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A Longitudinal Examination of Suicide-Related Thoughts and Behaviors among Bariatric Surgery Patients

Kathryn H Gordon, PhD[1,2], **Wendy C King, PhD**[3], **Gretchen E White, MPH**[3], **Steven H Belle, PhD**[3], **Anita P Courcoulas, MD, MPH**[4], **Faith E Ebel, MS**[5], **Scott G Engel, PhD**[1], **Dave R Flum, MD, MPH**[6], **Marcelo W Hinojosa, MD**[6], **Alfons Pomp, MD**[5], **Walter J Pories, MD**[7], **Dino Spaniolas, MD**[7], **Bruce M Wolfe, MD**[8], **Susan Z. Yanovski, MD**[9], and **James E Mitchell, MD**[1]

[1]Neuropsychiatric Research Institute, Fargo, ND, United States

[2]Psychology, North Dakota State University, Fargo, ND, United States

[3]Epidemiology, University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA, United States

[4]Surgery, University of Pittsburgh Medical Center, Pittsburgh, PA, United States

[5]Weill Cornell Medicine, New York, NY, United States

[6]Surgery, University of Washington, Seattle, WA, United States

[7]Surgery, Brody School of Medicine, East Carolina University, Greenville, NC, United States

[8]Surgery, Oregon Health Sciences University, Portland, OR, United States

[9]Office of Obesity Research, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, United States

Abstract

Background: Past research suggests self-harm/suicidality are more common among adults who have undergone bariatric surgery than the general population.

Objectives: To compare prevalence of self-harm/suicidal ideation over time and identify pre-surgery risk factors for post-surgery self-harm/suicidal ideation.

Setting: The Longitudinal Assessment of Bariatric Surgery-2 is a cohort study with pre-surgery and annual post-surgery assessments conducted at ten US hospitals.

Methods: Adults with severe obesity undergoing bariatric surgery between March, 2006 and April, 2009 (N=2458). Five-year follow-up is reported. Self-reported history of suicidality

Corresponding author: Kathryn H. Gordon, Ph.D., Associate Professor, Department of Psychology, North Dakota State University, Dept. 2765, P.O. Box 6050, Fargo, ND 58108-6050, kathryn.gordon@ndsu.edu, Phone: 701-231-8622. kathryn.gordon@ndsu.edu, KingW@edc.pitt.edu, Whiteg@edc.pitt.edu, belle@edc.pitt.edu, courcoulasap@msx.upmc.edu, fee2002@med.cornell.edu, Scott.Engel@SanfordHealth.org, daveflum@uw.edu, hinojosa@uw.edu, alp2014@med.cornell.edu, poriesw@ecu.edu, Konstantinos.spaniolas@stonybrookmedicine.edu, wolfeb@ohsu.edu, yanovskis@extra.niddk.nih.gov, jmitchell@nrifargo.com.

assessed retrospectively via the Suicide Behavior Questionnaire-Revised (SBQ-R) and self-reported self-harm/suicidal ideation assessed prospectively via the Beck Depression Inventory-1 (BDI-1).

Results: The SBQ-R was completed by 1540 participants; 2217 completed the BDI-1 pre- and post-surgery. Over 75% of participants were female, with a median age of 46 years and body mass index of 45.9 kg/m^2. Approximately one-fourth of participants (395/1534) reported a pre-surgery history of suicidal thoughts and/or behavior (SBQ-R). The prevalence of self-harm/suicidal ideation (BDI-1) was 5.3% (95% CI, 3.7–6.8) pre-surgery and 3.8% (95% CI, 2.5–5.1) at year-1 post-surgery (P=.06). Prevalence increased over time post-surgery to 6.6% (95% CI, 4.6–8.6) at year-5 (P=0.001) but was not significantly different than pre-surgery (P=.12).

Conclusions: A large cohort of adults with severe obesity who underwent bariatric surgery had a prevalence of self-harm/suicidal ideation that may have decreased in the first post-operative year but increased over time to pre-surgery levels, suggesting screening for self-harm/suicidality is warranted throughout long-term post-operative care. Several risk factors were identified that may help with enhanced monitoring.

Keywords

suicide; bariatric surgery; suicidal ideation; obesity

Approximately 15% of U.S. adults have severe obesity (body mass index; BMI≥35 kg/m²).[1] Bariatric surgery, the most effective and enduring treatment, typically results in sustained weight loss and improvement in multiple health domains with low short-term risk.[2–3] Bariatric surgery patients have reduced long-term all-cause mortality when compared to non-bariatric surgical controls with severe obesity.[4] However, concerns about suicide risk following bariatric surgery have emerged.[4,5]

