Research Article

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Impact of the COVID-19 Pandemic on the Success of Bariatric Surgeries in Patients with Severe Obesity

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Keywords

Bariatric surgery · Weight outcome · Lockdown · Obesity · COVID-19

Abstract

Introduction: SARS-CoV-2 infection (COVID-19) pandemic may influence the weight outcomes of bariatric surgeries (BS). Here, we intended to compare the weight outcome of patients who underwent BS before and during the pandemic time. ***Methods:*** In a retrospective, single-center study, the information of two groups of patients; first COVID-19 group ($n = 51$) consisted of those that underwent BS during the pandemic and completed a year of follow-up, second non-COVID-19 group included 50 patients who underwent BS and were followed up before the pandemic. All the patients' anthropometric and obesity-related disease data were compared between groups. ***Results:*** Weight loss and the decrease of body mass index 1 year after the surgery, as well as excess weight loss and total weight loss, were significantly higher in the non-COVID-19 group compared to the COVID-19 group ($p < 0.05$). Although the rate of remission for diabetes mellitus, hypertension, and dyslipidemia was higher in the non-COVID-19 group, the differences were not statistically significant ($p > 0.05$). ***Conclusion:*** We showed a significantly poorer weight outcome at the 1-year follow-up of the BS during the pandemic compared to the pre-pandemic. These results need further investigations to determine the preventive measures and management by evaluating the associated factors.

Introduction

The first case of SARS-CoV-2 infection (COVID-19) was detected in Iran in February 2020, and Iran entered the pandemic in March 2020 [1]. As in other parts of the world, quarantine and stay-at-home policies were in place to prevent the spread of the COVID infection. Some studies around the world have shown that quarantine policies have led to increased unhealthy diets and reduced physical activity [2–4]. A large study of 2,766 people in Italy found that quarantine had many psychological effects on people, increasing stress-induced eating and weight gain [5–8]. Quarantine policies also have led to an impaired immune system due to reduced physical activity and the consequent exacerbation of many chronic dis-

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eases, including metabolic and heart diseases, even without causing weight gain [9–16].

Obesity, which was a global health problem before the pandemic, has been severely affected by the pandemic and has increased in prevalence [17]. On the other hand, bariatric surgeries, which are the most effective approach for treating obesity [18], have been canceled due to pandemic control policies [19, 20]. An international study comparing bariatric surgeries during the pandemic and pre-pandemic years showed that 30-day morbidity and mortality following surgery were not significantly different [21]. However, decreased physical activity and increased unhealthy food intake following quarantine policies, along with other psychosocial factors, may have affected the course of weight loss after bariatric surgery [22]. To our knowledge, only a few studies have been conducted comparing the weight outcomes of bariatric surgery between the pre-pandemic period and the pandemic period. This single-center study is designed to examine this hypothesis by comparing the weight outcomes of people who underwent bariatric surgery during the pandemic with patients who underwent bariatric surgery and were followed up for 1-year post-surgery before the pandemic.

Materials and Methods

This is a retrospective, matched cohort, observational study using the bariatric surgery department database of the Shiraz University of Medical Sciences (SUMS). This large database contains more than 1,000 patients who have undergone bariatric surgery in southwest Iran since 2012. Following the COVID-19 pandemic in Iran, as in all parts of the world, periods of global lockdowns were applied, of which the first period lasted from March 2020 to June 2020. Elective surgeries, including bariatric surgeries, were initially canceled but gradually resumed. Data were analyzed within 1 year before and after lockdown periods in Iran. All individuals who underwent bariatric surgery during the pandemic and completed a 1-year postoperative period during the lockdown periods were included in the study. On the other hand, individuals who underwent bariatric surgery before the pandemic and spent a year after surgery before the beginning of the pandemic and lockdown periods were also included. The researchers adhered to the Declaration of Helsinki. Written informed consent was provided by the patients regarding the publication of the study. The University's Ethics Committee has approved this study (IR.SUMS.REC.1400.687).

