Florida Public Health Review

Volume 2 Article 23

1-18-2024

# Trends in the Utilization of Metabolic and Bariatric Surgery (MBS) Procedures by Race and Ethnicity in Florida (2006-2017)

Siyao Liu
*St. Jude Children's Research Hospital*

Sarah E. Messiah
*University of Texas Health Science Center at Houston*

Denise C. Vidot
*University of Miami School of Nursing and Health Studies*

Preesha Malladi
*Florida State University*

WayWay M. Hlaing
*University of Miami Leonard M Miller School of Medicine*, whlaing@med.miami.edu

# TRENDS IN THE UTILIZATION OF METABOLIC AND BARIATRIC SURGERY (MBS) PROCEDURES BY RACE AND ETHNICITY IN FLORIDA (2006-2017)

**Siyao Liu, MS**
**Sarah E. Messiah, PhD, MPH, FTOS**
**Denise C. Vidot, PhD**
**Preesha Malladi**
**WayWay M. Hlaing, MBBS, PhD**

Florida Public Health Review
Volume 20
Published January 18, 2024

*Metabolic and bariatric surgery (MBS) is an increasingly common treatment option for individuals with severe obesity, but utilization disparities remain with race and ethnic minority groups completing the procedure less frequently than non-Hispanic Whites. We examined the trends in MBS procedure types and prevalence of utilization by race and ethnicity among Florida inpatients.*

*Discharge records with any MBS using the International Classification of Diseases 9th or 10th edition Procedure Coding System (ICD-PCS), were extracted from the Florida Agency for Health Care Administration (AHCA) inpatients' data (2006 to 2017). Those who completed either Laparoscopic Roux-en-Y Gastric Bypass (RYGB), Sleeve Gastrectomy (SG), Laparoscopic Adjustable Gastric Banding (LAGB), LAGB Revision and Repair (LAGBREV), or LAGB Removal (LAGBREM) were included in the analysis. Cochran-Mantel-Haenszel tests evaluated the trend over time for*

**Background |** Approximately 9.2% of United States (US) adults (6.9% of men and 11.5% of women)[1] have severe obesity, defined as a body mass index (BMI; measured in weight in kilograms over height in meters squared or kg/m$^2$) over 40 kg/m$^2$. In Florida, 37.1% of the population has obesity with racial and ethnic groups disproportionately impacted[2]. Specifically, Non-Hispanic Black (NHB) individuals have a higher prevalence (13.8%) of severe obesity compared to non-Hispanic White (NHW) (9.3%) and Hispanic individuals (7.9%)[1]. Obesity is a risk factor for multiple diseases, including coronary heart disease, stroke, type 2 diabetes, non-alcoholic fatty liver disease, osteoarthritis, and certain types of cancers, and is a significant burden on the health care system[3].

As the trends in severe obesity continue to rise, with projections estimating that by 2030, 10% of all adults in the US will be severely obese, examining trends in treatment utilization is important[4]. Metabolic and bariatric surgery (MBS) is an increasingly common treatment option for individuals with severe obesity. In 2011, an estimated 158,000 MBS procedures were performed, the use of MBS increased among youth and adults in the US. The eligibility criteria established by the National Institutes of Health (NIH) included adults with a BMI >= 40 kg/m$^2$ or BMI >= 35 kg/m$^2$ with at least one comorbidity or BMI 30 kg/m$^2$ with a serious health problem linked to obesity[7-10]. Major updates to the NIH guidelines were recently published[11]: MBS is now recommended for individuals with a body mass index (BMI) >= 35 kg/m$^2$, regardless of presence, absence, or severity of co-morbidities. For individuals with metabolic disease, the new guideline[11] threshold of BMI is 30-34.9 kg/m$^2$.

The use of MBS has increased 10-fold worldwide in the past twenty years[3]. Additionally, as MBS has evolved and with the development of laparoscopic surgery, usage continues to rise[3]. The most common procedures include sleeve gastrectomy (SG), Roux-en-Y (RYGB), and laparoscopic adjustable gastric band (LAGB). According to English et al.[12], the types of MBS performed have changed over the years, with SG having a large growth trend since 2011 (> 346%), while gastric band procedures have decreased by 87% since 2011. However, fewer studies have examined the trends of MBS procedures in Florida.

