

Original Investigation

Self-harm Emergencies After Bariatric Surgery

A Population-Based Cohort Study

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IMPORTANCE Self-harm behaviors, including suicidal ideation and past suicide attempts, are frequent in bariatric surgery candidates. It is unclear, however, whether these behaviors are mitigated or aggravated by surgery.

OBJECTIVE To compare the risk of self-harm behaviors before and after bariatric surgery.

DESIGN, SETTING, AND PARTICIPANTS In this population-based, self-matched, longitudinal cohort analysis, we studied 8815 adults from Ontario, Canada, who underwent bariatric surgery between April 1, 2006, and March 31, 2011. Follow-up for each patient was 3 years prior to surgery and 3 years after surgery.

MAIN OUTCOMES AND MEASURES Self-harm emergencies 3 years before and after surgery.

RESULTS The cohort included 8815 patients of whom 7176 (81.4%) were women, 7063 (80.1%) were 35 years or older, and 8681 (98.5%) were treated with gastric bypass. A total of 111 patients had 158 self-harm emergencies during follow-up. Overall, self-harm emergencies significantly increased after surgery (3.63 per 1000 patient-years) compared with before surgery (2.33 per 1000 patient-years), equaling a rate ratio (RR) of 1.54 (95% CI, 1.03-2.30; $P = .007$). Self-harm emergencies after surgery were higher than before surgery among patients older than 35 years (RR, 1.76; 95% CI, 1.05-2.94; $P = .03$), those with a low-income status (RR, 2.09; 95% CI, 1.20-3.65; $P = .01$), and those living in rural areas (RR, 6.49; 95% CI, 1.42-29.63; $P = .02$). The most common self-harm mechanism was an intentional overdose (115 [72.8%]). A total of 147 events (93.0%) occurred in patients diagnosed as having a mental health disorder during the 5 years before the surgery.

CONCLUSIONS AND RELEVANCE In this study, the risk of self-harm emergencies increased after bariatric surgery, underscoring the need for screening for suicide risk during follow-up.

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Morbid obesity is an epidemic in affluent countries.¹ Currently, approximately 6% of Americans have morbid obesity² because conventional methods of weight control, such as diet, exercise, and behavioral counseling, are often insufficient for treating morbid obesity.³ In contrast, bariatric surgery is an effective treatment for morbid obesity, leading to an estimated 60% to 80% reduction in excess weight within a year of surgery.^{4,5} These surgical procedures work by restricting gastric capacity (eg, gastric banding or resection), reducing absorption surface (eg, intestinal bypass), or a combination of both (eg, Roux-en-Y gastric bypass).^{4,6} Previous reviews^{5,7,8} confirm a safety profile of bariatric surgery with surgical mortality rates that average less than 1%. The recently demonstrated efficacy of this procedure in treating type

2 diabetes mellitus further increases the potential indication of these operations in complicated obesity.⁸

Mental health problems are prevalent in morbidly obese patients and those undergoing bariatric surgery.^{9,10} These problems, including current substance misuse, major depression, and eating disorders, can compromise the surgical outcomes and success.¹¹ Consequently, most bariatric care programs in North America involve mental health professionals to evaluate and prepare patients for maximum success.¹²⁻¹⁵ Most of these professionals prefer conducting clinical interviews, and many also use symptom inventories (eg, Beck Depression Inventory).¹⁶ The American Society for Metabolic and Bariatric Surgery acknowledges that there is no consensus among experts on the structure, content, and inclusion criteria for these

evaluations despite existing recommendations to provide a preoperative psychological evaluation component in surgical services.¹⁷

Studies have found that weight loss positively influences mental health,^{9,18} but findings are mixed in patients undergoing bariatric surgery.^{11,19,20} In theory, the permanent changes in body image, diet-related stress, and unmet expectations of weight loss could increase mental health problems, such as binge eating, substance misuse, and self-harm behaviors.^{15,21,22} Conversely, neurohormonal mechanisms may underlie postoperative mental health problems^{23,24}; for example, gastric bypass surgery can reduce levels of peripherally released neuropeptides that regulate the centrally acting neuropeptide Y,²³ a neurohormone associated with depression, addiction, and suicide.²⁴⁻²⁶ The nature of these conflicting theories is at best exploratory and indicates substantial uncertainty about whether bariatric surgery has positive or negative effects on mental health.²⁷

