

## Background

As the obesity rates rise in the United States, the incidence of bariatric surgery has also increased. Included within the group of patients undergoing bariatric surgery are women of child-bearing age with plans for conception, pregnancy, and labor and delivery (L&D). Bariatric surgery has been shown to improve menstrual cycle irregularities as well as conception rates. However, there is limited data on its effects on both pregnancy and L&D outcomes, especially given the nutritional deficiencies that often accompany post-bariatric surgery patients.

## Aims

Identify the impact of prior bariatric surgery on:

- 1) Complications of pregnancy: hypertension, diabetes, gestational diabetes, mental health disorders, alcohol dependence, missed/spontaneous abortions, thromboembolic complications (, hyperemesis, preeclampsia, and nutritional deficiencies
- 2) Complications of L&D: C-section, assisted vaginal, and breech delivery, anesthesia complication, placenta previa, fetal distress, infection, ectopic, bleeding after delivery, thromboembolic complications, spontaneous and missed abortions, retained placental, fetal disproportion, and early membrane rupture

Secondary aims included total length of stay, total cost of delivery, average age at delivery.

## Methods

**Study Type:** Retrospective cohort analysis of the 2012 Nationwide Inpatient Sample (NIS) database.

**Inclusion criteria:** ICD-9 codes for pregnancy and L&D

**Exposure of interest:** ICD-9 code for history of bariatric surgery

**Primary outcome:** Percentage of women with common pregnancy and L&D complications

**Secondary outcomes:** length of stay (LOS), hospitalization cost, and average age at delivery.

**Statistical Analysis:** Differences between cases and controls were compared with student t-test and chi-square tests; multivariable logistic regression was used to control for confounders. Statistical significance was set at p <0.05.