Disparities in severe obesity and MBS outcomes have been shown to exist, with racial-ethnic minorities often having less weight loss, longer hospital lengths of stay, and more readmission rates[13]. Studies to determine potential disparities in the utilization of

MBS by race-ethnic groups are scarce in Florida. With rising severe obesity proportions, it is crucial to understand these trends in MBS procedures and how these trends could differ by race-ethnic groups. Therefore, this study aimed to examine the (a) patterns of MBS by procedure types and (b) trends of each MBS utilization by race and ethnicity in Florida.

**Methods |** *Study Database and Population*

The Florida Agency for Health Care Administration (AHCA) inpatient data from 2006 to 2017 were retrospectively examined. 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[14]. The Institutional Review Board approval at University of Miami was exempt from secondary analysis study of de-identified AHCA data.

*Metabolic and Bariatric Surgery Procedure Types*

Patients who underwent any MBS were identified using the International Classification of Diseases 9th edition Procedure Coding System (ICD-9-PCS) for years 2006 to 2015 (codes: 43.82, 43.89, 44.38, 44.68, 44.95, 44.96, 44.97) and ICD 10th edition Procedure Coding System (ICD-10-PCS) for years 2015 to 2017 (codes: 0DB64Z3, 0DB60ZZ, 0DB63ZZ, 0DB67ZZ, 0D16479, 0D1647A, 0D164J9, 0D164JA, 0D164K9, 0D164KA, 0D164Z9, 0D164ZA, 0DQ64ZZ, 0DV64CZ, 0DW643Z, 0DW64CZ, 0DP643Z, 0DP64CZ). The ICD-9 codes were used in the earlier part of 2015 and switched to the ICD-10 codes in the latter part of 2015. These codes were further categorized into five main procedures: Laparoscopic Roux-en-Y Gastric Bypass (RYGB) [*ICD-9*: 44.38; *ICD-10*: 0D16479, 0D1647A, 0D164J9, 0D164JA, 0D164K9, 0D164KA, 0D164Z9, 0D164ZA], Sleeve Gastrectomy (SG) [*ICD-9*: 43.82, 43.89; *ICD-10*: 0DB64Z3, 0DB60ZZ, 0DB63ZZ, 0DB67ZZ], Laparoscopic Adjustable Gastric Banding (LAGB) [*ICD-9*: 44.68, 44.95; *ICD-10*: 0DV64CZ], Laparoscopic Adjustable Gastric Banding Revision and Repair (LAGBREV)[*ICD-9*: 44.96; *ICD-10*: 0DV64CZ, 0DW643Z, 0DW64CZ], and Laparoscopic Adjustable Gastric Banding Removal (LAGBREM) [*ICD-9*: 44.97; *ICD-10*: 0DP643Z, 0DP64CZ]. Of 34,203,104 inpatient discharge records in Florida in 12 years (2006-2017), our analysis was restricted to 90,845 records with known MBS codes.

*Covariates*

There were four mutually exclusive race-ethnic groups [non-Hispanic White (NHW), non-Hispanic Black (NHB), Hispanic, and Other). Age (years) and hospital length of stay (days) were treated as continuous variables. Self-reported gender was dichotomized as female and male. Based on BMI [weight (kg)/height $(m)^2$], weight status was categorized using the International Classification of Diseases 9th (2006-2015) or 10th (2015-2017) edition Clinical Modification codes (ICD-9-CM or ICD-10-CM) to classify as overweight, obese, severely obese, and unknown. For accuracy, V- and Z-codes were used to cross-validate the weight status designated by the ICD-9-CM and ICD-10-CM codes, respectively. Four insurance categories were created: (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). The type of admission was dichotomized (emergency versus non-emergency).

