



The Association Between Bariatric Surgery and Psychiatric Disorders: a National Cohort Study

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Abstract

Purpose Previous studies have shown that bariatric surgery reduces the risk of cardiovascular outcomes. Less is known about the effects of bariatric surgery on psychiatric disorders. This cohort study compared the differential risk of psychiatric disorders between those who did and did not undergo bariatric surgery, from before until after the surgery.

Materials and Methods We used PearlDiver-Mariner, a national all-payor claims database. Patients were followed for 1 year before and after the index date and a difference-in-differences (DiD) study design was executed.

Results We included 56,661 bariatric surgery patients matched to 56,661 individuals with obesity. Among bariatric surgery patients, the risk of psychiatric was 18% 1 year before and increased to 70% 1 year after surgery. Among individuals with obesity, the risk of psychiatric disorders also increased from 1 year before to 1 year after, but by less (21% versus 46%). DiD analysis suggested that bariatric surgery was associated with a 27 percentage point differential increase in the risk of psychiatric disorders across all patients, representing a 135% relative increase. Results using 3 years as the pre- and post-periods lead to similar inferences.

Conclusion Preexisting psychiatric disorders are similarly prevalent among bariatric surgery patients and individuals with obesity. The prevalence of psychiatric disorders increased over time for both groups, but to a larger extent among bariatric surgery patients. Adequate treatment for psychiatric disorders and appropriate implementation of behavioral health interventions may be needed to reduce the burden of psychiatric disorders following bariatric surgery.

Keywords Bariatrics · Bariatric surgery · Psychiatry

Key Points

- In this cohort study of 113,322 obesity patients eligible for surgical intervention, bariatric surgery was associated with a 27 percentage point differential increase in the risk of overall psychiatric disorders across all patients, for a relative increase of 135%.
- These trends were driven by depressive and affective disorders, anxiety disorders, personality disorders, eating disorders, and other disorders not involving psychoses.
- Adequate treatment for psychiatric disorders and appropriate implementation of behavioral health interventions may be needed to reduce the risk of psychiatric disorders following bariatric surgery.

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Introduction

A large body of literature on the psychosocial aspects of severe obesity has reported that the burden of psychiatric disorders among bariatric surgery patients is substantial [1–3]. Using the most recent Diagnostic and Statistical Manual of Mental Disorders, a study reported that 55% of patients undergoing bariatric surgery met the criteria for at least one lifetime psychiatric disorder, with mood disorders and anxiety disorders being the most prevalent [4]. The consequences associated with pre-existing psychiatric disorders are evident and may threaten the effectiveness of bariatric surgery. Studies have reported that current and lifetime psychiatric disorders are associated with lower percentage of excess body mass index loss and weight loss, higher risk of readmission, and longer hospital length of stay [5–7]. These findings are exacerbated by reports suggesting that bariatric surgery does not improve mental health quality of life compared to non-surgical intervention [8].

While the physical health benefits of surgical intervention are undeniable, research suggests that psychiatric disorders may increase in the postoperative phase, illuminating concerns regarding the safety of bariatric surgery. Studies among bariatric surgery patients have reported higher rates of disordered eating, alcohol use and misuse, and depression in the postoperative period compared to the preoperative period [9–13]. However, these studies have not been able to confirm such an association because researchers did not include a nonsurgery control group. The rate of psychiatric disorders increases over the lifespan among the general population; thus, an increase in the rate of psychiatric disorders in the postoperative period would be expected even if bariatric surgery is not associated with the risk of psychiatric disorders. As such, clinicians cannot accurately counsel patients about postoperative psychiatric disorders and their relation to preoperative psychiatric disorders. One recent study did compare postoperative depression between bariatric surgery and matched controls, but they did not evaluate before and after changes in depression [14]. Furthermore, most studies evaluating pre- and post-surgical psychopathology have been conducted in small cohorts outside of the USA, limiting the generalizability of these findings. This is important given that bariatric surgery practice as well as evaluation of psychiatric disorders varies substantially.

In order to address this gap, a nationwide population-based cohort study was conducted to assess the association between undergoing weight loss surgery and risk of psychiatric disorders. This was accomplished by comparing before and after changes in the risk of psychiatric disorders between those who did and did not undergo bariatric surgery using a difference-in-differences (DiD) study design.

