Original Investigation

Mental Health Conditions Among Patients Seeking and Undergoing Bariatric Surgery
A Meta-analysis

Aaron J. Dawes, MD; Melinda Maggard-Gibbons, MD, MSHS; Alicia R. Maher, MD; Marika J. Booth, MS; Isomi Miake-Lye, BA; Jessica M. Beroes, BS; Paul G. Shekelle, MD, PhD

IMPORTANCE Bariatric surgery is associated with sustained weight loss and improved physical health status for severely obese individuals. Mental health conditions may be common among patients seeking bariatric surgery; however, the prevalence of these conditions and whether they are associated with postoperative outcomes remains unknown.

OBJECTIVE To determine the prevalence of mental health conditions among bariatric surgery candidates and recipients, to evaluate the association between preoperative mental health conditions and health outcomes following bariatric surgery, and to evaluate the association between surgery and the clinical course of mental health conditions.

DATA SOURCES We searched PubMed, MEDLINE on OVID, and PsycINFO for studies published between January 1988 and November 2015. Study quality was assessed using an adapted tool for risk of bias; quality of evidence was rated based on GRADE (Grading of Recommendations Assessment, Development and Evaluation) criteria.

FINDINGS We identified 68 publications meeting inclusion criteria: 59 reporting the prevalence of preoperative mental health conditions (65 363 patients) and 27 reporting associations between preoperative mental health conditions and postoperative outcomes (50 182 patients). Among patients seeking and undergoing bariatric surgery, the most common mental health conditions, based on random-effects estimates of prevalence, were depression (19% [95% CI, 14%-25%]) and binge eating disorder (17% [95% CI, 13%-21%]). There was conflicting evidence regarding the association between preoperative mental health conditions and postoperative weight loss. Neither depression nor binge eating disorder was consistently associated with differences in weight outcomes. Bariatric surgery was, however, consistently associated with postoperative decreases in the prevalence of depression (7 studies; 8%-74% decrease) and the severity of depressive symptoms (6 studies; 40%-70% decrease).

CONCLUSIONS AND RELEVANCE Mental health conditions are common among bariatric surgery patients—in particular, depression and binge eating disorder. There is inconsistent evidence regarding the association between preoperative mental health conditions and postoperative weight loss. Moderate-quality evidence supports an association between bariatric surgery and lower rates of depression postoperatively.

Supplemental content at jama.com

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Aaron J. Dawes, MD, Department of Surgery, David Geffen School of Medicine at UCLA, Ronald Reagan UCLA Medical Center, 757 Westwood Plaza, B711, Los Angeles, CA 90095 (adawes@mednet.ucla.edu).

JAMA. 2016;315(2):150-163. doi:10.1001/jama.2015.18118

Bariatric surgery is an accepted method of promoting weight loss and improving obesity-related physical comorbidities in severely obese individuals.[1-4] Mental health conditions have received less attention. Approximately 19% of US residents have a mental health condition,[5] including 8% with depression[6] and 1% to 5% with binge eating disorder.[7,8] These conditions may be more common among patients seeking bariatric surgery than in the general population.[9-12] However, published prevalence estimates vary[13,14] and no systematic reviews describe the prevalence of conditions such as depression, substance abuse, and eating disorders.

We conducted a systematic review with 3 aims: (1) to estimate the prevalence of mental health conditions in patients seeking and undergoing bariatric surgery; (2) to evaluate the association between preoperative mental health conditions and weight loss after surgery; and (3) to evaluate the association between surgery and the clinical course of mental health conditions.

Methods

We convened an expert panel to define the scope of our review and develop the protocol.[15] Our PROSPERO registration number is CRD42014008675. Based on input from our panel, we defined mental health conditions as depression, anxiety, posttraumatic stress disorder (PTSD), personality disorders, substance abuse disorders, suicidality or suicidal ideation, and eating disorders—primarily binge eating disorder. Eating behaviors not classified as disorders (eg, grazing and cognitive restraint) and cigarette smoking were outside our scope.

We used weight loss as our postoperative bariatric outcome. Mental health outcomes included suicide incidence and the prevalence, symptoms, and treatment of mental health conditions. We defined persons seeking or being evaluated for bariatric surgery as candidates to distinguish them from populations in which all patients received surgery (recipients).

We searched PubMed, MEDLINE on OVID, and PsycINFO for English-language studies published before November 23, 2015. Search terms included *bariatric, obesity*, the names of surgical procedures, *psychiatric disorders*, and *eating disorders* (eAppendix in the Supplement). We supplemented our search with: (1) citations from an earlier systematic review by Livhits and colleagues[11] (search dates 1988-2010); (2) studies recommended by our technical expert panel; and (3) reference mining of included articles.

For inclusion, each study had to address at least 1 specific aim (ie, prevalence, associations, or both), report findings from primary research, and report data for adults (≥18 years) with a body mass index (BMI [calculated as weight in kilograms divided by height in meters squared]) of at least 35. We required all mental health diagnoses to be made preoperatively and excluded studies that asked patients to recall their preoperative health status.

We required studies that reported prevalence data to measure mental health conditions using a formal method (such as a validated instrument or the *Diagnostic and Statistical Manual of Mental Health Disorders-5*-SCID (Fifth Edition, Structured Clinical Interview). Studies using a diagnostic scale to make diagnoses had to report a threshold value and the corresponding prevalence estimate. For example, we included studies stating, "15% of candidates had major depressive disorder based on a Beck Depression Inventory (BDI) threshold of 20," but not studies reporting, "the mean BDI score was 25."

Association studies were also required to make the diagnosis of mental health conditions preoperatively, but these studies were allowed to report either prevalence or nonprevalence measurements of postoperative health status as long as they were formally assessed. For example, we included association studies reporting a change in mean BDI after surgery even if a threshold for the diagnosis of depression was not stated.

Two independent reviewers assessed each study for inclusion and extracted data including country, patient composition (candidates vs recipients), method of recruitment, sample demographics, details of the operation, mental health conditions assessed, methods of assessment, and whether the surgical team was blinded to the assessment. This final item was added based on evidence that prevalence estimates may be higher if patients are told their response will not be shared with the surgical team.[16] Discrepancies were reconciled through discussion.