Participants

In the lockdown period of 2020, 62 people underwent surgery, of which 57 had their information fully recorded in the database. People whose information were incomplete or did not have a complete follow-up were excluded from the study. In addition, patients under 18 years, as well as those who developed the COVID-19 infection during the pandemic, were excluded from the study. The exclusion of patients who developed COVID-19 infection was because some patients with COVID-19 infection had severe weight loss. Therefore, this severe weight loss due to COVID-19, not bariatric surgery, might impact the results. Finally, 51 people who underwent surgery during the pandemic were gathered. In addition, 50 people who underwent surgery before the pandemic were included as the control group. The patients who underwent surgery during the pandemic were matched based on sex, age, and initial body mass index (BMI) to those who underwent surgery before the pandemic to assemble a cohort of control patients.

Data Gathering

In the pre-pandemic period, all the patients were closely followed for clinical assessment over 10 days; one, three, six, nine, and 12 months after the surgery. During the COVID-19 pandemic, patients were followed by telephone consultations except when a physical examination was necessary for emergent situations, in which a quick in-person visit was scheduled. Before surgery, all demographic information and underlying diseases were recorded in the database. Patients' weights, BMI, and other anthropometric data, including waist and hip circumferences, were measured and recorded both before and every 3 months after surgery during medical visits. Weight loss was assessed by the %total weight loss (TWL), % excess weight loss (EWL), and % excess BMI loss (EBMIL). %TWL was calculated as ([preoperative weight- weight on follow-up]/[preoperative weight]) × 100. %EWL was calculated as ([preoperative weight- weight on follow-up]/[preoperative weight – ideal weight]) × 100. %EBMIL was calculated as ([preoperative BMI- BMI on follow-up]/[preoperative BMI – 25]) × 100. Patients' laboratory data and status were also recorded for obesity-related diseases, including diabetes mellitus, hypertension, dyslipidemia, ischemic heart diseases, and sleep apnea. Besides, exercise per week was assessed based on the International Physical Activity Questionnaire (IPAQ) [23].

Remission and improvement in obesity-related diseases were defined by the standardized outcomes reporting in metabolic and bariatric surgery devised by the American Society for Metabolic and Bariatric Surgery (ASMBS) [24]. Remission of comorbidities was considered if the disease was controlled without any medications. Improvement was defined by the reduction in the frequency of symptoms and the need for medications.

Surgical Techniques

Patients underwent laparoscopic sleeve gastrectomy or Roux-en-Y gastric bypass. Laparoscopic sleeve gastrectomy was performed using five to six 60 mm stapler cartridges. In the Roux-en-Y gastric bypass, the gastric pouch was made with three 60 mm stapler cartridges (one horizontal and two vertical). The biliopancreatic limb was 50 cm, and the alimentary limb was 150 cm. Also, both gastrojejunostomy and jejunojejunostomy anastomoses were created using a 60 mm stapler with sizes of 3 cm and 6 cm, respectively.

Statistical Analysis

The sample size was calculated based on EBMIL in the study by Vitiello et al. [25]. Regarding EBMIL in the COVID (62.3 ± 18.9) and non-COVID groups (77.1 ± 18.9), the sample size, with a 1:1 ratio, was calculated at least 26 patients in each group. Statistical analysis was performed using SPSS software version 26. The normality of the variables was determined by the Kolmogorov-Smirnov test. All presented variables did not have normal distribu-

Table 1. Demographic and preoperative clinical information of participants in the COVID-19 group and non-COVID-19 group

