



The impact of COVID-19 on medium term weight loss and comorbidities in patients undergoing bariatric surgery and its association with psychological wellbeing

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Abstract

Background The COVID-19 epidemic imposed significant stressors on individuals and changed how medical care is delivered. The affect that this stress has placed on the field of bariatric surgery and the associated outcomes is not well established.

Methods A retrospective review of a prospectively collected database from a single academic institution was conducted. Weight loss and comorbidity outcomes were compared between a cohort of patients operated on during the pandemic and a matched group operated on prior to COVID-19. GAD-7 and PHQ-9 questionnaires were used to assess for anxiety and depression, respectively.

Results A total of 329 and 155 patients were enrolled in the pre-pandemic and COVID-19 groups respectively. There were no significant differences in pre-operative BMI ($p = 0.437$) or comorbidities: Type II DM ($p = 0.810$), hypertension ($p = 0.879$), sleep apnea ($p = 0.502$), and hyperlipidemia ($p = 0.227$). Post-operatively, weight loss was comparable at all time points out to 1 year. Type II DM resolution rates were higher in the control cohort at 6 months ($p = 0.007$), but not at 12 months ($p = 1.000$). There was no statistically significant difference in resolution rates between the control group and the COVID-19 group for the other measured comorbidities. There was no difference in objective measures of anxiety and depression when comparing the two groups (both $p > 0.05$).

Conclusions The COVID-19 pandemic has fundamentally changed how society and medical systems function. Focusing on pre-operative dietary training and screening for inadequately managed psychological comorbidities yielded similar weight loss outcomes notwithstanding the significant societal and individual stressors with which patients were faced.

Keywords COVID-19 · Psychological wellbeing · Bariatric surgery

The COVID-19 pandemic has imposed a high toll on the way society functions not only due to the drastic financial and emotional impact, but also due to the way it has changed social interactions. Moreover, it dramatically altered how medical care was delivered and how providers optimized safe and consistent access for patients. Telehealth programs were often slow to commence and were inconsistent across the health care system [1]. This is particularly relevant for patients in the pre- and post-bariatric surgery process due to

the reliance on close follow-up to ensure successful weight loss and metabolic outcomes. In many situations, triage of resources necessitated cessation of bariatric surgery procedures with a resulting negative outcome for patients [2]. Individuals undergoing bariatric surgery could experience increased emotional distress, resulting in increased eating psychopathology, mental health exacerbation, and difficulties with self-management [3]. Addressing these challenges requires novel approaches to redefining psychosocial care before and after bariatric surgery [4].

There is a higher prevalence of depression-related and anxiety-related disorders in preoperative bariatric surgery patients. Increasing scores on the Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2-RF) have been shown to correlate with decreased weight loss at 5 years following bariatric surgery [5]. Given the

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psychological burden imposed on society related to the COVID-19 pandemic and the decreased access to bariatric care, the outcomes of bariatric surgery are likely to be influenced by the pandemic. There is preliminary data that the short-term outcomes were negatively influenced by the decreased access to care [6]. Longer term data is currently lacking.

It is hypothesized that the medium-term outcomes will have decreased weight loss due to challenges surrounding the COVID-19 pandemic such as social distancing, closing of multiple businesses, closing of multiple recreation and social centers, increased unemployment rate, financial struggle and overall negative financial and psychological impact. More specifically, it is conjectured that the outcomes will correlate with pre-operative GAD-7 and PHQ-9 results, which assess for anxiety and depression, indicating that the psychological toll of COVID-19 extended onto the outcomes of bariatric surgery. Contrastingly, nonsignificant findings may hint at the psychological resilience of well-prepared bariatric patients and/or the need for longer-term follow-up.

Methods

After obtaining Institutional Review Board approval (IRB #202009443), a retrospective review of a prospectively collected database was completed from a single academic institution. Inclusion criteria for the control and COVID-19 cohorts included all patients undergoing bariatric surgery in 2017 and 2018 (control group) and a group that had bariatric surgery since March of 2020 (when COVID-19 was declared a pandemic) to December 2020 (COVID-19 group). Exclusion criteria include age < 18 and revisional bariatric surgery.

