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## Risk of Suicide after Long Term Follow-up from Bariatric Surgery

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### Abstract

**Purpose**—Bariatric surgery is recognized as the treatment of choice for class III obesity (body mass index  $\geq 40$ ) and has been increasingly recommended for obese patients. Prior research has suggested an excess of deaths due to suicide following bariatric surgery but few large long term follow up studies exist. We examined post-bariatric surgery suicides by time since operation, sex, age, and suicide death rates as compared to US suicide rates.

**Methods**—Medical data following bariatric operations performed on Pennsylvania residents between 01/01/1995 and 12/31/2004 were obtained from the Pennsylvania Health Care Cost and Containment Council. Matching mortality data from suicides between 09/1/1996 and 12/28/2006 were obtained from the Division of Vital Records, Pennsylvania State Department of Health.

**Results**—There were 31 suicides (16,683 operations), for an overall rate of 6.6/10,000, 13.7 per 10,000 among men and 5.2 per 10,000 among women. About 30% of suicides occurred within the first two years following surgery, with almost 70% occurring within three years. For every age category except the youngest, suicide rates were higher among men vs. women. Age and sex-matched suicide rates in the US population (ages 35–64) were 2.4/10,000 (men) and 0.7/10,000 (women).

**Conclusions**—Compared to age and sex-matched suicide rates in the U.S., there was a substantial excess of suicides among all patients who had bariatric surgery in Pennsylvania during a ten-year period. These data document a need to develop more comprehensive longer-term surveillance and follow-up methods in order to evaluate factors associated with post-bariatric surgery suicide.

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## Keywords

bariatric surgery; suicides; public health

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## Introduction

Bariatric surgery has emerged as the treatment of choice for class III obesity, [1, 2] and by current criteria is appropriate for over 5% of the obese adult US population (BMI  $\geq 40$  or BMI  $\geq 35$  with comorbid conditions).[3] There are few studies of a longer term follow up of large samples of individuals who have had bariatric surgery. While the reported short-term (e.g., 30-day operative) mortality associated with these procedures is low,[4–10] studies with longer term follow up have better characterized death rates and associated risk factors. [6, 10–19] Several prior studies have documented an excess of suicide deaths post bariatric surgery[11, 13, 16, 20–22] with the majority of events occurring more than one year post surgery. Adams and colleagues found that the age, body mass index (BMI), and sex-adjusted hazard of suicide in the surgical group was double that of matched controls, but the small absolute number of suicides (n = 21 in the surgical group vs. 8 among controls) limited power to detect statistically significant differences.[11]

The reasons for an excess of suicides among these surgery patients are not known. The prevalence of depression and co-morbid mental illness is high among morbidly obese individuals[23–26] and bariatric surgery candidates.[27, 28] Kalarchian and colleagues reported a 66% lifetime history of at least one axis I disorder (e.g., mood, anxiety, substance use, or eating disorder) among candidates for bariatric surgery. Presence of an axis I disorder was significantly related to a higher baseline BMI and poorer functioning on all subscales of the SF-36, a validated measure of physical and emotional functional health status.[27] Pre-surgical psychopathology may in turn contribute to post-surgical outcomes. Lifetime history of mood or anxiety disorder (compared to no history) has been associated with a significantly smaller decrease in BMI during the first six months following surgery. [29]

Literature on aspects of suicide and obesity is less clear. Suicidal ideation[26, 30, 31] and suicide attempts[26, 31, 32] increase with BMI, but suicide mortality bears a strong inverse relationship to BMI in men.[30, 33, 34] The role of weight change also appears to be important in understanding suicide risk.[35] Sansone and colleagues[36] reported that 10% of bariatric surgery candidates had a history of prior suicide attempts, a major risk factor for suicide mortality.[37] Despite perioperative psychological evaluation, there may be under-recognition and under-treatment of mental illness both before and after surgery,[38, 39] perhaps in part due to inconsistencies in the initial evaluation of bariatric surgery candidates. [40] Given the increasing utilization of bariatric surgery as an effective treatment of severe obesity,[41–43] it is critical to better characterize the suicide risks among post-bariatric surgery patients.

