IFSO

ORIGINAL CONTRIBUTIONS

Outcomes of Bariatric Surgery in African Americans: an Analysis of the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) Data Registry

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Abstract

Background The incidence of obesity is disproportionally high in African Americans (AA) in the United States. This study compared outcomes for AA patients undergoing Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy (SG) with non-AA patients.

Methods The MBSAQIP database was reviewed for RYGB and SG patients (2015–2017). Patients were identified as AA or non-AA and grouped to RYGB or SG. Combined and univariate analyses were performed on unmatched/propensity matched populations to assess outcomes.

Results After applying exclusion criteria, 75,409 AA and 354,305 non-AA patients remained. Univariate analysis identified AA-RYGB and AA-SG patients were heavier and younger than non-AA patients. Overall, AA patients tended to have fewer preoperative comorbidities than non-AA patients with the majority of AA comorbidities related to hypertension and renal disease. Analysis of propensity matched data confirmed AA bariatric surgery patients had increased cardiovascular-related disease incidence compared with non-AA patients. Perioperatively, AA-RYGB patients had longer operative times, increased rates of major complications/ICU admission, and increased incidence of 30-day readmission, re-intervention, and reoperation, concomitant with lower rates of minor complications/superficial surgical site infection (SSI) compared with non-AA patients. For SG, AA patients had longer operative times and higher rates of major complications and 30-day readmission, re-intervention, and mortality, coupled with fewer minor complications, superficial/organ space SSI, and leak.

Conclusion African American patients undergoing bariatric surgery are younger and heavier than non-AA patients and present with different comorbidity profiles. Overall, AAs exhibit worse outcomes following RYGB or SG than non-AA patients, including increased mortality rates in AA-SG patients.

Keywords African Americans · Sleeve gastrectomy · Roux-en-Y gastric bypass · Surgical outcomes

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Background

Data from the Centers for Disease Control report African Americans (AA) and Hispanics have the highest age-adjusted prevalence of obesity in the United States (46.8% AAs and 47.0% Hispanics versus 37.9% non-Hispanic whites and 12.7% non-Hispanic Asians) [1]. Despite the differences in obesity rates between races, racial minorities (including AA patients) undergo disproportionately fewer bariatric procedures for treatment of obesity (Roux-en-Y Gastric Bypass [RYGB] or sleeve gastrectomy [SG]) compared with non-Hispanic white patients [2–4].

The rise in obesity rates in the United States represents major clinical and financial health challenges. Minorities are disproportionately affected within the obese patient population, often as a result of lower socioeconomic status and/or limited access to healthcare and insurance [5–7]. These factors are likely to contribute to subsequent disparities in both the weight loss options available, as well as the outcomes of such options (including elective bariatric and metabolic surgery). For example, in 2015, Sheka et al. analyzed data from more than100,000 patients in the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) database and reported AA patients had a higher body-mass index (BMI) at time of operation, concomitant with differences in peri-operative disease burden, longer length of stay, and higher rates of re-admission following either a RYGB or SG procedure. However, the authors used only one year of data, and although they did perform a multivariate analysis, they did not use propensity matching in their analysis [8].

The goals of this study were to utilize the bariatric surgery-specific patient data contained within MBSAQIP to determine the proportion of AA versus non-AA patients undergoing bariatric surgery, analyze the relative differences between pre-operative co-morbidities based on the surgical procedure performed, and determine whether disparities in outcomes between these groups exists using propensity matched patient populations. Primary outcomes were intra-operative outcomes, post-operative complications, and 30-day mortality. Secondary outcomes included patient discharge destination, re-admission, re-intervention, and re-operation.

Methods

Institutional Assurances

Our Institutional Review Board has deemed that retrospective analyses of public, anonymized data sets are exempt from review.

Data Source

Data were accessed from the MBSAQIP Participant Use Files (PUFs) (2015–2017) and queried for patients undergoing laparoscopic RYGB or SG procedures [9]. Exclusion criteria included patients who underwent revisions or conversions, mini-loop gastric bypass, gastric plication, endoscopic therapies, emergency cases, hand-assisted cases, open procedures, or intragastric balloon procedures. Leak rate was determined by filtering the interventions table for intervention related to bariatric surgery due to staple line or anastomotic leak and joined to the main MBSAQIP file by case ID.

Patient Demographics

Patient demographics and clinical characteristics were compared between AA and non-AA patients to include sex, BMI, and comorbidities at time of their bariatric procedure. For our analysis, several combined variables were generated to allow for clinically significant comparisons to be made between groups. Major complications were defined as acute renal failure, cardiac arrest requiring cardiopulmonary resuscitation, coma > 24 h, cerebral vascular accident (CVA), myocardial infarction (MI), ventilator use ≥ 48 h, pneumonia, progressive renal insufficiency, pulmonary embolism (PE), sepsis, septic shock, unplanned intubation, and/or unplanned admission to the intensive care unit (ICU). A classification of minor complications included wound disruption, surgical site infection (SSI), deep surgical site infection (dSSI), organ space surgical site infection (osSSI), and urinary tract infections (UTI) [10]. Following grouping by race (AA versus non-AA patients), a subgroup analysis was performed based on the type of procedure performed (RYGB or SG).

