Bariatric Surgery among Medicare Subgroups: Short- and Long-Term Outcomes

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Abstract

Objective.—This study sought to examine weight change, postoperative adverse events, and related outcomes of interest among age-qualified (AQ) and disability-qualified (DQ) Medicare recipients compared to non-Medicare (NM) patients undergoing initial bariatric procedure.

Methods.—LABS-2 is an observational cohort study of 2458 adults who underwent Roux-en-Y gastric bypass (RYGB) or laparoscopic gastric band (LAGB) bariatric surgery. Weight, percent body fat, functional status, and comorbidities were assessed at baseline and annually for 5 years as well as postoperative adverse events. We categorized the 1943 participants who reported insurance type into AQ, DQ, or NM.

Results.—Median preoperative BMI ranged from 45 to 48 kg/m^2 across groups. For RYGB, 5-year BMI loss was approximately 30% for all groups, and for LAGB, BMI loss was 12–15%. Diabetes remission after 5 years was also similar across groups within procedure type (RYGB: 33–40%, LAGB: 13–19%). The frequency of adverse events after RYGB ranged from 4.1% for NM to 6.7% for DQ. After LAGB, there were no adverse events for AQ, while 3% of DQ and 1.8% of NM had at least one.

Conclusion.—Medicare participants experienced substantial BMI loss and diabetes remission with a frequency of adverse events similar to that of NM participants.

Keywords

bariatric surgery; Medicare; subgroup analysis; weight change; functional status

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Introduction

Bariatric surgery has become an increasingly common means to achieve sustained weight loss and comorbidity remission among patients whose obesity persists beyond first-line behavioral and medical interventions.[1–4] However, surgical reports from large and long-term studies often demonstrate varied clinical outcomes among study populations, underscoring the role that individual- and group-level characteristics play in determining the degree of efficacy.[5–8] The lack of uniformity in outcomes among bariatric surgical recipients has driven the emergence of a body of literature dedicated to analyzing short- and long-term outcomes in distinct subpopulations to predict the metabolic response or weight loss in particular candidates.[9–12]

Bariatric surgical outcomes in the Medicare population are of increasing importance given the rising prevalence of obesity and concomitant increase in life expectancy.[13–15] However, the majority of analyses focusing on Medicare populations utilize retrospective administrative or clinical data,[16–19] limiting the availability and specificity of certain important outcomes. In addition, large gaps in the literature persist in comparisons of specific bariatric procedures in Medicare recipients, a concern highlighted in a recently published systematic review from the Agency for Healthcare Research and Quality.[20,21] As highlighted in the report, Medicare recipients comprise two subpopulations: those that qualify based on permanent disability and those who are age-qualified (65 years). The proportion of disability-qualified Medicare recipients undergoing bariatric surgery is now greater than the proportion of age-qualified recipients,[22] signaling a demographic shift away from the currently available literature examining this population and towards the need for analyses which highlight the specific Medicare subgroups. The goal of this study was to examine bariatric surgery outcomes among the two Medicare subsets and participants who were covered by other insurance types. Baseline characteristics, short-term complication outcomes, changes in functional status, comorbidity remission, and five-year BMI change were assessed in these three groups.

Methods

Participants

The Longitudinal Assessment of Bariatric Surgery (LABS-2) is an observational cohort study of adults (N=2458) 19 to 78 years of age undergoing first-time bariatric surgery at one of 6 geographically diverse clinical centers in the United States (New York, North Carolina, North Dakota, Oregon, Pennsylvania, and Washington state).[23] Participants underwent surgery between March 2006 and April 2009 and were followed annually through July 2015. Assessments were conducted prior to surgery, 6- and 12-months following surgery, then annually for at least 5 years. All participants provided informed consent and the study protocol was approved by institutional review boards of participating institutions. The LABS-2 study design and recruitment details have been detailed elsewhere.[24]

Analytic Sample

Participants who underwent (1) laparoscopic adjustable gastric banding (LAGB) or (2) Roux-en-Y gastric bypass (RYGB) were included in this study; those who underwent other less common (4.5%) bariatric procedures were excluded. Participants were further excluded from analyses if they did not report having medical insurance, did not indicate the type of insurance, or had an insurance type that could not be classified. Our final analytic sample included 1943 participants (79.0% of the total cohort) (Figure 1). Participants were categorized into three subgroups based on their self-reported insurance coverage: (1) age-qualified (AQ) Medicare recipients who were 65 years and older at the preoperative visit (n = 97, 5%); (2) disability-qualified (DQ) Medicare recipients who were less than 65 years old (n = 245, 12.6%); and (3) non-Medicare recipients (n = 1601, 82.3%).

