

**INTERACTION OF RACE WITH WEIGHT LOSS AND RESOLUTION OF OBESITY
CO-MORBIDITIES IN PATIENTS UNDERGOING LAPAROSCOPIC ROUX-EN-Y
GASTRIC BYPASS (LRYGB): AN ANALYSIS OF 83,059 BOLD DATABASE
PATIENTS**

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Summary: Resolution of obesity-related co-morbidities and weight loss was analyzed in 83,059 patients who underwent laparoscopic Roux-en-Y gastric bypass. Outcomes varied by patients' racial characteristics. The greatest differences were seen 6 months postoperatively.

Abstract

Background: Previous studies identified differences by race in the distribution of medical problems associated with morbid obesity. Whether or not outcomes after LRYGB vary by race is unknown.

Methods: Data from 83,059 BOLD database LRYGB patients was analyzed retrospectively in five groups: African-American (n=9,055), Caucasian (n=63,352), Hispanic (n=6,893), Asian (n=198), and Other (n=3,561).

Results: Weight and BMI were higher in African-Americans versus Caucasians, Hispanics, Other (12 months, $p<0.0001$). Hypertension was increased among African-Americans versus Caucasians, Hispanics, Other through 24 months ($p<0.01$). Caucasian cholelithiasis (18 months, $p<0.05$), abdominal panniculitis (12 months, $p<0.01$), and depression (24 months, $p<0.05$) continued higher than other races. GERD was highest in African-Americans and Caucasians. Dyslipidemia affected Caucasians, African-Americans, and Other most (12 months, $p<0.05$). Hispanic depression was lowest (24 months, $p<0.05$). Other had highest stress urinary incontinence (12 months, $p<0.05$).

Conclusions: LRYGB outcomes vary by race, maximum at 6 months. These results may aid LRYGB management.

Introduction

The incidence of many medical conditions varies by race.^{1,2} For example, Caucasians are significantly associated with gastroesophageal reflux (GERD).³ Hypertension, gout, some psychiatric disorders, and back pain are increased among African Americans.^{2,4,5,6} Incontinence affects non-Hispanic whites more than it does Asians and African Americans.⁷ Mortality due to alcohol is highest in Native Americans, followed by African-Americans, Caucasians, and Asians.⁸

The distribution of weight-related medical problems in morbidly obese patients also varies significantly by race. Pre-operatively among patients about to undergo LRYGB, Adams observed significant inter-racial differences in the incidence of obesity co-morbidities. African-Americans had the highest BMI and rates of asthma and sleep apnea. Asians and African-Americans had higher hypertension. Asians also had highest diabetes. Caucasians had higher rates of ischemic heart disease, cholelithiasis, GERD, liver disease, somatic complaints, and depression. Hispanics had lower rates of hypertension and sleep apnea.¹

While the clinical characteristics of obese patients vary by race, whether or not race interacts with bariatric surgery outcomes is unknown. The objective of this study was to identify racial variations in weight loss and in the resolution of obesity-related medical problems following LRYGB.

Materials and Methods

With the approval of the Data Access Committee of the Surgical Review Corporation and of the Institutional Review Board of Our Lady of Lourdes Medical Center, Camden, NJ data from 83,059 Surgical Review Corporation Bariatric Outcomes Longitudinal Database (BOLD) patients who underwent laparoscopic Roux-en-Y gastric bypass (LRYGB) between June 1, 2007 and December 31, 2010 was analyzed retrospectively in five groups: African-American (n=9,055), Caucasian (n=63,352), Hispanic (n=6,893), Asian (n=198), and Other (Pacific Islander, Native American, or >1 race listed in BOLD; n=3,561).⁹

Age, weight, BMI, sex, race and the percentage frequency of obesity co-morbidities were obtained from BOLD, including hypertension (HTN), angina, congestive heart failure (CHF), deep vein thrombosis/pulmonary embolism (DVT/PE), ischemic heart disease, peripheral vascular disease (PVD), pulmonary hypertension (PHT), obstructive sleep apnea (OSA), obesity hypoventilation syndrome (OHS), asthma, abdominal hernia, panniculitis, cholelithiasis, gastroesophageal reflux disease (GERD), liver disease, stress urinary incontinence, diabetes mellitus, gout, hyperlipidemia, irregular menses, polycystic ovarian syndrome (PCOS), pseudotumor cerebri, back pain, fibromyalgia, lower extremity edema, musculoskeletal pain, mental health diagnoses, disability, depression, psychologic impairment, alcohol use, substance abuse, and tobacco use were examined. Although BOLD recorded several degrees of disease severity for each obesity co-morbidity, to secure adequate analytic statistical power, these gradations were grouped together as a dichotomous present/absent designation.