Statistical Analysis

Statistical analysis was performed using R Software (V3.4 R Foundation for Statistical Computing, Vienna, Austria). Continuous variables are reported as mean ± standard deviation, and categorical variables are reported as frequencies and percentages. While performing univariate analyses of continuous variables, paired t test or Wilcoxon's rank-sum tests were employed for parametric (unmatched) and non-parametric (matched) data, respectively. A Chi-square test for categorical variables was used. Covariate matching was performed by nearest neighbor matching algorithm using the *MatchIt* package [10] with matching being performed based on patient demographics (age, BMI, and race) and comorbid risk factors (diabetes requiring insulin, hypertension (HTN) requiring medication, gastroesophageal reflux disease [GERD], cardiac conditions, hyperlipidemia, history of deep venous thromboembolism [DVT], venous stasis, anticoagulation therapy, renal conditions, previous foregut surgery, smoking status, functional

independence, mobility status, oxygen usage, obstructive sleep apnea, and chronic steroid usage). Distributions of covariates between control and treatment groups were assessed by absolute mean differences between groups (Fig. 1a and b). A *P* value of < 0.05 was considered significant, and a *P* value of < 0.0001 was considered highly significant.

Results

Univariate Analysis of Patient Distribution, Demographics, and Preoperative Observations

Using the complete MBSAQIP data set (2015–2017), 555,239 cases were identified, from which 429,714 remained after exclusion criteria were applied. Within this data set, there were 75,409 (17.55%) AA and 354,305 (82.45%) non-AA patients (Table 1). Of the AA cohort, 21.78% underwent a RYGB (versus 28.57% non-AA) and 78.22% underwent a SG procedure (versus 71.43% non-AA) (Table 1). Compared with non-AA patients, AA patients were younger, more likely to be female, and had a higher BMI at time of surgery (Table 1). In considering pre-operative comorbidities, AA and non-AA patients presented with different clinical profiles. Overall, AA patients exhibited fewer comorbidities than non-AA patients with the exception of HTN, history of PE, inferior vena cava (IVC) filter, chronic steroid use, and renal insufficiency/dialysis (Table 1).

Effect of Race on Intraoperative and Post-Operative Observations

When comparing AA with non-AA patients undergoing a RYGB or SG procedure, operative times were longer for AA patients and AA patients were less likely to have a drain placed (Table 2). Post-operatively, AA patients exhibited increased risk of major complications concomitant with decreased rates of minor complications, and this is reflected in the incidence of the specific post-operative comorbidities described in Table 2.

Roux-en-Y Gastric Bypass Subset Analysis

When performing a subset analysis based on procedure type, AA patients undergoing RYGB were younger, had higher mean BMIs, and included more females than males compared with non-AA patients (Table 3). When examining matched data sets, only pre-operative BMI remained significantly different (48.41 ± 9.05 versus 48.05 ± 8.83 kg/m^2) (Table 3). When using unmatched patient data sets, AA patients exhibited notably different comorbidity profiles compared with non-AA, with AA patients being more likely to have hypertension, renal insufficiency, diabetes (insulin and non-insulin-

dependent), require a mobility device, require dialysis, have a history of PE, and have an IVC filter (Table 3). Conversely, non-AA patients were more likely to have GERD, prior PTC, cardiac surgery, history of MI, hyperlipidemia, venous stasis, COPD, and sleep apnea (Table 3). However, the majority of differences in co-morbidities observed between AA and non-AA patients no longer retained significance following data matching and analysis (Table 3). The exception to these findings was prior history of DVT (1.90% [AA] versus 1.50% [non-AA]), IVC filter placement (1.46% [AA] versus 1.19% [non-AA]), anticoagulation (2.50 [AA] versus 2.08 [non-AA]), prior cardiac surgery (0.80% [AA] versus 0.53 [non-AA]), and history of percutaneous transluminal coronary angioplasty (1.66% [AA] versus 1.36% [non-AA]) (Table 3).

When considering intra-operative data, operative duration, incidence of drain placement, and conversion to an open approach were higher in AA-RYGB compared with non-AA-RYGB patients, differences that persisted when analyzing matched patient data sets (Table 4). In evaluating post-operative outcomes, it is of particular note that AA-RYGB patients were more likely to succumb to mortality within 30 days when analyzing unmatched data, but these differences were no longer evident when analyzing matched data. In addition, AA patients were more likely to experience major complications than non-AA patients, and after matching, AA-RYGB patients had longer operative times, higher major complications (including conversion to open, renal insufficiency (RI), pulmonary embolism (PE), blood transfusion, ICU admission), as well as 30-day readmission, re-intervention, and reoperation rates, and discharge to place other than home (DOTH) compared with non-AA patients (Table 4). Finally, AA-RYGB patients were more likely to experience dehydration, have a drain placed, and undergo a swallow study than non-AA-RYGB patients, but less likely to have minor complications, superficial SSI, and the anastomosis checked. (Table 4).