Measures

Demographic characteristics and insurance information were self-reported at baseline. Insurance was dichotomized into Medicare or non-Medicare (including Medicaid, Tricare, and private health insurance), and Medicare was further categorized into AQ and DQ. Comorbidities were assessed at baseline and annual visits through Year 5. High low-density lipoprotein cholesterol (LDL) level was defined as patients currently receiving a lipid-lowering medication or having an LDL level of 160 mg/dL or greater. Low high-density lipoprotein cholesterol (HDL) level was defined in patients as less than 40 mg/dL and high triglycerides as a fasting triglyceride level of 200 mg/dL or greater. Hypertension was defined by having self-reported antihypertensive medication use, systolic blood pressure 140 mmHg, or diastolic blood pressure 90mm Hg. Dyslipidemia was defined as having hyperlipidemia (lipid-lowering medication use or LDL-C 160 mg/dL), HDL <40 mg/dL, or triglycerides 200 mg/dL. Diabetes was defined as diabetes medication use, HbA1c 6.5%, or 8-hour fasting glucose 126 mg/dL. Participants diagnosed with polycystic ovary syndrome who were taking Metformin were not categorized as having diabetes if they did not meet the HbA1c or fasting glucose criteria. Remission of comorbidities was defined as participants who had the comorbidity at baseline with its absence at follow-up.

To determine the incidence of short-term postoperative complications, a composite endpoint was created. This binary endpoint was created to indicate whether a participant died before the 6-month follow-up interview or had any of the following major adverse events within 30 days of the bariatric surgical procedure: deep-vein thrombosis or venous thromboembolism; reintervention with the use of a percutaneous, endoscopic, or operative technique; or failure to be discharged from the hospital within 30 days of the surgery. These adverse events were selected to complement the use of the composite endpoint originally constructed in Flum et al. examining the total LABS study population (N=4776).[25] Similar to the original endpoint, readmission was not included as an adverse event, given the spectrum of problems that led to readmission. Composite endpoints for the total LABS cohort have been described in detail.[25]

Weight was measured at in-person follow-up visits with the Tanita Body Composition Analyzer (model TBF-310; Tanita Corporation of America, Inc., Arlington Heights, IL). When not obtained in-person, clinical weight was measured by research or medical

personnel on a non-study scale. If neither in-person nor clinical weight was available, participants' self-reported weight was used—self-reported weights in the LABS-2 study have been previously described in detail and validated.[26] Body mass index (BMI) was calculated as weight in kilograms divided by height in meters square, using height at baseline and weight for each follow-up visit. Percentage body fat was collected at baseline and follow-up assessments with the Tanita Body Composition Analyzer. Self-reported functional health and well-being over the past four weeks was collected at baseline and follow-up visits with the Medical Outcomes Study 36-Item Short-Form (SF-36) instrument. [27,28] Items for eight quality of life domains were aggregated to the modified physical component summary (PCS) and modified mental component summary (MCS) using scoring algorithms provided by Optum (Optum, Inc., Eden Prairie, MN). Scores for these summary variables range from zero to 100 and are normed such that a value of 50 is the United States population norm, with lower scores indicating lower health quality.[29]

Statistical Analyses

Descriptive statistics summarize characteristics and outcomes among the two Medicare subpopulations and the non-Medicare group and by surgery type. Frequencies and percentages are reported for categorical variables. Medians and interquartile ranges (IQR) are reported for continuous variables.

Mean percent BMI change from baseline was estimated for each follow-up visit using linear mixed effects models with repeated measures to account for individual-level correlation resulting from the longitudinal structure of the data. Models were stratified by insurer group and surgery type. All models included fixed effects for visit, surgical procedure, and the interaction of these terms as well as a linear random slope term for visit and first-order autoregressive variance-covariance structure for the residual error. Estimated means and 95% confidence intervals (CI) are reported from these models.