Previous work²⁸ has increased concerns about the incidence of self-harm in patients undergoing bariatric surgery. A systematic review²⁸ of 30 studies suggested that suicide risk for patients undergoing bariatric surgery was 4 times higher than the general population norm. The temporal proximity of some suicides immediately after bariatric surgery also suggested a causal relationship.²⁸⁻³⁰ To further evaluate this association, we compared self-harm behaviors before and after bariatric surgery using province-wide health registers.²⁹

Methods

Study Design

We conducted a population-based, self-matched, longitudinal cohort analysis of patients living in Ontario who underwent bariatric surgery. We used an exposure crossover design in which patients undergoing bariatric surgery served as their own controls.³¹ The main strength of this approach was to eliminate confounding owing to genetics, personality, and all other stable characteristics. The incidence of self-harm emergencies in the 3 years after surgery was compared with the incidence in the 3 years before surgery. The Ethics Review Board of the Sunnybrook Research Institute and the Institute for Clinical Evaluative Sciences approved this study and granted waiver for individual consent.

Study Population

This study included all adults aged 18 to 65 years living in Ontario, Canada, who underwent bariatric surgery between April 1, 2006, and March 31, 2011. The data analyses were completed between October 2014 and March 2015. Follow-up for each patient was 3 years prior to surgery and 3 years after surgery. The last date of follow-up was March 31, 2014. In Ontario, patients qualified for bariatric surgery if their body mass index (calculated as the weight in kilograms divided by height in meters squared) exceeded 40 or exceeded 35 with any of the following 4 conditions: coronary heart disease, type 2 diabetes, sleep apnea, or medically refractory hypertension.³² Eligible patients were evaluated for surgery by the multidisciplinary

team, including psychologists and psychiatrists, at a central intake and assessment center.^{33,34} In Ontario, the minimum age for bariatric surgery is 18 years. We selected the upper age limit based on the statistics that few patients older than 65 years undergo bariatric surgery.^{35,36} Individuals lacking a valid Ontario health card or who had multiple bariatric operations were excluded. All patients had at least 3 years of evaluation before (eg, April 1, 2003) and 3 years after surgery (eg, March 31, 2014) based on their use of health care services. The sampling was comprehensive and population based, reflecting the practice of approximately 200 surgeons.

Data Sources

Patients Undergoing Bariatric Surgery

Eligible patients were identified from the Ontario Health Insurance Plan database, which tracks outpatient and inpatient surgical procedures. By using fee codes for bariatric procedures (S114, S120, and S189), we extracted patient information about the date and type of procedure, namely, gastric bypass, intestinal bypass, and sleeve gastrectomy. These operations represent more than 70% to 80% of bariatric procedures performed in North America³⁷ and approximately 98% of public funded procedures performed in Ontario in 2013.³⁵

Self-harm Events

Data on self-harm events were extracted from the National Ambulatory Care Reporting System and recorded using the *International Classification of Diseases, 10th Revision (ICD-10)*, codes. This data set systematically records all the emergency visits in Ontario.³⁸ The data were recorded from all accredited emergency departments, including those providing care for mental health conditions. This data set has been previously used to evaluate the risk of suicide after an emergency visit related to a self-poisoning.³⁹ In this study, we categorized 4 distinct mechanisms of self-harm behaviors, namely, medications (X61-64), alcohol (X65), poisoning by toxic chemicals (X66-69), and physical trauma (X70-84). Each emergency was considered as a separate visit. Additional data on ambulance use and hospitalization were extracted from the National Ambulatory Care Reporting System as binary variables (yes or no). Triage urgency was coded according to Canadian Triage Acuity Scale by grouping as higher (ie, resuscitation, emergency, and urgent) or lower (all remaining).^{40,41}