Sleeve Gastrectomy Subset Analysis

A subset analysis of unmatched SG patient data demonstrated that AA-SG patients were younger, had higher mean BMIs, and included more females than males compared with non-AA patients (Table 5). Following propensity matching, AA patients were still younger (42.18 ± 10.87 [AA] versus 42.19 ± 11.24 years [non-AA]) with higher BMIs (46.67 ± 8.40 [AA] versus 46.46 ± 8.46 years [non-AA]) (Table 5). AA-SG patients had overall fewer co-morbidities when compared with non-AA-SG patients, with non-AA-SG patients having higher rate of GERD, prior PTC, prior cardiac surgery, history of MI, hyperlipidemia, venous stasis, anticoagulation, prior foregut surgery, smoking, COPD, oxygen dependence, and sleep apnea. AA-SG patients did have higher rates of hypertension, renal insufficiency, history of PE, dialysis, as well as presence of IVC filter. As with the RYGB patient subset

Fig. 1 Covariate balance (Love) plots showing absolute mean difference before (unadjusted; circles) and after (adjusted; squares) propensity score matching using a nearest neighbors algorithm for (**a**) Roux-enY gastric bypass (RYGB) patients and (**b**) sleeve gastrectomy patients
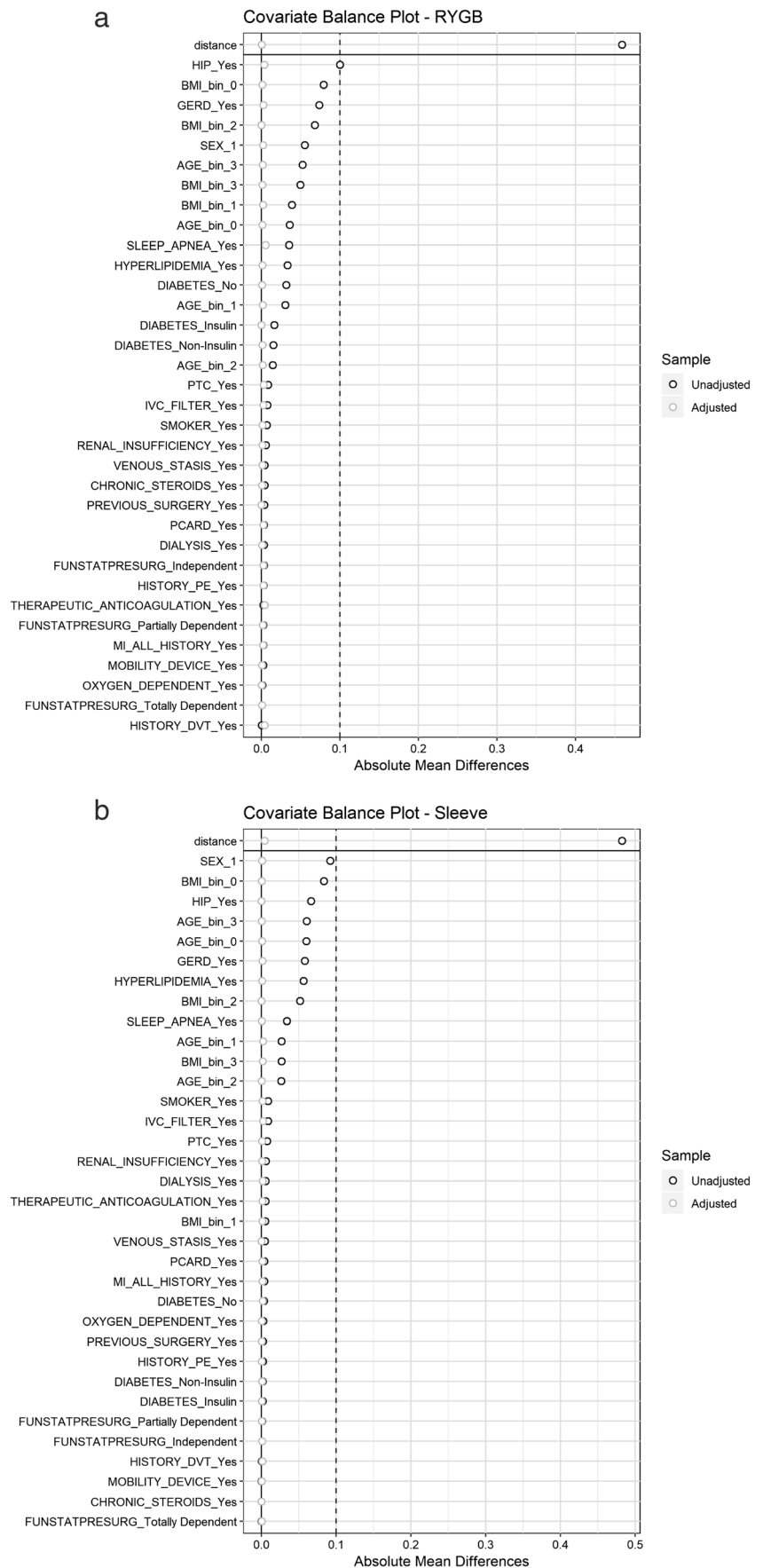
Table 1 Demographics and pre-operative comorbidities for African American (AA) vs. non-African American (non-AA) patients undergoing Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy (SG) procedures