## Results

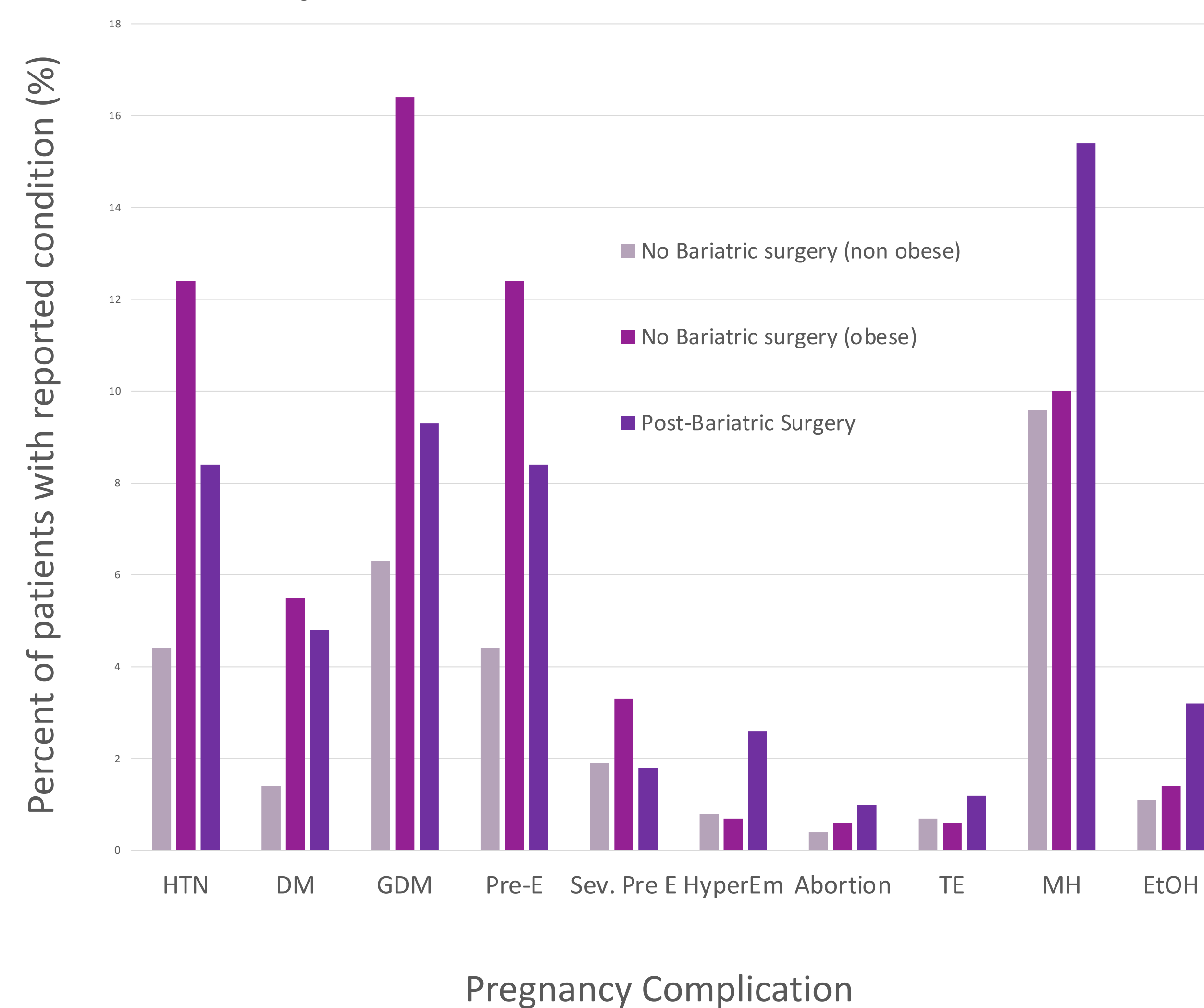
Diagnosis	Post-Bariatric Surgery, % (95% CI) N=8,185	Controls (no obesity), % (95% CI) N=211,155	P <sub>1</sub>	Controls (with obesity), % (95% CI) n= 212,945	P <sub>2</sub>
Total charges per admission, USD	19,107	14,971	<0.001	19,148	0.9
Mean age, years	33	28	<0.001	28.5	<0.001
Length of stay, days	3.33	2.8	<0.001	3.27	0.4
Hypertension (HTN)	8.4 (7.0, 9.7)	4.4 (4.2, 4.6)	<0.001	12.4 (12, 12.7)	<0.001
Diabetes (DM)	4.8 (3.7, 6.0)	1.4 (1.3,1.5)	<0.001	5.5 (5.3, 5.7)	0.2
Gestational diabetes (GDM)	9.3 (7.9, 11)	6.3 (6.0,6.5)	<0.001	16.4 (16, 16.8)	<0.001
Mental antepartum	3.2 (2.3, 4.0)	1.1 (0.9, 1.2)	<0.001	1.0 (0.9, 1.1)	<0.001
Mental health disorders (MH)	15.4 (14,17)	10 (10,11)	<0.001	9.6 (9.3,9.9)	<0.001
Alcohol dependence (EtOH)	3.2 (2.3, 4.0)	1.4 (1.3, 1.5)	<0.001	1.1 (1.0, 1.2)	<0.001
Liver disease in pregnancy	0.6 (0.2, 1.0)	6.4 (5.6, 7.1)	0.9	0.5 (0.5, 0.6)	0.7
Spontaneous or missed abortions	1.0 (0.5, 1.5)	0.6 (0.5, 0.6)	0.04	0.4 (0.3, 0.5)	<0.001
Thromboembolic complications (TE)	1.2 (0.7, 1.8)	0.6 (0.5, 0.7)	<0.001	0.7 (0.7, 0.8)	0.03
Hyperemesis (HyperEm)	2.6 (1.8, 3.3)	0.7(0.6, 0.8)	<0.001	0.8 (0.7, 0.9)	<0.001
Severe pre-eclampsia	1.8 (1.1,2.5)	1.9 (1.8,2.1)	0.08	3.3 (3.2, 3.5)	0.001
Pre-eclampsia (Pre-E)	8.4 (7.0, 9.7)	4.4 (4.1, 4.6)	<0.001	12.4 (12, 13)	<0.001
Nutritional deficiencies	41(38, 43)	30 (29, 30)	<0.001	39 (38, 40)	0.2

**Table 1A.** Pregnancy complications in pregnant women with prior bariatric surgery compared to pregnant those without bariatric surgery. P<sub>1</sub> refers to comparison between post-bariatric cohort and general cohort without obesity, and P<sub>2</sub> for comparison between post-bariatric cohort and cohort with obesity.