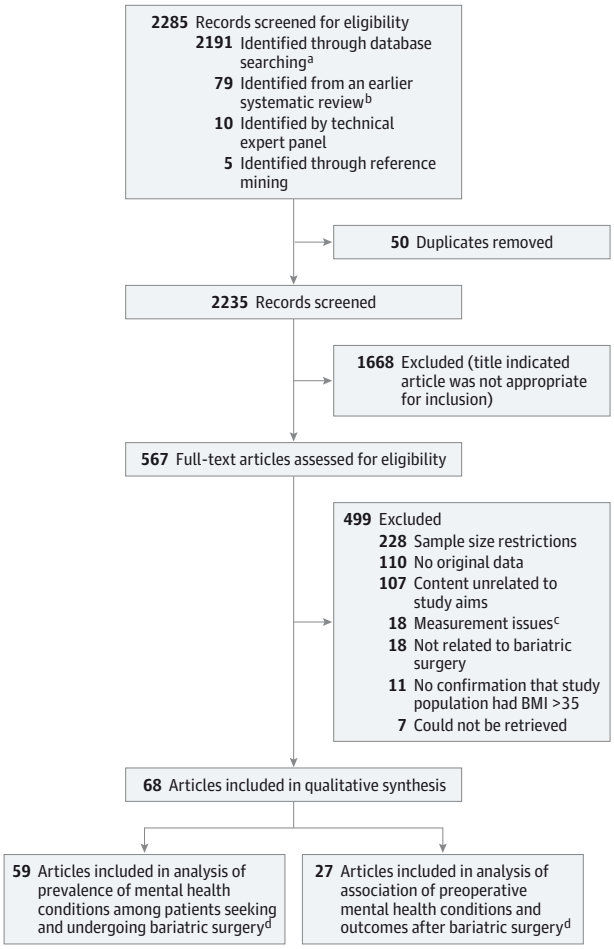
We estimated the prevalence of each mental health condition using a random-effects meta-analysis for pooled binomial data.[17] We performed formal tests of heterogeneity using the I^2 statistic.[18] We also explored for potential heterogeneity by stratifying our analyses on variables potentially related to either true differences in prevalence or the risk of bias, including study population (candidates vs recipients), study design (randomized vs observational, consecutive vs nonconsecutive sampling), and, for depression, whether the diagnosis was made using a scale or clinical interview. We compared estimates between subgroups using meta-regression[19]; finding no statistically significant differences, we present only unstratified data. All analyses were conducted using Stata 12.1.

If studies reported both lifetime and current prevalence, we used current values; if the timeline was not specified, we assumed data pertained to current prevalence. If studies used multiple methods to diagnose a mental health condition, our study psychiatrist selected the most relevant measure. We compared summary estimates for each condition with published estimates for the US population and considered a relative increase of 25% or greater to be clinically relevant.

For association studies, we classified articles as those measuring bariatric outcomes vs mental health outcomes. Results were further grouped by the outcome being measured. Given the variability in study design and outcome measurement, association data were reported narratively.

A preliminary search returned a large number of small, single-institution observational studies. To assess their value, we first restricted eligibility to studies with more than 500 participants, calculated weighted median estimates, and then compared our results with estimates calculated under a re-

Figure. Results of the Literature Search



[a] Search strategies and details are provided in eAppendix (Supplement).

[b] Records were sourced from Livhits et al.[11]

[c] Measurement issues included preoperative data not measured during preoperational period and unreported diagnosis method for data provided.

[d] Subgroups were not mutually exclusive.

laxed criterion (≥ 200 participants). Because no differences were found, we concluded that further relaxing the threshold to include studies with sample sizes of less than 200 would be very unlikely to influence our results. We, therefore, restricted our final analyses to: (1) randomized controlled trials (RCTs); (2) multi-institutional observational studies; (3) single-institution studies with random or consecutive sampling and a sample size of at least 200; and (4) single-institution studies with nonconsecutive sampling and a sample size of at least 500. Even with these restrictions, our sample included 70% of published patient data.

We assessed the quality of included studies by adapting existing quality assessment tools.[20,21] We selected 6 items related to risk of bias (study design, sampling strategy, follow-up rate at primary end point, criterion standard for diagnosis, whether assessments were kept confidential, and controlling for confounders) and 1 item each on generalizability (multisite vs single site) and statistical power (sample size).

We rated the quality of evidence for each finding based on criteria established by the GRADE (Grading of Recommendations Assessment, Development and Evaluation) Working Group.[22] Quality was classified as high, moderate, low, or very low based on study design, magnitude of the association, and consistency of the results across studies. All classifications were determined by consensus among the research team.

Results

Our literature search yielded 2191 titles. To this, we added 79 citations from Livhits and colleagues[11] and 15 references identified by our expert panel. Of these, 567 articles addressed our specific aims (**Figure**). After screening, 68 articles met inclusion criteria (59 regarding prevalence of mental health conditions; 27 regarding associations between preoperative mental health conditions and postoperative outcomes). Eighteen of these articles contributed to both analyses.

Prevalence of Mental Health Conditions

We identified 59 publications reporting prevalence data from 52 studies (eTable and eReferences in the Supplement). The most commonly studied condition was depression (34 studies) followed by binge eating disorder (25), and anxiety (22). In general, 70% to 80% of patients were women, the mean age was 40 to 50 years, and the mean BMI was 45 to 50.

Random-effects pooled estimates for the prevalence of each mental health condition are presented in **Table 1**. Conditions ranged in prevalence from any mood disorder (23% [95% CI, 15%-31%]) to psychosis (1% [95% CI, 0%-1%]). The 3 most common individual diagnoses were depression (19% [95% CI, 14%-25%]), binge eating disorder (17% [95% CI, 13%-21%]), and anxiety (12% [95% CI, 6%-20%]). Prevalence estimates were 9% (95% CI, 5%-13%) for previous suicidal ideation, 3% (95% CI, 1%-4%) for substance abuse disorders, and 1% (95% CI, 1%-2%) for PTSD. I^2 statistics were high for all estimates, ranging from 57% to 99%.

The quality of evidence was moderate regarding an increased prevalence of mental health conditions among bariatric patients based on the number of studies and the moderate-to-large magnitude of the prevalence difference. At 23%, the prevalence of any mood disorder among bariatric patients was greater than the US population estimate of 10%.[23] The prevalence of depression (19%) and binge eating disorder (17%) was also greater among bariatric patients than in the general US population (8% for depression; 1%-5% for binge eating disorder).[6-8]

Preoperative Mental Health Conditions and Bariatric Outcomes

We identified 27 publications from 26 studies reporting data on associations: 6 reporting on bariatric outcomes[24,26,31,35,45-47]; 17 reporting on mental health outcomes (References 3, 14, 25, 27-30, 32-34, 36, 37, 39, 40, 42-44); and 3 studies reporting on both.[38,41,48] Patient demographics were similar to those re-

Table 1. Prevalence of Preoperative Mental Health Conditions Among Patients Seeking and Undergoing Bariatric Surgery

Condition	Studies Reporting Data	Patients Reporting Data	Patients With Condition	Prevalence Estimate, % (95% CI)[a]
Any mood disorder	10	3307	788	23 (15-31)
Depression	34	51 908	12 009	19 (14-25)
Binge eating disorder	25	13 769	2400	17 (13-21)
Anxiety	22	38 459	10 515	12 (6-20)
Suicidal ideation or suicidality	6	3518	315	9 (5-13)
Personality disorders	6	3002	184	7 (1-16)
Substance abuse disorders[b]	19	40 725	1515	3 (1-4)
Posttraumatic stress disorder	10	15 039	187	1 (1-2)
Psychosis	6	3406	31	1 (0-1)

[a] Pooled estimate based on random-effects meta-analysis.