Results

Baseline Characteristics

Of the 1943 participants included in the analysis, 1432 (73.7%) underwent RYGB and 511 (26.3%) underwent LAGB. The study sample was predominantly female (79.5%) and white (86.5%), with a baseline median weight of 127.5 kg (IQR: 114.3 – 144.7) (median BMI: 45.5, IQR: 41.5–50.9) and median percent body fat of 50.3% (IQR: 44.3 – 53.3%). At the preoperative visit, 673 participants (34.6%) had diabetes, 1304 (67.1%) had hypertension, and 1011 (52.0%) had dyslipidemia. A greater proportion of AQ and DQ participants had a history of smoking (62.9% and 52.6%, respectively) than NM participants (40.5%). Further, AQ Medicare participants had somewhat lower preoperative BMI than DQ and non-Medicare participants. Diabetes was highly prevalent in Medicare participants (>50%) as well as non-Medicare participants (30.8%). Preoperative SF-36 mental health scores were similar across the three groups (48.2–53.0) while preoperative PCS scores were lower for both Medicare subsets (29.6 and 34.7 for DQ and AQ, respectively) compared to the non-Medicare group (40.3). Finally, over half of all AQ participants underwent LAGB (55.7%)

while only 27.3% of DQ and 24.4% of non-Medicare participants underwent LAGB. These and other selected characteristics of the analytic sample are reported in Table 1.

One- and Five-Year BMI and Body Fat Change

Median BMI loss and body fat change were comparable among the three groups within the respective procedure type (Table 2). Participants who underwent RYGB had 31–34% lower BMI at Year 1 and had approximately 29% lower BMI at Year 5. Percent BMI change was lower among those who underwent LAGB and was comparable across Medicare and non-Medicare groups. At year 1, BMI loss was 12–14%, and was similar at year 5.

Though percent body fat was comparable at baseline among the three groups, AQ recipients experienced a greater degree of median percent body fat loss at both Year 1 and Year 5 for both procedure types when compared to the non-Medicare population, despite losing less overall weight. DQ participants mirrored non-Medicare participants in median body fat loss at both Years 1 and 5 for both procedure types (Figure 2).

Composite Endpoint

The frequency of short-term postoperative adverse events was consistently low for participants who underwent LAGB (0–3%; Table 2). For those who received RYGB, 6.7% of DQ patients had a short-term postoperative adverse event while 4% of AQ and non-Medicare patients experienced an event. Within 30 days after surgery, two patients died; both were non-Medicare participants who underwent RYGB. By 5 years, four participants died as a direct result of a complication occurring during or after their bariatric procedure. Three of these deaths occurred in patients undergoing RYGB (2 DQ, 1 NM). Only one participant in the total sample failed to be discharged from the hospital within 30 days (DQ undergoing LAGB).

Among participants requiring an abdominal operation within 30 days of surgery, DQ patients experienced reoperation at a higher rate for both RYGB (6.2%) and LAGB (3.0%) compared to AQ and NM patients (0.0–2.6%). However, percutaneous and endoscopic reinterventions remained lowest among DQ participants (0.6–1.5%). By 5 years, abdominal reoperations related to the bariatric procedure increased among all groups, with the lowest occurence observed in AQ undergoing RYGB (4.7%) and the highest among non-Medicare participants undergoing LAGB (19.2%).

Comorbidity Remission

Patterns in diabetes remission mirrored those of BMI change, with greater improvements observed among those undergoing RYGB compared to those undergoing LAGB. Following RYGB, approximately 48% of individuals in all three groups were in diabetes remission at Year 1, tapering to 33–40% by Year 5. Between 14% (for AQ) and 30% (for DQ and non-Medicare) who underwent LAGB were in diabetes remission at Year 1, with an increase in remission observed for AQ participants (18%) and decreases observed for DQ and non-Medicare groups (13% and 19%, respectively) at Year 5.

Similarly, a larger proportion of RYGB participants experienced hypertension remission than those undergoing LAGB. For the RYGB group, remission ranged from 23% (AQ) to 39% (non-Medicare) at Year 1 and all groups tapered at a relatively similar rate by Year 5. Following LAGB, both DQ and AQ participants experienced an increase in hypertension remission from Years 1 (2–10%) to 5 (6–12%), while non-Medicare participants experience higher levels of disease over time. Those undergoing RYGB experienced variable degrees of dyslipidemia remission at Year 1 (14–37%), with greatest remission observed in the non-Medicare group at Year 5 (30%). Participants undergoing LAGB experienced 13–17% dyslipidemia remission at Year 1, with decreases in remission observed for the Medicare groups when compared to non-Medicare by Year 5.

Changes in Functional Status

For PCS scores, AQ recipients scored comparably with the NM group at baseline and experienced an increase in physical functioning one year postoperatively for both procedure types (RYGB: +33%; LAGB: +21%), tapering 6–13% by Year 5. Despite DQ recipients reporting lower baseline PCS scores compared to the non-Medicare group, those undergoing RYGB experienced a substantial increase (+38%) at Year 1. Decreases in functioning were reported for both procedure types (RYGB: −15%; LAGB: −5%) by Year 5.