Diagnosis	Post-Bariatric Surgery, % (95% CI) N= 9,159	Controls (no obesity), % (95% CI) N=3,599,717	P
Total charges per delivery, USD	18,945	15,071	<0.001
Mean age, years	33	28	<0.001
Length of stay, days	3.3	2.6	<0.001
C-section	46 (44,49)	32 (31,32)	<0.001
Breech delivery	1.5 (1.0,2.1)	1.0 (0.9,1.0)	0.01
Assisted vaginal delivery	51 (49, 53)	65 (65.1, 65.4)	<0.001
Anesthesia complications	0.7 (0.3, 1.0)	0.3 (0.3, 0.3)	0.02
Placenta previa (PP)	2.7 (1.9,3.4)	1.9 (1.8,1.9)	0.01
Fetal distress	47.4 (45,50)	26 (25.8,26)	<0.001
Puerperium, infections	1.9 (1.3,2.5)	0.8 (0.8,0.9)	<0.001
Ectopic pregnancies	0.5 (0.2,0.8)	0.1 (0.1, 0.1)	<0.001
Bleeding after delivery	2.3 (1.6, 3)	3.0 (2.9, 3.0)	0.12
Spontaneous or missed abortions	0.65 (0.3, 1.0)	0.12 (0.1, 0.9)	<0.001
Thromboembolic complications, puerperium	0.9 (0.4, 1.3)	0.56 (0.54, 0.58)	0.07
Retained placenta	0.4 (0.1, 0.7)	0.5 (0.5, 0.5)	0.8
Disproportion, fetal	1.4 (0.8,1.8)	1.7 (1.6,1.7)	0.3
Early membrane rupture	8.6 (7.3, 9.9)	8.7 (8.7,8.8)	0.8

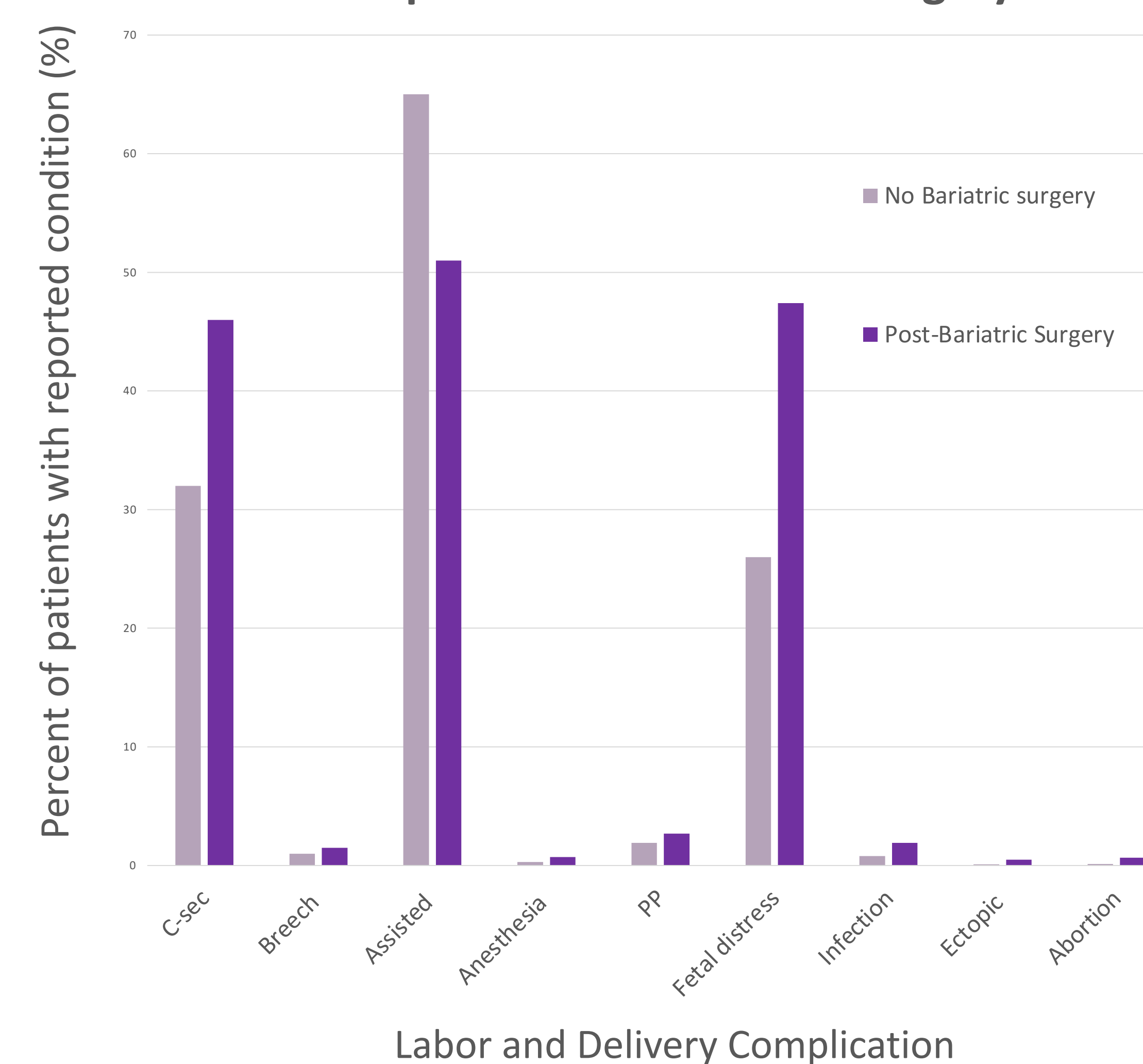
**Table 1B.** L&D complications in pregnant women with prior bariatric surgery compared to those without bariatric surgery. P value reported for the comparison between the post-bariatric cohort and the general cohort.

