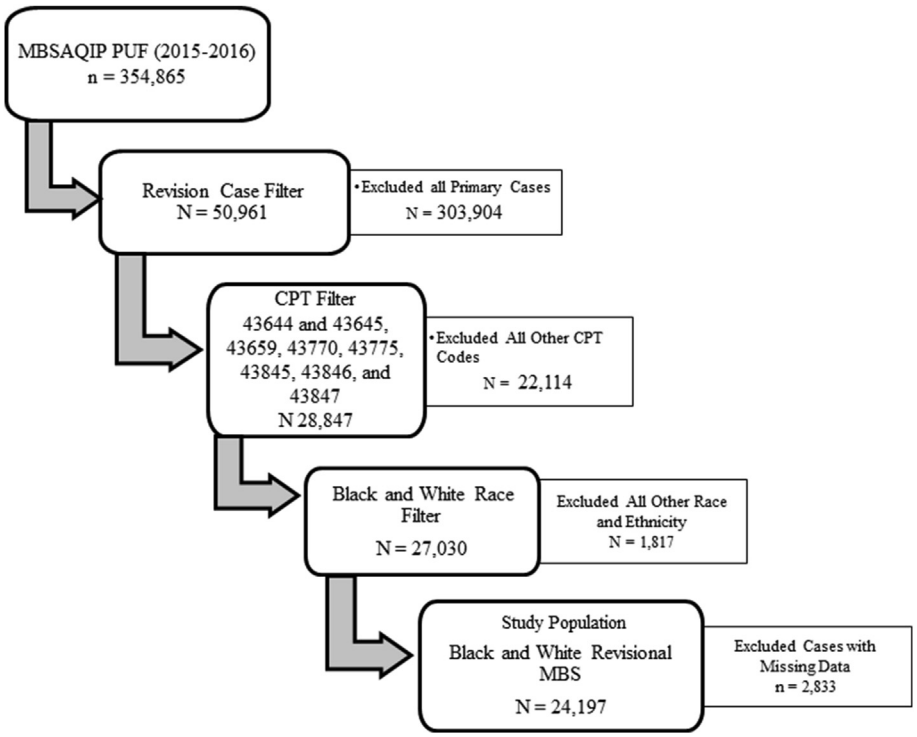

Fig. 1. Flow diagram of inclusion and exclusion criteria.
MBSAQIP = Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program, PUF = Participant Use Database, CPT = Current Procedure Terminology, MBS = Metabolic and Bariatric Surgery.

outcomes in Black MBS patients.[12–17] Outcomes of revisional bariatric surgery in ethnic minorities with severe obesity remains understudied and poorly understood. The aim of this study is to compare perioperative outcomes in non-Hispanic Black and non-Hispanic White patients undergoing revisional bariatric surgery and to ascertain if there is disparity in outcomes.

Material and methods

The MBSAQIP participant user file

Patients who had a revisional bariatric operation between January 1, 2015 and December 31, 2016 were identified from the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program Participant Use Data File (MBSAQIP PUF). We performed a retrospective analysis comparing bariatric surgical outcomes between non-Hispanic Black and non-Hispanic White patients who had a revisional bariatric procedure. The MBSAQIP is responsible for the accreditation of bariatric surgical facilities in the United States. Among the requirements for certification, surgical facilities are required to report bariatric surgical outcomes to the MBSAQIP, a Health Insurance Portability and Accountability Act (HIPAA)-compliant data file registry containing prospectively entered, risk-adjusted, clinically rich data using standardized definitions for preoperative, intraoperative, and postoperative variables that are specific to metabolic and bariatric surgical care. Data points are abstracted at participating institutions by certified reviewers who are audited for accuracy of performance.

Inclusion and exclusion criteria

For the purposes of this study, inclusion criteria were limited to non-Hispanic Black and non-Hispanic White adult patients who had a revision/conversion bariatric procedure between January 1, 2015 and December 31, 2016. Cases were identified by the variable name (CPTUNLISTED REV/CONV) and variable label (Revisional/Conversion Flag) in the MBSAQIP PUF database. This variable name and variable label identified patients who had revision/conversion of a principal bariatric operation. Exclusions included all primary bariatric procedures (no revision/conversion flag), age < 18 years, cases with missing data, surgical approaches other than conventional laparoscopic and robotic-assisted approaches, and all other races/ethnicities. A flow diagram of inclusion and exclusion criteria is depicted in Fig. 1.