Variable	Non-COVID-19 group (*n* = 50)	COVID-19 group (*n* = 51)	*p* value
Age, mean (SD), year	37.6 (10.2)	38.4 (10.6)	0.698
Gender, *n* (%)			
Male	9 (18)	15 (29.4)	0.178
Female	41 (82)	36 (70.6)	
Weight, mean (SD), kg	116.4 (17.3)	118.1 (21.1)	0.815
BMI, mean (SD), kg/m^2	43.3 (3.4)	44.1 (6.2)	0.767
Type of surgery, *n* (%)			
Gastric bypass	37 (74)	37 (72.5)	0.660
Sleeve	13 (26)	14 (27.5)	
Comorbidities, *n* (%)			
Diabetes mellitus	10 (20)	6 (11.7)	0.257
Hypertension	11 (22)	9 (17.6)	0.583
Dyslipidemia	19 (38)	13 (25.4)	0.177
Ischemic heart disease	3 (6)	5 (9.8)	0.715
Obstructive sleep apnea	22 (44)	11 (21.5)	**0.016**
Exercise per week, METs-hr	23.1 (2.4)	23.2 (2.1)	0.522

SD, standard deviation; BMI, body mass index; METs-hr, metabolic equivalents-hour.

tion except age and TWL. Then, χ^2/Fisher exact or independent *t* test/Mann-Whitney was used to compare the two groups. A *p* value lower than 0.05 was considered statistically significant.

Results

Demographic Data and Preoperative Clinical Information

A total of 101 patients with a mean age of 38.0 ± 10.4 years were included in the study. Among the cases, 77 (76.2%) were female. The evaluation of 50 patients was done before the COVID-19 pandemic, and the other 51 were evaluated during the pandemic. No patients were lost during the follow-up. Demographic and preoperative weight information of patients is demonstrated in Table 1. In addition, the type of surgery and patients' exercise per week, in addition to the history of comorbidities, are shown. In the non-COVID-19 group, 41 (82%) were female compared to 36 (70.6%) female patients in the COVID-19 group. Among all variables, only obstructive sleep apnea was significantly different in comparison between the groups (*p* value = 0.016); 22 patients reported a history of obstructive sleep apnea in the non-COVID-19 group, while 11 were in the COVID-19 group.

Weight Loss

Weight loss and the decrease of BMI 1 year following the operation were 44.9 ± 11.0 kg and 16.0 ± 3.9 kg/m^2 in the non-COVID-19 group, while they were 35.9 ± 13.6 kg and 13.4 ± 4.9 in the COVID-19 group, respectively. Therefore, weight loss and BMI decrease were significantly higher in the non-COVID-19 group compared to the COVID-19 group (*p* value <0.001 and 0.004, respectively). The decrease of waist and hip circumferences was also more in the non-COVID-19 group (both *p* values <0.001); however, the division of waist circumference by hip showed no significant difference between the groups (*p* value = 0.060). Also, EWL and TWL were 93.04 ± 20.36% and 38.64 ± 7.65% in the non-COVID-19 group and 72.22 ± 21.09% and 30.13 ± 8.56% in the COVID-19 group, respectively (both *p* values <0.001). EBMIL was also higher in the non-COVID-19 group (88.98 ± 19.48 compared to 72.63 ± 22.10, *p* values <0.001) (shown in Table 2).

Comorbidity Remission

The comorbidity remission of diabetes mellitus, hypertension, dyslipidemia, and sleep apnea is demonstrated in Table 2. Although the rate of remission or improvement for diabetes mellitus (100% > 83.3%), hypertension (100% > 88.8%), and dyslipidemia (63.1% > 53.8%) was higher in the non-COVID-19 group, the differences were not statistically significant. In addition, the rate of remission or improvement for obstructive sleep apnea was 100% in both groups.