**Pregnancy Complications: Prior Bariatric Surgery compared to Non-Obese and Obese Controls**



**Chart 1A.** Bar graph comparing incidence of pregnancy complications (%) in women with prior bariatric surgery compared to obese women without bariatric surgery and non-obese women without bariatric surgery. All comparisons were statistically significant.

**L&D Complications: Prior Bariatric Surgery Compared to No Bariatric surgery**



**Chart 1A.** Bar graph comparing incidence of labor and delivery complications (%) in pregnant women with prior bariatric surgery compared to pregnant women without bariatric surgery. All above comparisons were statistically significant.

## Discussion

1. Bariatric surgery reduces the incidence of metabolic disorders such as hypertension, diabetes (including gestational), and pre-eclampsia as compared to obese individuals
2. Bariatric surgery increases the incidence of hyperemesis, nutritional deficiencies, spontaneous abortion, thromboembolism, alcohol use, and mental health disorders compared to both obese and non obese individuals without bariatric surgery.
3. Bariatric surgery increases the incidence of labor and delivery complications, including C-section and breech delivery, fetal distress, anesthesia complications, infections in puerperium ectopic pregnancy, spontaneous abortion, and thromboembolic complications.
4. On average, pregnant women with bariatric surgery had a longer length of stay and were older when compared to non-obese patients without bariatric surgery
5. On average, pregnant women with bariatric surgery had an increased total cost of pregnancy as well as labor and delivery when compared to non-obese patients without bariatric surgery.

## Strengths/Limitations

This study employs a novel approach by using the NIS Database which provides a wealth of information by utilizing ICD-9 codes. Using this robust dataset allows us to study a range of complications in both pregnancy and L&D allowing for a more complete understanding about the potential beneficial and adverse effects of bariatric surgery in the pregnant population. However, this dataset is limited to allow only for correlation and not causation. Further studies are needed to assess the in what ways bariatric surgery increases risk of these complication. Particularly intriguing are the increased risk on mental health disorders and thromboembolic complications in both pregnancy and L&D.

## Conclusion

Pregnant women with history of bariatric surgery have increased risk of pregnancy and L&D complications and should be considered high-risk pregnancies and deliveries as the rate of potential complications is higher compared to those without prior bariatric surgery, including when compared to pregnant women with obesity.