Detailed characteristics of suicides following bariatric surgery (e.g., by time since surgery, age, gender, year of surgery) have not been widely published. We extend our prior work by describing these characteristics of all reported suicides among Pennsylvania residents who

underwent bariatric surgery from January 1, 1995 to December 31, 2004 and died between September 1, 1996 and December 28, 2006. This study design captures suicides and methods of suicide related to all bariatric surgeries performed during this time period within the state of Pennsylvania, and therefore is not restricted to only a few major medical centers that may have unique selection criteria or follow up programs.

## Methods

Data were obtained from the following 2 sources: (1) the Pennsylvania Health Care Cost and Containment Council database,[44] to identify patients hospitalized for bariatric surgery, and (2) the Division of Vital Records, Pennsylvania State Department of Health, to determine suicides (as judged by the coroner or medical examiner) and obtain copies of death certificates.

The Pennsylvania Health Care Cost and Containment Council collects data in the state of Pennsylvania, including all hospital discharges and ambulatory/outpatient procedure records each year from hospitals and freestanding ambulatory surgery centers. The hospitals and freestanding surgery centers are required by law to electronically submit quarterly administrative data for all in-patient discharges and select specified ambulatory/outpatient procedures within 90 days after the end of a quarter.

The study design and methods of ascertainment of bariatric surgery cases has been previously described in detail.[16] All state-resident patients who underwent bariatric surgery in Pennsylvania were identified in the Pennsylvania Health Care Cost and Containment Council database. Each study subject fulfilled the following criteria: all in-patient discharges with *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis codes of 278.00 (obesity, unspecified) or 278.01 (morbid obesity); and all in-patient discharges with major diagnostic group code 10 and diagnostic related group code 288 (operating procedures for obesity). Thus, to be included, an individual would need to have either ICD-9 code 278 or 278.01 and group codes 10 and 288.

The following variables were collated for each patient: (1) age at surgery, (2) sex, (3) race, (4) date and year of surgery, (5) hospital where the surgery was performed, (6) county where the surgery was performed, and (7) primary operating surgeon. After identification of the patient cohort, the data were directly matched with the database of the Division of Vital Records, Pennsylvania State Department of Health, using the Social Security number of patients in addition to age and sex. The matching was performed directly between the staffs of the Pennsylvania Health Care Cost and Containment Council and the Division of Vital Records. A positive match would occur only if a patient had died and the death certificate was archived by the Division of Vital Records. Suicide was determined by the county coroner or medical examiner.

The death certificates of the patients who had undergone bariatric surgery and who had died from suicide within the study period (n=31) were made available to us for review. Pennsylvania residents who died outside the state would be missed by the surveillance

methods. Less than 2% of Pennsylvania residents are estimated to have died outside the state.[45]

Previous studies have documented the completeness of the Pennsylvania vital statistics system.[46] We selected only Pennsylvania residents so that we would have a population-based study and because of the decreased likelihood that they would move out of the state after bariatric surgery. We did not obtain information on patients from outside Pennsylvania or outside the United States who had undergone bariatric surgery during this time in Pennsylvania hospitals. For estimations of rates and follow-up, we used only the first bariatric surgical procedure for each patient. The study was deemed exempt by the Institutional Review Board at the University of Pittsburgh.

We compared the suicide rates/10,000 person-years of follow up with reported United States suicide rates[47] and with suicide rates in the state of Pennsylvania.[48] To our knowledge, there are no available suicide rates for a truly comparable population of morbidly obese individuals who did not have bariatric surgery (e.g., who met similar criteria for bariatric surgery such that they would have been selected by a bariatric surgery center to have the procedure.)