As part of a standardized pre-operative evaluation patients underwent a formal evaluation by a clinical psychologist. As a part of this evaluation, patients underwent screening with the Generalized Anxiety Disorder Assessment (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) which is the depression module of the PHQ and evaluates for the nine DSM-IV criteria for depression. [7, 8] These are screening tools for the quantification of the degree of anxiety and depression from which a prospective patient suffers. Additional pre-operative appointments were held monthly with bariatric dietitians until cleared for surgery as well as an evaluation by the surgical staff.

Data points collected include patients age, gender, pre-operative weight and BMI and post-operative weight and BMI. Weight loss is described as weight, BMI and percent excess weight loss (%EWL). Additional comorbidities assessed include type II diabetes mellitus (DMII), hypertension (HTN), dyslipidemia (HLD) and obstructive

sleep apnea (OSA). Follow-up time points included 1, 3, 6 and 12 months.

Results

A total 329 patients were enrolled in the control group. The weight and BMI of this group was 132.6 kg and 45.4 kg/m² respectively. The mean GAD-7 score was 1.65 and PHQ-9 score was 2.31. A total of 155 patients were included in the COVID-19 cohort. The mean pre-operative weight and BMI was 134.1 kg and 44.9 kg/m². There was no difference in the control vs COVID-19 cohorts for pre-operative BMI ($p = 0.437$), GAD-7 ($p = 0.625$) or PHQ-9 ($p = 0.327$) scores (Table 1). Weight loss outcomes for the control group and COVID-19 group were recorded at 1 month (113.3 kg vs 113.3 kg), 3 months (105.3 kg and vs 104.3 kg), 6 months (98.7 kg vs 96.9 kg), and 12 months (93.3 kg vs 92.7 kg) and did not reach a difference of statistical significance at any point throughout the 12-month follow-up period (Table 2).

Demographic makeup was evaluated and included age and gender. There was a statistically significant, but clinically irrelevant difference in ages between the two groups. Otherwise, there were no differences in the demographic make-up. Comorbidities between the two groups pre-operatively included Type II DM ($p = 0.810$), hypertension ($p = 0.879$), sleep apnea ($p = 0.502$), and hyperlipidemia ($p = 0.227$) and there were no significant differences in these (Table 3). Resolution rates of Type II DM for the pre-COVID-19 group was 80.5% and the COVID-19 was 55.9% and was statistically significant ($p = 0.007$). However, at the 12-month time point follow-up there was noted

Table 1 Pre-operative weight and mental health variables between control and COVID-19 groups

Pre-operative variables	Control group (<i>n</i> = 329)	COVID-19 group (<i>n</i> = 155)	<i>p</i> -value
First recorded weight (kg)	132.6	134.1	0.577
Pre-op weight (kg)	126.3	126.8	0.841
BMI	45.4	44.9	0.437
GAD-7	1.65	1.78	0.625
PHQ-9	2.31	2.01	0.327

to be no difference in the resolution of Type II DM [84.1% for the pre-COVID-19 group and 85.7% for the COVID-19 ($p = 1.000$)] (Tables 4, 5).

Table 2 Follow-up weight loss data in the control and COVID-19 cohorts

Length of follow-up	Control group (<i>n</i> = 328)	COVID-19 group	<i>p</i> -value
1 month (weight in kg/BMI)	113.3/40.5	113.3/40.2	0.988/0.641
3 months (weight in kg/BMI)	105.3/37.8	104.3/37.0	0.355/0.185
6 months (weight in kg/BMI)	98.7/35.5	96.9/34.7	0.383/0.243
1 year (weight in kg/BMI)	93.3/33.5	92.7/33.0	0.848/0.662

Table 3 Comorbidity data pre-operatively in the control and COVID-19 groups

	Control group (329 pts)	COVID-19 group (155 pts)	<i>p</i> -value
Type of surgery	127 RYGB/202 SG	82 RYGB/73 SG	0.030
Gender	47 Male/282 Female	32 Male/123 Female	0.077
Average age	42.6 years	44.9 years	0.029
DM	84 (25.5%)	38 (24.5%)	0.810
HTN	161 (48.9%)	77 (49.7%)	0.879
HLD	113 (34.3%)	62 (40.0%)	0.227
OSA	117 (35.6%)	60 (38.7%)	0.502

Table 4 Comorbidity resolution at 6 months postoperatively

	Pre-COVID-19	COVID-19	<i>p</i> -value
Diabetes mellitus	62/77 (80.5%)	19/34 (55.9%)	0.007
Hypertension	90/146 (61.6%)	31/65 (47.7%)	0.059
Sleep apnea	34/107 (31.8%)	10/49 (20.4%)	0.143
Hyperlipidemia	52/104 (50.0%)	20/56 (35.7%)	0.083