Patient Factors

The Registered Persons Database was used to extract data on the patient's age, sex, socioeconomic status (quintiles), and home location (rural or urban).⁴¹⁻⁴³ On the basis of distributions, we categorized age into 2 groups as older (≥ 35 years) and younger (< 35 years). This database derived socioeconomic status from the home postal code through Canadian Census data and the mean annual household income associated with a given postal code.^{43,44} Previous studies^{44,45} using the same data have categorized the income status as quintiles: low, next lower, middle, next higher, or high income. Because of the expected low incidence of the outcome, we combined the 2 lowest-income quintiles as lower-income status and the other 3 quintiles as higher-income status. We also used the physician visit

and hospitalization databases⁴⁶ to extract information about mental health diagnosis (yes or no) of major depression (*ICD-10* code F32 and *ICD-9* code 296), anxiety disorder (*ICD-10* code F43 and *ICD-9* codes 300 and 309), and alcohol misuse (*ICD-10* code F10 and *ICD-9* code 303) during the 5 years before surgery.

Statistical Analysis

We compared the rate of self-harm emergencies during the 3 years after surgery to the rate of self-harm emergencies during the 3 years before surgery. Each interval was then divided into segments of 13 weeks (91 days), hereafter termed quarters.⁴⁷ Generalized estimating equation modeling was used to compute rate ratios of self-harm emergencies in the post-

operative interval compared with the preoperative interval. Rate ratios were computed for relevant patient subgroups and after excluding patients with 4 or more emergencies in the follow-up period. All the analyses were performed using SAS statistical software, version 9.3 (SAS Institute Inc).

Results

A total of 8815 patients underwent bariatric surgery during the 5-year enrollment interval (Table 1). Of the patients, 7176 (81.4%) were women, the mean (SD) age was 42 (10) years, 7386 (83.8%) lived in urban areas, and 4050 (45.9%) had a lower-income status. A total of 8681 patients (98.5%) received Roux-en-Y gastric bypass, 89 (1.0%) received an intestinal bypass, and 45 (0.5%) received a sleeve gastrectomy. A total of 5635 patients (63.9%) had a history of anxiety disorders, 688 (7.8%) had mental health disorders, and 54 (0.6%) had alcohol misuse. All-cause mortality at 3 years was 1%.

Table 1. Characteristics of 8815 Patients Undergoing Bariatric Surgery

Characteristic	No. (%) of Patients	No. (%) of Self-harm Emergencies in 3 Years Before and After Surgery (N = 158)
Sex		
Male	1639 (18.6)	14 (8.9)
Female	7176 (81.4)	144 (91.1)
Age, y		
18-34	1752 (19.9)	47 (29.7)
35-65	7063 (80.1)	111 (70.3)
Socioeconomic status, income		
Lower	4050 (45.9)	84 (53.2)
Higher	4733 (53.7)	73 (46.2)
Home location		
Urban	7386 (83.8)	143 (90.5)
Rural	1427 (16.2)	15 (9.5)
Type of surgery		
Roux-en-Y gastric bypass	8681 (98.5)	156 (98.7)
Mental health diagnosis^a		
Anxiety	5635 (63.9)	147 (93.0)
Depression	688 (7.8)	88 (55.7)
Alcohol	54 (0.6)	5 (3.2)

^a Within last 5 years.

Self-harm Emergencies

A total of 111 patients (1.3%) had at least 1 self-harm emergency before or after surgery, including 11 who experienced emergencies in both intervals, 37 in the preoperative interval, and 63 in the postoperative interval. A total of 62 separate self-harm events occurred in the preoperative interval and 96 in the postoperative interval. The overall rate averaged approximately 5 events per quarter in the preoperative period and 8 events per quarter in the postoperative period (Figure). Most events were reported in women (n = 144), those who were 35 years or older (n = 111), those living in urban areas (n = 143), or those diagnosed as having mental health disorder in the last 4 years (n = 147). Six patients had 5 or more emergencies during follow-up.