A review and meta-analysis of post-bariatric surgery suicides revealed a four-fold higher rate when compared to the general population,[5] which may be attributable to bariatric surgery patients having more pre-surgery suicide risk factors than the general population.[6–10] One study[11] reported higher rates of self-harm hospitalizations among bariatric surgery patients than the general population,[12] but no change in self-harm hospitalization rates pre- to post-bariatric surgery, while another reported a higher rate of self-harm emergencies post-surgery than pre-surgery.[13] Hypothesized mechanisms for potentially elevated rates of self-harm or suicide following surgery include disappointment with weight loss or regain and changes in absorption of medication, alcohol kinetics, peptides and hormones, impulsivity, health-related quality of life, and sexual functioning.[10,14] There is also some evidence that suicide attempt risk is higher following Roux-en-Y gastric bypass [RYGB] in particular.[15] However, a recent meta-analysis did not find a difference in pooled suicide prevalence by type of bariatric surgical procedure (i.e. restrictive, malabsorptive or both).[16]

Most studies of self-harm/suicide in the bariatric surgery population have used cross-sectional/retrospective data and lack sufficient detail about suicidal intent.[14,17] Using five-year follow-up data from a multi-center longitudinal study of adults undergoing bariatric surgery, we aimed to evaluate changes in the prevalence of self-harm/suicidal ideation pre-

to post-surgery and during the post-surgery period and to identify factors associated with post-surgery self-harm/suicidal ideation risk. We also examined participants' suicidality history and described post-surgery suicides.

Methods

Participants

The Longitudinal Assessment of Bariatric Surgery-2[18] is an observational cohort study and is registered at: https://www.clinicaltrials.gov/ct2/show/NCT00465829. Adult patients seeking a first bariatric surgery by participating surgeons at 10 hospitals at 6 clinical centers throughout the U.S. were recruited between February, 2006 and February, 2009. Protocols were approved by the Institutional Review Boards at each center, and all participants provided written informed consent. By close of enrollment (April, 2009), 2458 participants underwent bariatric surgery. The flow of participants is shown in eFigure 1 [supplement].

Unless otherwise noted, measures were collected following the surgery approval process within 30 days prior to surgery and annually, following surgery. Participants were informed that their responses were confidential except in cases of potential serious harm. If participants reported suicidal ideation in the past week or any future self-harm intent, medical personnel conducted a risk assessment and contacted emergency services as necessary. Study forms are available at https://repository.niddk.nih.gov/studies/labs/Forms/.

Measures

SBQ-R.—The Suicidal Behavior Questionnaire-Revised (SBQ-R)[19] measures past suicidal thoughts/behaviors and future suicide risk. It was completed at the year-4 or year-5 assessment. One item asked if participants had "thought about or attempted to kill yourself," any time pre-surgery and another item assessed this with a "since surgery" timeframe. Those who completed the SBQ-R at year-4 completed a past-year version of the questionnaire at year-5 that was used to update the "since surgery" status to represent the previous five years. Due to low frequencies for each of the six response categories, they were collapsed into four categories indicating 'never,' 'brief passing thought,' 'had plan' (combining the response options 'I had a plan at least once to kill myself but did not try to do it' and 'I had a plan at least once to kill myself and really wanted to die'), and 'had prior attempt' (combining the response options 'I have attempted to kill myself, but did not want to die' and 'I have attempted to kill myself and really hoped to die,' with the latter three categories indicating 'suicidality.'

BDI-1.—The Beck Depression Inventory-Version 1 (BDI-1) measures depression symptoms[20,21] and includes an item about thoughts and plans of self-harm/suicide within the past week. The response, "I don't have any thoughts of harming myself," was coded as 'no self-harm/suicidal ideation.' Due to low frequency of the other five response options, they were collapsed to indicate 'self-harm/suicidal ideation.'

Suicide deaths.—Vital status was determined through annual study follow-up. A query of the National Death Index, a database of death records on file in state vital statistics offices

(http://www.cdc.gov/nchs/ndi.htm), was performed through 2014. Causes of death were adjudicated by committee using all available sources (medical records, autopsy report, death certificate). In cases of inadequate information for adjudication, the death certificate cause was used. Suicide was defined as death adjudicated as “definite” suicide. Potential suicide was defined as death adjudicated as “probable” suicide, “definite” or “probable” alcohol or drug poisoning with unknown intent or non-adjudicated deaths with intentional self-harm or alcohol or drug poisoning as cause of death on the certificate.

Other Measures.—Sociodemographic data were self-reported on study-specific questionnaires.[18] Participants underwent weight measurement to the nearest pound and height to the nearest inch using a wall-mounted stadiometer, which was used to calculate baseline BMI (kg/m²) and percent weight loss: 100*(baseline weight-follow-up weight)/ baseline weight.