[b] Includes alcohol abuse, drug abuse, and unspecified substance abuse; tobacco use and abuse were excluded.

ported in prevalence studies. **Table 2** summarizes each study; quality assessments are listed in **Table 3**. Of the 26 studies, 18 were prospective (including 3 RCTs) and 16 involved consecutive sampling. Follow-up rates were high (>80% at the primary end point) in 9 of the 18 prospective studies, moderate (60%-80%) in 7, and low (<60%) in 2. Fourteen of the 26 studies controlled for confounders (References 3, 14, 24, 26, 29-35, 38, 40, 41, 47) using statistical methods or design; 3 studies used both matching and multivariable regression.[3,32,34]

There was inconsistent evidence regarding the association between preoperative mental health conditions and postoperative weight loss. Five studies reported on depression. The first found no difference in weight loss at 1 year but less weight loss at 4 years for patients with preoperative depression or anxiety (7.9- vs 12.5-unit decrease in BMI) (P = .047).[24] Four other studies found no difference in postoperative weight loss between patients with and without preoperative depression. The first found no association between preoperative depression and weight loss at 6 months (mean difference in excess BMI loss, −0.6% [95% CI, −3.8% to 2.6%]) or 1 year after surgery (−1.9% [95% CI, −4.0% to 7.8%]).[45] The second found no association between BDI scores and weight loss but reported a reduced risk of significant weight regain (≥15% of total weight loss) in patients with higher preoperative BDI scores (odds ratio, 0.94 per unit increase [95% CI, 0.91-0.98]).[35] Although retrospective, this study controlled for 14 preoperative and postoperative confounders. The third reported no difference in percent BMI loss between patients with and without depression (difference at 6 months, 27.8% vs 27.8% [P = .95]; at 12 months, 35.8% vs 36.5% [P = .45]; and at 24 months, 38.3% vs 37.4% [P = .52]).[48] This study had a high follow-up rate at 6 months (85%) and at 12 months (80%) but low follow-up at 24 months (47%). The fourth study reported no difference in excess weight loss at 1 year between patients with depression (43.4%) and those without depression (43.9%; P = nonsignificant [exact value was not provided]) but had a low follow-up rate (53%) and did not control for cofounders.[46] One study found no association between a current mood disorder and weight loss 2 or 3 years after surgery, but this study did not specifically report on depression.[41]

Five studies (2 consecutive, 3 nonconsecutive) provided mixed results regarding the association between preoperative binge eating disorder and postoperative weight loss. One consecutive-sample study found that patients with preoperative binge eating disorder lost more weight after surgery (0.19 percentage point–greater decrease in BMI; P = .014), while the other consecutive-sample study found no difference (Cohen d = 0.24; P = .29).[26,31] The first monitored patients with a current diagnosis of binge eating disorder for 4 years; the second included patients with a lifetime diagnosis of binge eating disorder and followed up patients up to 3 years after surgery. All 3 nonconsecutive sample studies, including an RCT comparing 2 bariatric surgery procedures, found no difference in weight loss between patients with and without preoperative binge eating disorder.[38,41,47] One study[47] involved patients with a lifetime diagnosis and followed-up patients for 1 year; the other 2 studies involved patients with a current diagnosis of binge eating disorder and analyzed patients twice: at 1 year and then either 3 or 5 years after surgery.

The quality of evidence was very low for all associations between preoperative mental health conditions and postoperative weight loss, with the exception of depression, for which the quality of evidence was upgraded to low because all 5 studies reported no difference in postoperative weight loss at 1 year.

Bariatric Surgery and Postoperative Mental Health Outcomes

Bariatric surgery was associated with lower rates and fewer symptoms of multiple mental health conditions, particularly depression. Depression improved following bariatric surgery in 11 of the 12 studies (References 14, 25, 27, 28, 33, 36, 39, 42-44, 48) including 2 RCTs that evaluated behavioral health interventions after surgery. This included a reduction in both depression prevalence[14,25,27,33,41,43,48] and the frequency and severity of depressive symptoms.[14,28,36,39,42,44] Ten studies were prospective (5 with high follow-up, 5 with moderate) and 3 controlled for confounding using multivariable regression.

Two RCTs evaluating behavioral health interventions after bariatric surgery found improvements in depression for both the intervention group and the usual-care group. One study found lower rates of depression at 6 months and 1 year after surgery for participants in a comprehensive behavioral-motivational program and controls, with slightly

Table 2. Studies Measuring the Association Between Preoperative Mental Health Conditions and Postoperative Mental Health or Bariatric Outcomes

