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Sociodemographic Correlates of Bariatric Surgery by Procedure Type among a Statewide Ethnically Diverse Patient Population

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ABSTRACT

Florida Agency for Health Care Administration (AHCA) 2013 inpatient data was used to conduct a retrospective review using International Classification of Diseases 9th edition (ICD-9) procedure codes to examine the sociodemographic correlates of three bariatric procedures [Laparoscopic Roux-en-Y Gastric Bypass (RYGB), Laparoscopic Adjustable Gastric Banding (LAGB), and Sleeve Gastrectomy (SG)]. Race-ethnic groups included non-Hispanic white (NHW), non-Hispanic black (NHB), Hispanic, and other. The sample (n=6,424, mean age 46 years) was predominantly NHW (57.4%), female (74.9%), commercial-insurance carriers (51.2%), and severely obese (98.8%). SG was the most common procedure (57.9%) followed by RYGB (39.3%), and LAGB (2.8%). Regardless of bariatric procedure type, over 40% were covered by commercial insurance. The relationship between insurance status and bariatric procedure type was statistically significant (p<0.01). However, race-ethnicity and bariatric procedure relationship was not significant after adjusting for age, sex, and insurance status.

Despite the current high obesity frequencies across all demographics in the state of Florida, NHW women (compared to their sex-ethnic-specific counterparts) in our sample received the highest proportion of bariatric surgeries. Further research should examine why this finding continues despite obesity and its health-related consequences affecting all sex-ethnic groups.

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BACKGROUND

Over the past 15 years, the number of Americans with a body mass index (BMI) of 40 or more kilograms per meter squared (kg/m2) has increased by 50% and those with a BMI $\geq$ 50 kg/m^2 increased by 75% (Ogden et al., 2015; Allison et al., 2008). Those who are severely obese (BMI $\geq$ 40 kg/m^2 or $\geq$ 35 kg/m^2 with $\geq$ 1 co-morbidity) are 2 to 3 times likely to die of preventable diseases than those at a healthy weight (i.e., BMI between 18.5 and 25 kg/m^2) (Allison et al., 2008; Angrisani et al., 2015; Calle et al., 1999).

As of 2016, 39.8% of adults were obese and 7.7% of adults were severely obese, while 18.5% of youth were obese and 5.6% were severely obese (Hales et al., 2018). Stratified by race and ethnicity, statistics show that 47.0% of Hispanic and 46.8% of non-Hispanic black (NHB) adults in the United States (US) were obese, and among non-Hispanic white (NHW), 37.9% were obese, underscoring the race-ethnic disparities among US adults (Angrisani et al., 2015; Hales et al., 2017; Ogden et al., 2015), this same pattern was shown in youth (Hales et al., 2017; Hales et al., 2018).

Bariatric (baros: weight, iatrikos: art of healing) surgery has become not only an increasingly accepted and utilized obesity treatment option when conventional lifestyle change methods (decreased caloric intake, increased physical activity level) fail, but also a safe and medically effective treatment choice for severe obesity (Fryar, Carroll, and Ogden 2012; Allison et al., 2008). Bariatric surgery for those with severe obesity has been shown to be highly effective in reducing body weight and reversing co-morbidities. Several studies show that obese individuals who undergo bariatric surgery have better quality of, and longer lives than those who do not undergo bariatric surgery (Fryar, Carroll, and Ogden 2012; Calle et al., 1999).

A 2016 survey from the American Society of Metabolic and Bariatric Surgery (ASMBS) found that 41% of the obese population are eligible for bariatric surgery (ASMBS, 2016). However, only about one-third of those eligible actually consider bariatric surgery as an option and of those only 1% actually received the surgery (ASMBS, 2016; ASMBS, 2018). Previous studies have found that most patients who

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undergo bariatric surgery are NHW, women, and/or have private insurance (Mainous et al., 2013; Santry et al., 2005; Wallace et al., 2010; Kizy et al., 2017; Obesity Coverage, 2017). Similar to adults, Schilling et al. (2008) found that 68% of children/adolescent who underwent bariatric surgery were white and 72% were female. Yet, race-ethnic minority groups tend to have higher proportions of those eligible for bariatric surgery, based on BMI and co-morbidity diagnoses, than their white counterparts (ASMBS, 2016; Mainous et al., 2013). NHB, men, and the socioeconomically disadvantaged have been under-represented among those who undergo bariatric surgery (Nguyen et al., 2004; Santry et al., 2005; Wallace et al., 2010; Wee et al., 2014). While some bariatric procedure-focused studies have examined subgroups such as minorities (Bayham et al., 2012), elders (Gerhart, Young, and Nguyen 2015; Ramirez et al., 2012) and children (Wasserman and Inge 2014; Thakkar and Michalsky 2015), characteristics of bariatric procedure recipients from Florida have not been reported.

With a population over 20 million, Florida's racial and ethnic demographics are made up of 54.1% NHW, 25.6% Hispanic, 16.1% NHB, and 4.2% other (World Population Review 2018). A report by the Robert Wood Johnson Foundation (RWJF) stated that 28% of adults were obese with ethnic minority groups being disproportionately affected (i.e., 35% NHB, 28% Hispanic versus 26% NHW) (RWJF, 2017). Youth rates of obesity in Florida are among the highest, as 36% of children aged 10-17 are obese, ranking 4th in the nation for childhood obesity (RWJF, 2017). By 2030, almost 60% of Floridians are projected to be obese if these trends continue (Florida Health, 2013) and could result in an economic impact costing the state $34 billion dollars in health care over the next 17 years (Florida Medical Association 2014).