*Statistical Analysis*

Descriptive data analysis of categorical variables was performed with frequencies and percentages, whereas means, standard deviations, and other measures of dispersion were computed for continuous variables. Types of MBS procedures and race-ethnic groups in each year were evaluated using the Chi-Square tests. Hypothesis testing was conducted using Chi-Square or Fisher's Exact test for categorical variables and Student's t-test or Kruskal-Wallis test for continuous variables. The Cochran-Mantel-Haenszel statistic was used to evaluate the trend over time of a specific MBS procedure by four race-ethnic groups. The p-value of $\leq 0.05$ was used as a statistically significant threshold. SAS v9.4 (SAS Institute Inc., Cary, NC, USA) software was used for data management and analyses.

**Results |** The analytical sample included a total of 90,845 records. The average ($\pm$ standard deviation or SD) age was 47 ($\pm$ 14) years. The race-ethnic breakdown was 61.7% NHW, 18.0% Hispanic, 17.2% NHB, and 3.1% Other. The sample was predominantly NHW (61.7%), and female (75.5%). Fifty percent of patients had commercial insurance and 92.3% had severe obesity. The average ($\pm$ SD) length of hospital stay was 2.5 ($\pm$ 4.5) days. Most (96%) patients were admitted as non-emergency type (Table 1).

MBS procedures by year trends were statistically significant ($p < 0.05$). RYGB procedures decreased from 65.6% (2006) to 20.3% (2017) while conversely, SG procedure increased from 8.7% (2006) to 75.3% in 2017. LAGB procedure decreased from 24.5% in 2006 to 0.3% in 2017. The removal of LAGB (LAGBREM) became more frequent over time, whereas the revision procedure (LAGBREV) remained constant over time (Figure 1).

The number of all MBS procedures combined increased from 4,272 in 2006 to11,821 in 2017 In the 12-years, SG (45.1%) was the most common procedure, followed by RYGB (38.9%), LAGB (12.0%), LAGBREM (3.1%), and LAGBREV (0.9%) (data not shown).

The trends in utilization of three main procedures (SG, RYGB, and LAGB) by race-ethnicity were illustrated in Figures 2 to 4. Race-ethnic group differences and trend tests in Figures 2, 3, and 4 were statistically significant at $p < 0.05$. The SG procedure increased over time for all race-ethnic groups ($p < 0.05$). In 2006, the highest proportion of SG recipients was NHW (65.8%), followed by Hispanic (17.5%), NHB (14.3%), and Other (2.4%). In 2017, however, the highest proportion of SG recipients was NHW (52.9%), followed by NHB (23.4%), Hispanic (19.8%), and Other (3.9%) (Figure 2).

The laparoscopic RYGB procedure utilization for NHW declined from 69.5% in 2006 to 60.8% in 2017, while utilization remained stable among NHB over time. However, Hispanics received more RYGB procedures over time (13.4% in 2006 to 20.2% in 2017). Likewise, the use of RYGB increased in the Other group (2.1% in 2006 to 4.1% in 2017) (Figure 3).

As observed for the RYGB procedure, utilization of LAGB for NHW declined from 80% in 2006 to 61.5% in 2017. The use of LAGB increased for all other groups comparing the proportions from 2006 to 2017: 6.2% to 17.9% in Hispanic, 12.5% to 15.4% in NHB, and 1.2% to 5.1% in Other. Recipients of LAGB were the highest among NHW, followed by NHB, Hispanic, and Other in 2006. In 2017, recipients of LAGB remained the highest among NHW, followed by Hispanic, NHB, and Other (Figure 4).