For MCS scores, baseline values were comparable among the three groups (score range: 48–53), with greater gains observed for those undergoing RYGB throughout Year 5, with only DQ recipients reporting a decrease by Year 5 (−3%). Medicare groups undergoing LAGB experienced net decreases in MCS scoring at Year 5 (−5–9%) as compared to non-Medicare recipients. These and other outcomes, for both procedures, are reported in Table 2.

Discussion

In this longitudinal study of health outcomes after bariatric surgery, we observed low incidence of short-term postoperative adverse events and comparable BMI declines and chronic disease remission in both Medicare and non-Medicare patients. This analysis provides new information on the short- and long-term durability of two bariatric surgery procedures among age- and disability-qualified Medicare recipients, filling a knowledge gap recently highlighted by the Agency for Healthcare Research and Quality.[21]

Composite Endpoint

When multiple postoperative outcomes are of interest for a single intervention, the construction of composite endpoints has been validated for use in clinical trials.[30] Complementing the measure created by Flum et al.,[25] the composite endpoint constructed for this analysis included a number of adverse events (described in Methods) intended to characterize the safety of the two bariatric procedures. Among Medicare recipients, a group that is assumed to be of greater operative complication risk given advanced age and/or disability, very few participants had any of the adverse events, with the highest frequency among DQ undergoing RYGB (6.7%). Further, composite endpoints in this analysis were highly comparable to those described in Flum et al., validating the inclusion of the non-Medicare group. It was an unexpected finding that AQ recipients experienced a lower

incidence of adverse events for both procedures as compared to DQ recipients, a substantially younger population. A plausible explanation may be that prior analyses examining operative complications failed to account for disability among Medicare recipients. While inference is limited given our small sample size, it may offer a preliminary basis to suggest that disability or lower functional status, instead of age, is a better predictor of adverse events immediately following surgery. Further, segregating composite endpoint calculation by procedure type also controlled for the differences in procedure type utilization among AQ and DQ recipients. The rationale to reduce operative complication risk by routinely selecting older candidates to undergo LAGB, a lesser-invasive procedure, may not be warranted given that AQ participants undergoing RYGB and LAGB had a similar incidence of composite endpoints.

Procedure Type Utilization

A substantially higher proportion of AQ recipients underwent LAGB (55.7%) than the non-Medicare group (24.4%). This may be at least partly due to surgeons' election to perform the lesser-invasive procedure for this group—advanced age has been cited to be a predictor for adverse events[18]. Further, DQ recipients underwent LAGB at a similar rate to the non-Medicare group (27.3%), further suggesting that age, rather than Medicare status, may have played a role in utilization of LAGB versus RYGB in AQ recipients. This observation would not have been detected had these two subpopulations been analyzed as one group.

BMI Change

Another outcome of interest has been the BMI change over time between the three groups. Though BMI change was comparable among all subjects in this analysis, the observation that weight loss was sustained among AQ recipients—a group that disproportionately underwent the lesser-invasive LAGB—while weight loss tapered for the DQ and non-Medicare population suggests that AQ recipients experienced and sustained a greater degree of success despite undergoing the less efficacious procedure. The role and degree to which senescence is responsible for this observation warrants further investigation.

Although clinical outcomes were not starkly different between the three subgroups, differences in preoperative comorbidity burden, short-term complications, and procedure type utilization may inform surgeon risk assessment. This analysis demonstrates that using insurer-type as a proxy for age or comorbidity burden may be unwarranted. Further, use of proxy variables to confer risk profiles may have deleterious repercussions for persons seeking obesity treatment, by either being inaccurately ascribed greater perioperative risk or being denied access to an effective treatment altogether due to physician risk aversion. The growing proportion of younger disability-qualified Medicare recipients requires an evolving and informed approach for this emerging demographic. Analyses that inadvertently misclassify these recipients may misguide bariatricians and the greater scientific community about the effectiveness of bariatric surgery in the Medicare population.