Thus, this study aimed to (1) describe the characteristics of Florida inpatients who underwent bariatric surgery; (2) compare the prevalence of bariatric procedure by insurance status, and (3) evaluate the relationship between socio-demographic factors for each bariatric procedure among patients admitted in Florida hospitals in 2013. We hypothesize that the choice to undergo (or not) bariatric procedure depends on the type of insurance coverage and out-of-pocket cost individuals might incur.

METHODS

Data Source

A retrospective cross-sectional study was performed using the 2013 Florida Agency for Health Care Administration (AHCA) inpatients data. The AHCA maintains an administrative database that includes discharge and financial data from all long-term acute, short-term acute, and short-term acute care psychiatric hospitals in Florida (AHCA, 2017). The data do not contain any personal identifiers; hence, the Institutional Review Board approval was exempt.

Sample Selection

Patients who were 16 years and older and who underwent any bariatric procedure were identified using the following seven International Classification of Diseases 9th edition Clinical Modification (ICD-9-CM) codes: 43.82, 43.89, 44.38, 44.68, 44.95, and 44.96. These six codes were further categorized into three main procedures: Laparoscopic Roux-en-Y Gastric Bypass (RYGB), Laparoscopic Adjustable Gastric Banding (LAGB), and Sleeve Gastrectomy (SG). Of approximately 2.6 million discharge records in Florida in 2013, our analysis was restricted to 6,424 records of 16 years and older with known bariatric procedure codes.

Clinical Criteria and Definitions of Bariatric Procedure

The National Institutes of Health (NIH) has established eligibility criteria for bariatric procedure. They are: (1) adults with a BMI $\geq$ 40 kg/m^2 or BMI $\geq$ 35 kg/m^2 with at least one co-morbidity (i.e., diabetes, hypertension, or coronary heart disease) or a BMI $\geq$ 30 kg/m^2 with a serious health problem linked to obesity (recommended procedure being LAGB only); (2) children 18 years and younger with severe obesity (BMI $\geq$ 40 kg/m^2 and have reached their adult height) and/or those with an established history of serious health problems due to the excess weight (Gebhart, Young, and Nguyen 2015; Wasserman and Inge 2014; Khan et al., 2016).

This study focuses on three common (RYGB, LAGB, and SG) bariatric procedures performed in 2013. The RYGB procedure reduces the stomach size to a small pouch, roughly the size of an egg (ASMBS, 2013). The SG procedure is performed by removing roughly 80% of the stomach (Bayham et al., 2012). Although SG is originally the first step in a two-step bariatric process, it has now become a primary procedure of its own attributing to its high achievement in inducing weight loss (Bayham et al., 2012). The LAGB procedure is the least invasive procedure; it uses an inflatable band that can adjust, dependent upon how much of the stomach needs to be restricted (Angrisiani et al., 2015).

Covariates

Age (years) and total hospital charges (US $) were treated as continuous variables. Age was also categorized at above or below median age (46 years) and included in the regression models. Self-reported gender was dichotomized as female and male. Self-reported race-ethnicity was categorized into four mutually exclusive groups (NHW, NHB, Hispanic, and Other). Insurance status was defined and grouped as follows: (1) Commercial (health maintenance organization (HMO), preferred provider organization (PPO) insurance, or commercial liability coverage);

(2) Federal (Medicare, Medicare managed care, Tri-care, or other federal government-sponsored insurance); (3) State (Medicaid, Medicaid managed care, worker's compensation, or other state or local government-sponsored insurance); and (4) Uninsured or Underinsured (self-pay, non-payment, kid-care, or others). Type of admission was dichotomized (emergency versus elective/urgent) and discharge status was categorized into three groups (discharged home, discharged to another facility for continued care, or died in hospital).

Both ICD9-CM diagnosis codes and V-codes were used to cross-validate inpatient's weight status. The ICD9-CM diagnosis codes and V-codes were used to categorize and define weight status into three groups: (1) overweight was defined as having an adult (> 20 years old) BMI between 25 kg/m^2 and 29.9 kg/m^2 or a pediatric (< 20 years old) BMI between the 85th and < 95th percentile adjusted for age and sex (ICD-9-CM code of 278.02, or V-codes of V85.0, V85.1, V85.22, V85.23, V85.24, or V85.25); (2) obesity was defined as having an adult BMI between 30 kg/m^2 and 39.9 kg/m^2 or a pediatric BMI $\geq$ 95th percentile adjusted for age and sex (ICD-9-CM code of 278.00 or V-codes of V85.30, V85.31, V85.32, V85.33, V85.34, V85.35, V85.36, V85.37, V85.38, or V85.39); and (3) severe obesity was defined as having an adult BMI $\geq$ 40 kg/m^2 or a pediatric BMI > 95th percentile adjusted for age and sex (ICD-9-CM code of 278.01 or V-codes of V85.40, V85.41, V85.42, V85.43, V85.44, V85.45, V85.51, V85.52, V85.53, or V85.54) (National Institute of Diabetes and Digestive Kidney Diseases (NIDDK), 2017).

Statistical Analyses

Explanatory data analyses were performed with frequencies and percentages for categorical variables and with mean and standard deviation for continuous variables. Hypothesis testing was conducted with appropriate statistical tests for continuous (Student's t-tests or one-way ANOVA) and categorical (Chi-square or Fisher's exact tests) variables. The relationship between socio-demographic (age, sex, race-ethnicity, and insurance status) factors and each bariatric procedure type were examined by fitting a multivariable logistic regression model for RYGB, LAGB, and SG, respectively. Age (< 46 vs. $\geq$ 46 years), sex (female vs. male), race-ethnicity (NHW, NHB, Hispanic vs. Other as the reference group), and insurance status (Federal, State, Uninsured/Underinsured vs. Commercial insurance as the referent group) were simultaneously adjusted in each of three models. Adjusted odds ratio (aOR) and corresponding 95% confidence interval (CI) were calculated. All data management and statistical analyses were performed with SAS v9.4 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Descriptive Statistics

Of 2,673,465 discharge records, our analysis was restricted to 6,424 (approximately 0.24%) records with valid bariatric procedure codes. The mean (standard deviation or SD) age of patients was 46 (13) years. There were more females (*74.9%*) than males (25.1%) in our sample. The most common bariatric procedure was SG (57.9%) followed by RYGB (39.3%), and LAGB (2.8%). The majority of patients were NHW (*57.4%*) and almost all (98.8%) were severely obese. Most admission (98.7%) types were for elective surgery and most were discharged (96.3%) home after the procedure (Table 1).