Table 2. Weight loss and resolution of comorbidities of participants in the COVID-19 group and non-COVID-19 group

Variable	Non-COVID-19 group (*n* = 50)	COVID-19 group (*n* = 51)	*p* value
Weight loss, mean (SD), kg	44.9 (11.0)	35.9 (13.6)	**<0.001**
BMI decrease, mean (SD), kg/m^2	16.0 (3.9)	13.4 (4.9)	**0.004**
WC decrease, mean (SD), cm	33.0 (8.6)	24.0 (9.0)	**<0.001**
HC decrease, mean (SD), cm	34.5 (8.7)	23.8 (7.3)	**<0.001**
WC/HC decrease ratio, mean (SD)	0.009 (0.04)	0.0115 (0.063)	0.060
EWL, mean (SD), %	93.04 (20.36)	72.22 (21.09)	**<0.001**
TWL, mean (SD), %	38.64 (7.65)	30.13 (8.56)	**<0.001**
EBMIL, mean (SD), %	88.95 (19.48)	72.63 (22.10)	**<0.001**
Comorbidities, *n* (%)			
Diabetes mellitus			
Remission	8/10 (80.0)	4/6 (66.6)	0.335
Improvement	2/10 (20.0)	1/6 (16.6)	0.245
Hypertension			
Remission	11/11 (100.0)	7/9 (77.7)	0.450
Improvement	0/11 (0.0)	1/9 (11.1)	0.112
Dyslipidemia			
Remission	7/19 (36.8)	5/13 (38.4)	0.222
Improvement	5/19 (26.3)	2/13 (15.3)	0.091
Obstructive sleep apnea			
Remission	22/22 (100.0)	11/11 (100.0)	–
Improvement	0/22 (0.0)	0/11 (0.0)	–
Ischemic heart disease	0/3 (0)	0/5 (0)	–

SD, standard deviation; BMI, body mass index; WC, waist circumference; HC, hip circumference; EWL, excess weight loss; TWL, total weight loss; EBMIL, excess body mass index loss.

Conclusion

Since bariatric surgery is considered a highly cost-effective approach to morbid obesity, its reduced efficiency during the COVID-19 pandemic would be an important issue [26]. As a global pooled analysis in 2011 showed that obesity was a major risk factor for severe H1N1 infection in the 2009 influenza A pandemic, it could be similar to COVID-19 [27]. Studies showed the same issue during the COVID-19 pandemic. The risk of severe COVID-19 is reported to be increased in patients with obesity [28–30], in a way that a BMI of 40 kg/m^2 is considered a risk factor for severe illness [31]. Also, a noticeable association has been shown between BMI and mortality risk in patients with COVID-19 [32]; it is worth mentioning that a lack of universally accepted diagnostic criteria or cut-off for sarcopenic obesity may affect any disease risk prediction, including COVID-19 [33]. The mechanism for more severe infection in patients with obesity may be that higher levels of angiotensin-converting enzyme 2 (ACE2) receptors are expressed in patients with obesity; this leads to more viral load [34]. Also, leptin dysregulation in this population may cause more severe infection [34]. Besides, a few studies introduce new potential underlying mechanisms to explain the relationship between excess adiposity and COVID-19, such as leptin-contributing signaling pathways [35]. The situation worsens because of vaccines' less potential effect on these individuals due to their weakened immune response [36]. Therefore, raising the efficiency of bariatric surgeries is necessitated, as the effect of bariatric surgery on reducing the severity of COVID-19 infection has been reported [37].

A few studies have been conducted comparing the postoperative results of bariatric surgery before and through the pandemic. A study by El Moussaoui et al. [26] compared the results of laparoscopic sleeve gastrectomy at a 1-year follow-up with a control group before the COVID-19 pandemic; the mean of both EWL and TWL was significantly lower in the COVID group (%EWL: 67.6 vs. 78.3, *p* value: 0.036; %TWL: 28.2 vs. 34.3, *p* value: 0.025). Also, in another study by Conceição et al. [22], weight loss regained was significantly higher in the COVID group compared to the non-COVID group at 3-year follow-up. In our study, we came to similar results; both EWL and

TWL were significantly lower in the COVID group, showing poorer weight results at 1-year follow-up during the pandemic (%EWL: 72.22 vs. 93.04, %TWL: 30.13 vs. 38.64, both p values <0.001). However, in the study by Ruiz de Angulo et al. [38], although EWL and TWL during the first year after sleeve gastrectomy were lower in the COVID group, the differences were not statistically significant (%EWL: 47.37 vs. 51.14, p value: 0.438; %TWL: 21.14% vs. 24.67, p value: 0.115). In general, although not all studies came to the same results, poorer weight outcomes were achieved through the pandemic.