Strengths and Limitations

This is a preliminary examination of the outcomes following bariatric surgery for Medicare and non-Medicare patients, and several limitations should be noted. First, patients were not

randomized to receive either procedure, and AQ Medicare patients far more frequently received the less-invasive LAGB procedure. Nevertheless, we observed that even among AQ patients who did undergo RYGB, there was no greater frequency of adverse events and very similar improvements in health at 1- and 5-year follow-up. Second, the extent of selection bias – the degree to which patients who were recommended bariatric surgery and enrolled in the study differ from the general population of Medicare patients with obesity – is likely to limit generalizability. Third, sample sizes in the AQ group were small, which limited the precision of our estimates. Finally, because AQ and non-Medicare groups are confounded by age, it is not possible to infer any effect of Medicare membership on age-related chronic disease outcomes. Despite the small sample sizes, this analysis is one of the largest prospective samples to date to examine these two subpopulations, with five years of follow-up in weight loss and comorbidity outcomes.

The primary strength of this study is the availability of long-term follow-up with high retention.[31] Five years of data enabled an investigation of differences in BMI between these two groups and a non-Medicare population for two procedure types. In a recently-released report by the Agency for Healthcare Research and Quality that focused on short- and long-term surgical outcomes in the Medicare population,[21] the authors identified an absence of direct (head-to-head) comparisons between different surgical procedures in the Medicare population in the literature. The current analysis addresses this gap. Another strength of this study is its prospective nature. While most published Medicare analyses rely on the retrospective review of administrative or clinical databases and limit outcomes of interest to available data, the LABS-2 study collected data on clinical and behavioral outcomes using standardized protocols and validated measures to test a diverse array of administered by trained study staff and investigators.

Conclusion

Both AQ and DQ Medicare recipients enrolled in a nationally representative study undergoing two bariatric surgical procedures lost weight and maintained this loss through five years. Though BMI change and comorbidity outcome differences among the three groups were not clinically meaningful, future studies that include more Medicare eligible patients may be needed to more precisely characterize their outcomes. Although previous studies have combined Medicare AQ and DQ into a single group or focused entirely on AQ patients, differences in procedure type utilization and composite endpoint between these groups suggest they should be considered separately in risk and effectiveness assessments. Continued analyses of clinically meaningfully subpopulations will help inform the growing evidence base for personalized approaches in bariatric surgery.

Acknowledgments

Characteristics of Participants in the Longitudinal Assessments of Bariatric Surgery-2 (LABS-2) Study. SOARD. 2013 Nov-Dec;9(6):926–35. Epub 2013 March 7.).

Individual deidentified participant data (including data dictionaries) can be made immediately available to external investigators (upon request to the senior author) once the research team has completed planned analyses. This is expected to be approximately one year after publication of this study. Other documents (e.g. study protocol, informed consent form, clinical assessment forms) can be accessed at: http://www.edc.gsph.pitt.edu/labs/Public/LABS-1DescriptionPaper/.

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What is already known?

- Medicare patients are assumed to have higher postoperative risk given advanced age.

- There is heterogeneity in weight change after bariatric surgery among Medicare patients.

- Medicare patients typically undergo laparoscopic adjustable gastric banding, as opposed to Roux-en-Y gastric bypass, due to high operative risk.

What this adds to what was known?

- This study is the first to examine outcomes of different operative procedures among two Medicare subgroups: those who qualify for Medicare due to age and those with permanent disabilities. A third non-Medicare group was included.

- This study demonstrates that age-qualified Medicare recipients had fewer postoperative adverse events than those who are disability-qualified.

- This study provides weight change and other outcomes of interest among Medicare subgroups.