Diabetes, hypertension, dyslipidemia, and sleep apnea status were determined using laboratory values, physical examination measures, participant report, and comorbid diagnoses from healthcare providers and medical records. Severe walking limitation was defined as the self-reported inability to walk 200 feet without assistance. The Medical Outcomes Study 36-item Short-Form Health Survey (SF- 36)[22] is a generic measure of functional health. Using norm-based methods, the general health and bodily pain domain scores of the Medical Outcomes Study 36-item Short-Form Health Survey (SF- 36),[22] a generic measure of functional health, were used to transform participant scores to a mean of 50 and standard deviations of 10 in the general U.S. population; higher scores indicating better functioning. Perceived social support was measured using the belonging domain score from the 12-item Interpersonal Support Evaluation List (ISEL-12); a higher score (range 1–12) indicating greater support availability.[23] Sexual dissatisfaction was defined as self-report of being “dissatisfied” or “very dissatisfied” with overall sexual life on a study-specific questionnaire.[24] Past-week depressive symptomatology was measured with the BDI-1; a higher score (range 0–63) reflected greater severity.[20]

Smoking and illicit drug use were assessed with the LABS-2 Behavioral Form.[25] Regular alcohol consumption (i.e., ≥ twice/week) and alcohol use disorder (AUD) symptoms were determined using the Alcohol Use Disorders Identification Test (AUDIT).[25,26] The therapeutic classes of prescription medications and frequency information were used to identify participants currently taking opioid analgesic medication, anti-anxiety medication, or anti-depressant medications at least daily. Past-year counseling and lifetime history of hospitalizations for psychiatric or emotional problems were assessed with the LABS-2 Psychiatric and Emotional Test Survey.[25]

Data Analytic Strategy

Analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA). All reported *P* values are two-tailed; *P* values less than 0.05 were considered statistically significant.

Potential selection bias due to missing data was examined by comparing pre-surgery characteristics of those in the SBQ-R and BDI-1 analysis samples to those not in the

respective analysis samples using Pearson's chi-squared test, the Cochran-Armitage test, or the Wilcoxon rank sum test for categorical, ordinal, and continuous variables, respectively.

A mixed-effects ordinal logistic regression model was used to determine pre-surgery predictors of suicidality in the five years post-surgery. Due to the low frequency of suicide 'plans' and 'attempts,' these two categories were collapsed resulting in three categories (i.e., no thoughts/plans/attempts, thoughts only, and plans/attempts). The parallelism assumption (constant odds of being in the next more severe category of suicidality) was tested and was not violated. Based on the literature,[5,10,14,27] these pre-surgery variables were considered: suicidality history, self-harm/suicidal ideation, age, sex, race, ethnicity, marital status, education, unemployment, household income, BMI, diabetes, hypertension, dyslipidemia, sleep apnea, severe walking limitation, SF-36 general health score, SF-36 bodily pain score, ISEL belongingness score, dissatisfaction with sexual life, BDI-1 depressive symptoms score, smoking status, regular alcohol consumption, AUD symptoms, illicit drug use, prescription opioid use, anti-anxiety medication use, anti-depressant medication use, psychiatric counseling, and lifetime history of psychiatric hospitalization. Due to the large number of variables under consideration, a model with each factor was tested first. Next, factors with $P<0.20$ were entered into a multivariate model with site as a random effect and surgical procedure (RYGB, LAGB, other) as a fixed effect and retained if significant.

Among those in the BDI-1 sample, longitudinal analyses were performed with mixed models with a person-level random intercept. Models controlled for site, age, and pre-surgery smoking status, which were associated with missing follow-up data[28] as fixed effects. Sensitivity analyses were performed to examine the robustness of results with respect to the missing at random assumption (eAppendix 1 [Supplement]).

A Poisson mixed model with robust error variance was used to estimate self-harm/suicidal ideation and test for differences by time point. Pairwise comparisons were made between pre-surgery vs. year-1 and pre-surgery vs. year-5. Stability in the estimates of self-harm/suicidal ideation following surgery was evaluated by testing for linear and quadratic trends from year-1 to year-5. *P*-values were adjusted to control for overall type I error.[29]

Poisson mixed models with robust error variance were also used to determine factors related to post-surgery self-harm/suicidal ideation with time entered as a discrete fixed effect. First, a pre-surgery model was constructed using the same pre-surgery variables and same model building strategy described above. Because the pre-surgery suicidality history was missing for approximately one-third of the BDI-1 sample, a three-category variable was created with missing recoded to unknown. A second model was constructed to identify pre-to-post-surgery changes independently associated with post-surgery self-harm/suicidal ideation, controlling for pre-surgery factors identified in the previous analysis. The following variables were considered: pre-to-post-surgery change in SF-36 general health score, SF-36 bodily pain score, ISEL belongingness score and BDI-1 depression symptoms score, with control for the corresponding pre-surgery values, post-surgery marital status, unemployment status, household income, diabetes, hypertension, dyslipidemia, sexual life dissatisfaction, smoking, regular alcohol consumption, AUD symptoms, illicit drug use, prescription opioid use, anti-anxiety medication use, anti-depressant medication use, psychiatric counseling,

with consideration for pre-surgery status (e.g., became single vs. stayed married, became unemployed vs. remained employed). Interactions between time and covariates were tested and retained if significant.

Results

Sixty-three percent (n=1540) of participants completed the SBQ-R at five years post-surgery, while ninety percent (N=2217) completed the BDI-1 item pre-surgery and at least one follow-up (eFigure 1 [supplement]). A comparison of pre-surgery characteristics between those included and excluded from the analysis samples is provided in eTable 1 [supplement]. The proportion reporting self-harm/suicidal ideation at the pre-surgery assessment was similar for those who completed vs. did not complete the SBQ-R.