Data collection

Data collected included demographic factors such as age, gender, pre-operative body mass index (BMI) and weight, health summary status variables including the American Society of Anesthesiologists' (ASA) classification, and pre-operative comorbidities such as history of myocardial infarction (MI), hypertension requiring medication, hyperlipidemia, renal insufficiency, renal failure requiring dialysis, vein thrombosis requiring therapy, history of pulmonary embolism (PE), diabetes, smoking history, renal disease, dialysis, obstructive sleep apnea, history of chronic obstructive pulmonary disease (COPD), and oxygen dependence. Our primary outcome measure was 30-day mortality. Secondary outcomes of interest included operative length, postoperative

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Table 1
Patient characteristics in unmatched racial cohorts.

Continuous variables, mean ± SD	Black n = 5,028	White n = 19,169	p-value
Age (years)	46.3 ± 9.9	49.2 ± 11.3	<0.0001
BMI (kg/m^2)	42.8 ± 8.6	40.4 ± 9.2	**<0.0001**
Categorical variable, n (%)			
Operation Name			**<0.0001**
Laparoscopic gastric bypass	1,430 (28.4)	5,519 (28.8)	
Duodenal switch	1,046 (20.8)	4,814 (25.1)	
Adjustable gastric band	170 (3.4)	342 (1.8)	
Laparoscopic sleeve gastrectomy	2,227 (44.3)	7,997 (41.7)	
Open gastric bypass	155 (3.1)	4,977 (2.6)	
ASA Class			**0.004**
1	22 (0.4)	99 (0.5)	
2	1,315 (26.2)	5,493 (28.7)	
3	3,527 (70.2)	13,044 (68.1)	
4	163 (3.2)	525 (2.7)	
5	1 (0.02)	3 (0.02)	
Gender			**<0.0001**
Male	444 (8.8)	2,995 (15.6)	
Female	4,584 (91.2)	16,174 (84.4)	
Pre-operative comorbidities, n (%)			
History of myocardial infarction	54(1.1)	301(1.6)	**0.009**
Hypertension	2,608 (51.9)	7,963 (41.5)	**<0.0001**
Hyperlipidemia	783 (15.6)	4,095 (21.4)	**<0.0001**
Chronic kidney disease	32 (0.6)	87 (0.5)	0.09
Dialysis-dependent	21 (0.4)	23 (0.1)	**<0.0001**
DVT requiring therapy	95 (1.9)	486 (2.5)	**0.008**
History of pulmonary emboli	88 (1.8)	344(1.8)	0.83
Inferior vena cava filter	80 (1.6)	211 (1.1)	**0.005**
Total functional dependence	30 (0.6)	115 (0.6)	0.98
Diabetes mellitus	811 (16.3)	3,131 (16.3)	0.73
Smoker	282 (5.6)	1,609 (8.4)	**<0.0001**
Chronic steroid/immunosuppression	108 (2.2)	377 (2.0)	0.41
Obstructive sleep apnea	1,223 (24.3)	4,966 (25.9)	**0.02**
COPD	81 (1.6)	354 (1.9)	0.26
Oxygen-dependent	17 (0.3)	123 (0.6)	**0.01**
Anticoagulation	120 (2.4)	622 (3.2)	**0.002**
Venous stasis	16 (0.3)	153 (0.8)	**0.0003**

SD = standard deviation, y = years, lbs = pounds, BMI = body mass index, ASA = American Society of Anesthesiologist, DVT = deep vein thrombosis, COPD = chronic obstructive pulmonary disease.

length of stay, 30-day adverse outcomes such as reoperation, readmission, intervention and ICU admission, and aggregate complications such as leak, bleeding, venous thromboembolic events, cardiovascular, renal and pulmonary complications, and surgical site infections, as defined in Appendix 1.

Matched analysis

To account for possible confounders, 1:1 case-control matching was performed of Black and White patients having a revisional bariatric procedure. 1:1 matching by several physician-selected clinically relevant baseline variables were used to identify new cohorts with equal distributions of possible confounding variables. Successful matches between Black and White patients consisted of 100% conformity on all categorical data points and proximity to within a specified caliper distance for continuous data points. Candidate variables used in matching included demographic factors, health summary status variables, and comorbidities.