Source (Country)	Method and Date of Recruitment	Sample Size[a]	Women, No. (%)	Mean BMI	Mean Age, y	Follow-up, No. (%)[b]	Surgical Approach(es)	Mental Health Diagnoses Assessed	Method of Assessment	Timing of Assessment	
										Preoperative	Postoperative
Articles From Randomized Clinical Trials (n = 3)											
Gade et al,[42] 2015 (Norway)	Assessed a 10-week cognitive behavioral therapy intervention for dysfunctional eating, depression, and anxiety; September 2011-December 2013	80	69%[c]	44	44	80 (78)	RYGB, 84%[c]; sleeve gastrectomy, 16%[c]	Depression, any anxiety disorder	Hospital Anxiety and Depression Scale	At study enrollment (14 weeks prior to surgery)	1 Year after surgery
Morseth et al,[38] 2015 (Norway and Sweden)	Compared laparoscopic RYGB and laparoscopic duodenal switch at 2 Scandinavian hospitals; February 2006-August 2007	60	42 (70)	55	36	100%	Laparoscopic RYGB, 31 (52%); laparoscopic duodenal switch, 29 (48%)	Binge eating disorder	Eating Disorder Examination questionnaire	At evaluation for surgery (time not stated)	6 Months and 1, 2, and 5 years after surgery
Nijamkin et al,[27] 2013 (US)	Assessed a preoperative intervention to improve depressive symptoms (dates not stated)	144		36	33	133 (92)	RYGB, 100%	Depression	BDI-II	At evaluation for surgery (time not stated)	6 and 12 months after surgery
Articles With Consecutive or Random Sampling of Patients Receiving Surgery (n = 16)											
Adams et al,[3] 2007 (US)	Consecutive patients undergoing RYGB at a single surgical practice in Utah 1984-2002	7925	84[c]	45	39	NA	RYGB, 100%	Suicide	National Death Index in combination of *ICD-9* and *ICD-10* codes	NA	As long as 18 years after surgery depending on operation date (mean, 7.8 years)
Ahmed et al,[32] 2013 (US)	All patients with a diagnosis of bipolar disorder who underwent bariatric surgery at any of the 23 hospitals within an integrated care system; 2006-2009	144	128 (89)	42	44	NA	Laparoscopic RYGB, 124 (86%); LAGB, 10 (7%); open RYGB, 5 (4%); gastric sleeve, 5 (4%)	Time to psychiatric hospitalization, No. of outpatient visits for psychiatric or behavioral health	Administrative records	Any time prior to the date of surgery	Any time within each 1-year period after surgery (mean follow-up, 2.1 years)
Bhatti et al,[40] 2015 Canada)	All adults living in Ontario who underwent bariatric surgery; April 2006-March 2011	8815	7176 (81)	Not stated	42	NA	RYGB, 8681 (99%); intestinal bypass, 89 (1%); sleeve gastrectomy, 45 (0.5%)	Self-harm emergencies	*ICD-10* codes	Any time within the 3 years prior to surgery	As long as 3 years after surgery
Booth et al,[43] 2015 (UK)	All patients with a record of bariatric surgery in the UK Clinical Practice Research Datalink, January 2000-April 2012	3045	2406 (79)	44	46	2488 (63)	LAGB, 1297 (43%); RYGB, 1265 (42%); sleeve gastrectomy, 477 (16%)	Depression	Medical record review (diagnosis in current year or lifetime diagnosis + current antidepressant use)	Any time within the 3 years prior to surgery	Any time within each 1-year period after surgery up to 7 years (mean follow-up not stated)
Cremieux et al,[25] 2010 (US)	All patients in a proprietary database of 5 million US residents who had bariatric surgery and continuous insurance coverage; January 1998-January 2006	5502	4553 (83)	Not stated	44	NA	RYGB, 73%[c]; mix of other procedures	Depression	Claims data	Any time to 90 days prior to surgery	Between 30 and 120 days after surgery
Dixon et al,[36] 2003 (Australia)	Consecutive patients receiving bariatric surgery at a university program; 1999-2003	487	412 (85)	44	41	77%[c]	LAGB, 100%	Depression	BDI	At evaluation for surgery (time not stated)	1, 2, 3, and 4 years after surgery
Hayden et al,[28] 2011 (Australia)	Random sample of patients who underwent lap band surgery at a single bariatric center (dates not stated)	258	84%[d]	43	42	NA	LAGB, 100%	Depression	BDI	At evaluation for surgery (time not stated)	12 Months after surgery

(continued)

Table 2. Studies Measuring the Association Between Preoperative Mental Health Conditions and Postoperative Mental Health or Bariatric Outcomes (continued)

Source (Country)	Method and Date of Recruitment	Sample Size[a]	Women, No. (%)	Mean BMI	Mean Age, y	Follow-up, No. (%)[b]	Surgical Approach(es)	Mental Health Diagnoses Assessed	Method of Assessment	Timing of Assessment	
										Preoperative	Postoperative
Hayden et al,[33] 2014 (Australia)[e]	Consecutive patients meeting eligibility criteria for bariatric surgery at 1 institution; 2007-2009	204	168 (82)	43	45	150 (74)	LAGB, 100%	Any mental health condition, depression, OCD, PTSD, schizophrenia, alcohol abuse, any anxiety disorder; bipolar, panic, generalized anxiety, and binge eating disorders	SCID	At evaluation for surgery (time not stated)	2 Years after surgery
King et al,[29] 2012 (US)	Participants in the LABS-2 observational study who underwent surgery and completed AUDIT at baseline and either 1 or 2 years after surgery; February 2006-February 2009	1945	1532 (79)	46	47	1945 (86)	RYGB, 1360 (70%); LAGB, 490 (25%); gastric sleeve, 50 (3%); banded gastric bypass, 30 (2%); BPD, 15 (1%)	Depression, alcohol abuse, binge eating disorder	BDI, AUDIT	At study enrollment (within 30 days of scheduled surgery date)	1 and 2 years after surgery
Lapidoth et al,[31] 2011 (Sweden)	Consecutive patients receiving surgery at 4 Swedish bariatric clinics (dates not stated)	130	102 (78)	47	41	102 (78)	RYGB, 100 (77%); gastric banding, 18 (14%); VBG, 7 (5%); BPD, 5 (4%)	Binge eating disorder	Eating Disorders in Obesity questionnaire, Eating Disorder Examination questionnaire	At evaluation for surgery (time not stated)	3 Years after surgery
Legenbauer et al,[24] 2009; Legenbauer et al,[26] 2011 (Germany)	Consecutive patients receiving surgery in 6 German hospitals approached on the day of admission (dates not stated)	151	101 (67)	51	39	121 (80)	Mix of gastric banding and gastroplasty	Any mental health condition, depression, anxiety, binge eating disorder	Composite International Diagnostic Interview, Structured Interview for Anorexia and Bulimia Nervosa	Day of admission for surgery	1 and 4 years after surgery
Mitchell et al,[14] 2014 (US)	Participants in the LABS-2 observational study who underwent surgery, completed the BDI at baseline, and had at least 1 follow-up visit, February 2008-February 2009	2146	1685 (79)	46[e]	46[e]	1782 (83)	Not stated (but in other LABS-2 reports, proportion receiving RYGB was ≈70%)	Depression	BDI	At study enrollment (time not stated)	At 6 months and 1, 2, and 3 years after surgery
Odom et al,[35] 2009 (US)	Surveys distributed to consecutive patients undergoing surgery at 1 institution (dates not stated); response rate, 18.1%	203	147 (85)	30	51	NA	RYGB, 100%	Depression	BDI	Not stated	At a mean follow-up of 28 months after surgery
Sockalingam et al,[44] 2014 (Canada)	Consecutive patients scheduled for bariatric surgery at a regional bariatric surgery center; February 2010-November 2012	223	133 (81)	49	44	164 (74)	RYGB, 156 (95); sleeve gastrectomy, 8 (5)	Any Axis I disorder, any mood disorder, any anxiety disorder, binge eating disorder	Patient Health Questionnaire-9, Generalized Anxiety Disorder-7 scale, Mini International Neuropsychiatric Interview	After completion of presurgery assessment process (time not stated)	12 Months after surgery
Tindle et al,[30] 2010 (US)	Patients undergoing bariatric surgery in Pennsylvania Health Care Cost and Containment Council database; 1995-2004	16 683	Not stated	Not stated	Not stated	NA	Not stated	Suicide	Death certificates recorded by Pennsylvania State Department of Health	NA	As long as 10 years after surgery depending on operation date (mean follow-up not stated)
Wise et al,[45] 2015 (US)	Patients undergoing laparoscopic RYGB at a single academic medical center; 2004-2013	647	515 (80)	47	47	NA	Laparoscopic RYGB, 100%	Depression, anxiety	Medical record review	Any time prior to surgery to 5 days postoperatively	180 and 365 days after surgery