We performed data analysis with SPSS statistical software (SPSS Categories 4.1 for Windows; SPSS Inc, Chicago, Illinois). We estimated suicide rates by the time since surgical procedures to the date of death. Person-years of observations were accumulated from the date of surgery to the date of death or to the end of the study. The number of nonwhite patients was very low and therefore we used the total and age-specific death rates rather than race-specific rates. The manner of death listed on the death certificates were reviewed by 2 of us (HAT and LHK).

## Results

There were 31 total suicides. Mean age of the deceased was 45, and they were primarily female (65%, Table 1) and White (94%). Mean time to death was about 3 years after surgery, with 10% occurring in the first year, 29% within the first two years, and 68% within three years after surgery. (Table 2) The distribution of suicides by year of bariatric surgery is shown in Table 3. The incidence of suicide was 6.6 (per 10,000 person-years). Men had higher rates of suicide in each age category except those 24 or younger. (Table 4) The overall rate of suicide among men was over twice that of women (13.7 vs. 5.2 per 10,000). Men aged 45–54 had the highest rates of suicide (21.7 per 10,000), while women under age 35 had the highest rates (about 14.0 per 10,000). These rates are substantially higher than those of the general age-matched US population over the same time period, (i.e. US suicide rates age 35–64 for men 2.4/10,000 and 0.7/10,000 for women.)[49] Similarly, for Pennsylvania, suicide rates age 35–64 in 2005 were 2.5/10,000 for men and 0.6/10,000 for women.[48]

Suicides were categorized according to 4 main modes of death: drug overdose (n = 16), gunshot wound (n = 9), carbon monoxide poisoning (n = 4) and hanging (n = 2) (Table 5).

## Discussion

We examined all suicides occurring between 1996 and 2006 among post-bariatric surgery patients residing in Pennsylvania. There were 31 total suicides in this population, for an overall rate of 13.7 per 10,000 among men and 5.2 per 10,000 among women. It is very likely that suicide deaths were also underestimated because some of the deaths were listed as drug overdose, rather than suicide, on the death certificate. In this case, the suicide rate post-bariatric surgery would be even higher than what we have reported. In addition, the deaths due to drug overdose, whether intentional or not, are also a cause for concern.

A recent report from the Agency for Healthcare Research and Quality estimated that in 2004 there were 121,055 bariatric surgery procedures done in the United States.[50] Even more recent figures from the American Society for Metabolic and Bariatric Surgery report 225,000 procedures annually.[41] Annual rates of bariatric surgery have risen dramatically over the past decade (e.g., 400 percent between 1998–2002)[43] and are expected to rise further given the effectiveness of bariatric surgery for weight loss and possible associated reductions in morbidity and mortality. [1, 18, 51] Estimating conservatively using the 2004 AHRQ rates, if the overall suicide rate of the current study (6.6/10,000 person-years) were applicable to the total US sample, then there would have been approximately 500 suicide deaths between 2004 and 2010, (excluding deaths from other causes) among those who had bariatric surgery in 2004.

What are the possible etiologies for the high suicide rate demonstrated among post-bariatric surgery patients? First, it is not possible for this study to determine whether the participants were at higher likelihood of committing suicide prior to bariatric surgery. Our data cannot separate the host characteristics such as increased risk prior to surgery (e.g., related to mental illness, distress, or depression) from the effects of bariatric surgery itself. Nor can we determine from our data whether the risk of suicide is increased among individuals who were unsuccessful, i.e. regained weight after the bariatric surgery. Interestingly, the majority of suicides in this study occurred at the time point well documented for both routine and significant weight re-gain (i.e., within 2–4 years),[52] as well as the timeframe when routine follow-up from the bariatric surgery program itself may be waning. It is possible that patients who were initially successful with weight loss eventually re-gained their weight and became depressed. However, mental health problems may become manifest even without weight re-gain. Improvements in body image and affective disorders tend to improve in the first 1–2 years following bariatric surgery, but then may revert to preoperative levels by 3 years, despite sustained weight loss.[39] Case reports detailing forensic and medical characteristics of completed suicide following bariatric surgery further illustrate this paradox.[53]