Over a half of NHW (56.5%) opted for the most common procedure (SG) followed by Hispanic (20.3%), NHB (19.9%), and Other (3.3%) ($p < 0.0001$). A similar pattern was observed for the RYGB procedure with the following race-ethnic-specific proportions: NHW (59.0%) followed by Hispanic (22.5%), NHB (15.4%), and Other (3.0%) ($p<0.0001$). However, for the LAGB procedure, the distribution varied with 61.9% NHW, 20.4% NHB, 13.8% Hispanic, and 3.9% Other ($p < 0.0001$) (Figure 1).

Over a half (*51.2%*) of patients had Commercial insurance while others had either Federal- (*25.7%*) or State-sponsored (*10.9%*) insurance with about *12%* being Uninsured/Underinsured patients. Regardless of type of procedure, over 40% of patients were Commercial insurance carriers. Federally sponsored carrier was the most common insurance for the LAGB patients but it was the second most common insurance in RYGB and SG patients. State-sponsored insurance was reported in 16.2% of RYGB, 7.7% of SG and 4.4% of LAGB recipients. Approximately 14.4% (SG), 9.1% (RYGB), and 8.2% (LAGB) recipients were Uninsured/Underinsured in our sample. The relationship between insurance status and bariatric procedure type was statistically significant ($p < 0.0001$) (Figure 2).

Variation in total hospital charges (US $) was also observed between procedure types. The average hospital charges were the highest for the RYGB ($ 73,882) followed by SG ($ 59,403), and LAGB ($ 55,776) procedure. The median hospital charges followed the same pattern as the average charges: RYGB ($ 60,511) followed by SG ($ 50,665), and LAGB ($ 48,979) procedure (Table 2). Of note in Table 1, two overweight (BMI 25 to 29.9 kg/m^2) patients underwent bariatric surgery of which one received LAGB and one received SG procedure. Three patients died in hospitals and all were recipients of the RYGB procedure, i.e., 0.05% of the sample population.

Sociodemographic Correlates

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The odds of undergoing the SG procedure were lower in women than in men (*aOR: 0.87, 95% CI: 0.77-0.98*). However, the odds of undergoing the RYGB (*aOR: 1.12, 95% CI: 0.99-1.26*) and LAGB (*aOR: 1.34, 95% CI: 0.93-1.92*) procedure were higher in women than in men. Sex-RYGB and sex-LAGB relationships were not statistically significant. Race-ethnicity was only significant for NHB undergoing RYGB or SG, otherwise race-ethnicity was not a significant factor for any of the three bariatric procedures after adjusting for age, sex, and insurance status (Table 3). Insurance status (specifically Federal versus Commercial insurance carrier) was a significant factor regardless of bariatric procedure type. Both Federal and State carriers were less, but Uninsured/Underinsured inpatients (*aOR: 1.29, 95% CI: 1.09-1.53*) were more likely than Commercial insurance carriers to receive the SG procedure. In contrast, Federal and State carriers were more, but Uninsured/Underinsured inpatients were less likely than Commercial carriers to receive the RYGB procedure ($p < 0.001$). Federal insurance carriers (versus Commercial carriers) were about two times likely to receive the LAGB (*aOR: 2.32, 95% CI: 1.65-3.25*).

Table 1: Characteristics of Florida inpatients by bariatric procedure types (n = 6,424): 2013 Florida Agency for Health Care Administration (AHCA) data.

			Bariatric Procedure						
	Total		**RYGB**		**LAGB**		**SG**		**P-Value**
	n	**%***	**n**	**%***	**n**	**%***	**n**	**%***	
	6,424	**100.00**	**2,525**	**39.31**	**182**	**2.83**	**3717**	**57.86**	
Age (years)									<0.0001
Mean (SD)**	46 (13)		46 (13)		51 (14)		46 (13)		
Median	46 (36; 56)		46		52		46		
25th% (75th%)	36 (56)		37 (56)		41 (63)		36 (55)		
Minimum (Maximum)	16 (89)		16 (84)		16 (75)		16 (89)		
Sex									0.10
Male	1,612	25.09	606	24.00	39	21.43	967	26.02	
Female	4,812	74.91	1,919	76.00	143	78.57	2750	73.98	
Race/Ethnicity* **									<0.0001
Non-Hispanic White	3,684	57.35	1,486	59.04	112	61.88	2086	56.47	
Non-Hispanic Black	1,161	18.07	388	15.42	37	20.44	736	19.92	
Hispanic	1,343	20.91	567	22.53	25	13.81	751	20.33	
Other	204	3.18	76	3.02	7	3.87	121	3.28	
Weight Status									<0.0001
Overweight	2	0.03	0	0	1	0.55	1	0.03	
Obesity	75	1.17	22	0.87	11	6.04	42	1.13	
Severe Obesity	6,347	98.80	2,503	99.13	170	93.41	3674	98.84	