Statistical analysis

Univariate analyses were performed of unmatched and matched racial cohorts, using Pearson χ 2 test for categorical variables and independent sample t-tests for normally distributed continuous variables. All statistical analysis was performed with SPSS version 25 (IBM Corporation). A p-value < 0.05 was considered statistically significant.

Results

Baseline patient characteristics and outcomes

Of 27,030 revisional bariatric cases identified in the 2015–2016 MBSAQIP database, 24,197 were included in our analysis; of which, 20.8% were non-Hispanic Black patients. 2,833 cases were excluded for missing data. The mean age and body mass index (BMI) were 48.56 ± 11.05 years and 40.91 ± 9.17 kg/m,[2] respectively. Patient characteristics of the unmatched racial cohorts are outlined in Table 1. Black patients were significantly younger, ($p < 0.0001$), had a higher preoperative BMI ($p < 0.0001$) and were more likely to be female ($p < 0.0001$). Bariatric procedures were similarly distributed between racial cohorts, except for a higher rate of adjustable gastric band (3.4% vs. 1.8%), sleeve gastrectomy (44.3% vs 41.7%) and open gastric bypass (3.1% vs 2.6%) performed in Black patients. Black

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Table 2
Perioperative outcomes in unmatched racial cohorts.

	Black n = 5,028	White n = 19,169	p-value
Operation length (min)	128.0 ± 69.8	124.9 ± 70.7	**0.006**
HLOS (days)	2.3 ± 3.1	2.21 ± 3.1	0.11
30-day Outcomes, n (%)			
Unplanned ICU Admission	70 (1.4)	317 (1.7)	0.19
Reoperation	166 (3.3)	648 (3.4)	0.78
Readmission	372 (7.4)	1314 (6.9)	0.18
Intervention	178 (3.5)	648 (3.4)	0.58
Mortality	12 (0.2)	37 (0.2)	0.52
Death related to operation	7 (0.14)	19 (0.1)	0.67
Perioperative complications, n (%)			
Acute renal failure	7 (0.1)	25 (0.1)	0.88
Progressive renal insufficiency	7 (0.1)	17 (0.09)	0.31
Cardiopulmonary arrest	9 (0.2)	13 (0.07)	**0.02**
Myocardial infarction	2 (0.04)	5 (0.03)	0.61
DVT requiring therapy	11 (0.2)	45 (0.2)	0.83
Pulmonary emboli	13 (0.3)	35 (0.2)	0.28
Anticoagulation for presumed/confirmed VTE	26 (0.5)	83 (0.4)	0.43
Transfusion	88 (1.8)	276 (1.4)	0.11
Unplanned intubation	20 (0.4)	57 (0.3)	0.26
Peripheral nerve injury	1 (0.02)	1 (0.01)	0.31
Wound disruption	7 (0.14)	21 (0.1)	0.58
Ventilator > 48 h	11 (0.2)	57 (0.3)	0.35
Pneumonia	25 (0.5)	116 (0.6)	0.37
Urinary tract infection	26 (0.5)	113 (0.6)	0.55
Sepsis	27 (0.5)	116 (0.6)	0.57
Septic shock	12 (0.2)	58 (0.3)	0.45
Superficial surgical site infection	36 (0.7)	223 (1.2)	**0.006**
Deep surgical site infection	11 (0.2)	54 (0.3)	0.65
Organ space surgical site infection	43 (0.9)	29 (1.2)	0.1
Aggregate perioperative complications, n (%)			
Leak	41 (0.8)	208 (1.1)	0.09
Bleeding	32 (0.6)	142 (0.7)	0.44
Cardiovascular	10 (0.2)	23 (0.1)	0.18
Pulmonary	54 (1.1)	232 (1.2)	0.42
Renal	14 (0.3)	43 (0.2)	0.48
Venous thromboembolism	39 (0.8)	123 (0.6)	0.3
Surgical site infection	103 (2.1)	542 (2.8)	**0.002**

min = minutes, HLOS = postoperative length of stay, ICU = intensive care unit, DVT = deep vein thrombosis, VTE = venous thromboembolism, CPR = cardiopulmonary arrest.