The mean rate of self-harm in the preoperative period was 2.33 events per 1000 patients annually, whereas the rate in the postoperative period was 3.63 events per 1000 patients annually (Table 2). The observed increase yielded a rate ratio of 1.54 (95% CI, 1.03-2.30; P = .007). Significant increases were particularly evident in those 35 years or older, those with lower-income status, and those living in

Figure. Quarterly Frequency of Self-harm Emergencies Before and After Surgery

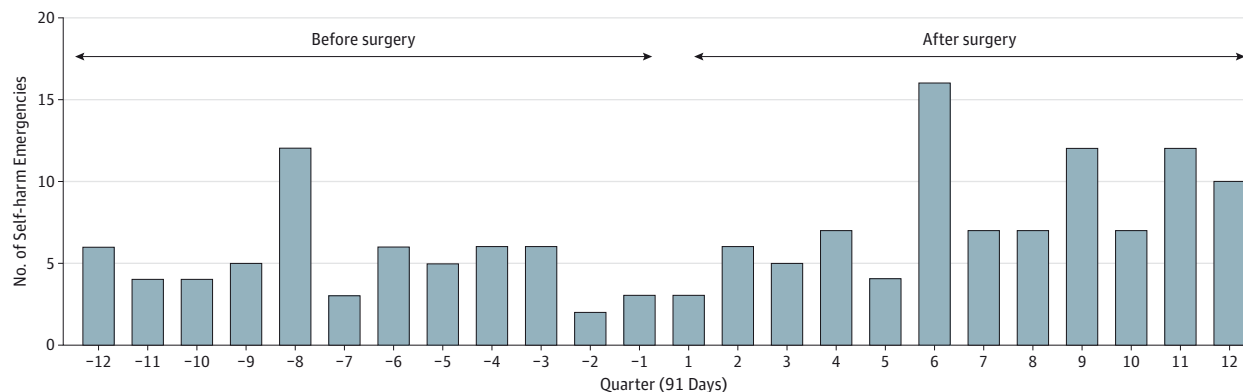


Table 2. Rates of Self-harm Emergencies

Characteristic	Rate per 1000 Patient-years		Rate Ratio (95% CI)	P Value
	Before Surgery	After Surgery		
Total patients	2.33	3.63	1.54 (1.03-2.30)	.007
Sex				
Male	1.03	1.83	1.80 (0.60-5.37)	.29
Female	2.63	4.03	1.52 (1.00-2.33)	.05
Age, y				
18-34	4.20	4.77	1.14 (0.65-1.99)	.63
35-65	1.90	3.37	1.76 (1.05-2.94)	.03
Socioeconomic status, income				
Lower	2.23	4.70	2.09 (1.20-3.65)	.01
Higher	2.47	2.67	1.08 (0.62-1.88)	.77
Home location				
Urban	2.70	3.73	1.37 (0.90-2.10)	.14
Rural	0.47	3.00	6.49 (1.42-29.63)	.02
Type of surgery				
Roux-en-Y gastric bypass	0.71	3.60	1.50 (1.01-2.26)	.01
Mental health diagnosis ^a				
Anxiety	3.67	5.00	1.36 (0.90-2.07)	.14
Depression	21.80	20.80	0.95 (0.51-1.78)	.88

^a Within last 5 years.

Table 3. Characteristics of Self-harm Emergencies

Characteristic	Total No. of Events	Rate per 1000 Patient-years		Rate Ratio (95% CI)	P Value
		Before Surgery	After Surgery		
Mechanism					
Alcohol	8	0.03	0.27	7.00 (0.86-56.89)	.26
Toxic chemicals	12	0.13	0.30	2.00 (0.33-12.10)	.26
Medications	115	1.60	2.77	1.71 (1.09-2.69)	<.01
Physical	33	0.60	0.63	1.07 (0.56-2.07)	.86
Ambulance used					
Yes	85	1.23	1.97	1.57 (1.04-2.55)	.04
No	73	1.10	1.67	1.51 (0.80-2.85)	.08
Triage urgency					
Higher	147	2.07	3.47	1.66 (1.09-2.52)	<.01
Lower	11	0.27	0.17	0.57 (0.24-1.37)	.37
Outcome of visit					
Hospitalized	85	0.36	0.60	1.63 (0.94-2.82)	.02
Discharged	69	0.32	0.47	1.47 (0.86-2.55)	.12

rural areas. We evaluated for significant interactions across important baseline strata (eg, age, sex, income status, rurality, and mental health) and observed no significant effect modification. The above association remained significant (rate ratio, 1.54; 95% CI, 1.05-2.26; $P = .003$) after removing patients with 4 or more emergencies.