(continued)

Table 2. Studies Measuring the Association Between Preoperative Mental Health Conditions and Postoperative Mental Health or Bariatric Outcomes (continued)

Source (Country)	Method and Date of Recruitment	Sample Size[a]	Women, No. (%)	Mean BMI	Mean Age, y	Follow-up, No. (%)[b]	Surgical Approach(es)	Mental Health Diagnoses Assessed	Method of Assessment	Timing of Assessment	
										Preoperative	Postoperative
Articles With Nonconsecutive and Nonrandom Sampling of Patients Receiving Surgery (n = 7)											
Adams et al,[37] 2012 (US)	Patients receiving surgery from 3 bariatric surgeons in Utah; 2000-2011	418	84%[c]	47	43	387 (93)	RYGB, 100%	Suicide	National Death Index	NA	As long as 6 years after surgery depending on operation date (mean follow-up not stated)
Dixon et al,[39] 2015 (US)	Patients enrolled in a phase 4 clinical trial evaluating the safety and effectiveness of the LAP-BAND system at 7 clinical sites (dates not stated)	149	135 (91)	35	40[e]	95%[c]	LABG, 100%	Depression, binge eating disorder	BDI-II, Questionnaire on Eating and Weight Patterns-Revisited	At study enrollment (time not stated)	1, 2, 3, 4, and 5 years after surgery
Fuchs et al,[46] 2015 (US)	Patients receiving surgery at a single medical center; January 2006-August 2013	590	480 (81)	44[e]	44	278 (53)	LAGB, 368 (62%); gastric sleeve, 222 (38%)	Depression, any anxiety disorder, bipolar disorder, schizophrenia	Structured psychological interview, medical record review, Center for Epidemiological Studies Depression questionnaire, Montgomery-Asberg Depression Rating Scale	At evaluation for surgery (time not stated)	1 Year after surgery
Kalarchian et al,[41] 2015 (US)	Participants in the LABS-2 observational study who were recruited into a substudy on the psychosocial effects of bariatric surgery[f]	165	135 (82)	45[e]	46[e]	154 (93)	RYGB, 98 (59%); LAGB, 67 (41%)	Any mood disorder, depression, bipolar disorder, anxiety, binge eating disorder, substance abuse	SCID	At study enrollment (time not stated)	2 and 3 years after surgery
Lavender et al,[47] 2014 (US)	Participants in the LABS-2 observational study who were recruited into a substudy on the neurocognitive effects of bariatric surgery[f]	68	90%[c]	47	43	68 (52)	Not stated	binge eating disorder	SCID	Within 30 days prior to surgery	12 Months after surgery
Svensson et al,[34] 2013 (Sweden)	Participants in the surgical cohort portion of the Swedish Obese Subject study; 1987-2001	2010	71%[c]	42	47	87%[c]	VBG, 1369 (68%); gastric banding, 376 (19%); RYGB, 265 (13%)	Self-reported alcohol problems	Self-reported alcohol consumption, answer to survey question: "Do you think you have alcohol problems?"	4 Weeks prior to surgery	6 Months and 1, 2, 3, 4, 6, 8, 10, 15, and 20 years after surgery
White et al,[48] 2015 (US)	Patients who underwent gastric bypass surgery at 2 academic medical centers (dates not stated)	357	307 (86)	51	44	303 (85)	RYGB, 100%	Depression	BDI	Not stated	6, 12, and 24 months after surgery

Abbreviations: AUDIT, Alcohol Use Disorders Identification Test; BDI, Beck Depression Inventory; BMI, body mass index; BPD, biliopancreatic diversion; LABS-2, Longitudinal Assessment of Bariatric Surgery-2; LAGB, laparoscopic adjustable gastric bypass; NA, not applicable; OCD, obsessive-compulsive disorder; PTSD, posttraumatic stress disorder; RYGB, Roux-en-Y gastric band; SCID, Structured Clinical Interview for *DSM*; VBG, vertical banded gastroplasty.

[a] Patients reporting data.

[b] Follow-up rates reflect those for the primary end point or the first listed end point if primary not stated. If studies only reported data about patients returning for follow-up, sample size and number returning for follow-up may be identical. For these studies, follow-up rate reflects patients for whom data were not reported.

[c] Category includes only percent data, number of patients was not reported.

[d] Population consisted of candidates for surgery and 98% received surgery. Data report patients who received surgery.

[e] Study reports median instead of mean values for BMI, age, or both.

[f] Although the larger LABS-2 study involved consecutive sampling, participants in this subsample were selected in a nonconsecutive fashion from the larger group.

Table 3. Quality Rating for Studies Measuring the Association Between Preoperative Mental Health Conditions and Postoperative Mental Health or Bariatric Outcomes