It may be possible that pre-surgical psychological distress, whether diagnosed or not, could be exacerbated if the results of surgery were disappointing or failed to yield hoped-for improvements in quality of life. Furthermore, body image has been shown to have poor correlation with actual weight loss,[54] suggesting that other factors may be driving worsening dissatisfaction with body image over time. Recurrence of pre-existing psychiatric disorders could go unrecognized and be associated with suicide. Finally, preliminary

evidence suggests that post-bariatric surgery patients may be more susceptible to substances such as alcohol, which could theoretically contribute to unfavorable outcomes.[55]

The absolute suicide rates are low (even though much higher than those of the general population). Small select follow up studies of short duration might miss the increased risk of suicide due to lack of power, underscoring the need for large sample sizes to adequately study this phenomenon.[56] There are no large randomized clinical trials of bariatric surgery. The Swedish Obesity Study[18] was not a true randomized trial and also unfortunately it does not provide any data on suicides. A comparison of similar obese individuals who have not had bariatric surgery is unlikely to be very helpful for several reasons.

Comparisons with obese individuals would not be ideal because of the substantial selection bias with bariatric surgery, including exclusion of some depressed individuals, poorer or uninsured patients, those who are less compliant with behavioral changes or who do not demonstrate reasonable likelihood of follow up after surgery, and those who have other chronic diseases and health behaviors such as heavy alcohol consumption or cigarette smoking. Some investigators have compared obese individuals who have been admitted to the hospital, i.e., in-hospital obesity patients, with bariatric surgery patients, presuming both groups are in the hospital for a procedure and therefore comparable. However, this represents a bias, since the reason that obese people are admitted to the hospital is not generally for their obesity in isolation, but because they have an active illness or disease that may or may not be associated with their obesity. Therefore, they will tend to have much higher mortality than obese individuals who were admitted for bariatric surgery. This is commonly referred to as Berksonian Bias.[57]

Despite the strengths of the study, which include the ability to capture causes of death for all individuals who underwent bariatric surgery in the state of Pennsylvania between 1995–2004, our study is limited by several factors. We lack information on the frequency of suicides among the different bariatric surgery programs. That is, are the suicide rates different in relationship to the characteristics of the programs, such as size of program, type of surgery performed, and extent of medical and psychological follow up? In addition, characteristics of both the suicides versus nonsuicide participants, and whether the risk of suicide can be identified by certain premorbid (i.e. prior to the bariatric surgery) factors, are also important to understand. Unfortunately, the design of our study, which identified suicides by the death certificate, did not capture detailed individual characteristics of the suicides.

This limitation is important, because some suicides could theoretically be preventable after bariatric surgery by more careful monitoring and treatment of mental indices, including mood disorders, whether the increased suicide is due to host characteristics, results of surgery, or a combination. However, there is not enough existing evidence to determine if such additional monitoring would indeed prevent suicides. Another limitation is that the number of suicides are likely to be underreported due to reasons noted above (i.e., labelling a true suicide as a drug overdose on the death certificate). Finally, our study is limited by the absence of a truly comparable group of non-operated severely obese individuals who were



evaluated and approved for bariatric surgery, such as has been achieved in trials of pre-surgical weight loss.[58]

Knowledge gaps in this area may be narrowed by augmenting the current system of follow up and by requiring timely reporting of suicides through both the Surgical Review Committee's Center of Excellence or the American College of Surgeons' mechanism for mandated bariatric surgery outcomes reporting. Mandatory registries (or sub-registries within the Center of Excellence models) requiring detailed reporting from unfavorable surgical outcomes would serve to better track these rare but important suicide events and collect information to inform future research. Additional studies are needed to examine whether suicide is associated with: 1) surgery success or failure (i.e., inadequate weight loss or significant weight regain); 2) lifetime or current history of psychiatric disorder; or 3) psychosocial problems. It will also be important to determine both the feasibility and usefulness of intensified and prolonged post bariatric surgery monitoring.