As depicted in Figure 1, small proportions of inpatients underwent the removal (LAGBREM) and the revision (LAGBREV) procedures. However, LAGBREM became more frequent over time, whereas the revision procedure (LAGBREV) remained constant (Figure 1). As in other standard MBS procedures (SG, RYGB, LAGB), statistically significant ($p < 0.05$) differences among race-ethnic groups were observed for LAGBREM and LAGBREV. The trend test for LAGBREV by race-ethnicity was significant, but it was not significant ($p = 0.29$) for LAGBREM. While the removal surgery was stable for NHW, it increased in the NHB (8.7% in 2006 to 15.6% in 2017) and decreased in the Hispanic (17.4% in 2006 to 7.8% in 2017). The revision trends were the same as the removal procedure: increasing in the NHB (3.4% in 2006 to 12.4% in 2017) and decreasing in the Hispanic (17.2 % in 2006 to 8.2% in 2017). The utilization of LAGBREV was the highest among the NHW and the lowest among the Other, which was observed for all other MBS procedures (SG, RYGB, LAGB, LAGBREM) (Data now shown).

The most common procedure was RYGB (range: 46.6 – 65.6%) from 2006 to 2012. From 2013 to 2017, the most common procedure changed to SG (range: 55.3 – 75.3%). In 2006 (n=4,272), the most common procedure was RYGB (65.6%), followed by LAGB (24.5%), SG (8.7%), LAGBREV (0.7%), and LAGBREM (0.5%). In 2017 (n=11,821), the most common procedure was SG (75.3%), followed by RYGB (20.3%), LAGBREM (3.2%), LAGBREV (0.8%), and LAGB (0.3%).

Regardless of procedure type, NHWs were the highest recipient group proportionally of completing MBS in all years. More NHBs received LAGB compared to Hispanic patients in all years except 2017. More Hispanics received RYGB than their NHB counterparts in most years except 2007 and 2008. However, a steady decline in the RYGB trend (25.0% in 2011 to 20.2% in 2017) among Hispanics was observed. Conversely, the frequency of Hispanic receiving SG steadily increased from 13.6% in 2008 to about 20% in later years. The SG usage also increased over time for the NHBs. The LAGB use in NHBs over time is primarily stable, with an interesting spike in 2016 (37.5%).

**Discussion |** MBS has positive effects on weight loss and resolving obesity-related metabolic conditions (e.g., type 2 diabetes). Although it is recognized as an important treatment for severe obesity, MBS remains underutilized, considering the increasing prevalence of severe obesity.

Similar to previous national and international studies[15-18], SG outnumbered RYGB and LAGB over time, with increasing trends in the use of SG and decreasing usage of LAGB and RYGB usage. Additionally, we found significant differences in MBS types by race-ethnicity and MBS trends over time in four race-ethnic groups. Race-ethnic comparison studies were scarce but Landin et al.,[19] found that higher proportions of minority adults (NHB, Hispanic) utilized MBS from 2015 to 2018 in the US. A more recent study[6] indicated an increasing trend in MBS utilization in minority groups as well in the US.

An increasing trend in the SG procedure over the past decade[15] is often attributed to short and medium-term favorable metabolic outcomes and lower complications compared to RYGB[20]. The American Society of Metabolic and Bariatric Surgery (ASMBS) approved SG as a bariatric procedure in 2011[21]. According to Kzy and colleagues, SG increased from 38% to 63% from 2012 to 2015[15]. Since 2014, laparoscopic SG has become the leading bariatric procedure in the United States[22]. In a national study[23] of bariatric surgery trends in 2003-2008, authors found that the number of surgeries peaked in 2004 and plateaued in 2008, attributing to the exponential increase in the use of non-invasive laparoscopic procedures during the study period. Interestingly,

bariatric surgeon membership in the ASMBS also doubled during study period[3]. In our study (2006-2017), the number of all MBS spiked in 2009 (10,482 cases out of 980,845 total), plateaued for three years (about 6,000 cases in 2010-2012), and increased steadily from 2013 (about 7,000) to 2017 (about 12,000).

Fewer studies have analyzed specific MBS procedure types and trends by race/ethnicity. Interestingly, SG increased for all races/ethnicities except NHW patients, where there was a significant decrease from 2006 to 2017. This could be a reflection of the decrease in the proportion of NHWs undergoing MBS in the Florida patient population, which decreased by 16.5% from 2006 (71.8%) to 2017 (55.3%), while there were increases in the proportion of Hispanic and NHB patients undergoing MBS procedures (about 7% rise in each group). The change in race-ethnic make-up of Florida inpatients is more likely as the race-ethnic make-up of Florida population over the last decades has been stable over time[24]. Consistent with our findings, Pickett-Blakely and colleagues found that the proportion of Whites undergoing MBS decreased from 81% in 1998 to 72% in 2007[25]. However, NHW was the highest group receiving all MBS types combined compared to other race-ethnic counterparts in Florida. We found increased utilization of LAGB for NHB patients and RYGB for Hispanic patients.