Statistical analysis used General Linear Models that included baseline and

post-operative data, and were modified for binomial distribution of dichotomous variables. Continuous variables were analyzed using an ANOVA with treatment in the model. Pair-wise comparisons were performed on the least squares means of the treatments calculated from the ANOVA model to find differences in the treatment groups.

Results

For African-Americans, Caucasians, Hispanics, Asians, and Other, respectively, age was 43+-10, 47+-8, 48+-8, 46+-8, 47+-8 ($p<0.0001$), and female/male % was 86/14, 78/22, 78/22, 73/27, 81/19 ($p<0.0001$). The numbers of evaluable patients at pre-operative baseline, and at 2, 6, 12, 18, 24, and 36 months after LYRGB were: African-Americans - 9,055, 7,439, 4,285, 2,089, 599, 405, 23; Caucasians - 63,352, 48,986, 36,752, 21,362, 5,490, 4,469, 270; Hispanics - 6,893, 4,091, 3,503, 1,659, 426, 273, 16; Asians – 198, 137, 102, 46, 11, 4, 0; Other - 3,561, 5,213, 1,854, 975, 300, 211, 11.

Weight, weight loss and BMI by race after LRYGB are listed in Table 1. Weight and BMI were highest through 24 months in African-Americans and Asians. Follow-up was insufficient to support analysis at 36 months.

Cardio-Pulmonary co-morbidities by race with significant findings are displayed in Table 2. CHF, PVD, PHT, and asthma outcomes did not vary by race. Through 24 months, hypertension persisted higher among African-Americans compared with Hispanics and the Other group ($p<0.01$), and through 24 months versus Caucasians.

Hypertension was lowest among Hispanics. Asian hypertension decreased early, and then rose to pre-operative levels at 24 months. Obstructive Sleep Apnea resolved at high rates among all racial classifications, and was lowest among Hispanics and Other at 2 and 6 months. Angina and OHS varied by race only at 2 months.

Metabolic and endocrine co-morbidities by race with significant findings are tabulated in Table 3. The frequency of diabetes varied by race through six months, but resolved well in all groups. Distribution of gout was significant only at 2 months. Dyslipidemia was lowest among Hispanics and Asians, and highest in Caucasians and Other through 12 months ($p < 0.05$). Racial variation of dyslipidemia resolved after 12 months. Pseudotumor cerebri and PCOS did not vary by race.

Abdominal and Hepatobiliary co-morbidities by race are seen in Table 4. Cholelithiasis persisted essentially at baseline levels among all races. Abdominal panniculitis was highest in Caucasians and lowest among Asians and Hispanics through 12 months. GERD was lower through 18 months in Asians and Hispanics, and was highest in African-Americans and Caucasians ($p < 0.05$). Liver disease was highest in Asians and Caucasians through 6 months, and nearly doubled among Asians. Through 12 months, stress urinary incontinence was lowest among Asians and Hispanics and highest in the Other group ($p < 0.05$). Abdominal hernia did not vary by race.

Somatic co-morbidities by race are listed in Table 5. Back pain was consistently lowest in Hispanics compared to Caucasians, African-Americans, and Other ($p < 0.05$). Through 6 months, lower extremity edema and musculoskeletal pain were lowest in the Hispanic and Asian groups than for Caucasians and Other ($p < 0.05$).

Psychological and Social co-morbidities by race are displayed in Table 6. While a

mental health diagnosis was highest in Caucasians and Asians at 2 and 6 months, variation was not significant thereafter, and the incidence changed little from pre-operative in any group. Post-operative depression was lower among African-Americans, Hispanics, and Asian compared with Caucasians and the Other group, and persisted lowest in Hispanics and highest for Caucasians through 24 months. Psychological impairment was lowest in African-Americans through 6 months, and even lower among Hispanics and Asians at 18 months, and was consistently highest for Caucasians. Alcohol use, which varied significantly only through 6 months, was, nevertheless, most common numerically among Asians from baseline through 24 months.