Characteristics of LABS-2 participants and the SBQ-R and BDI-1 analysis samples are shown in Table 1. The majority of participants (N=1738) underwent RYGB, followed by LAGB (N=610).

A cross-tabulation of pre- and post-surgery suicidality as measured by the SBQ-R is shown in Table 2. From retrospectively-obtained SBQ-R results, 25.7% (395/1534) of participants reported a pre-surgery suicidality history, 46.3%(183/395) of whom also reported suicidality post-surgery. Attempted suicide (vs. suicidal thoughts or plans) was far less common, reported by 4.1%(63/1534) of participants pre-surgery, 12.7% (8/63) of whom also reported post-surgery attempts. All of those who attempted suicide post-surgery (0.8%; 13/1534) had at least a brief passing thought of suicide pre-surgery. However, a small percentage of participants (2.6%; 40/1534) had post-surgery onset of suicidal thoughts or plans.

Pre-surgery suicidality history greatly increased the odds of greater severity of post-surgery suicidality (eTable 2 [supplement]). Compared to those with no pre-surgery history, those with a suicidal thought history were 17.47(95% CI, 9.58–31.88) times more likely to have more severe post-surgery suicidality. Pre-surgery past-week self-harm/suicidal ideation (AOR, 7.16, 95% CI, 2.81–18.23) and younger age (AOR, 1.32, 95% CI, 1.05–1.67, per 10 years) were also significantly associated with greater severity of post-surgery suicidality. No other pre-surgery variables or surgical procedures were independently related to suicidality in the five years post-surgery.

Prevalence of self-harm/suicidal ideation from the BDI-1 is shown in Figure 1. The prevalence of self-harm/suicidal ideation was 5.3%(95% CI, 3.7–6.8) pre-surgery and 3.8%(95% CI, 2.5–5.1) at year-1 post-surgery (P=.06). Prevalence then increased over time to 6.6%(95% CI, 4.6–8.6) at year-5 (P=0.001), but was not significantly different than pre-surgery (P=.12). Observed and modeled data by time point are reported in eTable 3 [supplement].

Pre-surgery suicidality history, self-harm/suicidal ideation, being male, smoking, greater pain severity, antidepressant medication use, psychiatric counseling, and lifetime history of psychiatric hospitalization were independently associated with greater risk of self-harm/suicidal ideation in years 1–5 post-surgery (Table 3). As indicated by a significant interaction, the magnitude of the risk of post-surgery self-harm/suicidal ideation associated

with pre-surgery self-harm/suicidal ideation decreased over time. Surgical procedure type was not significantly associated with post-surgery self-harm/suicidal ideation.

Associations between pre- to post-surgery changes and post-surgery self-harm/suicidal ideation in years 1–5 are reported in Table 4. Worsening/less improvement in self-rated general health, increasing/less improvement in depressive symptoms, and starting vs. no antidepressant use were independently associated with greater relative risk of having post-surgery self-harm/suicidal ideation. Statistical power was limited to detect associations with some changes due to their low frequency (e.g., becoming single or getting married) and the low frequency of the outcome. While not representing changes, staying single vs. married and continuing antidepressant medication vs. no use were associated with having post-surgery self-harm/suicidal ideation, while continued prescription opioid use vs. no use was associated with lower risk (Table 4). Percent weight loss was not independently associated with risk of post-surgery self-harm/suicidal ideation (AOR=0.99, 95%CI, 0.93–1.05, per 5% weight loss; P=.69).

Average follow-up for vital status was 4.9 years for the 2458 participants. Among the adjudicated deaths within 5 years of surgery with assigned cause (N=40), 3 deaths were categorized as suicides (2 by drug poisonings and 1 by firearm discharge) and 2 deaths as potential suicides (1 as a definite drug poisoning with unknown intent and 1 as a probable drug poisoning with unknown intent). Among the deaths that could not be adjudicated (N=14), 2 deaths were categorized as potential suicides, both drug poisonings per the death certificate. Suicides and potential suicides occurred an average of 3.8 years and 3.9 years post-surgery, respectively. All occurred among participants who had undergone RYGB and experienced substantial weight loss (range: 19–46% of pre-surgery weight). Additional information on participants with suicide and potential suicide deaths is reported in eTable 4 [supplement].

Discussion

Among a large cohort of bariatric surgery patients, 25% reported a pre-surgery history of suicidality and 4% reported a past attempt. These rates are considerably higher than the general US population (i.e., 3.3% suicidal ideation, 0.6% suicide attempt)[30] but trend towards being lower compared to previous studies reporting pre-surgery lifetime rates. For example, in a study of 396 bariatric surgery-seeking individuals, 30.3% reported a history of suicidal ideation,[31] and lifetime prevalence of suicide attempts in bariatric surgery-seeking patients has been reported as 5.6% (among 396 patients),[31] 9.1% (among 121 patients),[32] and 11.2% (among 1020 patients).[33] A potential explanation for higher rates in previous studies is that samples of bariatric surgery-seeking individuals may include patients who were refused surgery due to history of suicidality, as current or recent suicidality is considered a contraindication for bariatric surgery,[34,35] while our study was conducted following approval for surgery. Another explanation for differences in rates may be due to sample size, as smaller studies produce less precise estimates.