Discharge Status**									0.02
Home	6,186	96.34	2,409	95.48	176	98.70	3,601	96.91	
To another facility	232	3.61	111	4.40	6	3.30	115	3.09	
Died	3	0.05	3	0.12	0	0.00	0	0.00	
Type of Admission									<0.0001
Emergency	34	0.53	7	0.28	12	6.59	15	0.40	
Urgent/elective	6,390	98.67	2,518	99.72	170	93.41	3702	99.60	

*Column Percentage

**SD: standard deviation

***missing=32

****missing=3

Overweight: BMI between 25kg/m^2 and 29.9 kg/m^2

Obesity: BMI between 30kg/m^2 and 39.9 kg/m^2

Severe Obesity: BMI $\geq$ 40 kg/m^2

BMI = Body Mass Index; kg/$m^{2:}$ kilograms per meters squared

RYGB: Laparoscopic Roux-en-Y Gastric Bypass

LAGB: Laparoscopic Adjustable Gastric Banding

SG: Sleeve Gastrectomy

Table 2: Insurance status and total hospital charges by bariatric procedure types among Florida inpatients (n = 6,424): 2013 Florida Agency for Health Care Administration (AHCA) data.

	Total		PROCEDURE TYPES						
			RYGB		LAGB		SG		P-Value
	n	%*	n	%*	n	%*	n	%*	
	6,424	**100**	**2,525**	**39.31**	**182**	**2.83**	**3,717**	**57.86**	
Insurance Status									<0.0001
Commercial (HMO/PPO)	3,287	51.17	1,117	44.23	73	40.11	2,097	56.42	
Federal (Medicare, etc.)	1,652	25.72	770	30.50	86	47.25	796	21.42	
State (Medicaid, etc.)	705	10.97	409	16.20	8	4.40	288	7.74	
Uninsured/ Underinsured	780	12.14	229	9.07	15	8.24	536	14.42	
Total Hospital Charges (US $)									<0.0001
Mean (SD)**	65,007 (59,017)		73,882 (83,904)		55,776 (30,526)		59,403 (33,234)		
Median 25th% (75th%)	54,234 42,301 (77,589)		60,511 46,549 (87,631)		48,979 36,921 (66,183)		50,665 39,547 (73,365)		
Minimum (Maximum)	7,457 (3,197,434)		7,457 (3,197,434)		16,218 (257,146)		19,181 (885,908)		

*Column Percentage

**SD: standard deviation

RYGB: Laparoscopic Roux-en-Y Gastric Bypass

LAGB: Laparoscopic Adjustable Gastric Banding

SG: Sleeve Gastrectomy

HMO: Health Maintenance Organization

PPO: Preferred Provider Organization

Table 3: Odds of each bariatric procedure type among Florida inpatients - Results of three multivariable logistic regression models: 2013 Florida Agency for Health Care Administration (AHCA) data.

Characteristics	**RYBG**		**LAGB**		**SG**	
	aOR (95% CI) *	P-value	aOR (95% CI) *	P-value	aOR (95% CI) *	P-value
Age						
< 46 years (vs. ≥ 46 years)	1.02 (0.91, 1.14)	0.746	0.79 (0.57, 1.11)	0.177	1.00 (0.90, 1.13)	0.895
Sex						
Female (vs. Male)	1.12 (0.99, 1.26)	0.071	1.34 (0.93, 1.92)	0.119	0.87 (0.77, 0.98)	0.02
Race/Ethnicity						
NHB (vs. Other)	0.70 (0.51, 0.96)	<0.001	0.94 (0.41, 2.15)	0.434	1.43 (1.05, 1.95)	<0.001
Hispanic (vs. Other)	1.03 (0.76, 1.41)	0.086	0.59 (0.25, 1.40)	0.085	1.02 (0.75, 1.39)	0.251
NHW (vs. Other)	1.05 (0.78, 1.41)	0.22	0.81 (0.37, 1.77)	0.941	0.98 (0.73, 1.32)	0.294
Insurance						
Federal (vs. Commercial)	1.70 (1.50, 1.93)	<0.001	2.32 (1.65, 3.25)	<0.001	0.53 (0.47, 0.60)	<0.001
State (vs. Commercial)	2.72 (2.29, 3.22)	<0.001	0.56 (0.27, 1.17)	0.261	0.38 (0.352 0.46)	<0.001
Uninsured/ Underinsured (vs. Commercial)	0.77 (0.65, 0.92)	<0.001	0.92 (0.53, 1.63)	0.577	1.29 (1.09, 1.53)	<0.001

*aOR = Adjusted Odds Ratio; CI = Confidence Interval

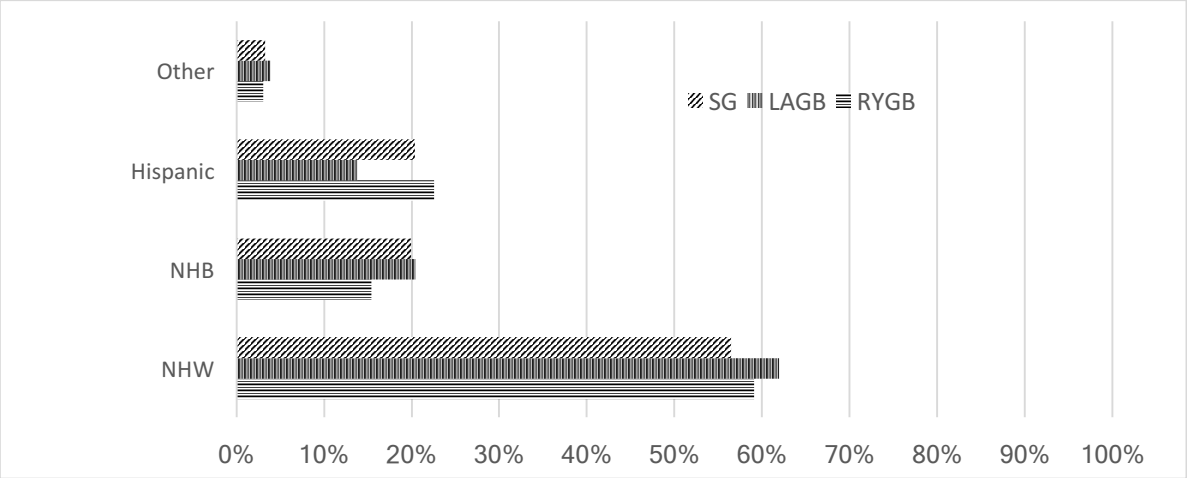
RYGB: Laparoscopic Roux-en-Y Gastric Bypass

