IFSO

BRIEF COMMUNICATION

Association Between Bariatric Surgery and Severe COVID-19 Outcomes in Florida

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Abstract

Less is known whether bariatric surgery (BS) is associated with improved outcomes of COVID-19 complications among patients with class III obesity. Using data from the Florida's state inpatient database (SID) in 2020, we performed multivariable logistic regressions to investigate the impact of prior BS on three separate events, including admission due to COVID-19 among patients eligible for BS (non-BS) and those with prior BS, ventilator usage, and all-cause mortality among those admitted due to COVID-19. Of 409,665 patients included in this study, 25,116 (6.1%) had a history of BS. Results from adjusted logistic regression showed that prior BS was associated with decreased risk of admission due to COVID-19 than that in non-BS group. The risk reduction was smaller among those with class III obesity (adjusted odds ratio [aOR]: 0.58; 95% CI: 0.51–0.66; $p < 0.001$) than those without (aOR: 0.32; 95% CI: 0.28–0.38; $p < 0.001$). Compared with the non-BS group, aOR of ventilator use and all-cause mortality for patients without class III obesity decreased by 58% and 78% ($p < 0.05$), respectively. However, these significances disappeared among patients with continued class III obesity after BS. Our findings suggest that patients with continued class III obesity after BS were still at higher risk of severe COVID-19 outcomes than those without.

Keywords Bariatric surgery · Obesity · COVID-19

Key points • Less is known whether bariatric surgery (BS) is associated with improved outcomes of COVID-19 complications among patients with class III obesity.

• BS was associated with risk reduction of inpatient admission due to COVID-19 and mortality; however, this protective effect seems to be diminished among post-bariatric patients with class III obesity.

• Our findings suggest that patients with continued class III obesity after BS were still at higher risk than those without.

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Introduction

Obesity is a recognized risk factor for severe SARS-COV-2 (COVID-19) outcomes [1]. Recent studies found that substantial weight loss achieved by bariatric surgery (BS) was associated with improved outcomes of COVID-19 [2, 3]. Some risk scores indicate that severe outcomes of COVID-19 (e.g., inpatient mortality) are more related to physiological parameters than weight [4, 5]. Yet there is little evidence supporting the association between BS and risk of COVID-19 severe outcomes among patients who are still obese or have not yet experienced significant weight loss. In this study, we aimed to investigate the association of BS on COVID-19 hospitalization, invasive ventilator use, and mortality stratified by obesity status using a statewide inpatient dataset.

Methods

In this retrospective cross-sectional study, we used data from the newly published 2020 Florida State Inpatient Database (SID) belonging to the Healthcare Cost and Utilization

Table 1 Demographics and comorbidity profile among patients stratified by class III obesity status and prior bariatric surgery status