Significance determined at $p < 0.05$

Table 5 Comorbidity resolution at 12 months postoperatively

	Pre-COVID-19	COVID-19	<i>p</i> -value
Diabetes mellitus	58/69 (84.1%)	6/7 (85.7%)	1.000
Hypertension	93/130 (71.5%)	8/16 (50.0%)	0.091
Sleep apnea	45/94 (47.9%)	6/11 (54.5%)	0.675
Hyperlipidemia	64/96 (66.7%)	6/13 (46.2%)	0.216

Significance determined at $p < 0.05$

Discussion

Notwithstanding the introduction and widespread use of vaccinations against COVID-19, the pandemic remains an important global public health issue. During the height of the pandemic many of the healthcare resources were diverted to provide treatment for COVID-19 cases [9]. In many areas the number of elective surgeries completed decreased drastically. At one point there were 10 million patients awaiting elective surgical procedures in the United Kingdom, a 250% increase above baseline [10]. This has led to an increased emphasis on the negative sequelae of

decreased access to elective care including impaired cancer survival and patients presenting with advanced stages of cardiovascular disease and other major illnesses [11]. The mental health consequences were similarly dire with a higher prevalence of depression and anxiety in those who suffered from or had family members who contracted COVID-19 [12].

The management of obesity was similarly mired down by COVID-19. A survey of the influence of COVID-19 on bariatric surgery practices during the pandemic noted that 62.8% of bariatric surgeons performed no elective cases during the height of COVID-19. Compounding this problem was an increase in the consumption of comfort foods and decreased physical activity due to social isolation protocols [13]. As the pandemic progressed and testing became more widespread healthcare systems have achieved a more normal clinical load. There is inadequate data on the influence that this new normal, both societal as well as medical, has had on the outcomes of bariatric surgery. This project sought to address the outcomes between a cohort of patients operated on during the pandemic versus those who completed their care prior to COVID-19 and how this was influenced by the patients' mental health.

It has been shown that bariatric patients present with high rates of psychiatric disorders [14]. The COVID-19 pandemic has added another level of stress with obligated social isolation, financial and health concerns. As a part of the pre-operative work-up all patients undergo the GAD-7 and PHQ-9 questionnaires. The GAD-7 is a seven-item survey to assess for the degree of anxiety a patient has. Each item has a score from 0 to 3; with a total score spanning from 0 to 21. The interpretation of this score is as follows: 0–4 no anxiety,

5–10 mild anxiety, 11–15 moderate anxiety, and > 15 severe anxiety. The PHQ-9 has nine items which are evaluated to determine the degree of depression a patient is experiencing. Each one is also scored 0–3; with a total score spanning from 0 to 27. Scores of 5, 10, 15, and 20 represent cut points for mild, moderate, moderately severe and severe depression, respectively. Given the association between poorly-managed mental health comorbidities and bariatric surgery outcomes, special attention was paid to the assessment of anxiety and depression in the cohort operated on during COVID-19 [15].

In this study, there were no differences between the control and COVID-19 groups when considering patient demographics, pre-operative weight, BMI, obesity-related comorbidities, or GAD-7 and PHQ-9 questionnaire results. Interestingly, the post-operative weight loss outcomes were similar at every post-operative appointment (Fig. 1). The comorbidity and resolution rates were also comparable pre- and post-operatively (Tables 3, 4, 5). There was a difference in the ratio of different bariatric surgeries performed and the average patient age. However, none were clinically relevant results.