In the 5 years following surgery, 15% reported suicidality, most of whom had a pre-surgery suicidality history. A significant trend in the prevalence of self-harm/suicidal ideation from

years one to five post-surgery indicates self-harm/suicidal ideation may increase with time passing following bariatric surgery, perhaps due to an initial decrease in the first post-operative year. This is further supported by the timing of suicides and potential suicides, which occurred, on average, almost four years post-surgery within a five-year timeframe. A previous study identified 31 suicides following bariatric surgery over a mean follow-up of 2.8 years and reported more deaths in the third year following surgery than in the first two years combined.[36]

As expected, pre-surgery suicidality was associated with increased risk of both suicidality and self-harm/suicidal ideation in the five years post-surgery. Several additional risk factors that were independent of, or existed prior to, surgery (e.g., younger age, being male, smoking, reporting greater pain, antidepressant use, psychiatric counseling, and psychiatric hospitalizations) were identified. Consistent with these findings, two previous studies reported that most self-harm incidents following bariatric surgery occurred in patients who had pre-surgery mental health problems.[11,13] One past study found that gastrointestinal complications post-surgery were predictive of self-harm, which may be consistent with our pain finding.[11]

Getting divorced (vs. remaining married), general health decline, depression symptom increase, and starting or continuing anti-depressant medication use (vs. no use) following surgery were also related to increased risk of self-harm/suicide ideation, while use of prescription opioid medication, possibly indicative of better pain control, was associated with lower risk. After accounting for these changes, neither weight loss or surgical procedure was related to post-surgery self-harm/suicidal ideation. Studies in the general population have also found that divorce and physical illness are suicide risk factors.[8]

Although we did not have sufficient statistical power to formally evaluate factors predictive of suicide, we examined characteristics of participants who died by suicide or potential suicide within five years of surgery. Of 7 decedents, 5 were female, median age was 44, and most were non-Hispanic, White, married, and denied substance use (smoking, alcohol, and illicit drugs) pre-surgery, consistent with the characteristics of the sample in general. However, the proportion of decedents with a pre-surgery history of psychiatric treatment was high, with five of six with available data reporting anti-depressant or anti-anxiety medication, counseling, and/or hospitalizations. Additionally, all decedents underwent RYGB, perhaps because it was the most common procedure at the time. However, potential mechanisms related to RYGB should be explored in future research; these include malabsorption of antidepressant medications, changes in peptides and hormones that may affect mood, and RYGB's association with increased risk for alcohol or substance use disorders.[10,15] In line with previous research,[13,36] overdoses accounted for two of the three suicides in our sample and four potential suicides. In contrast to their pre-surgery history, only two of five decedents with available data reported psychiatric treatment at the post-surgery assessment prior to their death. However, none reported self-harm/suicide ideation, perhaps owing to the use of a past-week measure.

Limitations to the study include lack of a control group and insufficient statistical power to evaluate suicide attempts/deaths. While self-harm emergencies are a strong predictor of

suicide,[37] a recent cohort study of Danish bariatric surgery patients and non-operated controls with obesity reported bariatric surgery was associated with an increased risk of self-harm but not suicide,[38] illustrating higher risk of one does not infer higher risk of the other. Neovius and colleagues[39] found higher rates of both suicide attempts and deaths among bariatric surgery patients as compared to weight-matched controls, although they speculated that their findings could be due to a selection bias. Additional studies of adults who undergo bariatric surgery with appropriate control groups, larger sample size, and long-term follow-up are warranted.

Other important limitations include missing data that history of suicidality was assessed 5 years post-surgery. Investigation of missing data confirmed that pre-surgery factors were similar between individuals included in the analyses vs. excluded due to missing SBQ-R or BDI-1 data. Longitudinal analyses of self-harm/suicidal ideation controlled for pre-surgery factors related to missing follow-up data. Although participants were told that research data were confidential, they may have under-reported pre-surgery self-harm/suicidal ideation due to concern that their responses could affect surgery eligibility. All potentially important risk factors (e.g., family history of suicide, trauma history, impulsivity, weight loss disappointment, changes in medication absorption, peptides, and hormones)[8,10] were not assessed. The study's strengths include the large geographically-diverse sample, standardized data collection including multiple measures related to self-harm and suicide, and longitudinal, multivariate analyses.