Materials and Methods

Data Source and Study population

A retrospective cohort study was executed using the PearlDiver Mariner Database (PearlDiver Technologies, Colorado Springs, CO, USA), which contains over 91 million patients from 2010 through 2020 (<http://www.pearliverinc.com/researchinfo.html>). Data consists of records for healthcare encounters processed by physician networks in all 50 US states, including outpatient, inpatient, and prescription claims billed to all payors. Claims are adjudicated using auditing policies and internal review is conducted by independent third parties (<http://www.pearliverinc.com/researchinfo.html>). Diagnoses and procedures can be identified with International Classification of Diseases (ICD)-9 and 10 diagnosis/procedure codes, and Current Procedural Terminology (CPT) codes. The study was provided exemption status by the Rush University Institutional Review Board

given that the database is Health Insurance Portability and Accountability Act-compliant and primary data collection was not conducted.

All patients who were eligible for bariatric surgery were identified using the definition endorsed by the Centers for Medicare and Medicaid Services: [15] body mass index (BMI) of 40 kg/m² or more or BMI of 35 kg/m² or more and at least one or more obesity-related comorbidities (type two diabetes mellitus (T2DM), hypertension (HTN), obstructive sleep apnea (OSA), non-alcoholic fatty liver disease, osteoarthritis, lipid abnormalities, gastrointestinal disorders, or heart disease). The presence of the qualifying comorbidity had to be within 1 year of the obesity diagnosis. Supplementary Table 1 documents the relevant ICD-9 and ICD-10 diagnosis codes for these comorbidities.

Intervention and Control Groups

Among those who were eligible for bariatric surgery, patients were categorized as undergoing bariatric surgery (Roux-en-Y gastric bypass or vertical sleeve gastrectomy) vs no bariatric surgery (individuals with obesity). Supplementary Table 2 reports the ICD-9 and ICD-10 procedure and CPT codes that were used to identify bariatric surgery procedures. The index date for bariatric surgery patients was the date of the operation (first date for those with multiple bariatric surgeries) whereas the index date for individuals with obesity was the date of their obesity claim. Since individuals with obesity had multiple healthcare encounters with a diagnosis of obesity that spanned multiple dates, the midpoint was chosen as the index date because obesity is a chronic disorder. The analysis was restricted to bariatric surgery patients and individuals with obesity who had active insurance 1 year before and 1 year after their index date to ensure the ability to identify outcomes.

Psychiatric Disorders

The primary outcome was all-cause psychiatric disorders defined as the presence of any diagnosis for a psychiatric disorder in the pre period (1 year before the index date) vs. the post period (1 year after index date). The full list of ICD 9- and 10 diagnosis codes for all psychiatric disorders are provided in Supplementary Table 3. Similar to a previous study, [16] psychiatric disorders were categorized into different mutually exclusive buckets: depression and affective disorders, organic disorders and dementias, alcohol-related disorders, drug disorders not alcohol related, schizophrenic disorders, other psychoses, anxiety disorders, personality disorders, eating disorders, suicidal ideation/self-harm, and other psychiatric disorders (not psychoses). Other psychiatric disorders (not psychoses) included a wide range of disorders such as non-psychotic hallucinations, emotional

disturbances, adjustment disorders (the most common of these subtypes), elimination disorders, and conduct disorders. Patients could have had a diagnosis for a psychiatric disorder in either the pre or post period, both the pre and post period, or neither the pre nor post period.

In sensitivity analyses, a longer observation period (3 years pre and post period) was evaluated. This required defining a smaller cohort than the primary cohort since the analysis had to be restricted to those who had 3 years of active insurance in the pre and post period. Furthermore, the definition of the outcome was limited to include only inpatient psychiatric disorders, only primary psychiatric disorders, and only inpatient primary psychiatric disorders for both the 1-year and 3-year analyses.

Confounders

Supplementary Table 1 presents ICD-9 and ICD-10 diagnosis codes used to identify patient comorbidities in the pre period. Comorbidities included T2DM, HTN, coronary artery disease, chronic kidney disease, rheumatoid arthritis, OSA, non-alcoholic fatty liver disease, congestive heart failure, chronic obstructive pulmonary disorder, osteoarthritis, lipid abnormalities, gastrointestinal disorders, and smoking. Demographic data included age, gender, geographic region, year of diagnosis, and insurance status.