	AA	Non-AA	P value
Demographics			
N	75,409	354,305	
Frequency (%)	17.55%	82.45%	
Mean age ± SD (yrs)	42.46 ± 10.93	44.66 ± 12.13	< 0.0001
Mean pre-op BMI ± SD (kg/m^2)	47.05 ± 8.58	45.01 ± 7.73	< 0.0001
Male (%)	13.75	22.03	< 0.0001
Female (%)	86.25	77.97	< 0.0001
RYGB (%)	21.78	28.57	< 0.0001
Pre-operative comorbidities (%)			
	AA	Non-AA	P value
GERD	25.28	31.13	< 0.0001
Mobility device	1.65	1.64	0.9172
Prior PTC	1.35	2.18	< 0.05
Prior cardiac surgery	0.81	1.17	< 0.0001
History of MI	0.99	1.35	< 0.0001
HTN	54.25	47.29	< 0.0001
Hyperlipidemia	19.47	25.04	< 0.0001
History of DVT	1.53	1.58	0.2828
Venous stasis	0.61	1.10	< 0.0001
Renal insufficiency	1.13	0.53	< 0.0001
Dialysis	0.72	0.20	< 0.0001
Anticoagulation	2.15	2.65	< 0.0001
Prior foregut surgery	1.38	1.65	< 0.0001
Diabetes insulin	8.63	8.62	0.5442
Diabetes non-insulin	17.91	17.75	0.5442
Smoker	7.92	8.75	< 0.0001
Total dependency	0.00	0.00	1.0000
COPD	1.45	1.78	< 0.0001
Oxygen dependent	0.52	0.76	< 0.0001
History of PE	1.33	1.10	< 0.0001
Sleep apnea	34.86	38.80	< 0.0001
Chronic steroids	1.80	1.68	< 0.05
IVC filter	1.45	0.58	< 0.0001

BMI, body mass index; GERD, gastroesophageal reflux disease; PTC, percutaneous transluminal coronary angioplasty; MI, myocardial infarction; HTN, hypertension; DVT, deep vein thrombosis; COPD, chronic obstructive pulmonary disease; PE, pulmonary embolism; IVC, inferior vena cava

analysis, many of the initial differences in pre-operative comorbidities between AA and non-AA patients undergoing SG were no longer evidenced when the analyses were performed using matched data (Table 5). The exceptions to these findings were prior history of cardiac surgery/MI, which were higher in the AA cohort compared with the matched non-AA cohort, and incidence of dialysis and history of IVC filter placement which were also higher in AA-SG patients (Table 5).

Perioperatively, the majority of differences identified in unmatched data remained significantly different when analyzing matched data with AA-SG patients being demonstrated to have longer operative times, higher incidence of major complications, including cardiac arrest, RI, PE, unplanned intubation, DVT, 30-day ICU admission, 30-day re-intervention, and 30-day mortality. AA-SG patients also demonstrated higher 30-day readmission, dehydration, and destination other than home compared with non-AA-SG patients (Table 6). Conversely, AA-SG patients had lower rates of minor complications, leak, superficial SSI, and osSSI as compared with non-AA-SG patients (Table 6).

Discussion

Our analysis using the MBSAQIP dataset identified AA patients undergoing RYGB and SG were younger, more likely to

Table 2 Outcomes for African American (AA) vs. non-African American (non-AA) patients undergoing Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy (SG) procedures

	AA	Non-AA	P value
N	75,409	354,305	
OR time ± SD (min)	88.70 ± 48.51	85.21 ± 46.86	< 0.0001
Drain placed	18.74	19.62	< 0.0001
Approach converted	0.17	0.15	0.1187
Over-sew sleeve	17.14	15.59	< 0.0001
Staple line reinforcement	53.36	47.50	< 0.0001
Anastomosis checked	78.31	77.91	< 0.0001
Discharge other than home	0.63	0.43	< 0.0001
Swallow study	39.91	35.37	< 0.0001
Drain present at 30 days	0.22	0.18	< 0.05
Minor complication	0.83	1.03	< 0.0001
Pneumonia	0.19	0.20	0.3272
Renal insufficiency	0.12	0.06	< 0.0001
Superficial SSI	0.30	0.44	< 0.0001
UTI	0.30	0.36	< 0.05
Dehydration	0.47	0.22	< 0.0001
Major complication	1.40	1.14	< 0.0001
Acute renal failure	0.09	0.07	< 0.05
CVA	0.01	0.01	0.3671
Intra-op. cardiac arrest	0.05	0.04	0.1609
Coma > 24 h	0.01	0.00	< 0.05
Deep SSI complication	0.05	0.06	0.1881
Intra/post-op MI	0.02	0.03	< 0.05
Ventilator > 48 h	0.08	0.07	0.6186
Organ space SSI	0.15	0.21	< 0.05
PE	0.18	0.09	< 0.0001
Sepsis	0.09	0.10	0.4132
Septic shock	0.06	0.05	0.8481
Unplanned intubation	0.16	0.14	0.0678
VTE	0.03	0.01	< 0.05
DVT requiring treatment	0.21	0.17	< 0.05
30-day ICU admission	0.80	0.65	< 0.0001
30-Day mortality	0.12	0.08	< 0.05
30-Day reoperation	1.28	1.19	< 0.05
30-Day readmission	4.99	3.55	< 0.0001
30-Day intervention	1.75	1.22	< 0.0001
PRBC within 72 h	0.66	0.65	0.5876
Bleeding	0.08	0.10	0.2289
Leak	0.07	0.12	< 0.05