patients had a significantly higher prevalence of some comorbidities, including hypertension ($p < 0.0001$), myocardial infarction ($p = 0.009$), chronic kidney disease requiring dialysis ($p < 0.0001$) and pre-existing IVC filter ($p = 0.005$); whereas, smoking ($p < 0.0001$), obstructive sleep apnea ($p = 0.02$), oxygen-dependence ($p = 0.01$), venous stasis ($p = 0.0003$) and anticoagulation for presumed or confirmed venous thromboembolism ($p = 0.002$) were significantly more prevalent in White patients at baseline.

Outcomes were compared between unmatched racial cohorts and are detailed in Table 2. Operative duration was longer in Black patients ($p = 0.006$). Perioperative outcomes were mostly similar between Black and White patients. Notable exceptions included a two to three-fold higher rate of perioperative cardiac arrest requiring cardiopulmonary resuscitation (CPR) (0.18% vs. 0.07%, $p = 0.02$) in Black patients and a significantly higher rate of aggregate surgical site infection (2.83 vs. 2.04% vs., $p = 0.002$) in White patients. 1:1 case-control matched analysis was performed of 7,286 Black and White patients who had a revisional bariatric operation. Cohorts were matched by patient demographics, operative variables and preoperative comorbidities. Descriptive statistics of the equally matched racial cohorts are detailed in Table 3.

Perioperative outcomes of the case-control matched cohorts were compared and are detailed in Table 4. There was no mortality difference between racial cohorts. After matching, operative duration (126 min vs. 121.8 min, $p = 0.008$) and postoperative length of stay (2.2 days vs. 2.0 days, $p = 0.0003$) were significantly longer in Black patients ($p = 0.008$). Even though these were statistically significant, the small differences between study cohorts may not be clinically relevant Thirty-day readmission rate (6.8% vs. 5.4%, $p = 0.009$) was also higher in Black patients. Superficial (1.2% vs. 0.7%, $p = 0.02$), aggregate (2.6% vs. 1.8%, $p = 0.01$) surgical site infection (SSI), was well as aggregate SSI (2.6% vs. 1.8%, $p = 0.01$) and aggregate bleeding (0.38% vs. 0.0.8%, $p = 0.02$) rates were significantly higher in White patients. All other outcome measures were similar between Black and White patients having a revisional bariatric procedure.

Discussion

Racial disparity in outcomes following metabolic and bariatric surgery remains largely unexplored and controversial. Some studies have reported no differences in mortality perioperative and complications,[18,19] while others have reported higher rates of complications among ethnic minority patients following bariatric surgery.[20,21] In a single institution review of 749 consecutive sleeve gastrectomy and gastric bypass cases, including 48% Black and 27% Hispanic patients), Elli et al. reported no significant differences in mortality, complications and hospital length of stay between racial/ethnic groups.[18] In a review of over 18,000 patients from the 2005–2007 ACS NSQIP database, Turner et al. also found no mortality difference between racial cohorts; however, several postoperative complications were notably higher in certain racial/ethnic cohorts, including 2.5-fold higher rate of pulmonary embolic

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Table 3
Patient characteristics of matched racial cohorts.