As depicted in Figure 1, the LAGB use was $\leq$ 1% in the last three years of the study period. Although the LAGB utilization trend in the NHB is upward, a decline was seen from 2016 (37.5%) to 2017 (15.4%). The LAGB procedure was cited as the least effective method of weight loss compared to other types of MBS[26]. However, a recent study[27] using the Metabolic and Bariatric Surgery Quality Improvement Program (MBSAQIP) Data Registry indicated that the LAGB remained effective and safe for weight loss. The LAGB is a reversible, anatomically sparing procedure that involves a band (e.g., a belt-like device made of silicone) around the stomach to make the upper part of the stomach smaller than its normal size. The life expectancy of the band requires the removal and/or revision of the index LAGB procedure. However, there are both medical (e.g., band infection, excessive nausea, vomiting, heartburn, other post-surgical complications) and non-medical reasons (e.g., weight regain, band slippage) for the removal and revision of the LAGB procedure[26-28].

Although a revision procedure is possible in other MBS (SG, RYGB), revision and removal of LAGB only in Florida are available. In our study, a small proportion of patients underwent LAGB removal and revision procedures during the 12-year period. The removal of the LAGB (LAGBREM) procedure increased, whereas the revision procedure (LAGBREV) remained constant over time. In a national study[27], authors concluded that about one-fifth of LAGB recipients will need reoperations due to inadequate weight loss or significant weight regain.

It is well documented that race-ethnic variations in obesity exist in US populations[29-31] of different age groups. The strength of the study is the availability of multi-year data that consists of diverse race-ethnic groups in Florida. Some limitations exist. First, the unit of analysis in the de-identified AHCA data is the number of discharge records, not the number of individuals. However, it is unlikely that an individual would receive more than one MBS procedure in a calendar year. It might be possible that LAGB removal and revision procedures could have been performed on the individual that received the index LAGB procedure in the same year if post-surgery complications exist. The proportions of LAGBREM and LAGBREV in our study are small, yet the data lack information on the reasons for the removal and revision. Second, weight status may be misclassified. We used both ICD codes and the V- or Z-codes to verify the weight status, and thus the degree of misclassification may be minimal. Those with missing or unknown weight status likely had other indications (e.g., comorbidities) for MBS. Finally, we did not investigate comorbidities and other social determinants which could elucidate reasons for MBS procedure selection by race-ethnic groups.

**Conclusion |** In this study, we found significant differences in MBS trends and procedure type by race-ethnic groups. We observed the procedure trends among Florida inpatients are similar to other national and international studies. Future studies should expound on the variations in access to care, insurance coverage, and social determinants between race-ethnic groups. These factors may have impacted the decision to complete MBS or select a specific type of MBS. Also, the trends in MBS should be continuously monitored (as data become available) in parallel to severe obesity trends in Florida. Understanding race-ethnic group difference has important public health implications and supports culturally competent care for those who need MBS.

**References |**

1. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of Obesity and Severe Obesity Among Adults: United States, 2017-2018. NCHS Data Brief. 2020;(360):1-8.