Statistical Analysis

Averages with standard deviations and patient counts with percentages were used to describe distributions of confounders among the entire cohort. Two sample *t*-tests and chi-squares were used to compare confounders between bariatric surgery patients and individuals with obesity. Given the concern for potential confounding, variables that were associated with treatment status at $p < 0.05$ were used to execute 1 to 1 coarsened exact matching.

Among the matched sample, the association between bariatric surgery and risk of psychiatric disorders was evaluated using quasi-experimental DiD. DiD is a causal inference method that mimics a natural experiment, providing robust evidence of causal effects between a treated and non-treated group. The main advantage of DiD is that it estimates the differential change in the outcome between the treated and non-treated groups. Thus, each patient is contrasted to themselves and acts as their own control, thus alleviating concerns of confounding.

Before and after changes in the risk of psychiatric disorders were contrasted in the bariatric surgery group with concurrent before and after changes among individuals with obesity thus estimating the net difference in the risk of psychiatric disorders between the two groups. A multilevel linear probability model was estimated with two observations

per person (one in the pre and one in the post period) to conduct the DiD analysis. The patient ID was used as the clustering variable and the outcome variable was an indicator variable for psychiatric disorders. The model included three independent variables: an indicator variable for treatment (bariatric surgery vs individuals with obesity), an indicator variable for time (post versus pre), and the main effect variable captured by the interaction term between the two aforementioned variables (treatment \times time) as is standard for DiD designs.

Coarsened exact matching coupled with DiD offers a powerful method for establishing evidence for causal effects. Coarsened exact matching adjusts for observable differences between bariatric surgery patients and individuals with obesity while the DiD design controls for unobservable differences between bariatric surgery patients and individuals with obesity. The DiD assumption of parallel trends in the pre period was verified. Furthermore, *P* values less than 0.05 were considered statistically significant. The Bellwether Software that accesses the Mariner Database and executes the queries was used to conduct all analyses (<http://www.pearliverinc.com/researchinfo.html>). The code that queried the database is provided in the [Supplementary Materials](#) to facilitate replication of analyses.