Intensified post-bariatric surgery monitoring, especially longer than the recommended six months, in turn would allow for assessment of factors that may be related to post-surgery suicides. An international consortium led by investigators from the United Kingdom recently published surgical guidelines stating that "established procedures should be monitored with prospective databases to analyze outcome variations and to identify late and rare events (p. 1105)."[59]

Another approach to improve monitoring of bariatric surgery patients in the future would be a continual mortality surveillance of sudden death in the US through the National Suicide Database,[60] which is collected from medical examiners and coroners offices and maintained at the National Center for Health Statistics. Unfortunately, this database currently does not contain any information on body weight or on bariatric surgery. However, if this information were added, the database could support retrospective inquiry to determine the situations related to suicide, and also attempt to pinpoint the suicides in relationship to specific surgical programs, including the quality of the follow up, behavioral support, and other factors. Regardless of method, a systematic, long-term monitoring program should be implemented, similar to post marketing surveillance for an approved drug. If bariatric surgery were a medication or medical device, post-marketing studies would be required and followed by FDA. A longer-term mechanism needs to be structured to adequately capture the important information related to these unfortunate and possibly preventable outcomes.

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### Clinical Significance

- Overall suicide rates among post-bariatric surgery patients in Pennsylvania over 10 years were 6.6/10,000: 13.7 per 10,000 among men and 5.2 per 10,000 among women. These are much higher than age and sex-matched US rates.
- ~70% of suicides occurred within three years after surgery, long past the usual 6-month monitoring period.
- Suicides are not necessarily attributed to the bariatric surgery, but may be related to myriad factors.

**Table 1**

## Characteristics of Suicide after Bariatric Surgery

	<b>N</b>	<b>Mean Age at Death (years)</b>	<b>Time from Surgery to Death (years)</b>
Women	20	44	3.5
Men	11	48	2.1
Total	31	45	3.0

**Table 2**

Distribution of Time Between Bariatric Surgery and Suicide in Years

Years	N	Cumulative %
<1	3	10
1 – <2	6	29
2 – <3	12	68
3 – <4	3	77
4 – <5	3	87
5	4	100
Total	31	

**Table 3**

## Risk of Suicide Death Versus Year of Procedure

<b>Year</b>	<b>Number of Procedures</b>	<b>Suicide (N)</b>
1995	32	--
1996	205	2
1997	366	2
1998	524	1
1999	687	1
2000	1094	5
2001	2015	4
2002	3164	8
2003	4778	4
2004	3818	4
<b>Total</b>	<b>16683</b>	<b>31</b>



Table 4

Incidence of Suicide by Age and Sex Per 10,000 Person-Years

Age	Men				Women				Total
	Person-Years	Suicide	Procedures	Rate/10,000	Person-Years	Suicide	Procedures	Rate/10,000	
<=24	--	--	107	--	1425	2	496	14.0	603
25-34	1261	2	451	15.9	3549	5	2898	14.1	3349
35-44	2799	2	942	7.1	12969	6	4427	4.6	5369
45-54	2761	6	954	21.7	16762	4	4193	2.4	5147
55-64	1180	1	443	8.5	3945	3	1579	7.6	2022
>=65	--	--	52	--	--	--	141	--	193
<b>Total</b>	<b>8001</b>	<b>11</b>	<b>2949</b>	<b>13.7</b>	<b>38650</b>	<b>20</b>	<b>13734</b>	<b>5.2</b>	<b>16683</b>

**Table 5**

Suicides in Pennsylvania Following Bariatric Surgery: 1996–2007

<b>Mode of Death</b>	<b>Race and Gender</b>	<b>Suicide (N)</b>
Drug/pill overdose (n = 16)		
	White Female	11
	White Male	3
	Black Female	1
	Hispanic Female	1
Gunshot wound (n = 9)		
	White Female	3
	White Male	6
Carbon monoxide (n = 4)		
	White Female	3
	White Male	1
Hanging (n = 2)		
	White Female	1
	White Male	1