2. Filipp SL, Cardel M, Hall J et al., Characterization of adult obesity in Florida using the OneFlorida clinical research consortium. Obes Sci Pract 2018 Jun 15;4(4):308-317. doi:10.1002/osp4.274

3. Lee WJ, Almalki O. Recent advancements in bariatric/metabolic surgery. Ann Gastroenterol Surg. 2017;1(3):171-179. Published 2017 Sep 10. doi:10.1002/ags3.12030

4. Wang Y, Beydoun MA, Min J, Xue H, Kaminsky LA, Cheskin LJ. Has the prevalence of overweight, obesity and central obesity levelled off in the United States? Trends, patterns, disparities, and future projections for the obesity epidemic. Int J Epidemiol. 2020;49(3):810-823. doi:10.1093/ije/dyz273
5. American Society for Metabolic and Bariatric Surgery. Estimates of Bariatric Surgery Numbers, 2011-2021. https://asmbs.org/resources/estimate-of-bariatric-surgery-numbers. Published 2022. Accessed August 3, 2023.
6. Messiah SE, Xie L, de la Cruz-Muñoz N, Lipshultz SE. Use of Metabolic and Bariatric Surgery Among US Youth. JAMA Pediatr. 2023;177(8):856-857. doi:10.1001/jamapediatrics.2023.0803
7. Gebhart A, Young MT, Nguyen NT. Bariatric surgery in the elderly: 2009-2013. Surg Obes Relat Dis. 2015;11(2):393-398. doi:10.1016/j.soard.2014.04.014
8. Khan S, Rock K, Baskara A, Qu W, Nazzal M, Ortiz J. Trends in bariatric surgery from 2008 to 2012. Am J Surg. 2016;211(6):1041-1046. doi:10.1016/j.amjsurg.2015.10.012
9. Pratt JSA, Browne A, Browne NT, et al. ASMBS pediatric metabolic and bariatric surgery guidelines, 2018. Surg Obes Relat Dis. 2018;14(7):882-901. doi:10.1016/j.soard.2018.03.019
10. Wasserman H, Inge TH. Bariatric surgery in obese adolescents: opportunities and challenges. Pediatr Ann. 2014;43(9):e230-e236. doi:10.3928/00904481-20140825-10
11. Eisenberg D, Shikora SA, Aarts E, Aminian A, Angrisani L et al., 2022 American Society of Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) Indications for Metabolic and Bariatric Surgery. Obes Surg. 2023;33(1):3-14. doi: 10.1007/s11695-022-06332-1
12. English WJ, DeMaria EJ, Brethauer SA, Mattar SG, Rosenthal RJ, Morton JM. American Society for Metabolic and Bariatric Surgery estimation of metabolic and bariatric procedures performed in the United States in 2016. Surg Obes Relat Dis. 2018;14(3):259-263. doi:10.1016/j.soard.2017.12.013
13. Welsh LK, Luhrs AR, Davalos G, Diaz R, Narvaez, A et al., Racial Disparities in Bariatric Surgery Complications and Mortality Using the MBSAQIP Data Registry. Obes Surg. 2020;30(8):3099-3110. doi: 10.1007/s11695-020-04657-3
14. Agency for Health Care Administration (AHCA). Florida Center for Health Information and Policy Analysis: Patient Databases General Information. https://fhfstore.blob.core.windows.net/documents/researchers/OrderData/documents/KeyDifferences%20Revised%202016).pdf. Published March 2016. Accessed August 3, 2023.
15. Kizy S, Jahansouz C, Downey MC, Hevelone N, Ikramuddin S, Leslie D. National Trends in Bariatric Surgery 2012-2015: Demographics, Procedure Selection, Readmissions, and Cost. Obes Surg. 2017;27(11):2933-2939. doi:10.1007/s11695-017-2719-1
16. Angrisani L, Santonicola A, Iovino P, Formisano G, Buchwald H, Scopinaro N. Bariatric Surgery Worldwide 2013. *Obes Surg*. 2015;25(10):1822-1832. doi:10.1007/s11695-015-1657-z
17. Steinberger AE, Nickel KB, Keller M, et al., National Trends in Pediatric Metabolic and Bariatric Surgery: 2010-2017. Pediatrics 2022 Dec 1;150(6):e2022057316. doi:10.1542/peds.2022-057316
18. Lazzati A, Salaün-Penquer N, Ortala M, Vignot M, De Filippo G, Jung C. Trends in metabolic bariatric surgery in adolescents in France: a nationwide analysis on an 11- year period. Surg Obes Relat Dis. 2021 Sep;17(9):1566-1575. doi: 10.1016/j.soard.2021.05.027.
19. Landin MD, Gordee A, Lerebours RC, Kuchibhatla M, Eckhouse SR, Seymour KA. Trends in risk factors for readmission after bariatric surgery 2015-2018. Surg Obes Relat Dis. 2022 May;18(5):581-593. doi: 10.1016/j.soard.2021.12.026.
20. Carlin AM, Zeni TM, English WJ, et al. The comparative effectiveness of sleeve gastrectomy, gastric bypass, and adjustable gastric banding procedures for the treatment of morbid obesity. Ann Surg. 2013;257(5):791-797. doi:10.1097/SLA.0b013e3182879
21. American Society for Metabolic and Bariatric Surgery (ASMBS) Clinical Issues Committee. Updated position statement on sleeve gastrectomy as a bariatric procedure. Surg Obes Relat Dis. 2012;8(3):e21-e26. doi:10.1016/j.soard.2012.02.001
22.Ponce J, DeMaria EJ, Nguyen NT, Hutter M, Sudan R, Morton JM. American Society for Metabolic and Bariatric Surgery estimation of bariatric surgery procedures in 2015 and surgeon workforce in the United States. Surg Obes Relat Dis. 2016;12(9):1637-1639. doi:10.1016/j.soard.2016.08.488
23. Nguyen NT, Masoomi H, Magno CP, Nguyen XM, Laugenour K, Lane J. Trends in use of bariatric surgery, 2003-2008. J Am Coll Surg. 2011;213(2):261-266. doi:10.1016/j.jamcollsurg.2011.04.030
24. Florida Department of Health, Florida Legislature, Office of Economic, and Demographic Research. Populaiton Dashboard Query: Population Characteristics and Trends (1970-2021). https://www.flhealthcharts.gov/ChartsReports/rdPage.aspx?rdReport=PopAtlas.PopulationAtlasDASHBOARD&rdRequestForwarding=Form. Query Accessed: August 17, 2023.