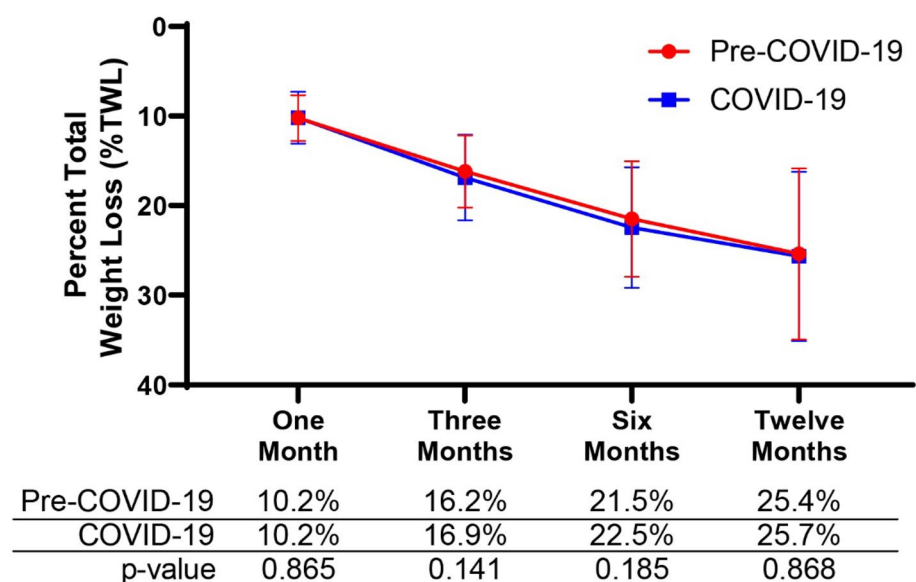
The similar weight loss at follow-up in both groups likely reflects a rigorous multidisciplinary pre-operative approach emphasizing patient preparedness for surgery rather than fast-tracking to the operating room. It is the standard practice that a patient with moderate to severe anxiety and depression would be referred for therapy to develop coping skills and establish a support network prior to proceeding with a final psychology evaluation to reassess candidacy. Indeed, the current data bears this out, with both the control and COVID-19 groups showing, on average, minimal depressive and anxious symptomatology. Further, patients who have an ongoing substance abuse disorder, are actively suicidal or have been admitted for any psychological disorders

have their surgeries deferred until these issues have been addressed in accordance with current ASMBS recommendations. When including this with a rigorous education on understanding macronutrients and tracking intake, the patients should be adequately prepared for the operation notwithstanding COVID-19.

Another aspect which likely contributed to the lack of a difference was the consistent and strong post-operative follow-up. It is the standard practice that patients are seen at regular intervals including 1 week, 1- 3-, 6- and 12-months post-operatively. In this cohort, follow-up was strong with 97%, 94% and 85% presenting at 1-, 3- and 6-months respectively. With bariatric clinicians and dieticians practicing in the same clinical space, re-education was available at each visit. Additionally, there was a strong push to adopt telehealth appointments early in the course of COVID-19, further increasing accessibility to the clinic in order to provide support while also satisfying social isolation protocols.

Psychological resilience, which is defined as positive adaptation in the face of adversity [16], has been studied within and outside the context of the COVID-19 pandemic. U.S. adults who engaged in more daily activities and had more social support during the pandemic were more psychologically resilient than those who did not [17]. Further, adults with low to normal levels of resilience—as defined by empirically-validated cut-off scores on the Brief Resilience Scale—displayed increases in mental distress during the early months of the pandemic [18]. Specifically, higher resilience has been found to be related to lower anxiety and depression during the pandemic [19]. It is possible that our samples have been selected—both by self-selection and through pre-operative protocols—to be similarly high in psychological resilience and related processes. Importantly, temporary increases in negative

Fig. 1 Graphical representation of weight loss over the follow-up period for the control and COVID-19 cohorts



emotions due to stressful events may be part of a healthy psychological response. The modal response to a traumatic event is recovery [3]. Taken together, the current data may be an encouraging sign that natural resilience processes buffer well-prepared bariatric surgery patients from disruptive events that impact their care.

There are several limitations to this paper. This is a single institution study whose COVID-19 burden and societal response was unique and may not be able to extrapolate to other regions. Further, this data was only tracked out to one year eliminating the potential for identifying longer term weight recidivism. A multi-institutional assessment with longer term follow-up would remove these limitations. With that said, the preponderance of weight loss would be expected within the first 6 months post-operatively. Further weight loss between 6 and 12 months is typically indicative of a motivated and engaged patient with adequate follow-up. In addition, the temporal delineation between the groups may not be optimal as those who got the operation in March 2020 may have already had a chance to establish pattern of healthy habits before COVID. Instead, the vulnerable patients may be the ones who needed to work on establishing a healthy habit newly during the pandemic and were starting the program after COVID began. While patients may have self-selected for their emotional well-being and ability to proceed with surgery during the pandemic, it is felt that the outcomes of this data highlight the importance of a multidisciplinary approach to the preparation for and follow-up after bariatric surgery.