Source (Country)	Design	Multisite	Sample Size	Follow-up Rate[a]	Standard Criterion for Diagnosis	Assessment Kept Confidential From Surgery Team	Method of Controlling for Confounders	Confounders Included in Analysis
Articles With Nonconsecutive Sampling (n = 3)								
Gade et al,[42] 2015 (Norway)	RCT	No	80	Moderate	Yes	Not stated	None[b]	NA
Morseth et al,[38] 2015 (Norway and Sweden)	RCT	Yes	60	High	Yes	Not stated	Statistical[b]	EDE-Q score, preoperative objective bulimic episodes (yes/no), type of operation (Roux-en-Y gastric bypass vs duodenal switch), time
Nijamkin et al,[27] 2013 (US)	RCT	No	144	High	Yes	Not stated	None[b]	NA
Articles With Consecutive Sampling of Patients Receiving Surgery (n = 16)								
Adams et al,[3] 2007 (USA)	Retrospective cohort with matched control	No	7925	NA	Yes	NA	Design (matching), statistical	Matching: sex, BMI, age, calendar year; Statistical: sex, age, BMI
Ahmed et al,[32] 2013 (US)	Retrospective cohort with matched control	Yes	144	NA	Yes	NA	Design (matching), statistical	Matching: center, sex, health plan membership; Statistical: calendar year, age, ethnicity, BMI[c], baseline outpatient psychiatric utilization, psychiatric medication use, comorbidities
Bhatti et al,[40] 2015 (Canada)	Retrospective cohort	Yes	8815	NA	Yes	NA	Design (repeated measures)	Time (preoperative and postoperative)
Booth et al,[43] 2015 (UK)	Prospective cohort with matched control[d]	Yes	3045	Moderate	Yes	NA[c]	None[d]	NA
Cremieux et al,[25] 2010 (US)	Retrospective cohort	Yes	5502	NA	Yes	NA	None	NA
Dixon et al,[36] 2003 (Australia)	Prospective cohort	No	487	Moderate	Yes	Not stated	None[e]	NA
Hayden et al,[28] 2011 (Australia)	Retrospective cohort	No	258	NA	Yes	NA	None	NA
Hayden et al,[33] 2014 (Australia)	Prospective cohort	No	204	Moderate	Yes	Not stated	Statistical	Other preoperative mental health conditions
King et al,[29] 2012 (US)	Prospective cohort	Yes	1945	High	Yes	Not stated	Statistical	Sex, age, race, ethnicity, marital status, education, employment status, household income, BMI, ISEL-12 scores, SF-36 scores, BDI, binge eating, treatment for psychiatric or emotional problems, smoking status, regular alcohol consumption, recreational drug use, surgical procedure, percentage of weight loss
Lapidoth et al,[31] 2011 (Sweden)	Prospective cohort	Yes	130	Moderate	Yes	Not stated	Statistical	Preoperative, BMI, pretreatment EDO/EDE-Q score
Legenbauer et al,[24] 2009 Legenbauer et al,[26] 2011 (Germany)	Prospective cohort with nonrandom control	Yes	151	Moderate	Yes	Not stated	Statistical	Preoperative BMI, age, sex
Mitchell et al,[14] 2014 (US)	Prospective cohort	Yes	2146	High	Yes	Not stated	Statistical	Surgical procedure, BMI, history of DVT/PE, OSA, severe walking limitation, baseline BDI score
Odom et al,[35] 2009 (US)	Retrospective cohort	No	203	NA	Yes	NA	Statistical	Sex, age, tobacco use, race, diabetes mellitus, hypertension, concerns over alcohol/drug use, BDI, preoperative BSI-18, preoperative eating behaviors (control of food urges, control over eating habits, engagement in self-monitoring), self-reported postoperative measures (stress, quality of sleep, well-being)
Sockalingam et al,[44] 2014 (Canada)	Prospective cohort	No	223	Moderate	Yes	No	None[f]	NA
Tindle et al,[30] 2010 (US)	Retrospective cohort	Yes	16 683	NA	Yes	NA	Statistical	Age, sex
Wise et al,[45] 2015 (US)	Retrospective cohort	No	647	NA	Yes	NA	None[g]	NA

(continued)

Table 3. Quality Rating for Studies Measuring the Association Between Preoperative Mental Health Conditions and Postoperative Mental Health or Bariatric Outcomes (continued)

Source (Country)	Design	Multisite	Sample Size	Follow-up Rate[a]	Standard Criterion for Diagnosis	Assessment Kept Confidential From Surgery Team	Method of Controlling for Confounders	Confounders Included in Analysis
Articles With Nonconsecutive Sampling of Patients Receiving Surgery (n = 7)								
Adams et al,[37] 2012 (US)	Prospective cohort with nonrandom control	Yes	418	High	Yes	NA	None[h]	NA
Dixon et al,[39] 2015 (US)	Prospective cohort	Yes	149	High	Yes	Not stated	None	NA
Fuchs et al,[46] 2015 (US)	Prospective cohort	No	590	Low	Yes	Not stated	None[i]	NA
Kalarchian et al,[41] 2015 (US)	Prospective cohort	Yes	165	High	Yes	Not stated	Statistical[j]	Preoperative mental health conditions, age, sex, race, preoperative BMI, surgical procedure, percent weight change
Lavender et al,[47] 2014 (US)	Prospective cohort	Yes	68	Low	Yes	Not stated	Statistical	Preoperative BMI
Svensson et al,[34] 2013 (Sweden)	Prospective cohort with matched control	Yes	2010	High	Yes	Not stated	Design (matching), statistical	Matching: sex; age; weight; height, waist and hip circumferences; SBP; serum cholesterol and triglyceride levels; smoking status; diabetes mellitus; menopausal status; 4 psychosocial variables; 2 personality traits[k]; Statistical: age, sex, daily smoking, alcohol consumption, total calorie intake at baseline
White et al,[48] 2015 (US)	Prospective cohort	Yes	357	High	Yes	Yes	None	NA

Abbreviations: BDI, Beck Depression Inventory score; BMI, body mass index; BSI-18, Brief Symptom Inventory-18 score; DVT/PE, deep vein thrombosis/pulmonary embolism; EDE-Q, Eating Disorder Examination-Questionnaire; EDO, Eating Disorders in Obesity questionnaire; ISEL-12, Interpersonal Support Evaluation List-12 score; NA, not applicable; OSA, obstructive sleep apnea; RCT, randomized clinical trial; SBP, systolic blood pressure; SF-36, Short Form-36 questionnaire.

[a] Categories include high (>80% follow-up), moderate (60%-80% follow-up), and low (<60% follow-up).

[b] Randomization does not control for confounding between surgery and our outcomes.

[c] Patients were enrolled prospectively into a database of primary care visits. The study then retrospectively reviewed this database, sampling all patients who received bariatric surgery. It is unclear whether mental health assessments were kept confidential from the surgical team.[43]

[d] Only unadjusted incidences of depression within each arm (surgery vs matched controls) were available. Additional analyses used multivariable regression to predict time trends in depression after controlling for sex, age, BMI, and index year through matching as well as group, index year, and time since surgery using multivariable regression techniques. However, no group × time interaction was presented that would allow for a comparison of change in depressive symptoms for surgery vs matched controls over time.

[e] Additional analyses used multivariable regression to predict changes in BDI score after controlling for age, sex, BMI, anthropometric measures, insulin resistance, and history of medical illness.

[f] Additional analyses used multivariable regression to predict employment outcomes after controlling for age; sex; percent total weight loss; history of Axis I disorder, mood disorder, anxiety disorder, or eating disorder; and change in Generalized Anxiety Disorder 7-Item, Patient Health Questionnaire-9, and SF-36 subscale scores.

[g] The association between weight loss and depression and anxiety was only assessed via bivariate, unadjusted analyses. Additional analyses used multivariable regression to predict weight outcomes, but only with variables that were significant in bivariate analyses (race, baseline BMI, hypertension, and diabetes).

[h] Analyses of changes in BMI and the incidence of comorbid medical conditions controlled for sex, age, BMI, income, education, and marital status via a propensity score equation. However, only the comparison of suicide incidence met our study criteria; this was performed using Fisher exact test without controlling for confounders.