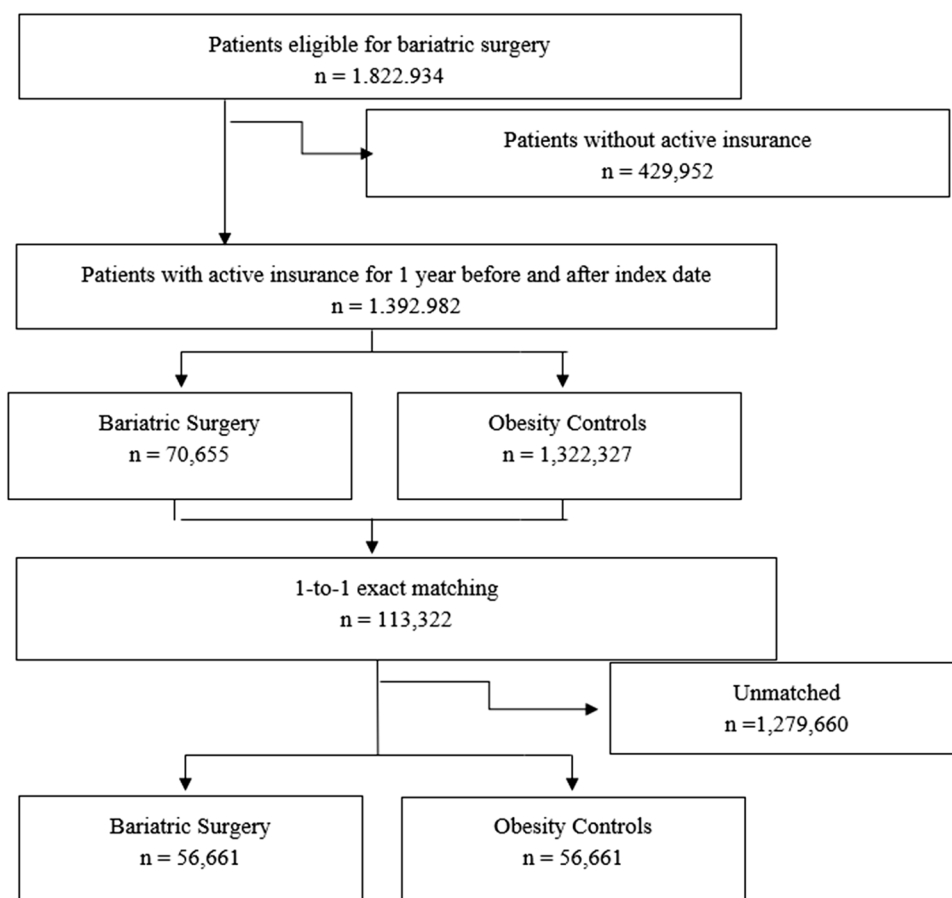
Results

Demographic Characteristics

Figure 1 presents a flow diagram describing the cohort selection for the 1-year unmatched population (1-year pre and post). A total of 1,822,934 patients who were eligible for bariatric surgery were identified, of which 1,392,982 had continuous insurance for 1 year before and after their index date. The cohort was comprised of 70,655 (5%) patients who underwent bariatric surgery and 1,322,327 (95%) individuals with obesity. Supplementary Table 4 presents the patient characteristics for the 1-year unmatched cohort. Table 1 presents these same characteristics for the 1-year matched groups, which contained 56,661 patients in each, for a total of 113,322 patients. The three-year analysis was comprised of 23,137 patients in each group, for a total of 46,274 patients.

One-Year Matched Cohort Difference-in-Differences

Table 2 presents the change in the risk of psychiatric disorders among bariatric surgery patients relative to individuals with obesity from 1 year before (pre) until 1 year after (post) the index date. In the pre period, the risk of an overall psychiatric disorders was 20% for all patients and was 3 percentage points higher on an absolute scale among

Fig. 1 Patient selection flow chart

individuals with obesity compared to bariatric surgery patients (21–18% = 3%). The risk of an overall psychiatric disorders increased among both bariatric surgery patients and individuals with obesity but did so much sharply in the surgery group. Bariatric surgery was associated with a 27 percentage point differential increase ([70–18%]–[46–21%]) in the risk of overall psychiatric disorders (95% confidence interval (CI), 26 to 28 percentage points) across all patients, for a relative increase of 135% ($27/20 \times 100$).

Similar trends were seen when evaluating the risk of inpatient psychiatric disorders, primary psychiatric disorders, and inpatient primary psychiatric disorders. For example, in the pre period, the risk of an inpatient psychiatric disorder was 1% for all patients and was slightly higher on an absolute scale among individuals with obesity compared to bariatric surgery patients (1–0% = 1%). The risk of an inpatient psychiatric disorder increased among both bariatric surgery patients and individuals with obesity, but the difference was significantly larger among those who underwent bariatric surgery. Across all patients, bariatric surgery was associated with a 22 percentage point differential increase ([24–0%]–[3–1%]) in the risk of inpatient psychiatric disorders (95%CI, 21 to 23), for a relative increase of 2,200% ($22/1 \times 100$).

When evaluating specific diagnoses, other psychiatric disorders (not psychoses), anxiety, and depressive/affective disorders were the most common. Bariatric surgery was associated with significantly increased risk of depressive/affective disorders, anxiety disorders, personality disorders, eating disorders, and other psychiatric disorders (not psychoses), but not with organic disorders and dementias, alcohol-related disorders, drug disorders not alcohol related, schizophrenic disorders, and other psychoses. Bariatric surgery was associated with decreased risk of suicidal ideation/self-harm. Table 3 presents the change in the risk of depressive/affective disorders among bariatric surgery patients relative to individuals with obesity from 1 year before until 1 year after the index date. The trends mirrored those for overall psychiatric disorders. The risk of depressive/affective disorders was similar in the pre period among bariatric surgery patients and individuals with obesity but increased to a larger extent in the post period among those who underwent surgical intervention. This translated to a 3 percentage point differential increase ([15–7%]–[13–8%]) in the risk of overall depressive/affective disorders (95% CI, 1 to 4), or a relative increase of 43% ($3/7 \times 100$). Table 4 presents the results for anxiety while Supplementary Tables 5–13 report the results for the rest of the psychiatric disorders.