OR, operating room; SSI, surgical site infection; UTI, urinary tract infection; CVA, cerebrovascular accident; MI, myocardial infarction; PE, pulmonary embolism; VTE, venous thromboembolism; DVT, deep vein thrombosis; ICU, intensive care unit; PRBS, packed red blood cell

be female, had higher BMIs, and different preoperative comorbidity profiles compared with non-AA patients. Post-operatively, outcomes for AA patients undergoing RYGB and

SG were worse overall than for non-AA patients, including higher major complications after RYGB and SG, and higher mortality after SG, factors that remained following propensity matching and analysis.

Several studies have addressed outcomes in AA patients previously using a range of available data sets. In a similar manner to our analysis, the Michigan Bariatric Surgery Collaborative compared cohorts of AA and white patients over an eleven-year period. While this study analyzed a smaller dataset than available through MBSAQIP, it is of note that the analysis covers a longer time period (11 years) than the data currently available in MBSAQIP. As reflected in our analysis of unmatched patient data, the Michigan collaborative study reported AA patients had a higher rate of any complication (although no differences in serious complications or mortality were identified), higher rates of emergency department visits, and higher incidence of readmission [11]. When looking at post-operative outcomes Amirian et al. (using MBSAQIP data from 2016) report similar findings to us, whereby AA patients had worse outcomes, including higher postoperative complications, readmission, and reoperations [12], while Tiwari et al., using the University HealthSystem Consortium (UHC) database, also report AA patients were at increased risk of adverse events following a laparoscopic RYGB procedure [13]. Examining mortality after bariatric surgery, Nguyen et al. report AA patients had significantly higher mortality compared with non-Hispanic whites (3.7 vs 2.3 per 1000 procedures, $P < 0.01$), although their analysis compared non-Hispanic AAs vs non-Hispanic whites and did not include matching and did not compare RYGB and SG separately [14].

When considering the total population who underwent a RYGB or SG procedure, it is of note that AA patients presented preoperatively with higher BMIs and (overall) fewer pre-operative comorbidities than non-AA patients (with the notable exception of HTN, renal insufficiency, dialysis, chronic steroids, IVC filter and history of PE). Similar to our findings, Balasubramanian et al. and Stanford et al. report that obese AA patients have less obesity related comorbidities compared with white patients with equivalent BMIs [15–17]. Similarly, Crawford et al., while examining the General Electric Centricity electronic medical record, found AAs to have lower rates of diabetes and hyperlipidemia compared with whites at similar BMIs of 40 and above, while exhibiting higher rates of hypertension in AAs compared with whites at BMIs of 40 and above [18]. Nunez Lopez et al., while looking at adolescent patients, also found that AA patients were more likely to have a higher BMI as well as higher rates of HTN pre-operatively [19]. However, it should be noted AA patients also present for bariatric surgery heavier and at a younger age than non-AA patients suggesting referral/access to care and/or insurance may not fully explain these differences.

Table 3 Demographics and pre-operative comorbidities for African American (AA) vs. non-African American (non-AA) patients undergoing Roux-en-Y gastric bypass (RYGB)

	AA	Non-AA	*P* value	Matched non-AA	*P* value
Demographics					
N	16,423	101,226		16,423	
Frequency (%)	13.96%	86.04%			
Mean age ± SD (yrs)	43.47 ± 11.09	45.23 ± 11.97	< 0.0001	43.45 ± 11.15	0.4980
Mean pre-op BMI ± SD (kg/m^2)	48.41 ± 9.05	45.75 ± 7.79	< 0.0001	48.05 ± 8.83	< 0.05
Male	15.10	20.62	< 0.0001	14.88	0.5779
Female	84.90	79.38	< 0.0001	85.12	0.5779
Pre-operative comorbidities (%)					
GERD	32.01	39.39	< 0.0001	31.77	0.6358
Mobility device	2.11	1.87	< 0.05	2.02	0.5869
Prior PTC	1.66	2.52	< 0.0001	1.36	< 0.05
Prior cardiac surgery	0.80	1.14	< 0.0001	0.53	< 0.05
History of MI	1.35	1.59	< 0.05	1.14	0.0911
HTN	61.62	51.61	< 0.0001	61.27	0.5109
Hyperlipidemia	26.19	29.53	< 0.0001	26.08	0.8114
History of DVT	1.90	1.83	0.5641	1.50	< 0.05
Venous stasis	0.83	1.24	< 0.0001	0.68	0.1261
Renal insufficiency	1.12	0.56	< 0.0001	0.97	0.1933
Dialysis	0.45	0.13	< 0.0001	0.34	0.1137
Anticoagulation	2.50	2.75	0.0722	2.08	< 0.05
Prior foregut surgery	1.40	0.18	< 0.05	1.37	0.8134
Diabetes insulin	15.39	13.74	< 0.0001	15.36	0.9550
Diabetes non-insulin	22.56	21.07	< 0.0001	22.70	0.9950
Smoker	7.67	8.37	< 0.05	7.79	0.6947
Total dependency	0.38	0.30	0.0901	0.30	0.1111
COPD	1.70	2.02	< 0.05	1.66	0.7313
Oxygen dependent	0.78	0.91	0.0967	0.71	0.4806
History of PE	1.49	1.21	< 0.05	1.25	0.0644
Sleep apnea	40.50	44.04	< 0.0001	39.96	0.3112
Chronic steroids	1.86	1.46	< 0.0001	1.75	0.4561
IVC filter	1.46	0.68	< 0.0001	1.19	< 0.05