Based on studies, several factors may be involved in reducing the efficacy of bariatric surgery for weight loss after surgery in the lockdown period, including mental, surgical, and dietary factors [39]. Although we did not aim to determine the factors contributing to poorer weight outcomes during the pandemic, these factors may be the same as factors for weight gain in the population with obesity that were recently reported. Eating disorders, psychological stress, sleep changes, reduced physical activity, and reduced access to healthcare treatments have been reported during the pandemic, which may contribute to weight gain in the general population or those with obesity [3, 22, 39–43]. As an important factor, eating disorders increased during the pandemic because of the limitation of daily living activities, media exposure, and fear of infection [42]. On the other hand, telephone consultations may not have the efficacy of face-to-face visits concerning diagnosis and drug prescription [26]. Besides, it has been shown that self-reported BMI was more than measured BMI in some individuals [26, 44]. Therefore, the solution to obtain better operative outcomes should be studied. Monitoring patients during follow-up, access to health care, and social support have to be provided more than before [45]. Also, telehealth, as a helpful method to improve patients' rehabilitation, should be considered more than before; telehealth core exercises and even telephone-based cognitive behavioral therapy may help patients have a better postoperative period [46, 47]. So, further supports concerning food security, accessing health care, and new physical activity routines are mandatory to achieve better results [48].

Although the remission rate of obesity-associated comorbidities in this study was higher in the non-COVID-19 group, the difference was not statistically significant (p value >0.05). This was in line with the study by El Moussaoui et al. [26]. They also reported higher remission rates in the control group compared to the COVID group; however, the differences were not significant. In the mentioned study, authors lined this issue to two reasons, which we also agree with: (1) the number of cases with comorbidities was not large enough to cause significant differences, and (2) the differences in weight outcomes between the groups were not high enough to lead comorbidities to remit in a statistically significant way. So, further studies are suggested regarding the impact of COVID-19 on the postoperative remission of obesity-associated comorbidities.

The current study was not without limitations. We followed our patients for up to 1 year following the operation; studies with longer follow-ups are suggested for more reliable results. Since different living conditions may exist based on the spread of the disease in a region or country, the generalization of the results of the study may be impeded. In addition, how people react differently to the pandemic can affect the results of the study. The evaluation of associated factors that led to poorer weight outcomes during the pandemic was not performed in our study. We suggest further studies regarding this issue.

In conclusion, the efficacy of bariatric surgery for weight loss was reduced during the lockdown period. In a single-center study, we showed a significantly poorer weight outcome at the 1-year follow-up of the operation during the pandemic compared to pre-pandemic in our center. This reduced efficiency of bariatric surgeries would be an important issue and necessitates further management and follow-up. Evaluating the associated factors and managing them has to be performed.

Statement of Ethics

The researchers adhered to the Declaration of Helsinki. This study has been approved by The Vice-chancellors of Shiraz University of Medical Sciences and by this University's Ethics Committee (approval number: IR.SUMS.REC.1400.687). Written informed consent was provided by the patients regarding participating in the study.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Neda Haghighat contributed in conception and design, data acquisition, statistical analysis, and revising the manuscript. Hamidreza Foroutan contributed in conception and design and revising the manuscript. Iman Hesameddini contributed in data acquisition and drafting the manuscript. Masoud Amini contributed in conception and design and revising the manuscript. Babak Hosseini contributed in conception and design and revising the manuscript. Nader Moeinvaziri contributed in conception and design and revising the manuscript. Seyed Vahid Hosseini contributed in conception and design and revising the manuscript. Hooman Kamran contributed in statistical analysis and drafting the manuscript. All authors approved the final version of the manuscript.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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