Medication overdose accounted for 115 events (72.8%), whereas physical trauma, including self-hanging, accounted for 33 events (20.9%). Ambulance involvement occurred in approximately half of events. Almost all events were considered of high triage urgency and resulted in hospitalization (Table 3). No emergency department deaths related to self-harm were reported. Emergencies in the postoperative pe-

riod required more use of ambulance services and were more likely to be high urgency.

Discussion

This study examined changes in self-harm emergencies after bariatric surgery in a relatively large sample of patients. The findings indicate that a few patients had self-harm emergencies; however, the risk of these emergencies increased significantly after surgery. Overall, the self-harm risk increased from 2 per 1000 patient-years to 3 per 1000 patient-years after bariatric surgery and equals a mean increase of approximately 50%.

Stratified analysis revealed increased, yet non-statistically significant, risks among those with a lower-income status and living in rural areas. Nearly all events occurred in patients who had a history of mental health disorder. Intentional self-poisoning by medications was the most common mechanism of attempted suicide. These events carried significant risk to the patient, with 85 (53.8%) requiring ambulance transport to a hospital, 147 (93.0%) classified as urgent, and 85 (53.8%) leading to a hospital admission.

Suicide is a recognized concern among patients undergoing bariatric surgery.³⁰ Several large studies and a meta-analysis^{28,30,48} consistently indicate that suicide rates were at least 4 times higher in patients undergoing bariatric surgery compared with the general population. Suicide deaths are an infrequent outcome when evaluating self-harm risks in patients.⁴⁹ This study suggests that the rate of self-harm emergencies in patients undergoing bariatric surgery was approximately 3.6 per 1000 patients annually, which is 3 times as high as the baseline population rate in Ontario of 1.2 per 1000 person-years.⁵⁰ Because self-harm emergencies are a strong predictor of suicide,⁵¹ these findings highlight the importance of screening for self-harm behaviors in patients undergoing bariatric surgery.

Our findings can be useful for planning postoperative care in patients undergoing bariatric surgery. The usual practice involves multiple visits during the first postoperative year with less frequent contact in subsequent years.^{16,52} This study found that the period for mental health support may need to be longer for some patients. This study also suggests that some patient factors may help identify patients at higher risk of self-harm. Rates were specifically distinctly accentuated in patients living in lower-income and rural areas, a pattern potentially relevant to screening and preparing patients for postoperative outcomes.^{53,54} One possible strategy, for example, might include activating a reliable support network to mitigate stress after postoperative changes in diet and lifestyle.⁵⁵ Patients with a history of major depression similarly accounted for almost all events, suggesting that such patients merit a comprehensive risk assessment. Last, medication misuse is a frequent mechanism,²⁸ thereby potentially suggesting the need for increased screening and monitoring for excessive drug or alcohol use.

The study findings may also be useful for emergency physicians indirectly involved in the care of patients undergoing bariatric surgery. Several past studies^{7,56-58} indicate increases in emergencies of all types during the postoperative period. This study found that patients undergoing bariatric surgery tend to have higher ambulance use and hospitalizations compared with other patients.⁴¹ Emergency medicine physicians often typically focus on acute complications rather than the long-term mental health problems exacerbated after surgery.⁵⁸ This study suggests that a postoperative emergency visit could be an opportunity to screen for mental health in patients that have undergone bariatric surgery.⁵⁹