2458 had initial bariatric surgical procedure

2348 had RYGB or LAGB surgery

1943 had and reported insurance

97 ≥ 65 years and older

1846 < 65 years
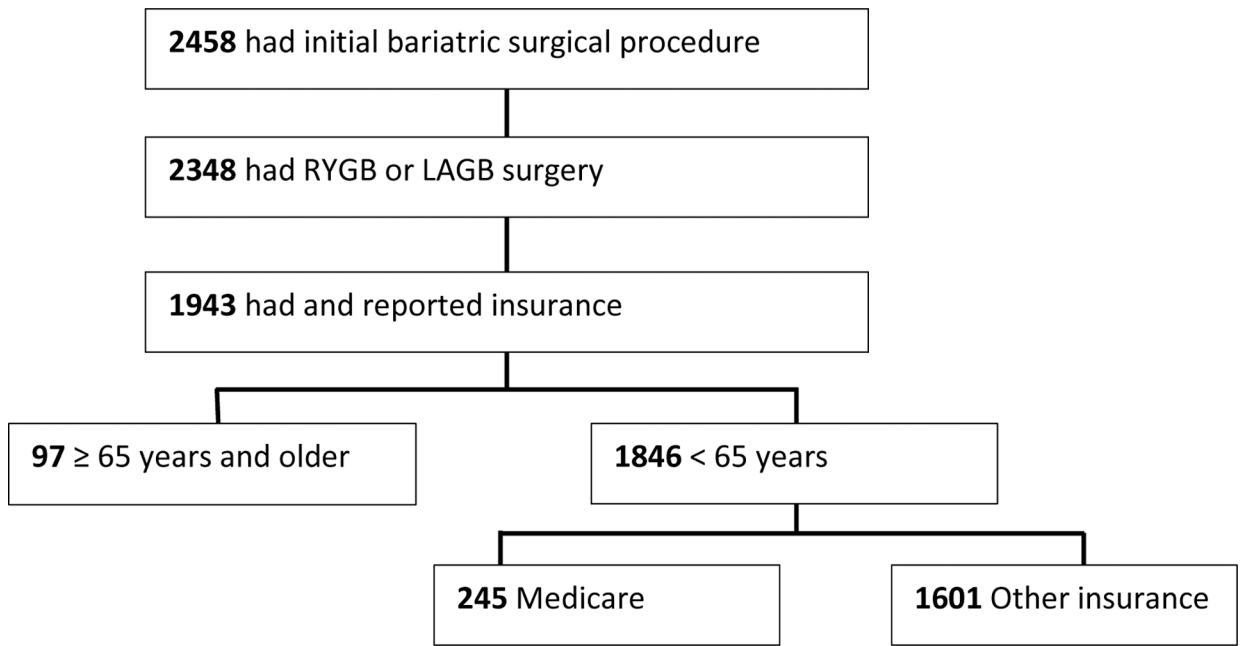
245 Medicare

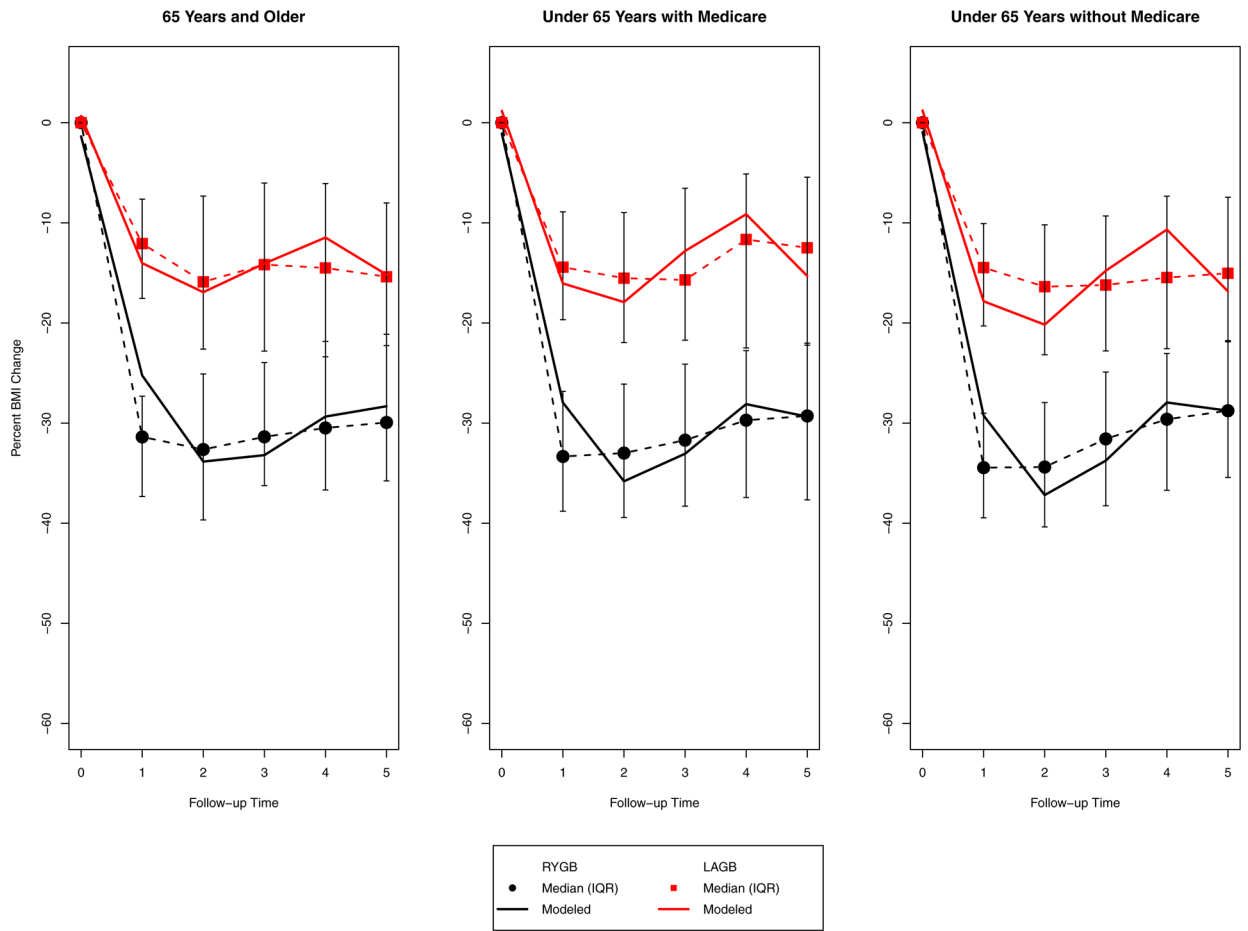1601 Other insurance

Figure 1.
LABS-2 Cohort Participants

Figure 2.
Observed and Modeled BMI Change in LABS-2 Participants

Table 1.

Baseline characteristics of LABS-2 participants included in study[a]

Characteristic	Age > 65	Age < 65 (n=1846)		Overall (n=1943)
	Age-Qualified (n=97)	Disability-Qualified (n=245)	Non-Medicare (n=1601)	
Median age (IQR), years	67.0 (66.0–68.0)	52.0 (43.0–57.0)	45.0 (37.0–52.0)	47.0 (38.0–55.0)
Female Sex	63 (64.9)	180 (73.5)	1302 (81.3)	1545 (79.5)
Race				
White	94 (96.9)	205 (83.7)	1381 (86.3)	1680 (86.5)
Black	2 (2.1)	24 (9.8)	160 (10.0)	186 (9.6)
Other	1 (1.0)	14 (5.7)	47 (2.9)	62 (3.2)
Missing	0 (0.0)	2 (0.8)	13 (0.8)	15 (0.8)
Ethnicity				
Non-Hispanic	94 (96.9)	235 (95.9)	1522 (95.1)	1851 (95.3)
Hispanic	3 (3.1)	10 (4.1)	77 (4.8)	90 (4.6)
Missing	0 (0.0)	0 (0.0)	2 (0.1)	2 (0.1)
Smoking status				
Never smoker	36 (37.1)	114 (46.5)	935 (58.4)	1085 (55.8)
Current smoker	0 (0.0)	14 (5.7)	63 (3.9)	77 (4.0)
Former Smoker	61 (62.9)	115 (46.9)	586 (36.6)	762 (39.2)
Missing	0 (0.0)	2 (0.8)	17 (1.1)	19 (1.0)
Median weight (IQR), kg	124.7 (112.9,137.0)	133.8 (116.1, 154.2)	127.0 (114.3,143.3)	127.5 (114.3, 144.7)