LAGB: Laparoscopic Adjustable Gastric Banding

SG: Sleeve Gastrectomy

All characteristic variables are simultaneously adjusted in each model.

Figure 1: Bariatric Procedure Types by Race/Ethnicity among Florida inpatients: 2013 Florida Agency for Health Care Administration (AHCA) data.



RYGB: Laparoscopic Roux-en-Y Gastric Bypass

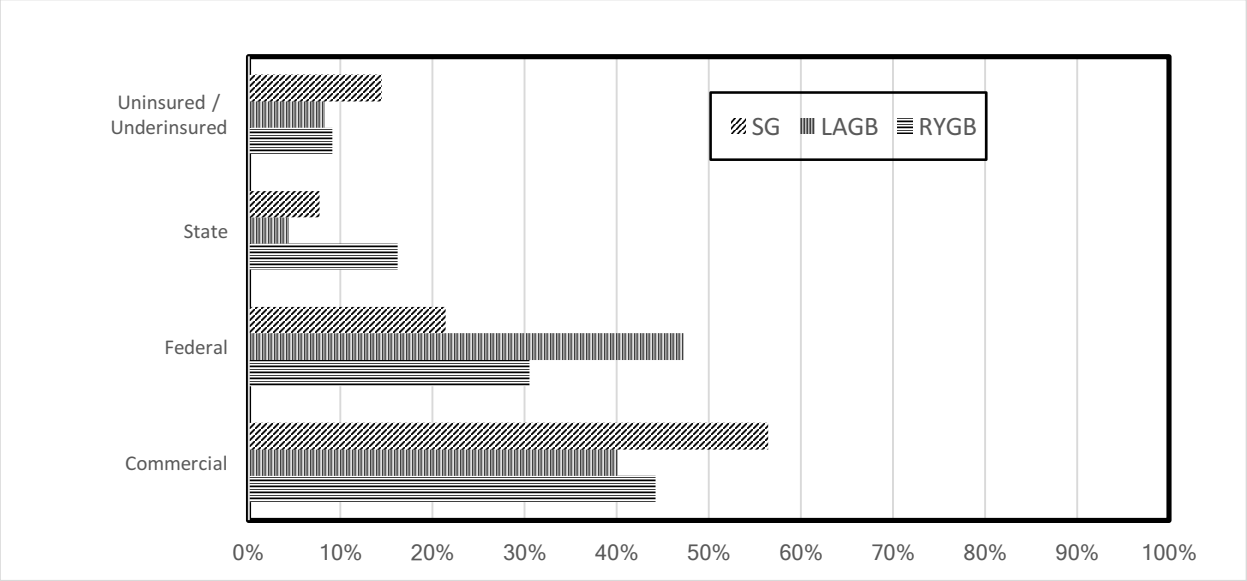
LAGB: Laparoscopic Adjustable Gastric Banding

SG: Sleeve Gastrectomy

NHB: non-Hispanic black

NBW: non-Hispanic white

Figure 2: Bariatric Procedure Types by Insurance Status among Florida inpatients: 2013 Florida Agency for Health Care Administration (AHCA) data.



RYGB: Laparoscopic Roux-en-Y Gastric Bypass

LAGB: Laparoscopic Adjustable Gastric Banding

SG: Sleeve Gastrectomy

DISCUSSION

This study examined the prevalence of three bariatric procedures among patients who were admitted in Florida hospitals in 2013. About 0.24% of hospital admissions were related to bariatric procedures. Race-ethnicity and bariatric procedure type was not significantly related in our study.

Based on the national and state statistics, ethnic minority groups are disproportionately affected by obesity problems compared to their NHW counterparts (Finkelstein et al., 2009; Cawley and Meyerhoefer 2012). Following a similar trend as the US, minorities are overrepresented among the obese group in Florida (Florida Medical Association 2014). Obesity prevalence is higher in NHB (35.6%) and Hispanic (27.9%) compared to NHW (25%) (Florida Medical Association 2014). Similarly, the literature has shown that the proportion of NHB women with BMI $\geq$ 40 kg/m^2 is twice that of Hispanic and NHW women (Sturm and Hattori, 2013). Both NHB and Hispanics, regardless of gender, are underrepresented in bariatric surgery utilization in our study. Our results indicate that most patients who undergo bariatric surgery are NHW women. Our findings are consistent with previous research and demonstrate that minority men and women in need of bariatric procedure are not receiving it or receiving it at a lower frequency than their NHW counterparts (Mainous et al., 2013). Further investigation is needed to understand the disconnect and differences between those receiving bariatric procedures and those specific populations eligible for bariatric procedures.