Table 1 Patient characteristics by treatment status among the matched 1 year cohort

	All patients		Bariatric surgery		Individuals with obesity	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
	113,322	–	56,661	–	56,661	–
Mean age ± standard deviation, years	48 ± 12		48 ± 12		48 ± 12	
Female	91,622	81.0	45,811	81.0	45,811	81.0
Region						
South	42,952	37.9	21,476	37.9	21,476	37.9
Midwest	22,678	20.0	11,339	20.0	11,339	20.0
Northeast	34,802	30.7	17,401	30.7	17,401	30.7
West	12,868	11.4	6434	11.4	6434	11.4
Unknown	22	0.0	11	0.0	11	0.0
Insurance						
Medicare	5304	4.7	2652	4.7	2652	4.7
Medicaid	6882	6.1	3441	6.1	3441	6.1
Commercial	98,534	87.0	49,267	87.0	49,267	87.0
Other government	804	1.0	402	1.0	402	1.0
Unknown	1798	1.6	899	1.6	899	1.6
Gastroesophageal reflux disease	10,010	8.8	5005	8.8	5005	8.8
Obstructive sleep apnea	11,742	10.4	5871	10.4	5871	10.4
Type II diabetes	16,782	14.8	8391	14.8	8391	14.8
Non-alcoholic fatty liver disease	280	0.2	140	0.2	140	0.2
Osteoarthritis	6320	5.6	3160	5.6	3160	5.6
Hypertension	32,444	28.6	16,222	28.6	16,222	28.6
Current smoker	2424	2.1	1212	2.1	1212	2.1
Congestive heart failure	224	0.2	112	0.2	112	0.2
Chronic kidney disease	536	0.5	268	0.5	268	0.5
Chronic pulmonary disorder	7670	6.8	3835	6.8	3835	6.8

Three-Year Matched Cohort Difference-in-Differences

Supplementary Table 14 and Supplementary Table 15 report patient characteristics in the 3-year unmatched and matched cohorts, respectively. Three-year analyses were generally consistent with the 1-year analyses. As seen in Table 2, risk of preoperative psychiatric disorders was 29% among all patients. Bariatric surgery was associated with a 23 percentage point differential increase ([84–28%]–[63–30%]) in the risk of overall psychiatric disorders (95% CI, 21 to 25 percentage points) across all patients, for a relative increase of 79% ($23/29 \times 100$). Trends by mental subtypes, treatment setting, and diagnosis severity were generally similar to the 1-year results (Supplementary Tables 5–13). The only exception was non-alcohol-related drug disorders. There was no difference between groups in the 1-year analysis. However, in the 3-year analysis, bariatric surgery was associated with a 2 percentage point differential decrease ([9–5%]–[12–6%]) in the risk of non-alcohol-related drug disorders (95% CI, 0 to 4 percentage points) across all patients, for a relative decrease of 40% ($2/5 \times 100$).

Discussion

Despite well-known physical health improvements caused by bariatric surgery, there are concerns of its potential impact on psychopathology beyond what would be expected for individuals with obesity who do not undergo surgical intervention. Yet few studies have compared before and after changes in the risk of mental disorders between these two groups. This crucial void was addressed by conducting a national cohort study of bariatric surgery candidates who did and did not undergo surgical intervention. The study found that preexisting psychiatric disorders were common among bariatric surgery patients and individuals with obesity. The risk of psychiatric disorders increased in the post period for both groups, but to a larger extent among those who underwent bariatric surgery. These trends were driven by depressive/affective disorders, anxiety disorders, personality disorders, eating disorders, and other disorders not involving psychoses. This is the first study to report a potential causal link between bariatric surgery and increased risk of psychiatric disorders using causal inference methods.