Median BMI (IQR), kg/m²	44.5 (40.3, 48.7)	47.8 (43.0, 53.4)	45.3 (41.5, 50.5)	45.5 (41.5, 50.9)
Median percentage body fat (IQR), %	49.7 (38.0, 52.5)	50.3 (36.8, 53.8)	50.3 (45.0, 53.1)	50.3 (44.3, 53.3)
Comorbidities				
Diabetes	49 (50.5)	131 (53.5)	493 (30.8)	673 (34.6)
High LDL	64 (66.0)	129 (52.7)	523 (32.7)	716 (36.9)
Low HDL	38 (39.2)	104 (42.4)	546 (34.1)	688 (35.4)
High triglycerides	17 (17.5)	64 (26.1)	307 (19.2)	388 (20.0)
Hypertension	88 (90.7)	185 (75.5)	1031 (64.4)	1304 (67.1)
Dyslipidemia	65 (67.0)	148 (60.4)	798 (49.8)	1011 (52.0)
Hyperlipidemia	57 (58.8)	108 (44.1)	440 (27.5)	605 (31.1)

| Characteristic | Age > 65 | | Age < 65 (n=1846) | | | |
	Age-Qualified (n=97)	Disability-Qualified (n=245)	Non-Medicare (n=1601)		Overall (n=1943)	
SF-36						
Modified PCS	34.7 (24.7, 42.0)	29.6 (24.3, 37.2)	40.3 (32.2, 48.0)		38.6 (30.4, 47.0)	
Modified MCS	53.0 (45.4, 58.8)	48.2 (35.6, 56.1)	51.6 (43.1, 56.9)		51.3 (42.3, 56.9)	
Surgery type						
RYGB	43 (44.3)	178 (72.7)	1211 (75.6)		1432 (73.7)	
LAGB	54 (55.7)	67 (27.3)	390 (24.4)		511 (26.3)	

Abbreviations: IQR, interquartile range; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; PCS, Physical Component Summary; MCS, Mental Component Summary; RYGB, Roux-en-Y gastric bypass; LAGB, Laparoscopic adjustable gastric band.