Continuous variables, mean ± SD	Black n = 3,643	White n = 3,643	p-value
Age (years)	45.63 ± 9.6	45.83 ± 9.9	0.39
BMI (kg/m^2)	42.18 ± 8.0	42.02 ± 8.3	0.40
Categorical variable, n (%)			
Operation Name			1.00
Laparoscopic gastric bypass	1,059 (29.1)	1,059 (29.1)	
Duodenal switch	723 (19.9)	723 (19.9)	
Adjustable gastric band	77 (2.1)	77 (2.1)	
Laparoscopic sleeve gastrectomy	1,718 (47.2)	1,718 (47.2)	
Open gastric bypass	66 (1.8)	66 (1.8)	
ASA Class			1.00
1	4 (0.1)	4 (0.1)	
2	1,033 (28.4)	1,033 (28.4)	
3	2,586 (71.0)	2,586 (71.0)	
4	20 (0.6)	20 (0.6)	
Gender			1.00
Male	240 (6.6)	240 (6.6)	
Female	3,403 (93.4)	3,403 (93.4)	
Pre-operative comorbidities, n (%)			
History of myocardial infarction	1 (0.03)	1 (0.03)	1.00
Hypertension	1,659 (45.5)	1,659 (45.5)	1.00
Hyperlipidemia	382 (10.5)	382 (10.5)	1.00
DVT requiring therapy	7 (0.2)	7 (0.2)	1.00
History of pulmonary embolic	5 (0.1)	5 (0.1)	1.00
Inferior vena cava filter	2 (0.05)	2 (0.05)	1.00
Total functional dependence	2 (0.05)	2 (0.05)	1.00
Diabetes mellitus	349 (9.6)	349 (9.6)	1.00
Current Smoker	121 (3.3)	121 (3.3)	1.00
Chronic Steroids	24 (0.7)	24 (0.7)	1.00
Obstructive sleep apnea	733 (20.1)	733 (20.1)	1.00
COPD	3 (0.08)	3 (0.08)	1.00
Anticoagulation for presumed/confirmed VTE	10 (0.3)	10 (0.3)	1.00

SD = standard deviation, y = years, lbs = pounds, BMI = body mass index, ASA = American Society of Anesthesiologist, DVT = deep vein thrombosis, COPD = chronic obstructive pulmonary disease, VTE = venous thromboembolism.

events in Black patients and a 4-fold higher rate of acute renal failure requiring dialysis in Hispanic patients.[20] In contrast to *Elli* et al. and *Turner* et al. who reported no mortality difference between racial/ethnic bariatric surgery cohorts, Nguyen et al.,[22] in their multivariate analysis of the 1999–2007 National Inpatient Sample (NIS) database, identified non-Hispanic Black race as an independent predictor of mortality (OR, 1.73) following bariatric surgery.

Revisional bariatric surgery has consistently been shown to be safe with varying degree of complications and success.[10,23,24] In their systematic review of 175 publications, Brethauer et al. highlighted the fact that while revisional surgery is safe and can be an effective treatment for weight recidivism after a primary bariatric operation, outcomes are often revisional procedure dependent.[10] In reviewing conversion of adjustable gastric band to gastric bypass or sleeve, reported overall complication rate was 8.5–12.2%, including a leak and bleeding rate 0.9–5.6% and 1.8%, respectively.[10,23,24] Studies have also reported significant variability in excess weight loss (23%–74%) following revisional bariatric procedures.[10,23,24]

To our knowledge, this is the first study examining racial disparities in outcomes between Black and White patients undergoing revisional bariatric surgery. In this study, we conducted a matched cohort analysis comparing outcomes of revisional bariatric surgery between non-Hispanic White and non-Hispanic Black patients with similar pre-operative characteristics. Adverse outcomes were not significantly higher in Black patients. Previous studies have not examined racial disparities among bariatric patients undergoing revisional bariatric surgery. In their study evaluating outcomes in primarily Black patients undergoing revisional bariatric surgery, Kendell et al. reported no mortality, and an overall complication rate of 8%, including postoperative bleeding (3%), intestinal obstruction (3%), sepsis (1%) and incisional hernia (1%).[25] While there were no comparative racial cohorts in the study by Kendall et al., their findings are consistent with findings of other revisional bariatric surgery outcome studies.[10,23,24]

Causality for the higher rate of readmission among Black patients in our study remains unclear. In comparing unmatched patient characteristics among our racial cohorts, Black patients had higher rates of chronic renal disease and particularly dialysis-dependence. Even though our study cohorts were equally matched on demographics and preoperative comorbidities, pre-existing conditions such as dialysis dependence may have remained a confounder, impacting outcomes such as readmission rates. Similarly, reasons for higher rate rates of aggregate bleeding and SSI among White patients remains elusive. At baseline, White patients had higher rates of chronic anticoagulation and history of deep vein thrombosis requiring anticoagulation. The database lacks granularity regarding the perioperative management of such medications; as a result, our attempts to adjust for confounders through our matching techniques may not fully account for such preoperative comorbid conditions as confounders, impacting outcomes such as postoperative bleeding and SSI.