Overall, following LRYGB African-Americans had the highest rate (n=2) of HTN, and angina, and the lowest psychological impairment, mental health diagnosis, and liver disease (n=3). Caucasians were highest in OSA, OHS, abdominal panniculitis, cholelithiasis, GERD, liver disease (2 months), stress urinary incontinence (2 months), dyslipidemia (12 months), back pain, lower extremity edema, musculoskeletal pain, depression, and psychological impairment (n=14), second highest in angina, and mental health diagnosis, and alcohol consumption, and were lowest in none. Hispanics did not rank highest in any co-morbidity, and had the lowest HTN, angina, OHS, abdominal panniculitis, gout, dyslipidemia, back pain, lower extremity edema, musculoskeletal pain (2 months), depression, psychological impairment and alcohol consumption (6 months) (n=13). Asians had the highest prevalence of liver disease, diabetes, gout, dyslipidemia, mental health diagnosis, and alcohol consumption (n=6), and lowest abdominal panniculitis, cholelithiasis, GERD, stress urinary incontinence, back pain (18 months), lower extremity edema (6 months), musculoskeletal pain (6 months), and

depression (n=8). Other group patients were highest in no category and had the lowest OSA, diabetes, alcohol consumption (2 months) (n=3).

Post-operative outcomes did not vary by race for congestive heart failure, pulmonary hypertension, asthma, peripheral vascular disease, abdominal hernia, polycystic ovarian disease, pseudotumor cerebri, impaired functional status, and substance abuse.

Discussion

The results of this study identify statistically and clinically significant variations by race in weight, BMI, and the resolution of obesity co-morbidities following LRYGB. Post-LRYGB weight loss occurred less rapidly among African-Americans and Asians compared with Caucasians, Hispanics, and Other. Hypertension persisted at higher rates among African-Americans than in the other groups. Obstructive sleep apnea was more prevalent among Caucasians up to six months following LRYGB, suggesting slower OSA resolution in that group. Abdominal conditions affected Caucasians most frequently. Alcohol consumption and liver disease were highest for Asians, among whom liver disease doubled. Diabetes mellitus resolved significantly in all racial groups, varying by race only up to 6 months. Dyslipidemia reduced more in Hispanics and Asians than in the other race groups through 12 months. Somatic complaints persisted higher among African-Americans and Caucasians. Mental health issues affected Caucasians and Asians most often. Angina, CHF, PHT, asthma, OHS, PVD, abdominal hernia, gout, PCOS, pseudotumor cerebri, and impaired functional status did not vary by race beyond 2 months after LRYGB. Overall, Caucasians fared worst in

resolving obesity co-morbidities and Hispanics benefitted most from LRYGB. Our review of the literature indicates that the significant variations by race of clinical outcomes after LRYGB observed here have not been reported previously in a patient population this large, and are important findings of this study.

After LRYGB, weight and BMI decreased significantly more rapidly among Caucasians, Hispanics and Other than in African-Americans and Asians through 24 months. This data confirms the findings of Sudan et al that African American weight loss and decline in BMI following LRYGB were less than for Caucasians or Hispanics, and adds Asians as a second ethnic category associated with inferior body mass reduction results.¹⁰ Previous single institution investigations have reported decreased weight loss and BMI reduction in African-Americans versus Caucasians.^{1,11,12,13,14,15,16,17} In contrast, Coleman and co-authors found greater reduction in weight and BMI among African-Americans than in non-Hispanic white patients.¹⁶ Our results further identified significantly impaired weight and BMI response to LRYGB among Asians, which is a significant new finding. The underlying causes of racial variation in post-LRYGB weight and BMI are not clear from the data.

Statistically significant racial differences in diabetes, with the highest incidence among Asians and Caucasians lower than African-Americans and Hispanics up to 6 months, observed early after LRYGB were too small to be clinically important. Consistent with previous reports, diabetes resolved effectively among all racial groups in our study.^{13,17} In contrast, Coleman and co-workers found that postoperative resolution of diabetes and metabolic syndrome was less likely to occur among Hispanics and non-Hispanic blacks in a recent study.¹⁶ The body of literature indicates

that obesity-induced Type II diabetes mellitus resolves well in all racial groups following LRYGB.