	Prior BS and BMI < 40	Prior BS and BMI ≥ 40	No BS and BMI ≥ 40
Total	13,712 (3.3)	11,404 (2.8)	384,549 (93.9)
Age			
18–44	2374 (17.3)	2124 (18.6)	79,671 (20.7)
45–64	6176 (45.0)	5672 (49.7)	142,427 (37)
> 64	5162 (37.7)	3608 (31.6)	162,451 (42.2)
Sex			
Male	3083 (22.5)	3211 (28.2)	170,564 (44.4)
Female	10,629 (77.5)	8193 (71.8)	213,985 (55.7)
Race/ethnicity			
White	9584 (69.9)	7323 (64.2)	231,894 (60.3)
Black	1602 (11.7)	1976 (17.3)	76,335 (19.9)
Hispanic	2165 (15.8)	1830 (16.1)	64,562 (16.8)
Other	361 (2.6)	275 (2.4)	11,758 (3.1)
RUCC category			
Metro	13,028 (95.0)	10,920 (95.8)	368,696 (95.9)
Non-metro	684 (5.0)	484 (4.2)	15,853 (4.1)
Insurance			
Medicare	7503 (54.7)	5796 (50.8)	196,827 (51.2)
Medicaid	1216 (8.9)	1014 (8.9)	51,419 (13.4)
Private	3735 (27.2)	3798 (33.3)	94,619 (24.6)
Other	1258 (9.2)	796 (7.0)	41,684 (10.8)
Median household income			
0–25th percentile	4683 (34.2)	3996 (35.0)	155,090 (40.3)
26th to 50th	5091 (37.1)	4244 (37.2)	138,398 (36.0)
51st to 75th	2869 (20.9)	2392 (21.0)	69,423 (18.1)
76th to 100th	1052 (7.7)	759 (6.7)	21,225 (5.5)
Missing	17 (0.1)	13 (0.1)	413 (0.1)
Length of stay			
0–5 days	10,339 (75.4)	8243 (72.3)	255,931 (66.6)
6–10 days	2272 (16.6)	2066 (18.1)	76,508 (19.9)
11–30 days	1005 (7.3)	1004 (8.8)	46,380 (12.1)
> 30 days	96 (0.7)	91 (0.8)	5714 (1.5)
Missing			16 (0)
COVID-19 as admission diagnosis	165 (1.2)	252 (2.2)	14,222 (3.7)
COVID-19 in any diagnosis	403 (2.9)	566 (5.0)	31,474 (8.2)
Comorbidity			
Type 2 diabetes	3006 (21.9)	3418 (30.0)	145,993 (38.0)
Hypertension	8313 (60.6)	8173 (71.7)	289,190 (75.2)
Dyslipidemia	4195 (30.6)	4434 (38.9)	179,999 (46.8)
Chronic respiratory disease	2972 (21.7)	3009 (26.4)	114,503 (29.8)
Cardiovascular disease	5345 (39.0)	5039 (44.2)	208,756 (54.3)
Immune disease	161 (1.2)	139 (1.2)	5209 (1.4)
Cancer	1375 (10.0)	956 (8.4)	37,833 (9.8)
Chronic kidney disease	883 (6.4)	911 (8.0)	45,811 (11.9)
Ventilator use	349 (2.6)	353 (3.1)	21,834 (5.7)
All-cause mortality during stay	177 (1.3)	130 (1.1)	9549 (2.5)

[*]Abbreviations: *BMI*, body mass index; *BS*, bariatric surgery; *RUCC*, rural–urban continuum codes. * "Other" in race/ethnicity include Asian or Pacific Islander, Native American, and other or missing value in RACE variable. *Class III obesity or BMI ≥ 40 kg/m^2 was identified by ICD-10 Z68.4

Project (HCUP) databases family. Approval for use of the SID de-identified patient-level data was obtained from the Institutional Review Board (IRB) of the University of Florida and the HCUP.

We used the International Classification of Diseases, Tenth Revision procedure code (ICD-10-PCS: Z98.84) to identify patients with prior BS as a surgical group. Patients with class III obesity (BMI ≥ 40 kg/m^2; ICD-10: Z68.4) but without prior BS record were included as the BS-eligible group. We used the I10_DX_Admitting variable to identify patients' admission due to COVID-19 (U07.1, J12.81, B97.29, B34.2). Additionally, we identified comorbidities reported to be associated with severe COVID-19 outcomes. Exclusion criteria were those who were non-Florida residents, younger than 18 years, without sex identification, or patients with any BS-related procedure record, including revision in 2020.

We further divided the BS surgical group by their obesity status (BMI ≥ 40 kg/m^2 or not). Patients were characterized based on demographics, baseline comorbidities, medical payment source, and severe outcomes (ventilator usage or all-cause mortality). We compared baseline characteristics using Chi-square test for categorical variables. We then performed multivariable logistic regressions to investigate the impact of prior BS on three separate events, including admission due to COVID-19 among all samples, ventilator usage, and all-cause mortality among those admitted due to COVID-19, while controlling for other covariates. All data analyses were performed using SAS 9.4 (Cary, NC). Statistical significance was defined as $p < 0.05$.

Results

In 2020, there were 25,116 patients with prior BS (surgical group) and 384,549 individuals eligible for BS. The rate of admission due to COVID-19 was the highest among patients eligible for BS (3.7%), followed by patients who had history of BS with (2.2%) or without (1.2%) class III obesity. In demographic composition, patients in the surgical groups had more females and lower prevalence of comorbidities (Table 1).

After adjusting demographic and comorbidity characteristics, prior BS was associated with decreased risk of admission due to COVID-19 than in non-BS group (Table 2). The risk reduction was smaller among those with class III obesity (adjusted odds ratio [aOR]: 0.58; 95% CI: 0.51–0.66; $p < 0.001$) than those without (aOR: 0.32; 95% CI: 0.28–0.38; $p < 0.001$). Compared with non-BS group, aOR of ventilator use and all-cause mortality for patients without class III obesity decreased by 58% and 78% ($p < 0.05$), respectively.