[i] Additional analyses used multivariable regression to predict changes in the percent estimated weight loss after controlling for sex, race, age, and surgery type. This analysis, combined all psychiatric disorders and did not report the impact of individual mental health conditions.

[j] Multivariable regression was used to control for confounders in evaluating the association between preoperative mental health conditions and postoperative weight loss. No statistical testing was used to assess changes in the prevalence of depression over time.

[k] Individual psychosocial variables and personality traits not listed.

larger improvements in the intervention group.[27] The second found lower Hospital Anxiety and Depression Scale scores at 1 year for both groups of an intervention assessing preoperative cognitive behavioral therapy.[42]

Eight prospective[14,33,36,39,41,43,44,48] and 2 retrospective cohort studies[25,28] found improvements in depression: 5 reporting on prevalence[25,33,41,43,48]; 4 on symptoms[28,36,39,44]; and 1 on both.[14] One large prospective study tracking 3045 bariatric surgery patients in the United Kingdom reported a reduction in depression prevalence during the first 3 years after surgery (odds ratio, 0.82 for year 1 [95% CI, 0.78-0.87]; odds ratio, 0.83 for year 2 [95% CI, 0.76-0.90]; and odds ratio, 0.87 for year 3 [95% CI, 0.78-0.97]).[43] However, this reduction in prevalence did not persist after 3 years. A second prospective study found a decrease in depression prevalence from 18% preoperatively to 6% at 2 years.[33] A third reported a decrease in depression prevalence from baseline (45%) to 6 months after surgery (12%) and also to 12 months after surgery (13%). A slight increase was observed between 12 and 24 months but prevalences remained below preoperative values.[48] A fourth study included more than 5500 US bariatric surgery patients and reported a 49% (95% CI, 41%-57%) reduction in depression prevalence within 4 months after surgery; however, this study did not control for confounders.[25] One study of 165 patients participating in a Longitudinal Assessment of Bariatric Surgery (LABS) consortium substudy found no change in the prevalence of depression over time (7.3% at baseline, 7.1% at 2 years, and 8.5% at 3 years).[41]

Five studies reported on changes in depressive symptoms. The first reported a 63% reduction in self-reported depressive symptoms at 12 months.[44] The second found a 28% to 54% decrease in BDI subscale scores at 12 months.[28] The third reported lower mean BDI scores at 1, 2, 3, and 4 years after LABG.[36] The fourth reported lower mean BDI scores at 1, 2, 3, 4, and 5 years after LABG but focused on patients with a BMI of 30 to 40.[39] The final study from the LABS consortium, a high-quality study based on its high follow-up rates (83% at 6 months, 79% at 1 year) and adjustment for confounders via multivariable regression, found a reduction in depression incidence and depression symptoms at 3-year follow-up. There was no change in hospitalizations for depression between 0 and 2 years postoperatively; however, hospitalization rates increased during the third year: 0.9% at baseline vs 1.7% in year 3 (P = .03).[14] The clinical significance of this late increase in hospitalization remains unknown.

All 3 studies reporting on changes in the prevalence or severity of binge eating disorder found improvement 2 years after surgery.[38,39,41] However, rates increased slightly when measured at later time points and returned to baseline in 1 of the 2 studies reporting on prevalence.[41]

Evidence regarding bariatric surgery and alcohol abuse was mixed. In 1 study, rates of alcohol consumption and abuse increased significantly during the second year after surgery, but only for patients undergoing Roux-en-Y gastric bypass (RYGB) as opposed to laparoscopic adjustable gastric band (LAGB).[29] The Swedish Obese Subjects study, a high-quality study based on its high follow-up rate (87% at 2 years) and 2 methods of controlling for confounders, found similar increases in consumption and self-reported alcohol abuse among vertical-banded gastroplasty patients, but did not report longitudinal data to determine year-to-year changes.[34] Neither study found a difference in alcohol consumption or abuse among LAGB patients, consistent with a third study focusing only on LAGB patients.[33]

Three studies reported on the incidence of suicide after bariatric surgery. The first found higher rates for patients undergoing bariatric surgery in Pennsylvania over a 10-year period (13.7 per 10 000 men and 5.2 per 10 000 women) than among an age- and sex-matched US population (2.4 per 10 000 men and 0.4 per 10 000 women).[30] The second reported a higher rate of suicide among patients undergoing RYGB than among matched controls; however, this difference was not statistically significant (2.6 vs 0.9 per 10 000 person-years, P = .22).[3] The third compared patients undergoing RYGB to individuals who sought but did not undergo bariatric surgery and found no difference in suicide rates between the groups.[37] The 3 studies relied on retrospective data and none accounted for potential differences in the prevalence of mental health conditions.

One additional study used administrative data to compare the incidence of self-harm emergencies before and after bariatric surgery in Ontario, Canada. The authors found an increased rate of emergency department visits for self-harm postoperatively (rate ratio, 1.54 [95% CI, 1.03-2.30]), but none of these visits resulted in death and the authors were unable to distinguish suicide attempts from unintentional self-harm injuries.[40]

There was no clear evidence regarding postoperative changes in either bipolar disorder or PTSD. One study reported no change in the rate of bipolar disorder after surgery,[33] while another found no association between surgery and time to psychiatric hospitalization or the risk-adjusted use of outpatient psychiatric services for bipolar disorder.[32] The only study on PTSD did not perform statistical tests.[33]

The quality of evidence was moderate that bariatric surgery is associated with lower postoperative rates of depression, fewer symptoms of depression, and decreased usage of antidepressant therapies, at least during the first 3 years after surgery. The quality of evidence was very low for all other associations. **Table 4** summarizes the quality of evidence for our findings.

Discussion

We found moderate-quality evidence that preoperative mental health conditions are common in patients seeking and receiving bariatric surgery. Meta-analysis of published data estimated that 23% of patients undergoing bariatric surgery reported a current mood disorder—most commonly depression—while 17% were diagnosed with an eating disorder. Both estimates are higher than published rates for the general US population, suggesting that special attention

Table 4. Quality of Evidence for Study Findings[a]