Table 2 Comparison of the risk of 1- and 3-year any psychiatric disorder between bariatric surgery patients and individuals with obesity from the pre to the post period

	Pre		Post	
	<i>N</i>	%	<i>N</i>	%
1-year overall psychiatric disorders				
Bariatric surgery (<i>N</i> =56,661)	10,269	18%	39,728	70%
Individuals with obesity (<i>N</i> =56,661)	11,734	21%	26,300	46%
1-year inpatient psychiatric disorders				
Bariatric surgery (<i>N</i> =56,661)	148	0%	13,746	24%
Individuals with obesity (<i>N</i> =56,661)	299	1%	1,812	3%
1-year overall primary psychiatric disorders				
Bariatric surgery (<i>N</i> =56,661)	5,600	10%	30,568	54%
Individuals with obesity (<i>N</i> =56,661)	5,777	10%	11,242	20%
1-year inpatient primary psychiatric disorders				
Bariatric surgery (<i>N</i> =56,661)	20	0%	10,755	19%
Individuals with obesity (<i>N</i> =56,661)	49	0%	254	0%
3-year overall psychiatric disorders				
Bariatric surgery (<i>N</i> =23,137)	6,529	28%	19,419	84%
Individuals with obesity (<i>N</i> =23,137)	6,997	30%	14,604	63%
3-year inpatient psychiatric disorders				
Bariatric surgery (<i>N</i> =23,137)	189	1%	7,476	32%
Individuals with obesity (<i>N</i> =23,137)	276	1%	1,118	5%
3-year overall primary psychiatric disorders				
Bariatric surgery (<i>N</i> =23,137)	3,659	16%	15,901	69%
Individuals with obesity (<i>N</i> =23,137)	3,662	16%	7,387	32%
3-year inpatient primary psychiatric disorders				
Bariatric surgery (<i>N</i> =23,137)	31	0%	5,426	47%
Individuals with obesity (<i>N</i> =23,137)	52	0%	126	1%

Table 3 Comparison of the risk of 1- and 3-year depressive/affective disorder between bariatric surgery patients and individuals with obesity from the pre to the post period

	Pre		Post	
	<i>N</i>	%	<i>N</i>	%
1-year overall depressive and affective disorders				
Bariatric surgery (<i>N</i> =56,661)	3,730	7%	8,251	15%
Individuals with obesity (<i>N</i> =56,661)	4,454	8%	7,232	13%
1-year inpatient depressive and affective disorders				
Bariatric surgery (<i>N</i> =56,661)	52	0%	1,896	3%
Individuals with obesity (<i>N</i> =56,661)	109	0%	389	1%
1-year overall primary depressive and affective disorders				
Bariatric surgery (<i>N</i> =56,661)	2,270	4%	3,672	6%
Individuals with obesity (<i>N</i> =56,661)	2,483	4%	3,506	6%
1-year inpatient primary depressive and affective disorders				
Bariatric surgery (<i>N</i> =56,661)	5	0%	20	0%
Individuals with obesity (<i>N</i> =56,661)	23	0%	62	0%
3-year overall depressive and affective disorders				
Bariatric surgery (<i>N</i> =23,137)	2,079	9%	7,068	31%
Individuals with obesity (<i>N</i> =23,137)	2,279	10%	6,449	28%
3-year inpatient depressive and affective disorders				
Bariatric surgery (<i>N</i> =23,137)	50	0%	1,508	7%
Individuals with obesity (<i>N</i> =23,137)	79	0%	349	2%
3-year overall primary depressive and affective disorders				
Bariatric surgery (<i>N</i> =23,137)	1,403	6%	3,158	14%
Individuals with obesity (<i>N</i> =23,137)	1,473	6%	2,888	12%
3-year inpatient primary depressive and affective disorders				
Bariatric surgery (<i>N</i> =23,137)	16	0%	34	0%
Individuals with obesity (<i>N</i> =23,137)	27	0%	48	0%

The importance of evaluating psychiatric disorders associated with bariatric surgery is motivated by expert guidelines that advocate for preoperative psychological evaluations among eligible candidates [17]. While current practice varies, preoperative psychological evaluations often include a battery of psychological tests coupled with clinical interviews conducted by a licensed behavioral health provider. Information obtained from these evaluations can be used to measure overall psychological status and readiness for surgery, while addressing behavioral afflictions that may prevent patients from achieving long-term weight loss reductions in the postoperative phase. The behavioral health provider can recommend delay or denial of surgery, which can occur in 15% of cases [18]. While no study has evaluated the effectiveness of preoperative psychological evaluations, use of preoperative assessments tailored towards high-risk patients to ensure safety is a fundamental tenet of surgical practice.