BMI, body mass index; GERD, gastroesophageal reflux disease; PTC, percutaneous transluminal coronary angioplasty; MI, myocardial infarction; HTN, hypertension; DVT, deep vein thrombosis; COPD, chronic obstructive pulmonary disease; PE, pulmonary embolism; IVC, inferior vena cava

When considering the data presented herein, as well as that published previously, it is imperative to highlight both the nature/size of the datasets available, and the types of analyses performed as they relate to clinical relevance. For example, when considering age and BMI at time of surgery, AA patients were significantly younger and had higher BMIs than non-AA patients whether considering all patients (Table 1, *P* < 0.001), those undergoing RYGB (Table 3, *P* < 0.0001) or those undergoing SG (Table 5, *P* < 0.001). However, closer examination of these differences reveals discrepancies in age were of the order of 2–3 years and BMIs of 2–3 kg/m^2, raising questions regarding the clinical significance of such differences relative to other underlying comorbidities that exist between the cohorts and the relevance of such findings to the

physician prior to considering procedure options. Similarly, when considering post-operative outcomes, the relative impact of findings such as the significant difference in PRBC use within 72-h evidenced in RYGB patients (1.22 [AA] versus 0.98% [matched non-AA], *P* < 0.05), should be weighed against other clinical factors such as incidence of PE, VTE, and 30-day ICU admission, reoperation, intervention, and mortality. Our analysis highlights the importance of using propensity matching when considering the analysis of large datasets such as the MBSAQIP database, and strongly suggests great care should be applied to interpreting the clinical relevance of those differences detected (relative to the size of the datasets being analyzed without matching the groups examined) as well as notable discrepancies that can arise when

Table 4 Outcomes for African American vs. non-African American (non-AA) patients undergoing Roux-en-Y gastric bypass (RYGB) procedure; univariate and matched data

	AA	Non-AA	P value	Matched non-AA	P value
N	16,423	101,226		16,423	
OR time ± SD	127.25 ± 58.69	118.60 ± 53.52	< 0.0001	117.14 ± 51.26	< 0.0001
Drain placed	29.98	27.70	< 0.0001	27.85	< 0.0001
Approach converted	0.37	0.27	< 0.05	0.18	< 0.05
Anastomosis checked	91.40	92.65	< 0.0001	92.27	< 0.05
Discharge other than home	0.86	0.54	< 0.0001	0.44	< 0.0001
Swallow study	33.34	27.78	< 0.0001	28.04	< 0.0001
Drain present at 30 days	0.20	0.29	< 0.05	0.26	0.2981
Minor complication	1.67	1.84	0.1257	2.01	< 0.05
Pneumonia	0.38	0.38	0.9264	0.35	0.6461
Renal insufficiency	0.23	0.09	< 0.0001	0.09	< 0.05
Superficial SSI	0.77	0.91	0.0928	1.08	< 0.05
UTI	0.47	0.51	0.4531	0.52	0.4798
Dehydration	0.77	0.38	< 0.0001	0.47	< 0.05
Major complication	2.15	1.76	< 0.05	1.64	< 0.05
Acute renal failure	0.17	0.11	< 0.05	0.10	0.1008
CVA	0.02	0	0.0547	0.01	0.6547
Cardiac arrest	0.07	0.06	0.6717	0.06	0.8272
Coma > 24 h	0.01	0	< 0.05	0	0.3173
Deep SSI complication	0.15	0.14	0.9028	0.13	0.6545
Intra/post-op MI	0.03	0.05	0.2583	0.05	0.4053
Ventilator > 48 h	0.19	0.14	< 0.05	0.13	0.1732
Organ space SSI	0.33	0.36	0.5901	0.33	0.9236
PE	0.26	0.14	< 0.05	0.11	< 0.05
Sepsis	0.21	0.17	0.3504	0.17	0.4456
Septic shock	0.13	0.11	0.3692	0.10	0.4231
Unplanned intubation	0.29	0.23	0.1980	0.20	0.1171
VTE	0.01	0.01	0.9719	0.01	1.0000
DVT requiring treatment	0.19	0.17	0.6100	0.17	0.6959
30-Day ICU admission	1.36	1.08	< 0.05	0.97	< 0.05
30-Day mortality	0.21	0.14	< 0.05	0.15	0.1888
30-Day reoperation	2.55	2.16	< 0.05	2.01	< 0.05
30-Day readmission	7.71	5.56	< 0.0001	5.36	< 0.0001
30-Day intervention	3.29	2.28	< 0.0001	2.32	< 0.0001
PRBC within 72 h	1.22	1.07	0.0838	0.98	< 0.05
Bleeding	0.27	0.24	0.5840	0.24	0.5827
Leak	0.09	0.10	0.5567	0.11	0.4793