Among a large cohort of adults with severe obesity who underwent bariatric surgery, the post-surgery prevalence of self-harm/suicidal ideation may initially decrease in the first post-operative year but then increase over time, suggesting screening for self-harm and suicidality, with referral for treatment when indicated, is warranted throughout long-term post-operative care. Several risk factors were identified that may help with enhanced monitoring, such as younger age, being male, history of suicidality, history of psychiatric treatment, divorce, and post-surgery health decline. Because long-term monitoring by bariatric programs can be challenging due to a high loss to follow-up after surgery, it is important that monitoring suicide risk be incorporated into primary care mental health screenings.[40–43] Mental health referrals should be made for individuals found to have thoughts of self-harm/suicidality, and treatment with therapy and/or medication should be considered.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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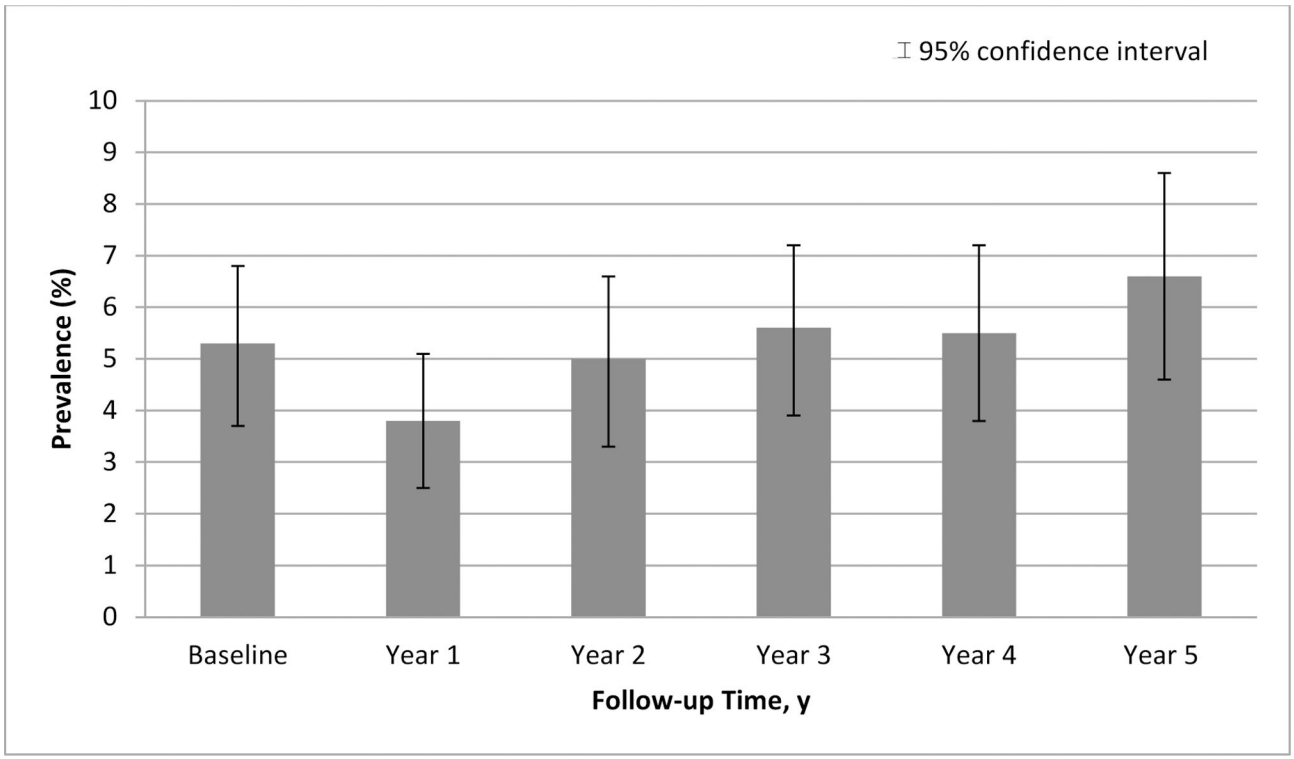
Highlights

- Bariatric surgery patients with pre-surgery suicidal ideation are at increased risk for post-surgery ideation.
- Suicidal ideation slightly decreased at year-1 post surgery but returned to pre-surgery levels at year-5.
- Suicide risk screening is warranted throughout long-term post-operative care.



*Model adjusted for site, age and pre-surgery smoking, which were related to missing follow-up data. There was not a significant difference between pre-surgery and year 1 prevalence (*P*=0.06) or pre-surgery and year 5 prevalence (*P*=0.12). However, there was a significant linear trend from year 1 to year 5 indicating increasing prevalence (*P*=0.001). Observed and modeled prevalence and 95%CI are reported in eTable 3 [supplement].

[a]Data obtained from the Beck Depression Inventory-1.

Figure 1.
Modeled* Prevalence of Self-harm/Suicidal Ideation in the Past Week, by Time Point.[a]

Table 1.

Pre-surgery Characteristics of Participants in the Longitudinal Assessment of Bariatric Surgery-2 Study and in the SBQ-R and BDI-1 Analysis Samples.