Through 24 months in this investigation, hypertension persisted at higher rates among African-Americans than in the other racial cohorts, and continued higher than Caucasians at 24 months. This is a significant finding, as prior studies have not identified such statistically and clinically significant variations by race in the resolution of hypertension after LRYGB.^{13,17,18,22} Consistent with the known increased prevalence of hypertension in the general African-American population, Adams observed the highest rates of hypertension in Asians and African-Americans among morbidly obese patients pre-operative for LRYGB.¹ The results here indicate that the increased African-American propensity for hypertension extends to impaired high blood pressure resolution following LRYGB. This advance knowledge should give bariatric surgeons an increased index of suspicion for persistent hypertension among African-Americans after LRYGB.

Data in the literature regarding remission of Obstructive Sleep Apnea following bariatric surgery has been conflicting. Weight loss is an important predictor for resolution, but other independent predictors, for example LRYGB compared to LAGB, have been reported.¹⁵ OSA was more prevalent among Caucasians in this study and, through six months following LRYGB, indicating that rates of resolution were slower in this demographic. These findings correlate with studies published elsewhere, with resolution of OSA in Caucasians and Hispanics less than African Americans.¹³

Abdominal problems, including panniculitis, cholelithiasis, GERD, and stress

urinary incontinence, persisted and/or developed most frequently among Caucasians in the present study. Caucasian cholelithiasis was higher than African Americans, Hispanics, and Other through 18 months. Conversely, panniculitis was lower for Hispanics than African Americans, Caucasians, and the Other group. African American stress urinary incontinence following LRYGB was reduced compared with Caucasians and Hispanics. GERD was less common in Hispanics and African-Americans compared to Caucasians. Abdominal comorbidities overall persisted among Caucasians to the greatest extent in our study, correlating with currently published literature.¹⁰

In this investigation, following LRYGB, liver disease nearly doubled among Asians, while it decreased in the comparator groups. Interestingly, although not statistically significant, Asian alcohol use was also consistently highest. This finding has been documented in the literature specifically in Chinese individuals.⁸ Higher rates of liver disease among the Asian population may be a direct correlate of greater alcohol consumption among Asians that has been reported here, and substantiated in the literature.¹⁷ However, it is important to note that liver disease was defined clinically in the BOLD database, as biopsies were not required to confirm the diagnosis. Nevertheless, the findings here are important contributions to our understanding of liver disease in bariatric surgery.

Our data indicates that dyslipidemia resolves at higher rates following LRYGB among Hispanics and Asians when compared to African-Americans and Caucasians. Prior studies have been unable to demonstrate any significant difference between ethnic groups or races in the resolution of hyperlipidemia at 1-year follow-up after

bariatric surgery.¹⁷ There has been a significant correlation between bariatric surgery and the discontinuation of lipid-lowering medications following bariatric procedures.¹⁹ However, mechanisms underlying the racial variations in dyslipidemia responses observed in this study are not clear from the data.

Somatic complaints persisted higher among African Americans and Caucasians in our study. Currently, the pathophysiology underlying this finding is unknown, as there are few research studies on this subject. LRYGB has resulted in significant improvement of self-reported complaints of back and lower extremity pain.²⁰ However, any correlation regarding resolution of somatic complaints among the different racial groups has not been reported previously. Thus, the finding here of higher somatic co-morbidities among African Americans and Caucasians is an important new contribution to the literature.

In this investigation, Caucasians consistently experienced the highest rates of depression and psychological impairment persistence, compared with the rest of the racial groups, in spite of excellent weight reduction. Psychological impairment was increased non-significantly also among Asians at 2 and 6 months. These observations contrast with recent publications in which depression and other Axis I disorders were associated with high pre-operative BMI, and with less weight reduction following bariatric surgery.^{21,22} From the results of the present study, one might speculate that the higher rates of co-morbidity non-resolution in the Caucasian cohort of this study may have exacerbated depression and other psychological impairments for those patients. Although the causes of these racial variations are not clear from the data, increased post-LRYGB Caucasian depression is a significant new observation.