Concurring with emerging evidence from recent studies, our results indicated that SG was the most common procedure among Florida inpatients (Vanek 2005; Nguyen et al., 2013; Lazzati et al., 2014; Khan et al., 2016). RYGB was the second most common procedure with over 99% of patients being severely obese. Literature indicated that the RYGB procedure was specifically recommended for severely obese patients, as it was the most invasive procedure and produced a significant amount of weight loss that may not be needed for patients who were overweight or at the lower end of obesity as defined by BMI (Bayham et al., 2012; Arterburn and Courcoulas, 2014). Additionally, Bayham et al., (2012) found that although RYGB produced more weight loss, the peri- and early post-operative complications were significantly greater in patients who underwent RYGB procedure than those who underwent SG procedure. This may be the reason that Florida inpatients (or Florida surgeons) favored the SG procedure for its low peri- and post-operative risks (Bayham et al., 2012; Benaiges et al., 2015).

Similar patterns within each race-ethnic group were seen, as the majority (i.e., number) of each group selected SG, followed by RYGB, and LAGB. A significant association between bariatric procedure type and NHB (versus other) was found. We did not find any significant association between bariatric procedure types and other race-ethnic group comparisons (i.e., NHW and Hispanic versus other) after adjusting for age, sex, and insurance status in our models. Since the means of receiving bariatric procedure information, gaining accessibility to receive such procedure, and affording bariatric procedure treatment options can be confusing to individuals; future studies should collect data on these characteristics and their variations between race-ethnic groups. Future studies should also examine the race-ethnic differences in the choice of procedure and how much of such choice was dependent upon the individual goals of therapy, risk of procedure, cost, expertise of patient's surgeon, and quality/quantity of information received prior to bariatric procedures.

We hypothesized that the choice to undergo (or not) bariatric procedure depends on the type of insurance coverage and out-of-pocket cost individuals might incur. In our analysis, we found statistically significant differences between bariatric procedure and insurance status. However, research has shown that insurance coverage and cost is not the driving factor in a person deciding upon bariatric procedure (Wee et al., 2013; Kim and Basu 2016). Health concerns and pre-existing medical conditions were the driving factors in a person's decision to undergo bariatric surgery (Trasande et al., 2009; Wee et al., 2013). Regardless, the costs of bariatric surgery vary by procedure type. In the US, the average procedure cost of RYGB is $ 23,000 followed by SG at $ 14,900 and LAGB at $ 14,500 (Kim and Basu 2016). These costs do not consider hospital room, post-operation monitoring, and other costs incurred during hospital stay. Furthermore, coverage for these costs is dependent upon a patient's insurance policy. Although cost is not synonymous with "hospital charges", the most common (SG) procedure among Florida patients had the mean and median hospital charges right between charges of RYGB and LAGB procedures in our study.

Further, the Florida AHCA data lack a socio-economic status (SES) variable at individual patient level, thus insurance status may serve as a surrogate for SES. Wallace et al. (2010), found that privately insured patients were "eight times more likely to obtain bariatric surgery" than those covered by other insurances programs. In that regard, a study by Mainous et al. (2013), found evidence consistent with our findings that demonstrated that although blacks had a higher proportion of persons eligible for bariatric surgery than whites, whites had higher rates of inpatient bariatric surgery utilization. Insurance coverage between these populations were different as well, as 21% of eligible blacks had no insurance, and only 1% of blacks who received bariatric surgery had

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no insurance; with the majority of inpatients having either Commercial or Federal insurance coverage (Mainous et al., 2013). Only about 11% of our sample carried State (e.g., Medicaid) insurance and another 12% lacked adequate insurance. Future studies should explore the racial-ethnic and insurance-status as well as other characteristic (e.g., socio-economic and clinical) differences of bariatric procedure recipients.

As disparity amongst race-ethnic, insurance status, and gender groups exists, new efforts to encourage these groups to seek bariatric procedures are warranted. Education for both providers and eligible patients on the benefits of bariatric surgery should be provided. In a study by Wee et al. (2014), they found that physicians were less likely to recommend bariatric surgery to minority patients even though minorities would be just as likely to consider undergoing surgery as whites, if recommended by their physician. In terms of personal reasons why patients might not consider surgery, Wee et al. (2014) found that "perceived risk of surgery rather than economic barriers was the most important deterrent cited by patients". Thus, bringing awareness regarding socio-demographic disparities in bariatric procedure utilization can inspire providers to recommend such procedure as an option. Also, providers could be prepared to offer information regarding these procedures (risks, benefits, costs, insurance coverage) to all eligible patients. These strategies (provider awareness and education) could likely increase appreciation of these procedures among under-represented populations to utilize them, if warranted. This may, in turn, minimize the socio-demographic differences in bariatric procedure utilization.

Policy can also play an important role in increasing bariatric utilization. As Florida has not yet expanded Medicaid (Henry J. Kaiser Family Foundation or KFF, 2018), policy makers should consider this as an option in an effort to increase access to care for eligible, uninsured populations. Providing an opportunity for eligible uninsured persons to receive bariatric surgery would also reduce socio-demographic disparities in access and utilization of such surgery.

Three study limitations should be noted. First, to protect the privacy of patients, the AHCA data contained no personal identifiers and our sample was based on records and not individuals. Since bariatric procedure is usually not performed more than once per patient in a calendar year, the unit of analysis in our study is likely to be individuals. The procedures could have included both the initial and revision bariatric procedures (ASMBS, 2013; Meyer et al., 2017). Second, it is likely that potential misclassification of weight status may exist. However, we used both ICD-9-CM and V-code assignments to cross-check the weight status and such use may have reduced misclassification. Third, the total hospital charges do not equate "procedure cost." As hospital charges and cost depend on multiple factors including health insurance status and hospital length of stay, health economic studies to estimate the true cost of procedure are recommended.