OR, operating room; SSI, surgical site infection; UTI, urinary tract infection; CVA, cerebrovascular accident; MI, myocardial infarction; PE, pulmonary embolism; VTE, venous thromboembolism; DVT, deep vein thrombosis; ICU, intensive care unit; PRBS, packed red blood cell

comparing "total datasets" with matched patient datasets [8, 20].

Given the high rates of obesity in the AA population, the impact of obesity on health, and the rates of post-operative complications that currently exist, our data suggest greater availability to bariatric surgery for AA-patients may be an important factor in improving outcomes and decreasing post-operative complication rates. Previous studies report

AAs tend to be less educated about metabolic and bariatric surgery (MBS) and have less weight loss than whites after MBS [21–23]. To fully examine the impact race may have on pre-operative comorbidities and outcomes for bariatric surgery it is important that other factors be considered [24]. For example, significant components in these types of studies may relate to the availability of access to healthcare, and bariatric surgery specifically, as well as socioeconomic, psychological

Table 5 Demographics and pre-operative comorbidities for African American (AA) vs. non-African American (non-AA) patients undergoing sleeve gastrectomy (SG) procedure

	AA	Non-AA	P value	Matched non-AA	P value
Demographics					
N	58,986	253,079		58,986	
Frequency (%)	18.90%	81.10%			
Mean age $\pm$ SD (yrs)	42.18 ± 10.87	44.44 ± 12.19	< 0.0001	42.19 ± 11.24	< 0.0001
Mean pre-op BMI $\pm$ SD (kg/m^2)	46.67 ± 8.40	44.71 ± 7.69	< 0.0001	46.46 ± 8.46	< 0.0001
Male	13.38	22.59	< 0.0001	13.29	0.6747
Female	86.62	77.41	< 0.0001	86.71	0.6747
Pre-operative comorbidities (%)					
GERD	23.40	29.22	< 0.0001	23.26	0.5724
Mobility device	1.52	1.55	0.5987	1.47	0.5328
Prior PTC	1.27	2.04	< 0.0001	1.17	0.1306
Prior cardiac surgery	0.81	1.18	< 0.0001	0.68	< 0.05
History of MI	0.89	1.26	< 0.0001	0.77	< 0.05
HTN	52.20	45.56	< 0.0001	52.21	0.9675
Hyperlipidemia	17.59	23.24	< 0.0001	17.49	0.6570
History of DVT	1.43	1.48	0.3070	1.30	0.0564
Venous stasis	0.55	1.04	< 0.0001	0.52	0.5766
Renal insufficiency	1.13	0.52	< 0.0001	1.02	0.0549
Dialysis	0.81	0.23	< 0.0001	0.63	< 0.05
Anticoagulation	2.06	2.61	< 0.0001	1.91	0.0601
Prior foregut surgery	1.37	1.59	< 0.0001	1.40	0.6185
Diabetes insulin	6.75	6.58	0.1360	6.81	0.7827
Diabetes non-insulin	16.62	16.43	0.1360	16.73	0.7827
Smoker	7.99	8.90	< 0.0001	7.84	0.3650
Total dependency	0.43	0.44	0.6833	0.39	0.3735
COPD	1.37	1.68	< 0.0001	1.39	0.7840
Oxygen dependent	0.45	0.69	< 0.0001	0.40	0.2095
History of PE	1.29	1.06	< 0.0001	1.22	0.3463
Sleep apnea	33.28	36.70	< 0.0001	33.24	0.8724
Chronic steroids	1.78	1.77	0.8221	1.78	0.9649
IVC filter	1.45	0.55	< 0.0001	1.22	< 0.05

BMI, body mass index; GERD, gastroesophageal reflux disease; PTC, percutaneous transluminal coronary angioplasty; MI, myocardial infarction; HTN, hypertension; DVT, deep vein thrombosis; COPD, chronic obstructive pulmonary disease; PE, pulmonary embolism; IVC, inferior vena cava

variables, rural vs urban residency, differences in referral for bariatric surgery, and insurance status, but these are not available for analysis in the MBSAQIP dataset [6, 7, 24–30].

Large data sets, such as MBSAQIP, provide the opportunity to analyze outcomes from multiple sites for surgical procedures. However, using such datasets for these analyses is not without limitations imposed by the nature of retrospective database studies. Specifically, the analyses performed is, by the nature of this type of study, limited by the data available within the MBSAQIP database. For example, MBSAQIP only captures data up to 30-days post-operatively, and thus we were unable to analyze long-term outcomes, such as sustained weight loss, comorbidity resolution, or complications occurring more than 30-days postoperatively. Similarly, MBSAQIP does not include regional data or information regarding insurance or socioeconomic status, and these data may be of particular significance when analyzing historically underserved patients.