Notwithstanding its significance, research investigating the risk of psychiatric disorders in relation to bariatric

surgery has been underemphasized since the main treatment goal of surgical intervention is to achieve sustainable weight reductions. Studies have reported mixed results, further undermining research in this arena. One meta-analysis evaluated 27 studies measuring changes in the risk of psychiatric disorders before and after bariatric surgery [19]. The study concluded that moderate evidence supported a lower risk of depression after surgery compared to before surgery. This finding has since been scrutinized by contradictory results. Using data from one state in Australia, researchers reported a higher risk of psychiatric disorders (including depression) after surgery compared to before surgery [10]. And yet the largest limitation of the current literature is that studies did not include a control group. Researchers have only been able to conclude that preexisting psychiatric disorders are risk factors for future psychiatric disorders among bariatric surgery patients, but as this is true in the general population, these studies have not been able to measure whether bariatric surgery is related to changes in risk of psychiatric disorders. While one study did include a control

Table 4 Comparison of the risk of 1- and 3-year anxiety between bariatric surgery patients and individuals with obesity from the pre to the post period

	Pre		Post	
	<i>N</i>	%	<i>N</i>	%
	–	–	–	–
1-year overall anxiety				
Bariatric surgery (<i>N</i> =56,661)	4,373	7%	9,166	16%
Individuals with obesity (<i>N</i> =56,661)	5,281	9%	7,914	14%
1-year inpatient anxiety				
Bariatric surgery (<i>N</i> =56,661)	63	0%	2,447	4%
Individuals with obesity (<i>N</i> =56,661)	126	0%	406	1%
1-year overall primary anxiety				
Bariatric surgery (<i>N</i> =56,661)	1,384	4%	2,278	7%
Individuals with obesity (<i>N</i> =56,661)	1,595	4%	2,337	6%
1-year inpatient primary anxiety				
Bariatric surgery (<i>N</i> =56,661)	0	0%	14	0%
Individuals with obesity (<i>N</i> =56,661)	5	0%	8	0%
3-year overall anxiety				
Bariatric surgery (<i>N</i> =23,137)	3,231	14%	6,733	29%
Individuals with obesity (<i>N</i> =23,137)	3,555	15%	5,970	26%
3-year inpatient anxiety				
Bariatric surgery (<i>N</i> =23,137)	84	0%	1,716	7%
Individuals with obesity (<i>N</i> =23,137)	111	0%	357	2%
3-year overall primary anxiety				
Bariatric surgery (<i>N</i> =23,137)	1,132	5%	2,286	10%
Individuals with obesity (<i>N</i> =23,137)	1,187	5%	2,050	9%
3-year inpatient primary anxiety				
Bariatric surgery (<i>N</i> =23,137)	0	0%	19	0%
Individuals with obesity (<i>N</i> =23,137)	0	0%	0	0%

group, researchers excluded all patients who had a previous diagnosis of depression, and thus were not able to measure before and after changes in psychiatric disorders [20]. These limitations provided the impetus for the current study.

Results reported in this study may have timely ramifications for individuals with obesity who undergo bariatric surgery, assuming adequate validation and replication across multiple studies. The concerning trends reported in the current study may warrant a reexamination of multidisciplinary protocols and the care services provided by behavioral health providers. Despite requirements ensuring multidisciplinary treatment, deficiencies in care coordination and communication lead to challenges, especially in the USA, where barriers often prevent adherence to guidelines. Bariatric surgery patients are medically complex, often diagnosed with several comorbidities with competing priorities that are being managed by multiple physicians. Furthermore, psychiatric disorders can express either as acute episodes across different periods of the life course or as chronic conditions. Thus, a multidisciplinary approach would be one in which

bariatric surgery was used to equally treat obesity and psychiatric disorders by developing lifelong interventions that individuals with obesity can adhere to. Given that some programs do not require psychological follow-up after surgery, the results in this study advocate for longitudinal evaluation and treatment of psychiatric disorders to allow providers to be more attuned with patients' overall psychological status and the effect it has on weight loss and other physical health outcomes. This is crucial for bariatric surgery patients, who must adhere to behavioral and lifestyle changes in order to ensure optimal benefit. Because psychiatric disorders can disrupt behavior, mental health treatment with well-coordinated follow-up may lead to healthier weight reductions as well as alleviate the burden of obesity-related complications. An alternative interpretation of our findings is that bariatric surgery may improve physical health outcomes by depleting psychological resources, which would require further research to characterize.