25. Pickett-Blakely OE, Huizinga MM, Clark JM. Sociodemographic trends in bariatric surgery utilization in the USA. Obes Surg. 2012;22(5):838-842. doi:10.1007/s11695-012-0629-9
26. Colquitt JL, Pickett K, Loveman E, Frampton GK. Surgery for weight loss in adults. Cochrane Database Syst Rev. 2014 Aug 8;2014(8):CD003641. doi:10.1002/14651858.CD003641.pub4
27. Nasri, B, Trainor, L, Jones, DB. Laparoscopic adjustable gastric band remains a safe, effective, and durable option for surgical weight loss. Surg Endosc 2022 Oct;36(10):7781-7788. doi:10.1007/s00464-022-09278-8
28. Roth AE, Thornley CJ, Blackstone RP. Outcomes in Bariatric and Metabolic Surgery: An Updated 5-Year Review. *Curr Obes Rep*. 2020;9(3):380-389. doi:10.1007/s13679-020-00389-8
29. Messiah SE, Xie L, Atem F, Mathew MS, Qureshi FG, Schneider BE, Cruz-Muñoz N. Disparity Between United States Adolescent Class II and III Obesity Trends and Bariatric Surgery Utilization, 2015-2018. Ann Surg. 2022 Aug 1;276(2):324-333. doi: 10.1097/SLA.0000000000004493.
30. Petersen R, Pan L, Blanck HM. Racial and Ethnic Disparities in Adult Obesity in the United States: CDC's Tracking to Inform State and Local Action. Prev Chronic Dis. 2019;16:E46. Published 2019 Apr 11. doi:10.5888/pcd16.180579
31. Pan L, Freedman DS, Sharma AJ, et al. Trends in Obesity Among Participants Aged 2-4 Years in the Special Supplemental Nutrition Program for Women, Infants, and Children - United States, 2000-2014. MMWR Morb Mortal Wkly Rep. 2016;65(45):1256-1260. Published 2016 Nov 18. doi:10.15585/mmwr.mm6545a2