	LABS-2 sample (N=2458)[a]		SBQ-R analysis sample (N=1540)[a]		BDI-1 analysis sample (N=2217)[a]	
	No.	(%)[b]	No.	(%)[b]	No.	(%)[b]
Age, years, median (25th, 75th)	46.0	(37.0, 54.0)	48.0	(38.0, 56.0)	46.0	(37.0, 55.0)
Female	1931	(78.6)	1220	(79.2)	1743	(78.6)
White race[c], No./total (%)	2102/2433	(86.4)	1308/1526	(85.7)	1897/2196	(86.4)
Hispanic/Latino ethnicity, No./total (%)	119/2456	(4.8)	76/1539	(4.9)	106/2216	(4.8)
Married or living as married, No./total (%)	1444/2264	(63.8)	907/1427	(63.6)	1324/2083	(63.6)
Education	(n=2334)		(n = 1428)		(n = 2082)	
High school or less	521	(23.0)	344	(24.1)	478	(23.0)
Some college/post high school education	918	(40.5)	558	(39.1)	844	(40.5)
College degree or higher	825	(36.4)	526	(36.8)	760	(36.5)
Unemployed, No./total (%)	86/2257	(3.8)	41/1425	(2.9)	79/2076	(3.8)
Household income	(n=2204)		(n = 1387)		(n = 2029)	
Less than $25,000	402	(18.2)	257	(18.5)	370	(18.2)
$25,000-$49,999	568	(25.8)	356	(25.7)	522	(25.7)
$50,000-$74,999	522	(23.7)	321	(23.1)	467	(23.0)
$75,000-$99,999	353	(16.0)	226	(16.3)	329	(16.2)
$100,000-$199,999	292	(13.2)	191	(13.8)	282	(13.9)
$200,000 or more	67	(3.0)	36	(2.6)	59	(2.9)
Body mass index[d], median (25th, 75th)	45.9	(41.7, 51.5)	45.8	(41.7, 51.3)	45.9	(41.8, 51.3)
Diabetes, No./total (%)	774/2314	(33.4)	491/1452	(33.8)	702/2109	(33.3)
Hypertension, No./total (%)	1601/2372	67.5	1010/1486	(68.0)	1466/2152	(68.1)
Dyslipidemia, No./total (%)	1254/1976	63.5	794/1505	(63.5)	1141/1801	(63.4)
Sleep apnea, No./total (%)	1288/2455	52.5	827/1540	(53.7)	1170/2216	(52.8)
Severe walking limitation, No./total (%)	153/2248	6.8	102/1411	(7.2)	137/2040	(6.7)
SF-36 general health score	(n=2268)		(n = 1430)		(n = 2086)	
Median (25th, 75th)	40	(32, 49)	40	(32, 47)	40	(32, 47)
SF-36 bodily pain score	(n=2261)		(n = 1424)		(n = 2079)	
Median (25th, 75th)	40	(32, 49)	40	(32, 49)	40	(32, 49)
ISEL belongingness score	(n=2260)		(n = 1423)		(n = 2078)	
Median (25th, 75th)	14	(12, 16)	14	(12, 16)	14	(12, 16)
Dissatisfied with sexual life, No./total (%)	1039/2077	(50.0)	660/1305	(50.6)	952/1912	(49.8)
BDI-1 depressive symptoms score	(n=2277)		(n = 1419)		(n = 2108)	
Median (25th, 75th)	6	(3, 11)	6	(3, 11)	6	(3, 11)
Current or recent smoker, No./total (%)	324/2454	(13.2)	167/1540	(10.8)	278/2213	(12.6)

	LABS-2 sample (N=2458)[a]		SBQ-R analysis sample (N=1540)[a]		BDI-1 analysis sample (N=2217)[a]	
Regular alcohol consumption, No./total (%)	146/2262	(6.5)	104/1426	(7.3)	142/2081	(6.8)
AUD symptoms, No./total (%)	148/2256	(6.6)	95/1421	(6.7)	140/2075	(6.7)
Illicit drug use, No./total (%)	100/2251	(4.4)	55/1419	(3.9)	90/2069	(4.3)
Prescription opioid use, No./total (%)	384/2398	(16.0)	257/1504	(17.1)	348/2173	(16.0)
Anti-anxiety medication use, No./total (%)	142/2259	(6.3)	87/1423	(6.1)	118/2070	(5.7)
Anti-depressant medication use, No./ total (%)	870/2246	(38.7)	535/1413	(37.9)	796/2060	(38.6)
Past-year psychiatric counseling, No./ total (%)	529/2246	(23.6)	328/1414	(23.2)	485/2065	(23.5)
Lifetime history of psychiatric	229/2250	(10.2)	157/1419	(11.1)	214/2072	(10.3)
hospitalization, No./total (%)						
Surgical procedure						
Roux-en-Y gastric bypass	1738	(70.7)	1081	(70.2)	1153	(70.1)
Laparoscopic adjustable gastric band	610	(24.8)	382	(24.8)	560	(25.3)
Other	110	(4.5)	77	(5.0)	104	(4.7)

Abbreviations: AUD, alcohol use disorder; BDI-1, Beck Depression Inventory 1; BMI, body mass index, ISEL, Interpersonal Support Evaluation List; SF-36, Short-Form Health Survey-36; SBQ-R, Suicide Behavior Questionnaire-Revised.

[a] Denominators shift between variables because of missing data.

[b] Data are reported as No. (%) unless otherwise indicated.

[c] Due to small numbers, non-white racial categories were combined: Asian, American Indian/Alaska Native, Black, Native Hawaiian/other Pacific Islander, multiple races.

[d] Calculated as weight in kilograms divided by height in meters squared.