Overall, more obesity comorbidities persisted following LRYGB among those of the Caucasian persuasion than in the other races. Caucasians had the greatest percentage of fourteen weight-related problems, including cholelithiasis, liver disease, diabetes, depression, and mental health diagnoses. Hispanics, on the other hand, experienced excellent BMI reduction, and demonstrated robust resolution of the greatest number of comorbidities, including GERD, dyslipidemia, back pain, depression, and eight others. While Asians had the highest prevalence of liver disease, diabetes, gout, dyslipidemia, mental health diagnosis, and alcohol consumption, they resolved six other categories at the highest rates. African-Americans and Other performed intermediate between Caucasians and Hispanics. These variations in post-LRYGB outcomes according to race have not been substantiated previously in the literature.^{10,15,22,23}

There are several limitations to this study. Firstly, the limits of a retrospective analysis of a prospectively collected database apply. Secondly, only clinical definitions were used in BOLD, including liver disease where biopsies were not required. Thirdly, after 24 months, analyses had reduced statistical power due to declining follow-up visits. Fourthly, the patients here chose to have LRYGB, and therefore the results of this study might not be applicable to other bariatric operations. While baseline data was included in the statistical analyses, pre-operative racial variations still may have influenced temporally downstream results. Finally, having to group the BOLD sub-categories of severity for obesity comorbidities together for statistical robustness precluded a more in-depth evaluation of these conditions.

Conclusion

Post-operative weight, BMI and the resolution of weight-related medical problems among morbidly obese patients who undergo LRYGB vary according to racial classifications. Weight and BMI persisted highest for African Americans and Asians. Hispanics benefitted most from LRYGB in the greatest number of obesity co-morbidities. Caucasians resolved these conditions least frequently. African-Americans, Asians, and the Other grouping outcomes were a middle cohort. While some racial variations persisted only six months, the advance knowledge of LRYGB outcomes variation by race presented here may help optimize management of morbidly obese patients who choose this operation.

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Tables

Table 1: Weight and BMI after LRYGB by Race						
<u>WEIGHT (kg)</u>	Baseline	2 months	6 months	12 months	18 months	24 months
African-American	139 +29	123 +27	105 +24	94 +22	92 +21	90 +20
Caucasian	133 +27	115 +26	90 +21	86 +20	83 +20	84 +20
Hispanic	129 +27	113 +25	95 +21	85 +19	82 +19	83 +19
Asian	124 +27	109 +23	95 +20	87 +21	87 +28	95 +41
Other	131 +27	114 +24	95 +21	86 +20	83 +18	86 +21
p-value	AA vs All= <0.01; C vs O,H= <0.01	AA vs All= <0.01; C vs O,H= <0.0001	AA vs O,C,H= <0.0001; C vs O,H= <0.0001	AA vs O,C,H= <0.0001; C vs O,H= <0.0001	AA vs O,C,H= <0.001; C,O,H vs A= <0.0001	AA vs C,H= <0.05; C vs O= <0.05
<u>BMI</u>	Baseline	2 months	6 months	12 months	18 months	24 months
African-American	50 +9	44 +8	38 +8	34 +7	33 +7	33 +7
Caucasian	47 +8	41 +7	34 +6	31 +6	30 +6	30 +6
Hispanic	48 +8	41 +7	35 +7	32 +6	30 +6	31 +6
Asian	46 +8	40 +7	35 +6	32 +6	33 +7	35 +12
Other	47 +9	42 +8	35 +7	31 +6	30 +6	31 +7
p-value	<0.0001	AA vs All= <0.02; C vs O,H= <0.0001	AA vs C,O,H= <0.001; C vs O,H,A = <0.01; A vs O,H= <0.05	AA vs C.O.H = <0.0001; C vs O,H,A= <0.01; A vs H= <0.05	AA vs C.O.H = <0.01; A vs C,O,H= <0.05	AA vs C,H = <0.01; C vs O= <0.05
AA= African American; C= Caucasian; H= Hispanic; A= Asian; O= Other						

Table 2: Cardio-Pulmonary Comorbidities after Laparoscopic Roux-en-Y Gastric Bypass by Race