Given the current weight recidivism rate following primary metabolic and bariatric surgery, revisional MBS will likely become an increasing proportion of bariatric procedures performed. While there is a lack of consensus regarding which revisional procedure is optimal for which patient, revisional MBS can be performed safely and with success. In our study, revisional bariatric surgery was found to be safe with outcomes that did not appear to be mediated by race/ethnicity. As such, race/ethnicity should not be a deterrent from access to this potentially beneficial procedure.

There are several limitations to our study. The MBSAQIP PUF is a retrospective dataset that is subject to biases inherent to any retrospective database analysis. Retrospective studies are often

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Table 4
Perioperative outcomes in 1:1 case-control matched racial cohorts.

	Black n = 3,643	White n = 3,643	p-value
Operation length (min)	126.0 ± 66.3	121.8 ± 67.4	0.008
HLOS (days)	2.2 ± 2.9	2.0 ± 2.5	**0.0003**
30-day Outcomes, n (%)			
Unplanned ICU Admission	32 (0.88)	43 (1.18)	0.2
Reoperation	112 (3.07)	116 (3.18)	0.79
Readmission	248 (6.81)	195 (5.35)	**0.009**
Intervention	108 (2.96)	119 (3.27)	0.46
Mortality	5 (0.14)	3 (0.08)	0.48
Death related to operation	2 (0.05)	2 (0.05)	0.47
Perioperative complications, n (%)			
Acute renal failure	2 (0.05)	0 (0.00)	0.16
Progressive renal insufficiency	1 (0.03)	3 (0.08)	0.32
Cardiopulmonary resuscitation	3 (0.08)	0 (0.00)	0.08
Myocardial infarction	1 (0.03)	0 (0.00)	0.32
DVT requiring therapy	9 (0.25)	8 (0.22)	0.81
Pulmonary emboli	8 (0.22)	5 (0.14)	0.4
Anticoagulation for presumed/confirmed VTE	16 (0.44)	9 (0.25)	0.16
Transfusion	59 (1.62)	39 (1.07)	0.04
Unplanned intubation	9 (0.25)	6 (0.16)	0.44
Peripheral nerve injury	1 (0.03)	0 (0.00)	0.32
Ventilator > 48 h	3 (0.08)	3 (0.08)	1.00
Pneumonia	14 (0.38)	10 (0.27)	0.41
Urinary tract infection	17 (0.47)	11 (0.30)	0.26
Sepsis	17 (0.47)	15 (0.41)	0.72
Septic shock	3 (0.08)	5 (0.14)	0.48
Superficial surgical site infection	24 (0.66)	43 (1.18)	**0.02**
Deep surgical site infection	8 (0.22)	11 (0.30)	0.49
Organ space surgical site infection	26 (0.71)	31 (0.85)	0.49
Aggregate perioperative complications, n (%)			
Leak	26 (0.71)	27 (0.74)	0.89
Bleeding	14 (0.38)	30 (0.82)	**0.02**
Cardiovascular	3 (0.08)	2 (0.05)	0.65
Pulmonary	26 (0.71)	22 (0.60)	0.56
Renal	3 (0.08)	3 (0.08)	1.00
Venous thromboembolism	21 (0.58)	15 (0.41)	0.32
Surgical site infection	64 (1.76)	95 (2.61)	**0.01**

HLOS = postoperative length of stay, ICU = intensive care unit, DVT = deep vein thrombosis, VTE = venous thromboembolic event.

limited by the completeness and integrity of data entry. As such, it is unclear how the 10% of cases was missing data that were excluded from analysis impacted our findings. While the MBSAQIP program offers training and oversight including auditing to ensure accuracy of data entry, variations in coding between institutions cannot be fully excluded as a source of bias.

Studies suggest that outcomes following revisional surgery can be mediated by the revisional procedure performed. Surgical approach and surgeon experience may also impact outcomes. The MBSAQIP database provides little insight into clinical decision-making regarding when to offer a revisional procedure and the type of revisional procedure offered. Details about the surgeon experience performing these procedures are also lacking in the database. These are potential confounders that may have biased our findings. In our study design, we ensured that revisional procedure types were equally distributed between the two racial cohorts evaluated. However, this may not have addressed to potential confounders outlined above. While revisional procedure types were equally distributed between racial cohorts, we did not match racial cohorts by procedure-type mainly due to the small sample of some procedure types. As a result, this may have also biased our findings.

