Changes in BMI Following Bariatric Surgery

Gagarin Zhao (gz2281)

Columbia University MAILMAN SCHOOL OF PUBLIC HEALTH

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ABSTRACT

- In the past 100 years, Roux-en-Y gastric bypass (RYGB) has been proven to be the most effective treatment for patients who are morbidly obese. However, laparoscopic adjustable gastric banding (LAGB) gained in popularity when it demonstrated that it could provide a simpler, safer, and less invasive alternative to the time-tested RYGB procedure.
- The current study analyzes changes in weight from the point of randomization until two year after assigning either of the two surgeries to groups of individuals who are morbidly obese.
- Analysis finds that both surgeries were very effective at decreasing BMI in participants following surgery in comparison to controls who received no surgery.
- Overall, the two surgeries do not show big differences in comparison to each other when examining BMI changes over time.

OBJECTIVE

- Obesity is a public health concern in the US. Using NHANES survey in 2009-2010, I analyze the effectiveness of two types of bariatric surgery techniques.
- **Main objective:** Examining the association between weight loss measured by BMI and weight loss treatments at last measurement of two years post-surgery, and over the two-year period following weight-loss surgery.
- Examining association of weight loss measured by BMI for gender, diabetic status, hypertension status, and alcohol consumption.

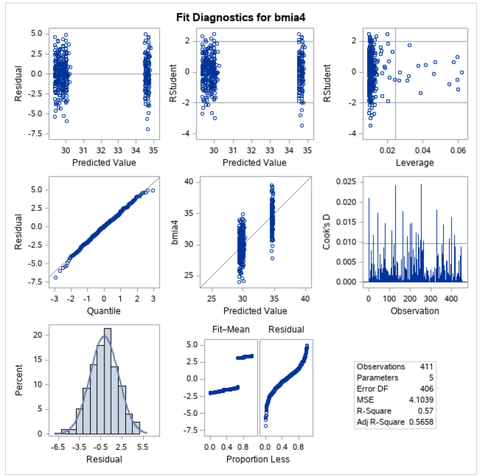
METHOD

- The dataset is comprised of static information regarding ID, gender (Male/Female), hypertension status (Yes/No), diabetes status (Yes/No), and their treatment arm (Control/LAGB/RYGB).
- Additionally, there are variables describing BMI and number of alcoholic drinks consumed per week measured at: baseline, 6, 12, 18, and 24 months.
- An interaction term between diabetes and alcohol level is included in the initial maximum model due to the previous literature describing a link between alcohol consumption and diabetes.
- Stepwise model selection with an SLE and SLS of p = 0.15 reveals that only TRT should be a part of the model. However, because the investigators are interested in gender, diabetic status, hypertension status, and substance abuse as research questions, all variables in the model for my analysis were kept for cross-sectional analysis at last measurement and analysis of BMI changes over time.
- Because diabetes and hypertension are only measured at baseline and cross-sectional analysis was done with BMI (and drinking) at last measurement, it is erroneous to analyze the effect diabetes and hypertension have on BMI at last measurement.
- **Analysis 1** uses multiple linear regression (MLR) to find the effect of bariatric surgery type, gender, and drinking on BMI at last measure.
- **Analysis 2** uses generalized estimating equation (GEE) to examine the change of BMI across five distinct times in measurement, as effected by bariatric surgery type, adjusting for gender.
- Cox Regression is used to analyze missing data in drinking and BMI across time.

RESULT

Analysis 1: Cross-Sectional Analysis of BMI at Last Measurement

BMI at Last Measurement vs. Treatment Arm					
Treatment	**N**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Control	137	34.626	2.154	27.800	39.500
LAGB	136	29.929	1.920	24.100	34.900
RYGB	138	29.526	1.991	24.000	34.000



- The interaction term between drinking and diabetes is removed due its insignificance in the cross-sectional analysis.
- Only treatment arm, drinking at last measure, and gender are kept in the final multiple linear regression model.
- Regression diagnostics show that assumptions of linearity, independence normality, lack of multicollinearity, homoscedasticity are met.
- Using adjusted R-square, 57% of the variability in BMI at last measure can be explained by gender, treatment, and current drinking.

- Treatment is the only significant predictor for BMI at last measurement, adjusting for gender and drinking.
- LAGB has a parameter estimate of -4.709 ($p < 0.0001$). Compared to the control group, those receiving this treatment had 4.709 lower BMI.
- RYGB has a parameter estimate of -5.158 ($p < 0.0001$). Compared to the control group, those receiving this treatment had 5.158 lower BMI.

Analysis 2: Longitudinal Analysis of BMI Over Two Years

Analysis Of GEE Parameter Estimates							
Parameter		**Estimate**	**Standard Error**	**95% Confidence Limits**		**Z**	**Pr > |Z|**
Intercept		36.8358	0.1858	36.4717	37.1998	198.30	<.0001
Drinking		-0.0027	0.0120	-0.0262	0.0208	-0.23	0.8197
Treatment	LAGB	-2.1527	0.1979	-2.5405	-1.7648	-10.88	<.0001
Treatment	RYGB	-2.4030	0.2038	-2.8024	-2.0036	-11.79	<.0001
Gender	Male	0.2700	0.1584	-0.0404	0.5804	1.70	0.0882
Time		-1.3630	0.0446	-1.4504	-1.2756	-30.57	<.0001

- Drinking is not a significant predictor for changes in BMI.
- Measurement time has a significant effect on changes in BMI ($Z = -30.57$, $p < 0.0001$).
- LAGB has a parameter estimate of -2.1527 ($p < 0.0001$). Compared to the control group, those receiving this treatment had 2.1527 lower BMI across baseline, 6, 12, 18, and 24 months after surgery.
- RYGB has a parameter estimate of -2.4030 ($p < 0.0001$). Compared to the control group, those receiving this treatment had 2.4030 lower BMI across measurements.
- After running Cox Regression (proportional hazards regression), there is low concern for missing data.
- Regression diagnostics show that assumptions are met.

CONCLUSION

- Hypertension and diabetes are not significant as predictors of lower BMI, and are excluded from the final analyses.
- At last measurement, both LAGB and RYGB are helpful in decreasing BMI than the control group who received no surgery.
- RYGB is associated with slightly lower BMI than receiving laparoscopic adjustable gastric banding at last measurement, but that difference is minimal when looking at changes over time.
- Results of surgery in general across the five measurement points are significant, but the two bariatric surgery types have similar effects on BMI across time in decreasing BMI. This confirms previous findings that the two procedures have similar efficacy in long-term decrease in BMI.
- Although gender is not a significant predictor of changes in BMI, adjusting for gender gives us a more accurate examination of the results of surgeries.
- Over two years, people in the study lose weight and their BMI decreases, regardless of their surgery type or if they were in the control who did not receive surgery.
- People who are lost to follow-up are not found to be biasing the findings at this point.

Limitations and Future Analyses

- Even though diabetes and hypertension are excluded from analysis during this study, they can affect and be effected by changes in BMI. Longitudinal analysis with BMI should include measurement of hypertension and diabetes moving forward.
- In future studies, researchers should consider analyzing both the effect of diabetes and hypertension on BMI and the reverse effects, as previous literature have shown BMI as a strong predictor of diabetes and hypotension.
- Other studies show promising data on safety and trajectory of weight loss in both LAGB and RYGB. Examining invasiveness and recovery time may be useful in the future.

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