Months	Race	HTN	OSA	ANGINA	OHS
Baseline	African American	65.46	45.81	3.16	1.54
	Caucasian	61.18	44.41	3.01	2
	Hispanic	50.18	40.5	1.86	1.26
	Asian	65.66	45.45	1.52	1.52
	Other	53.27	39.12	1.91	1.85
	<i>P</i>	<i>p</i> <0.0001	<0.0001	<0.0001	<0.0001
2	African American	56.36	39.89	2.46	1.46
	Caucasian	50.28	43.09	2.39	1.68
	Hispanic	39.97	34.33	1.39	0.99
	Asian	54.64	39.18	1.55	1.03
	Other	44.57	33.65	1.49	1.47
	<i>P</i>	AA v C,O,H <0.001; H v C, O <0.001	H vs AA,C =<0.01	C vs H =<0.05	AA vs C,H =<0.05
6	African American	49.54	32.16	2.1	1.33
	Caucasian	39.5	33.09	2.01	1.44
	Hispanic	31.17	27.03	1.03	0.86
	Asian	41.18	27.45	1.96	0.98
	Other	37.32	26.16	0.97	0.97
	<i>P</i>	AA v C,O,H <0.0001; H v C,O <0.001	AA vs C =<0.05	NS	NS
12	African American	46.43	26.76	1.77	1.63
	Caucasian	32.75	25.77	1.86	1.34
	Hispanic	25.8	18.51	0.6	0.84
	Asian	32.61	10.87	2.17	(0/46)
	Other	30.67	21.95	0.82	0.92
	<i>P</i>	NS	NS	NS	NS
18	African American	43.07	21.95	2.5	1.17
	Caucasian	29.36	22.33	1.69	1.38
	Hispanic	24.41	19.01	0.7	1.17
	Asian	63.64	27.27	0	(0/11)
	Other	29	18.67	1.67	1.33
	<i>P</i>	AA v C,O,H <0.001	NS	NS	NS
24	African American	43.95	21.73	2.22	2.22
	Caucasian	27.57	20.09	1.57	1.36
	Hispanic	23.08	19.01	0.73	1.47
	Asian		25	0	(0/4)
	Other	28.44	18.01	1.9	(0/211)
	<i>P</i>	AA v C,O,H <0.01	NS	NS	NS

HTN= Hypertension; OSA= Obstructive Sleep Apnea; OHS= Obesity Hypoventilation Syndrome; AA= African American; C= Caucasian; H= Hispanic; A= Asian; O= Other

Table 3: Metabolic and Endocrine Comorbidities after Laparoscopic Roux-en-Y Gastric Bypass by Race

Months	Race	DM	Gout	Dyslipidemia
Baseline	African American	35.94	4.79	30.86
	Caucasian	39.52	3.85	46.87
	Hispanic	38.1	1.7	31.37
	Asian	52.02	4.55	52.02
	Other	37.01	2.92	36.06
	<i>P</i>	<0.0001	<0.0001	<0.0001
2	African American	26.61	3.85	27.24
	Caucasian	27.48	3.38	41.16
	Hispanic	28.61	1.51	27.19
	Asian	39.18	4.12	46.39
	Other	26.24	2.76	32.47
	<i>P</i>	CvsAA,H =<0.0001; OvsH=<0.05	AA vs C,O =<0.05	H vs C,O =<0.01
6	African American	19.6	3.29	22.52
	Caucasian	19.32	2.95	34.06
	Hispanic	20.24	1.14	21.1
	Asian	23.53	0.98	39.22
	Other	19.42	1.78	29.13
	<i>P</i>	C vs AA =<0.01; C vs H =<0.05	NS	H vsAA,O,C =<0.001 HvsA <0.05; CvsH=<0.0001; CvsO=<0.05
12	African American	16.61	3.06	20.39
	Caucasian	14.36	2.74	28.15
	Hispanic	15.43	1.27	15.73
	Asian	15.22	(0/46)	19.57
	Other	13.85	2.15	27.18
	<i>P</i>	NS	NS	A vs AA,C,O =<0.05; HvsAA,C,O =<0.0001
18	African American	12.35	1.67	18.86
	Caucasian	12.55	2.64	25.99
	Hispanic	15.26	0.47	15.96
	Asian	27.27	(0/11)	36.36
	Other	11.67	1.33	26
	<i>P</i>	NS	NS	NS
24	African American	14.32	1.48	20.49
	Caucasian	14.32	2.24	23.81
	Hispanic	11.72	0.73	15.75
	Asian	(0/4)	(0/4)	(0/4)
	Other	11.85	0.47	28.44
	<i>P</i>	NS	NS	NS

DM= Diabetes Mellitus; AA= African American; C= Caucasian; H=Hispanic;
A= Asian; O= Other

Table 4: Abdominal and Hepatobiliary Comorbidities after Laparoscopic Roux-en-Y Gastric Bypass by Race