Discussion

In this study, we used the 2020 Florida inpatient data and found that prior BS was associated with significantly decreased likelihood of inpatient admission due to COVID-19 regardless of obesity status. Compared to BS-eligible patients, there were significant adjusted risk reductions in both ventilator usage and all-cause inpatient mortality among patients without class III obesity after BS; however, these significances disappeared among patients with continued class III obesity after BS.

A unique finding of our study is that even among patients with continued class III obesity, BS showed protective effect against inpatient admission due to COVID-19. Previous studies suggested that the amelioration effect on comorbidities by BS may increase overall immunity against COVID-19 infection [6]. However, we found no significant difference in the likelihood of severe COVID-19 outcomes between those with continued class III obesity stratified by prior BS status. A possible explanation is that obesity may serve as an independent risk factor for reduced cardiorespiratory function [7], leading to severe COVID-19 outcomes. Thus, it is essential to provide necessary interventional programs on weight loss after BS in clinical practice. Study limitations include lack of adjuvant pharmacotherapy and no patients' follow-up data, which may bias the results or of other causes of mortality.

Table 2 Multivariable logistic regression analysis of class III obesity status associated with COVID-19-related outcomes

Outcomes	No BS and BMI ≥ 40	Prior BS and BMI < 40	P value	Prior BS and BMI ≥ 40	P value
All patients					
COVID-19 admission	1.00	0.32 (0.28–0.38)	< 0.001	0.58 (0.51–0.66)	< 0.001
Among those admitted due to COVID-19					
Ventilator use	1.00	0.42 (0.21–0.84)	0.014	0.75 (0.48–1.17)	0.201
All-cause mortality	1.00	0.22 (0.08–0.60)	0.003	0.77 (0.46–1.29)	0.315

[*]Class III obesity or BMI ≥ 40 kg/m^2 was identified by ICD-10 Z68.4

Conclusion

Receiving BS was associated with decreased risk of COVID-19 infection; however, it did not seem to be a sole protective factor for severe COVID-19 outcomes among patients with continued class III obesity. Targeted weight loss management and education should be directed to avoid potential progressive COVID-19 outcomes for post-bariatric patients with continued class III obesity.

Declarations

Ethical Approval For this type of study, formal consent is not required. This study received Institutional Review Board (IRB) exemption approval from the University of Florida and the Healthcare Cost and Utilization Project (HCUP).

Consent to Participate Informed consent does not apply.

Conflict of Interest The authors declare no competing interests.

References

1. Tartof SY, Qian L, Hong V, et al. Obesity and mortality among patients diagnosed with COVID-19: results from an integrated health care organization. Ann Intern Med. 2020;173(10):773–81. https://doi.org/10.7326/M20-3742.

2. Jenkins M, Maranga G, Wood GC, et al. Prior bariatric surgery in COVID-19-positive patients may be protective. Surg Obes Relat Dis Off J Am Soc Bariatr Surg. 2021;17(11):1840–5. https://doi.org/10.1016/j.soard.2021.07.024.

3. Aminian A, Tu C, Milinovich A, et al. Association of weight loss achieved through metabolic surgery with risk and severity of COVID-19 infection. JAMA Surg. 2022;157(3):221–30. https://doi.org/10.1001/jamasurg.2021.6496.

4. Ebell MH, Cai X, Lennon R, et al. Development and validation of the COVID-NoLab and COVID-SimpleLab risk scores for prognosis in 6 US health systems. J Am Board Fam Med JABFM. 2021;34(Suppl):S127–35. https://doi.org/10.3122/jabfm.2021.S1.200464.

5. Li Y, Kong Y, Ebell MH, et al. Development and validation of a two-step predictive risk stratification model for coronavirus disease 2019 in-hospital mortality: a multicenter retrospective cohort study. *Front Med*. 2022;9. Accessed June 25, 2022. https://www.frontiersin.org/article/https://doi.org/10.3389/fmed.2022.827261

6. Naqvi A, MacKintosh ML, Derbyshire AE, et al. The impact of obesity and bariatric surgery on the immune microenvironment of the endometrium. Int J Obes. 2022;46(3):605–12. https://doi.org/10.1038/s41366-021-01027-6.

7. Sattar N, McInnes IB, McMurray JJV. Obesity is a risk factor for severe COVID-19 infection. Circulation. 2020;142(1):4–6. https://doi.org/10.1161/CIRCULATIONAHA.120.047659.