CONCLUSION

This retrospective study of Florida statewide inpatient data shows that sociodemographic factors differ by bariatric procedure types. Despite the current high obesity frequencies across all demographics in the state of Florida, NHW women (compared to their sex-ethnic-specific counterparts) in our sample received the highest proportion of bariatric surgeries. In summary, our study supports previous findings that show utilization of bariatric surgery is lower among minority groups and those without private insurance coverage. Findings of race-ethnic variations in specific bariatric procedure type have important clinical, public health, and economic implications. We recommend raising awareness of socio-demographic disparities in bariatric procedure utilization and knowledge about them among providers, eligible patients, and policy makers. Education and information should be provided to all eligible individuals regardless of race-ethnicity, and insurance status about all weight-loss treatment modalities (i.e., behavioral, medical, and surgical) to combat obesity epidemics in the state.

REFERENCES

Agency for Health Care Administration (AHCA), 2017. Florida Center for Health Information and Policy Analysis: Patient Databases General Information. https://fhfstore.blob.core.windows.net/documents/researchers/OrderData/documents/KeyDifferences%20(Revised%202016).pdf. Accessed January 20 2017.

Allison, D. B., Downey, M., Atkinson, R. L., Bollington, C. J., Bray, G. A., Meckel, R. H., . . . Tremblay, A. (2008). Obesity as a disease: a white paper on evidence and arguments commissioned by the Council of the Obesity Society. *Obesity (Silver Spring), 16*(6), 1161-1177. doi:10.1038/oby.2008.231

American Society for Metabolic and Bariatric Surgery (ASMBS). Current Procedural Terminology (CPT®) and International Classification of Diseases 9th edition (ICD-9) Codes for Bariatric Surgery, https://asmbs.org/wp/uploads/2012/01/1CPTandICD-9-Codes-for-Bariatric-Surgery-updated-Feb-2013d.pdf. Accessed January 20, 2017.

American Society for Metabolic and Bariatric Surgery (ASMBS) and NORC at the University of Chicago. (2016). New Insights Into Americans' Perceptions and Misperceptions of Obesity Treatments, and the Struggles Many Face. October 2016. http://www.norc.org/PDFs/ASMBS%20Obesity/Issu

e%20Brief%20B_ASMBS%20NORC%20Obesity%20Poll.pdf

American Society for Metabolic and Bariatric Surgery (ASMBS). (2018). Estimate of Bariatric Surgery Numbers, 2011-2017. June 2018. https://asmbs.org/resources/estimate-of-bariatric-surgery-numbers. Accessed October 20, 2018.

Angrisani, L., Santonicola, A., Iovino, P., Formisano, G., Buchwald, H., & Scopinaro, N. (2015). Bariatric Surgery Worldwide 2013. *Obes Surg, 25*(10), 1822-1832. doi:10.1007/s11695-015-1657-z

Arterburn, D. E., & Courcoulas, A. P. (2014). Bariatric surgery for obesity and metabolic conditions in adults. *BMJ, 349*, g3961. doi:10.1136/bmj.g3961

Bayham, B. E., Bellanger, D. E., Hargroder, A. G., Johnson, W. D., & Greenway, F. L. (2012). Racial differences in weight loss, payment method, and complications following Roux-en-Y gastric bypass and sleeve gastrectomy. *Adv Ther, 29*(11), 970-978. doi:10.1007/s12325-012-0062-4

Benaiges, D., Mas-Lorenzo, A., Goday, A., Ramon, J. M., Chillaron, J. J., Pedro-Botet, J., & Flores-Le Roux, J. A. (2015). Laparoscopic sleeve gastrectomy: More than a restrictive bariatric surgery procedure? *World J Gastroenterol, 21*(41), 11804-11814. doi:10.3748/wjg.v21.i41.11804

Calle, E. E., Thun, M. J., Petrelli, J. M., Rodriguez, C., & Heath, C. W., Jr. (1999). Body-mass index and mortality in a prospective cohort of U.S. adults. *N Engl J Med, 341*(15), 1097-1105. doi:10.1056/NEJM199910073411501

Cawley, J., & Meyerhoefer, C. (2012). The medical care costs of obesity: an instrumental variables approach. *J Health Econ, 31*(1), 219-230. doi:10.1016/j.jhealeco.2011.10.003

Finkelstein, E. A., Trogdon, J. G., Cohen, J. W., & Dietz, W. (2009). Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff (Millwood), 28*(5), w822-831. doi:10.1377/hlthaff.28.5.w822

Florida Health. (2013) Healthiest Weight Florida.http://www.floridahealth.gov/programs-and-services/prevention/healthy-weight/index.html. Assessed September 26, 2013.

Florida Medical Association. Florida Healthiest Weight: A Life Course Approach. (2014) https://med.fsu.edu/userFiles/file/HealthiestWeightLifeCourseApproach-8-11-14.pdf. Accessed August 11, 2014.

Fryar CD, Carroll MD, Ogden CL. (2012). Prevalence of overweight, obesity, and extreme obesity among adults: United States, trends 1960–1962 through 2009–2010. NCHS Health E-stat.

http://www.cdc.gov/nchs/data/hestat/obesity_adult_09_10/obesity_adult_09_10.htm. Accessed January 10, 2014.

Gebhart, A., Young, M. T., & Nguyen, N. T. (2015). Bariatric surgery in the elderly: 2009-2013. *Surg Obes Relat Dis, 11*(2), 393-398. doi:10.1016/j.soard.2014.04.014

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). Prevalence of Obesity among Adults and Youth: United States, 2015-2016. *NCHS Data Brief* (288), 1-8.

Hales, C. M., Fryar, C. D., Carroll, M. D., Freedman, D. S., & Ogden, C. L. (2018). Trends in Obesity and Severe Obesity Prevalence in US Youth and Adults by Sex and Age, 2007-2008 to 2015-2016. *JAMA*. doi:10.1001/jama.2018.3060

Henry J. Kaiser Family Foundation (KFF). (2018). Status of State Action on the Medicaid Expansion Decision. Updated September 11, 2018. https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D Accessed October 12, 2018.