Finally, our analyses focused on differences between AA patients compared with all other races (in the United States). Epidemiological data report higher obesity rates in African Americans and Hispanics compared with white, non-Hispanics in the United States [1]. Given similarities in socio-economic factors between AAs and Hispanics, and the racial disparities that exist in access to health care, education, and/or insurance [31], it would be of great interest to utilize the MBSAQIP to examine potential similarities and/or differences in underlying comorbidities and perioperative outcomes

Table 6 Outcomes for African American vs. non-African American (non-AA) patients undergoing sleeve gastrectomy (SG) procedure; univariate and matched data

	AA	Non-AA	P value	Matched non-AA	P value
N	58,986	253,079		58,986	
OR time ± SD	77.97 ± 39.00	71.86 ± 36.12	< 0.0001	71.09 ± 36.06	< 0.0001
Drain placed	15.61	16.39	< 0.0001	16.71	< 0.0001
Approach converted	0.12	0.10	0.1723	0.10	0.4793
Anastomosis checked	74.67	72.01	< 0.0001	72.06	< 0.0001
Discharge other than home	0.56	0.39	< 0.0001	0.35	< 0.0001
Swallow study	41.74	38.41	< 0.0001	38.64	< 0.0001
Drain present at 30 days	0.23	0.14	< 0.0001	0.17	0.0229
Minor complication	0.59	0.70	< 0.05	0.72	< 0.05
Pneumonia	0.13	0.13	0.9685	0.13	0.7454
Renal insufficiency	0.08	0.04	< 0.0001	0.04	< 0.05
Superficial SSI	0.17	0.25	< 0.05	0.26	< 0.05
UTI	0.26	0.30	0.1000	0.31	0.0786
Dehydration	0.39	0.15	< 0.0001	0.17	< 0.0001
Major complication	1.19	0.89	< 0.0001	0.90	< 0.0001
Acute renal failure	0.07	0.05	0.0573	0.04	0.1068
CVA	0.01	0.01	0.9205	0.01	0.5930
Cardiac arrest	0.04	0.03	0.0739	0.02	< 0.05
Coma > 24 h	0.01	0.00	< 0.05	0.00	0.1025
Deep SSI complication	0.02	0.03	0.3241	0.03	0.4327
Intra/post-op MI	0.02	0.03	0.1317	0.02	1.0000
Ventilator > 48 h	0.05	0.05	0.9311	0.03	0.3071
Organ space SSI	0.10	0.15	< 0.05	0.16	< 0.05
PE	0.15	0.07	< 0.0001	0.06	< 0.0001
Sepsis	0.06	0.07	0.2599	0.07	0.3522
Septic shock	0.03	0.03	0.8172	0.02	0.3034
Unplanned intubation	0.13	0.10	< 0.05	0.08	< 0.05
VTE	0.03	0.01	0.0013	0.02	0.2230
DVT requiring treatment	0.21	0.17	< 0.05	0.15	< 0.05
30-Day ICU admission	0.65	0.48	< 0.0001	0.49	< 0.05
30-Day mortality	0.10	0.06	< 0.05	0.05	< 0.05
30-Day reoperation	0.93	0.81	< 0.05	0.97	0.2946
30-Day readmission	4.23	2.75	< 0.0001	2.87	< 0.0001
30-Day intervention	1.32	0.80	< 0.0001	0.87	< 0.0001
PRBC within 72 h	0.51	0.48	0.3230	0.43	0.0614
Bleeding	0.03	0.04	0.3851	0.03	0.8728
Leak	0.07	0.13	< 0.0001	0.14	< 0.05

OR, operating room; SSI, surgical site infection; UTI, urinary tract infection; CVA, cerebrovascular accident; MI, myocardial infarction; PE, pulmonary embolism; VTE, venous thrombo-embolism; DVT, deep vein thrombosis; ICU, intensive care unit; PRBS, packed red blood cell

between AA and Hispanic patients undergoing bariatric surgery procedures for the treatment of obesity.

Conclusions

Using the MBSAQIP dataset (2015–2017), we identify that AA patients who undergo a RYGB or SG procedure are younger, heavier, and with different but overall lower comorbidities compared with non-AA patients. Close review of the specifics of these findings suggests care should be taken in interpreting data as it pertains to statistical differences relative to clinical significance. Nevertheless, when using matched patient data, it is of note that we identify AA patients continue to exhibit worse outcomes, including higher rates of major complications in both RYGB and SG patient subsets, and

higher mortality in SG patients compared with non-AA patients.

Compliance with Ethical Standards

Conflict of Interest Disclosures Drs. Hui, Roberts, Thompson, Barbat, Sundarsesan, Poliakin, and Mckillop have no conflicts of interest or financial ties to disclose.

Dr. Kuwada is a speaker for BD Bard and WL Gore and a consultant for Medtronic.

Dr. Gersin is a speaker for WL Gore and Medtronic, an investor in Standard Bariatrics, and a consultant for GI dynamics.

Dr. Nimeri is on the speakers' bureau of Medtronic.

Ethical Statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

Consent Statement Informed consent does not apply.

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