Table 2.

Suicidal Thoughts, Plans, and Attempts in the Five Years Since Bariatric Surgery by Pre-surgery Lifetime History.[a]

	Pre-surgery history of suicidality									
	Never		Brief passing thought		Had plan At least once to kill myself		Attempted to Kill myself		Since surgery totals	
Suicidality in the 5 years following surgery	N	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Never	1099	(71.6)	154	(10.0)	37	(2.4)	21	(1.4)	1311	(85.5)
Brief passing thought	35	(2.3)	79	(5.2)	29	(1.9)	18	(1.2)	161	(10.5)
Had plan at least once to kill myself	5	(0.3)	10	(0.7)	18	(1.2)	16	(1.0)	49	(3.2)
Attempted to kill myself	0	(0.0)	4	(0.3)	1	(0.1)	8	(0.5)	13	(0.8)
Prior to surgery totals	1139	(74.3)	247	(16.1)	85	(5.5)	63	(4.1)	1534	

[a] Data obtained from the Suicidal Behavior Questionnaire-Revised.

Table 3.

Associations between Pre-surgery Factors and Post-surgery Self-harm/Suicidal Ideation[a] (N=2001)

Pre-surgery factors[b]	**ARR**	**(95% CI)**	***P*-value**
Lifetime history of suicidality (ref=No)[c]	4.50	(3.06–6.62)	<.001
Past-week self-harm/suicidal ideation[d] (ref=No)			<0.01
Year 1	6.89	(3.41–13.89)	
Year 2	3.55	(1.88–6.70)	
Year 3	2.59	(1.27–5.28)	
Year 4	2.57	(1.30–5.08)	
Year 5	2.01	(1.05–3.87)	
Male sex (ref=Female)	1.60	(1.16–2.20)	<0.01
Age, per 10 years younger	1.09	(0.94–1.25)	0.26
Current smoker (ref=No)	1.56	(1.08–2.26)	0.02
Bodily pain score, per 5 SF-36 points lower[e]	1.14	(1.05–1.24)	0.001
Current antidepressant medication daily (ref=No)	1.55	(1.13–2.13)	0.01
Past-year psychiatric counseling (ref=No)	1.70	(1.21–2.38)	<0.01
Lifetime history of psychiatric hospitalization (ref=No)	1.72	(1.21–2.44)	<0.01
Surgical procedure			0.57
LAGB vs. RYGB	1.12	(0.56–2.24)	
Other vs. RYGB	0.86	(0.61–1.21)	

Abbreviations: ARR, adjusted relative risk; CI, confidence interval; LAGB, laparoscopic adjustable gastric band; RYGB, Roux-en-Y gastric bypass

[a] Past week status assessed at annual assessments with the Beck Depression Inventory-1.

[b] Site, age and pre-surgery smoking status, which were related to missing follow-up data, and surgical procedure were forced into the model. Additional pre-surgery factors were considered and retained if significant at $P<.05$.

[c] There was also an association between unknown vs. no history of suicidality: 3.25 (95% CI=2.11–4.99); p<.001.

[d] There was a significant interaction between baseline self-harm/suicidal ideation and follow-up time point, such that the risk associated with baseline self-harm/suicidal ideation was weaker with increasing time since surgery.

[e] Lower score indicates greater pain.

Table 4.

Independent Associations Between Pre-to-post-surgery Change and Self-harm/Suicidal Ideation Post-surgery[a] (N=1762)

Pre-to-post-surgery change	ARR	(95% CI)	*P*-value
Marital status			0.002
Got married vs. stayed single	0.53	(0.24–1.17)	
Got divorced vs stayed married	2.01	(0.93–4.34)	
Stayed single vs. stayed married	1.75	(1.16–2.64)	
Decrease in general health score, per 5 SF-36 points lower	1.07	(1.01–1.14)	0.02
Increase in depressive symptoms score, per 5 BDI-1 points higher	1.78	(1.64–1.92)	<.0001
Prescription opioid use			0.04
Stopped vs. continued	1.45	(0.61–3.45)	
Started vs. no use	1.03	(0.66–1.60)	
Continued vs no use	0.51	(0.27–0.94)	0.001[b]
Anti-anxiety medication use			
Stopped vs. continued	2.07	(0.88–4.88)	
Started vs. no use	1.04	(0.62–1.77)	
Continued vs no use	1.15	(0.50–2.65)	
Anti-depressant medication use			0.01
Stopped vs. continued	0.74	(0.43–1.25)	
Started vs. no use	1.94	(1.05–3.57)	
Continued vs no use	1.87	(1.11–3.13)	

Abbreviations: ARR, adjusted relative risk; CI, confidence interval; SF-36, Short-Form Health Survey-36.

[a]Past week status assessed at annual assessments with the Beck Depression Inventory-1.

[b]Site, age and pre-surgery smoking status, which were related to missing follow-up data, and surgical procedure were forced into the model. The model also controlled for pre-surgery factors reported in table 3 and the baseline SF-36 general health and Beck Depression Inventory-1 depressive symptoms scores.

[b]None of the comparisons of interest were significant.