Months	Race	Cholelithiasis	Abdominal Panniculitis	GERD	Liver Disease	Abdominal Hernia
Baseline	African American	14.46	4.61	43.43	3.96	4.61
	Caucasian	23.16	8.51	52.15	7.79	8.51
	Hispanic	18.89	5.06	39.78	6.69	5.06
	Asian	12.12	5.56	35.35	6.57	5.56
	Other	17.13	5.45	42.94	5.56	5.45
	<i>P</i>	<0.0001	<0.001	<0.0001	<0.001	<0.001
2	African American	14.4	4.48	33.78	3.74	4.48
	Caucasian	22.96	8.15	39.45	7.64	8.15
	Hispanic	18.01	4.65	30.26	6.36	4.65
	Asian	10.82	6.7	25.77	7.22	6.7
	Other	16.7	4.83	33.85	4.89	4.83
	<i>P</i>	AA vs ALL= <0.001; C vs O,A,H= <0.001; A vs O,H= <0.04	C vs AA,H,O= <0.05; A vs O= <0.05	O vs H = <0.05	C vs AA = <0.0001; C vs H = <0.05; C vs O = <0.01	C vs AA,H,O= <0.05; A vs O = <0.05
6	African American	15.64	4.97	26.49	3.62	4.97
	Caucasian	23.1	8.5	29.05	7.27	8.5
	Hispanic	18.36	4.97	22.61	5.54	4.97
	Asian	9.8	4.9	18.63	8.82	4.9
	Other	17.64	5.39	26.86	4.37	5.39
	<i>P</i>	AA vs ALL= <0.001; C vs O,A,H= <0.001; A vs O,H= <0.04	H vs AA,C,O= <0.05	C vs AA,O = <0.05; H vs AA,O = <0.05	C vs AA,A,H = <0.01; A v AA,O = <0.01	H vs AA,C,O= <0.05
12	African American	15.51	5.84	24.61	3.59	5.84
	Caucasian	23.99	9.11	24.79	6.9	9.11
	Hispanic	18.02	4.22	18.63	5.24	4.22
	Asian	13.04	2.17	13.04	13.04	2.17
	Other	17.44	6.05	22.15	4.41	6.05
	<i>P</i>	AA vs ALL= <0.001; C vs O,A,H= <0.001; A vs O,H= <0.04	H vs AA,C,O= <0.05	AA vs C, H = <0.0001	ALL NON-SIGNIFICANT	H vs AA,C,O= <0.05
18	African American	15.03	6.51	22.2	5.68	6.51
	Caucasian	24.68	10.77	24.54	7.25	10.77
	Hispanic	19.01	6.81	15.49	4.46	6.81
	Asian	9.09	(0/11)	9.09	9.09	(0/11)
	Other	18.67	3	21	3.67	3
	<i>P</i>	AA vs ALL= <0.001; C vs O,A,H= <0.001; A vs O,H= <0.04	ALL NON-SIGNIFICANT	H vs C, AA = <0.05	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT
24	African American	14.81	4.2	21.48	4.44	4.2
	Caucasian	23.9	7.79	22.35	4.61	7.79
	Hispanic	15.38	5.86	16.48	3.66	5.86
	Asian	(0/4)	(0/4)	(0/4)	(0/4)	(0/4)
	Other	18.01	3.32	21.33	2.84	3.32
	<i>P</i>	O vs H = <0.04	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT

GERD= Gastroesophageal Reflux Disease; AA= African American; C= Caucasian; H=Hispanic; A= Asian; O= Other

Table 5: Musculoskeletal Comorbidities after Laparoscopic Roux-en-Y Gastric Bypass by Race