Conclusion

COVID-19 has changed many facets of how medical care is delivered. Notwithstanding this fact, focusing on the principals of a strong preparative phase for bariatric surgery resulted in similar outcomes at out to 1 year post-operatively. Specific attention to identification of patients at risk for mental health regression with dedicated psychology assessments and support likely helped to mitigate the mental health stress associated with virus-related societal changes.

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Declarations

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References

1. Bates AT, Gadaleta D, Petrick AT (2020) Raising the standard: the impact of the COVID-19 response on bariatric surgery. *Bariatric Times*. 17(6):22
2. Ahmed B, Altarawni M, Ellison J, Alkhaffaf B (2021) Serious impacts of postponing bariatric surgery as a result of the COVID-19 pandemic: the patient perspective. *J Patient Exp*. <https://doi.org/10.1177/23743735211008282>
3. Sisto A, Vicinanza F, Tuccinardi D et al (2021) The psychological impact of COVID-19 pandemic on patients included in a bariatric surgery program. *Eat Weight Disord* 26:1737–1747. <https://doi.org/10.1007/s40519-020-00988-3>
4. Sockalingam S, Leung SE, Cassin SE (2020) The impact of coronavirus disease 2019 on bariatric surgery: redefining psychosocial care. *Obesity* 28:1010–1012. <https://doi.org/10.1002/oby.22836>
5. Marek R, Ben-Porath YH, L. (2016) Understanding the role of psychopathology in bariatric surgery outcomes. *Obes Rev* 17(2):126–141
6. Vitiello S, Berardi G, Velotti N, Schiavone V, Musella M (2021) Impact of COVID-19 lockdown on short-term weight loss in a single Italian institution. *Obes Surg* 31(7):3365–3368
7. Kroenke K, Spitzer R, Williams J (2001) The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 16(9):606–613
8. Spitzer R, Kroenke K, Williams J, Löwe B (2006) A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med* 166(10):1092–1097
9. Núñez A, Sreenganga S, Ramaprasad A (2021) Access to healthcare during COVID-19. *Int J Environ Res Public Health* 18(6):2980
10. The Lancet Rheumatology (2021) Too long to wait: the impact of COVID-19 on elective surgery. *Lancet Rheumatol* 3(2):e83
11. Meredith J, High K, Freischlag J (2020) Preserving elective surgeries in the COVID-19 pandemic and the future. *JAMA* 324(17):1725–1726
12. Nie X, Wang Q, Wang M, Zhao S, Liu L, Zhu Y, Chen H (2021) Anxiety and depression and its correlates in patients with coronavirus disease 2019 in Wuhan. *Int J Psychiatry Clin Pract* 25(2):109–114
13. Grant F, Scalvedi M, Scognamiglio U, Turrini A, Rossi L (2021) Eating habits during the COVID-19 lockdown in Italy: the nutritional and lifestyle side effects of the pandemic. *Nutrients* 13(7):2279
14. Barbuti M, Brancati G, Calderone A, Fierabracci P, Salvetti G, Weiss F, Carignani G, Santini F, Perugi G (2021) Prevalence of mood, panic and eating disorders in obese patients referred to bariatric surgery: patterns of comorbidity and relationship with body mass index. *Eat Weight Disord* 27(3):1021–1027
15. Sarwer DB, Wadden TA, Fabricatore AN (2005) Psychosocial and behavioral aspects of bariatric surgery. *Obes Res* 13(4):639–648. <https://doi.org/10.1038/oby.2005.71>
16. Norris FH, Tracy M, Galea S (2009) Looking for resilience: understanding the longitudinal trajectories of responses to stress. *Soc Sci Med* 68(12):2190–2198
17. Moreno-Camacho CA, Montoya-Torres JR, Jaegler A, Gondran N (2019) Sustainability metrics for real case applications of the supply

- chain network design problem: a systematic literature review. *J Clean Prod* 231:600–618
18. Barzilay R, Moore TM, Greenberg DM et al (2020) Resilience, COVID-19-related stress, anxiety and depression during the pandemic in a large population enriched for healthcare providers. *Transl Psychiatry* 10:291
 19. Galatzer-Levy IR, Huang SH, Bonanno GA (2018) Trajectories of resilience and dysfunction following potential trauma: a review and statistical evaluation. *Clin Psychol* 63:41–55

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