It is important to emphasize that while previous studies have reported a higher risk of suicide/suicidal ideation/self-harm, [9, 21, 22] the current study found the opposite. The results indicate that bariatric surgery was associated with lower risk of suicidal ideation/self-harm. Previous studies have also reported a higher rate of alcohol disorders, but our study did not confirm this. One reason why these discrepancies are present may be due to the possibility that the cohort in the current study is a healthier population than previous studies because of being limited to those patients that had full follow-up and thus were alive and did not die from suicide or any other cause. The risk of alcohol disorders and suicidal ideation/self-harm is so low that these biases could affect these results more so than for other psychiatric disorders that have a higher risk. Another reason could be a function of the unique insurance coverage patterns and socioeconomic characteristics of previous study populations. For example, Bhatti et al. [9] used a cohort from Ontario, Canada, which has universal healthcare coverage. Furthermore, it should be acknowledged that these outcomes would be recorded only if a provider/facility filed a claim to a third-party payor.

Several limitations should be considered when interpreting the study results. First, billing codes were used to identify psychiatric disorders, which may reflect a higher rate of healthcare utilization in the surgery group, and not necessarily psychiatric disorders. For example, some bariatric surgery programs require behavioral health visits following the surgical procedure, allowing the behavioral health provider to have a better opportunity to document diagnoses. It is possible that those who do not undergo surgical intervention have higher levels of psychiatric disorders but are not being recorded since they are not required to have follow-up visits. This is relevant because the overall risk of psychiatric disorders reported in the current study is higher than what has

been reported in previous studies. Prior studies have used structured clinical diagnostic interviews and psychological batteries, which more accurately reflect psychiatric disorders compared to billing codes. Administrative claims are collected for billing and reimbursement purposes, whereas these other tools are tailored specifically for a prospective study. This study only uses administrative claims, which adds a significant limitation to the interpretation of the results. There could be a large degree of inaccurate diagnoses as well as underreporting of specific diagnoses given that we cannot discern who conducted the evaluations (e.g., physician vs. psychologist). Underreporting of diagnoses in the pre-period would artificially increase the difference in risk of psychiatric disorders after surgery. To mitigate this concern, primary and inpatient diagnoses were also evaluated, since those may objectively reflect psychiatric disorders. Second, this study uses observational data without randomization to estimate a causal effect for bariatric surgery and does not control for unobserved confounding by mean BMI in each group for example. A DiD design where each patient acts as their own control was used to address this concern, thereby reducing the possibility of confounding. While the current study alone cannot be used to conclude that bariatric surgery causes increased risk of psychiatric disorders, it is important to explicitly report the goal of the study. Future studies are needed to validate the findings. It is also important to note that while our sample includes patients in all states of the USA, it is not nationally representative given that a 1:1 matched cohort was used. The generalizability of our findings is further undermined by the absence of socioeconomic status and race/ethnicity data. Finally, while individuals with obesity were determined to not have surgery in the pre period, the possibility that these individuals had bariatric surgery many years before cannot be excluded.

Conclusions

This study is the first to estimate the causal effect of bariatric surgery on the risk of psychiatric disorders from before until after surgical intervention compared to individuals with obesity. The burden of psychiatric disorders was high among bariatric surgery patients and individuals with obesity. The risk of psychiatric disorders increased over time for both groups but did so to a larger extent among those who underwent bariatric surgery. Increases in the risks of psychiatric disorders induced by bariatric surgery highlight the need for surgical teams that can deliver services that treat the whole patient, rather than individual medical conditions.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11695-022-05896-2>.

Declarations

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

Informed Consent Informed consent does not apply.

Conflict of Interest The authors declare no competing interests.

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