The published literature provides differing reasons for the association between bariatric surgery and the subsequent risk of self-harm. One hypothesis is that changes in alcohol metabolism after surgery may increase the likelihood of alcohol intoxication⁶⁰ or alcohol-related disinhibi-

tion with impulsivity leading to self-harm after surgery.⁶¹ The eating behaviors that lead to morbid obesity are often alternately considered as addictive behaviors,⁶² and surgery might lead to the method of substitution from food to substance misuse. A different hypothesis relates to increased stress and anxiety in postoperative patients,^{15,63} leading to anxiolytic use¹² or exacerbation of preexisting mental health conditions.⁶⁴ Last, the direct effects of surgery on the levels of neurohormones (eg, neuropeptide Y) need to be investigated as possible mediators of the likelihood of depression and suicidal behaviors.^{23,25} Findings from this study advocate a better understanding of these and other theories through future research of potential mechanisms of self-harm in patients undergoing bariatric surgery.²³

This study has several limitations. In particular, the data did not account for important surgery-related factors, such as failure in weight reduction or increases in postoperative stress contributing to self-harm behaviors after surgery.³¹ In addition, our database was not entirely comprehensive because some patients might have had bariatric surgical procedures outside Ontario.^{65,66} The *ICD-10* codes may overestimate or underestimate self-harm behaviors because substance misuse or intoxications may not have had a self-harming intent and because determining intent is often problematic.²⁸ Furthermore, emergency visits as an outcome could be an underestimate of actual self-harm behaviors. Previous work^{67,68} indicates that only half of the patients with self-harm-related injuries, including deaths, reach an emergency department. In addition, only *ICD-10* codes for emergency visits were extracted in this study. Because completed suicides generally preclude an emergency visit, these study methods do not provide a sensitive assay for suicide deaths. Moreover, the study interpretations might have benefitted by having a control group matched for a comparable surgery, yet comparisons to hernia surgery may be biased because of the limited information about associated suicide risk and the potential limits in interpreting confounders.⁶⁹ Last, this study may have selection bias because the Ontario Health Insurance Plan does not include gastric banding procedures.⁷⁰ Despite these limitations, the study findings provide an impetus for exploring self-harm behaviors after bariatric surgery.

Conclusions

Patients undergoing bariatric surgery have an increased risk for self-harm emergencies after the surgery. These adverse events undermine the overall benefits of bariatric surgery. The study findings could be useful for bariatric surgeons and emergency physicians in postoperative follow-up. Additional clinical implications include active postoperative screening for self-harm risk among patients who have undergone bariatric surgery and are presenting for follow up. Patient and surgery factors could help identify vulnerable patients. Overall, these findings imply that more work is needed to understand why self-harm behaviors increase in the postoperative period and how these risks might be reduced.

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Invited Commentary

Bariatric Surgery—More Than Just an Operation

Amir A. Ghaferi, MD, MS; Carol Lindsay-Westphal, PhD

Bariatric surgery is the most effective treatment of morbid obesity with a proven survival benefit.^{1,2} To view bariatric surgery as simply a weight loss procedure is misguided and can lead to inappropriate expectations and potentially dangerous consequences.

The preoperative approval process is rigorous and, unfortunately, not fully evidence based. Payers have set forth many requirements without significant attention to the perceived benefits or risks of delayed treatment. These requirements may include participation in supervised weight loss; medical clearance through cardiac, pulmonary, and general medical testing; a sleep study; and a mental health evaluation

to assess treatment of existing psychiatric diagnoses or to diagnose new mental health conditions.

The 1991 National Institutes of Health Consensus Development Conference on Gastrointestinal Surgery for Severe Obesity³ established the mental health evaluation requirement. The American Society for Metabolic and Bariatric Surgery explains that its purpose is to “identify psychosocial risk factors and make recommendations to both the client and surgical group that are aimed at facilitating the best possible outcome for the patient.”^{4(p1)} The mental health piece of this assessment remains difficult to standardize with common categories of assessment, including behavioral, cognitive or emotional, developmental, motivation, and expectations. Nonetheless, regardless of the type of surgery our patients undergo, there is an



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