Furthermore, the MBSAQIP database does not provide granular data regarding the indication for revisional surgery in our patient cohort. It is unclear if revisions were for weight loss failure, weight regain or other complication associated with the index bariatric procedure. Data on the timeframe between index and revision/conversion bariatric procedures is also lacking in the database. This is a clear limitation of the database, as the indication for revision, the index bariatric procedure, as well as the timeframe between procedures, may dictate operation complexity and subsequently impact outcomes. This is a confounder that our study could not account for because these variables are lacking in the database.

Conclusion

Revisional metabolic and bariatric surgery in increasing performed with overall lower mortality and morbidity. There is very little data on outcomes in different ethnic cohorts undergoing revisional bariatric procedures. While studies suggest racial disparity in outcomes following primary bariatric surgery, very little is known about outcome in racial/ethnic cohorts undergoing revisional bariatric surgery. In this study, mortality following revisional bariatric surgery was similar between Black and White patients. Overall, most complications were also similar between racial cohorts; suggesting that outcomes after revisional bariatric surgery may not be mediated by race/ethnicity. Further studies with larger patient cohorts are needed to validate these findings.

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Appendix 1. Definitions of aggregate complications

Aggregate Complication	Composite Variables
Leak	Reoperation with Suspected Reason: Leak
	Readmission with Suspected Reason: Leak
	Intervention with Suspected Reason: Leak
	Drain present over 30 days
	Complication: Organ space SSI
Bleeding	Reoperation with Suspected Reason: Bleeding
	Readmission with Suspected Reason: Bleeding
	Intervention with Suspected Reason: Bleeding
Cardiac/CVA	Reoperation with Suspected Reason: Cardiac NOS, CVA, or MI
	Readmission with Suspected Reason: Cardiac NOS, CVA, or MI
	Intervention with Suspected Reason: Cardiac NOS, CVA, or MI
	Complication of CVA
	Complication of MI
Pulmonary	Reoperation with Suspected Reason: Shortness of Breath, Pneumonia, or Other Respiratory Failure
	Readmission with Suspected Reason: Shortness of Breath, Pneumonia, or Other Respiratory Failure
	Intervention with Suspected Reason: Shortness of Breath, Pneumonia, or Other Respiratory Failure
	Complication: On Ventilator >48 h
	Complication: Unplanned Intubation
	Complication: Pneumonia
Renal	Reoperation with Suspected Reason: Renal Insufficiency
	Readmission with Suspected Reason: Renal Insufficiency
	Intervention with Suspected Reason: Renal Insufficiency
	Complication: Progressive Renal Insufficiency
	Complication: Acute Renal Failure
DVT or PE	Reoperation with Suspected Reason: Vein Thrombosis Requiring Therapy or Pulmonary Embolism
	Readmission with Suspected Reason: Vein Thrombosis Requiring Therapy or Pulmonary Embolism
	Intervention with Suspected Reason: Vein Thrombosis Requiring Therapy or Pulmonary Embolism
	Complication: Vein Thrombosis Requiring Therapy
	Complication: Pulmonary Embolism
	Complication: Anticoagulation initiated of presumed/confirmed vein thrombosis/PE
Wound infection	Reoperation with Suspected Reason: Wound Infection or Other Abdominal Sepsis
	Readmission with Suspected Reason: Wound Infection or Other Abdominal Sepsis
	Intervention with Suspected Reason: Wound Infection or Other Abdominal Sepsis
	Complication: Post-Op Superficial Incisional SSI occurrence
	Complication: Post-Op Deep Incisional SSI occurrence
Other Infection	Reoperation with Suspected Reason: Infection/Fever
	Readmission with Suspected Reason: Infection/Fever,
	Intervention with Suspected Reason: Infection/Fever
	Complication: Post-Op Sepsis Occurrence
	Complication: Post-Op Septic Shock Occurrence
	Complication: Post-Op Pneumonia occurrence
	Complication: Post-Op Urinary Tract Infection occurrence

SSI = surgical site infection, NOS = not otherwise specified, CVA = cerebrovascular accident, MI = myocardial infarction, DVT = deep venous thrombosis, PE = pulmonary emboli, ICU = intensive care unit.

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