[a]Data are n (%) unless otherwise indicated

Table 2.

Outcomes for LABS-2 participants, by surgery type[a]

	Age-Qualified (AQ) (=> 65 years)		Disability-Qualified (DQ)		<65 years Non-Medicare (NM)	
	RYGB (n=43)	LAGB (n=54)	RYGB (n=178)	LAGB (n=67)	RYGB (n=1211)	LAGB (n=390)
Composite adverse endpoint	2 (4.7)	0 (0.0)	12 (6.7)	2 (3.0)	52 (4.3)	7 (1.8)
Diabetes remission (%)[b]						
Year 1	10 (47.6)	4 (14.3)	43 (47.3)	12 (30.0)	201 (49.8)	26 (29.2)
Year 5	7 (33.3)	5 (17.9)	32 (35.2)	5 (12.5)	161 (39.9)	17 (19.1)
Hypertension remission (%)[b]						
Year 1	9 (23.1)	5 (10.2)	45 (33.6)	1 (2.0)	310 (38.5)	47 (20.9)
Year 5	4 (10.3)	6 (12.2)	26 (19.4)	3 (5.9)	191 (23.7)	30 (13.3)
Dyslipidemia remission (%)[b]						
Year 1	4 (14.3)	6 (16.2)	25 (22.9)	5 (12.8)	229 (36.5)	29 (17.0)
Year 5	3 (10.7)	5 (13.5)	18 (16.5)	3 (7.7)	186 (29.7)	28 (16.4)
Median percent BMI change						
Year 1	−31.4 (−37.3, −27.3)	−12.1 (−17.5, −7.6)	−33.3 (−38.8, −26.8)	−14.4 (−19.7, −8.9)	−34.4 (−39.5, −29.0)	−14.5 (−20.3, −10.1)
Year 5	−29.9 (−35.8, −21.1)	−15.4 (−22.3, −8.0)	−29.3 (−37.7, −22.0)	−12.5 (−22.2, −5.4)	−28.8 (−35.4, −21.8)	−15.0 (−21.9, −7.4)
Median percent body fat change						
Year 1	−39.7 (−59.9, −23.8)	−12.9 (−21.5, −4.8)	−29.7 (−48.2, −20.0)	−12.4 (−19.6, −4.2)	−32.5 (−47.0, −23.0)	−10.8 (−19.5, −5.0)
Year 5	−30.5 (−53.9, −20.5)	−14.4 (−26.3, −11.8)	−25.6 (−41.6, −17.1)	−9.3 (−14.1, −4.3)	−23.1 (−37.5, −13.9)	−9.6 (−19.2, −4.0)
Median percent SF-36 PCS change						
Year 1	33.0 (8.0, 66.6)	20.7 (6.8, 46.8)	38.1 (15.6, 61.1)	13.0 (−3.8, 30.5)	32.7 (14.1, 61.5)	17.9 (7.3, 36.3)
Year 5	24.0 (7.4, 62.4)	7.6 (−13.4, 33.7)	22.8 (−1.3, 56.3)	8.3 (−11.5, 24.2)	22.1 (5.1, 48.4)	14.4 (3.7, 30.6)
Median percent SF-36 MCS change						
Year 1	1.9 (−3.3, 16.2)	0.1 (−8.5, 15.6)	2.5 (−6.3, 19.7)	−1.4 (−11.2, 11.2)	3.6 (−4.1, 20.5)	3.3 (−4.3, 14.7)
Year 5	2.9 (−8.4, 13.7)	−5.3 (−18.1, 9.2)	−2.9 (−16.0, 16.3)	−8.8 (−19.0, 3.6)	−0.7 (−12.5, 11.3)	2.2 (−6.8, 15.8)

Abbreviations: RYGB, Roux-en-Y gastric bypass; LAGB, Laparoscopic adjustable gastric band; IQR, interquartile range; BMI, Body Mass Index; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; PCS, Physical Component Summary; MCS, Mental Component Summary.

[a]Data are median (IQR) unless otherwise indicated;

[b]Remission calculated among participants who had comorbidity at baseline.