Khan, S., Rock, K., Baskara, A., Qu, W., Nazzal, M., & Ortiz, J. (2016). Trends in bariatric surgery from 2008 to 2012. *Am J Surg, 211*(6), 1041-1046. doi:10.1016/j.amjsurg.2015.10.012

Kim, D. D., & Basu, A. (2016). Estimating the Medical Care Costs of Obesity in the United States: Systematic Review, Meta-Analysis, and Empirical Analysis. *Value Health, 19*(5), 602-613. doi:10.1016/j.jval.2016.02.008

Kizy, S., Jahansouz, C., Downey, M. C., Hevelone, N., Ikramuddin, S., & Leslie, D. (2017). National Trends in Bariatric Surgery 2012–2015: Demographics, Procedure Selection, Readmissions, and Cost. *Obesity Surgery, 27*(11), 2933-2939. doi:10.1007/s11695-017-2719-1

Lazzati, A., Guy-Lachuer, R., Delaunay, V., Szwarcensztein, K., & Azoulay, D. (2014). Bariatric surgery trends in France: 2005-2011. *Surg Obes Relat Dis, 10*(2), 328-334. doi:10.1016/j.soard.2013.07.015

Mainous, A. G., Johnson, S. P., Saxena, S. K., & Wright, R. U. (2013). Inpatient Bariatric Surgery Among Eligible Black and White Men and Women in the United States, 1999–2010. *The American Journal Of Gastroenterology, 108*, 1218. doi:10.1038/ajg.2012.365

Meyer, S. B., Thompson, C., Hakendorf, P., Horwood, C., McNaughton, D., Gray, J., . . . Chisholm, J. (2017). Bariatric surgery revisions and private health insurance. *Obes Res Clin Pract, 11*(5), 616-621. doi:10.1016/j.orcp.2017.04.009

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Overweight and Obesity Statistics. http://www.niddk.nih.gov/health-information/health-statistics/Pages/overweight-obesity-statistics.aspx. Accessed August 1, 2017.

Nguyen, N. T., Paya, M., Stevens, C. M., Mavandadi, S., Zainabadi, K., & Wilson, S. E. (2004). The relationship between hospital volume and outcome in bariatric surgery at academic medical centers. *Ann Surg, 240*(4), 586-593; discussion 593-584.

Nguyen, N. T., Nguyen, B., Gebhart, A., & Hohmann, S. (2013). Changes in the makeup of bariatric surgery: a national increase in use of laparoscopic sleeve gastrectomy. *J Am Coll Surg, 216*(2), 252-257. doi:10.1016/j.jamcollsurg.2012.10.003

Obesity Coverage. Weight loss surgery insurance coverage and costs. http://www.obesitycoverage.com/weight-loss-surgery-insurance-coverage-and-costs/. Accessed February 21, 2017.

Ogden, C. L., Carroll, M. D., Fryar, C. D., & Flegal, K. M. (2015). Prevalence of Obesity Among Adults and Youth: United States, 2011-2014. *NCHS Data Brief* (219), 1-8.

Ramirez, A., Roy, M., Hidalgo, J. E., Szomstein, S., & Rosenthal, R. J. (2012). Outcomes of bariatric surgery in patients >70 years old. *Surg Obes Relat Dis, 8*(4), 458-462. doi:10.1016/j.soard.2012.04.001

Robert Wood Johnson Foundation (RWJF). (2017). The State of Obesity in Florida. https://stateofobesity.org/states/fl/

Santry, H. P., Gillen, D. L., & Lauderdale, D. S. (2005). Trends in bariatric surgical procedures. *JAMA, 294*(15), 1909-1917. doi:10.1001/jama.294.15.1909

Sturm, R., & Hattori, A. (2013). Morbid obesity rates continue to rise rapidly in the United States. *Int J Obes (Lond), 37*(6), 889-891. doi:10.1038/ijo.2012.159

Thakkar, R. K., & Michalsky, M. P. (2015). Update on bariatric surgery in adolescence. *Curr Opin Pediatr, 27*(3), 370-376. doi:10.1097/MOP.0000000000000223

Trasande, L., Liu, Y., Fryer, G., & Weitzman, M. (2009). Effects of childhood obesity on hospital care and costs, 1999-2005. *Health Aff (Millwood), 28*(4), w751-760. doi:10.1377/hlthaff.28.4.w751

Vanek, V. W. (2005). State laws on insurance coverage for bariatric surgery: help or a hindrance? *Surg Obes Relat Dis, 1*(4), 424-429. doi:10.1016/j.soard.2005.05.001

Wallace, A. E., Young-Xu, Y., Hartley, D., & Weeks, W. B. (2010). Racial, Socioeconomic, and Rural–Urban Disparities in Obesity-Related Bariatric Surgery. *Obesity Surgery, 20*(10), 1354-1360. doi:10.1007/s11695-009-0054-x

Wasserman, H., & Inge, T. H. (2014). Bariatric surgery in obese adolescents: opportunities and challenges. *Pediatr Ann, 43*(9), e230-236. doi:10.3928/00904481-20140825-10

Wee, C. C., Huskey, K. W., Bolcic-Jankovic, D., Colten, M. E., Davis, R. B., & Hamel, M. (2014). Sex, Race, and Consideration of Bariatric Surgery Among Primary Care Patients with Moderate to Severe Obesity. *Journal of General Internal Medicine*, *29*(1), 68–75. http://doi.org/10.1007/s11606-013-2603-1

World Population Review. Population of cities in Florida (2018) http://worldpopulationreview.com/states/florida-population/cities/. Assessed March 2, 2018.

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