Months	Race	Back Pain	Lower Extremity Edema	Musculoskeletal Pain
Baseline	African American	44.01	26.2	26.17
	Caucasian	52.09	32.2	32.24
	Hispanic	42.01	20.5	20.53
	Asian	42.93	24.8	24.75
	Other	41.03	23	22.97
	<i>P</i>	<0.0001	<0.0001	<0.0001
2	African American	38.55	20.55	33.89
	Caucasian	45.17	23.58	41.35
	Hispanic	35.68	15.36	27.69
	Asian	37.63	18.04	31.44
	Other	36.29	17.41	33.16
	<i>P</i>	H vs O,C,AA =<0.05	AA vs C,H =<0.01	C vs AA,H =<0.0001; O vs H =<0.05
6	African American	33.37	17.43	29.87
	Caucasian	37.61	18.12	34.77
	Hispanic	29.03	12.3	23.52
	Asian	29.41	8.82	20.59
	Other	31.07	13.43	28.21
	<i>P</i>	H vs O,C,AA =<0.01	AA vs C,O,H =<0.01	H vs C,O =<0.05
12	African American	31.5	16.75	29.01
	Caucasian	33.39	15.47	30.69
	Hispanic	25.68	9.76	19.53
	Asian	34.78	10.87	17.39
	Other	29.23	12.72	24.92
	<i>P</i>	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT
18	African American	29.05	17.2	26.38
	Caucasian	30.27	14.55	27.8
	Hispanic	19.72	9.62	18.08
	Asian	18.18	9.09	27.27
	Other	29.33	11.67	25
	<i>P</i>	H vs AA,O,C =<0.05	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT
24	African American	27.9	15.31	26.42
	Caucasian	29.85	13.29	26.36
	Hispanic	24.91	8.06	18.68
	Asian	24.91	0	n=4
	Other	32.23	10.43	29.86
	<i>P</i>	O vs H,C,AA =<0.05	ALL NON-SIGNIFICANT	ALL NON-SIGNIFICANT

AA= African American; C= Caucasian; H=Hispanic; A= Asian; O= Other

Table 4: Abdominal and Hepatobiliary Comorbidities after Laparoscopic Roux-en-Y Gastric Bypass by Race

Months	Race	Mental Health Diagnosis	Depression	Psychological Impairment	Alcohol Use
Baseline	African American	6.58	22.96	11.02	27.1
	Caucasian	12.67	40.63	19.75	32.49
	Hispanic	7.59	23.79	11.36	25.2
	Asian	14.14	24.24	18.69	35.35
	Other	7.27	26.31	11.91	24.49
	<i>P</i>	<0.0001	<0.0001	<0.0001	<0.001
2	African American	6.15	21.21	10.19	21.23
	Caucasian	12.17	38.05	18.82	23.08
	Hispanic	7.16	21.59	10.55	20.01
	Asian	12.37	24.74	18.04	28.87
	Other	6.9	24.25	11.21	19.08
	<i>P</i>	C vs AA,O,H =<0.05	C vs AA,H =<0.0001; OvH =<0.05	C vs AA,H =<0.0002; CvsO=<0.05	C vs AA,O,H =<0.0001
6	African American	5.62	19.63	9.38	19.74
	Caucasian	10.91	35.4	16.94	22.18
	Hispanic	6.68	18.87	9.62	18.21
	Asian	11.76	16.67	14.71	27.45
	Other	6.31	23.09	9.98	18.39
	<i>P</i>	C vs AA,A,H =<0.05	AA vs C,O =<0.001; H vs C,O =<0.001	C vs AA, H =<0.01	C vs AA,O,H =<0.05
12	African American	6.22	19.72	9.77	19.29
	Caucasian	10.42	33.98	16.09	22.21
	Hispanic	6.69	17.78	9.22	16.15
	Asian	15.22	17.39	17.39	28.26
	Other	6.26	23.08	9.85	20.51
	<i>P</i>	ALL NON-SIGNIFICANT	H vs O,C,AA =<0.01; AA =<0.05	C vs	ALL NON-SIGNIFICANT
18	African American	6.01	20.03	9.02	17.53
	Caucasian	10.56	33.22	16.39	21
	Hispanic	6.34	17.37	8.22	13.85
	Asian	0	36.36	8.22	27.27
	Other	9.33	26	14.33	20
	<i>P</i>	ALL NON-SIGNIFICANT	AA vs C,O =<0.05; H vs C,O =<0.05	H vs C,O =<0.05; AA vs O =<0.05	ALL NON-SIGNIFICANT
24	African American	7.41	22.72	9.63	19.26
	Caucasian	11.05	34.44	16.51	22.02
	Hispanic	5.13	17.22	7.69	17.22
	Asian	0	N/A	50	25
	Other	8.06	26.54	12.8	20.85
	<i>P</i>	ALL NON-SIGNIFICANT	H vs A,O,C =<0.05; AA,C,O =<0.05	A vs	ALL NON-SIGNIFICANT

AA= African American; C= Caucasian; H=Hispanic; A= Asian; O= Other