Topic	Study Design	No. of Studies	No. of Patients	Risk of Bias	Indirectness	Inconsistency	Imprecision	Publication Bias	Quality of Evidence (GRADE)	Finding
Prevalence of mental health conditions in bariatric candidates and recipients	Observational	52	65 363	No serious risk of bias[a]	No serious indirectness	No serious inconsistency	No serious imprecision	Unknown	Moderate due to large prevalence difference	Greater than US population average (23% vs 10% for any mood disorder; For depression, 19% vs 8% For binge eating disorder, 17% vs 1%-5%
Preoperative depression and postoperative weight loss	Observational	5	1948	Serious	No serious indirectness	No serious inconsistency	No serious imprecision	Unknown	Low due to risk of bias	Preoperative depression not associated with differences in postoperative weight loss (all 5 studies found no difference in weight loss at 1 year; however, only 1 study had a follow-up rate ≥80% so risk of bias due to loss to follow-up remains)
Preoperative binge eating disorder and postoperative weight loss	Observational	5	574	Serious	No serious indirectness	Serious	Serious	Unknown	Very low due to risk of bias, inconsistency, and imprecision	Inconsistent association (1 study found more weight loss for patients with preoperative binge eating disorder, 4 studies found no difference)
Bariatric surgery and postoperative depression	Observational	12	12 760	No serious risk of bias	No serious indirectness	No serious inconsistency	Serious	Unknown	Moderate due to strong evidence of association	Surgery associated with decreased incidence and severity of depression in all but 1 study (ranging from 8%-74% across 11 studies)
Bariatric surgery and postoperative binge eating disorder	Observational	3	374	Serious	No serious indirectness	Serious	Serious	Unknown	Very low due to risk of bias, inconsistency, and imprecision	Inconsistent association (1 study found a lower incidence, 1 study found a reduction in severity, 1 study found no difference)
Bariatric surgery and postoperative alcohol abuse	Observational	3	4159	No serious risk of bias	No serious indirectness	Serious	Serious	Unknown	Very low due to inconsistency and imprecision	Inconsistent association (2 studies found increased alcohol consumption after surgery, 1 study found no difference)
Bariatric surgery and postoperative suicide or self-harm emergencies	Observational	4	33 841	Serious	No serious indirectness	Serious	Serious	Unknown	Very low due to risk of bias, inconsistency, and imprecision	Unclear association (1 study found an increased incidence of suicide, 1 study found an increased incidence of self-harm emergencies,2 studies found no difference)

[a] Not all studies included were at low risk of bias, however, estimates of prevalence were not statistically significantly different in studies of lower and higher quality.

should be paid to these conditions among bariatric patients.[7,8,49-51] Other mental health conditions, such as psychosis, PTSD, and personality disorders are less common but may be more prominent in select subgroups such as US veterans.[52]

We found no clear evidence that preoperative mental health conditions are associated with differential weight loss after surgery. Our results are consistent with a previous systematic review reporting no association between depression, anxiety, or binge eating disorder and postoperative weight loss.[11] In contrast to that review, we found no evidence supporting an association between personality disorders and poor weight loss.

We found some evidence to suggest that weight-loss surgery was associated with a reduction in the prevalence, frequency, and severity of depressive symptoms. However, our study cannot establish a causal relationship and several pathways may exist. First, weight loss may improve body image, self-worth, empowerment, and interpersonal relationships. Second, changes in digestion or intestinal absorption after surgery may alter the brain's biochemical signaling. Third, patients whose depression may improve on its own may be more likely to undergo surgery. Although our results should not be interpreted as indicating that surgery is a treatment for depression, severely obese patients with depression may gain psychological benefits in addition to the physical benefits already associated with surgery.[53-56]

The safety of patients with mental health conditions who undergo surgery appears to be complex. We found increased rates of alcohol abuse after surgery—particularly among RYGB patients—compared with similar populations treated nonoperatively. Our results were derived from 3 studies,[29,33,34] 2 of which showed increased self-reported alcohol problems after RYGB[29,34]; none of the 3 studies found increased rates after LAGB. These findings are consistent with results from another systematic review[57] and animal studies, which suggest that increased alcohol consumption after RYGB may be due to physiological changes following intestinal bypass that are not present after LAGB (eg, postprandial changes to intestinal hormone secretion).[58,59] One prospective cohort study suggested an increased rate of suicide after surgery[37] while another reported increased rates of self-harm emergencies.[40] Population-based estimates, including a recent meta-analysis by Peterhänsel and colleagues,[60] also demonstrate above-average rates of suicide among bariatric surgery patients but have been unable to disentangle the operation from comorbid mental health conditions. Further research is needed to assess whether bariatric patients are at higher risk for suicide and alcohol abuse as well as the appropriate mechanisms for postoperative monitoring in patients with a history of depression or substance abuse.

Our study has limitations. First, included studies varied in their use of scales, thresholds, and definitions of outcomes. The diagnosis of binge eating disorder, for example, underwent significant redefinition during our search period and did not exist as a psychiatric disorder until the *DSM-5* was released in 2013.[61] We report the scale or instrument used to make a diagnosis; for diagnoses made by interview, however, it was not always clear what criteria were used. Second, our results do not address the severity or chronicity of mental health conditions, which may be independently associated with postoperative bariatric or mental health outcomes. Third, bariatric candidates with severe mental illness are often screened out prior to referral for bariatric surgery and excluded from published studies. Our prevalence estimates, therefore, are likely to be conservative and our data on associations specific to patients who are referred to and considered for surgery. Fourth, our definition for a meaningful difference in the prevalence of mental health conditions was arbitrary, but our finding of a 100% increase in prevalence for several conditions seems to have face validity. Fifth, our sample size cutoffs were chosen to maximize the value of information for resources needed and our analyses suggest that including small, single-institution studies would not affect our results; however, we cannot exclude this possibility. Sixth, our results may not generalize since the majority of studies reported data from a single institution and, as a whole, capture the experiences of fewer than 200 hospitals and outpatient surgery centers performing bariatric surgery around the world. Seventh, we cannot exclude the possibility of publication bias.

Guidelines from the American Society for Metabolic and Bariatric Surgery and the Department of Veterans Affairs/Department of Defense recommend routine preoperative health assessments, including a review of patients' mental health conditions.[62,63] Other groups advocate for a more comprehensive, preoperative mental health examination in addition to the general evaluation currently performed by medical and surgical teams.[64,65] The results of our study do not defend or rebut such a recommendation.

Much of the difficulty in determining the effectiveness of preoperative mental health screening is due to the limitations of current screening strategies, which use a variety of scales and focus on mental health diagnoses rather than psychosocial factors. Previous reviews have suggested that self-esteem, mental image, cognitive function, temperament, support networks, and socioeconomic stability play major roles in determining outcomes after bariatric surgery.[10,66] Future studies would benefit from including these characteristics as well as having clear eligibility criteria, standardized instruments, regular measurement intervals, and transparency with respect to time-specific follow-up rates. By addressing these methodological issues, future work can help to identify the optimal strategy for evaluating patients' mental health prior to bariatric surgery.

Conclusions

Mental health conditions are common among patients seeking and undergoing bariatric surgery, particularly depression and binge eating disorder. There is inconsistent evidence regarding the association between preoperative mental health conditions and postoperative weight loss. Moderate-quality evidence supports an association between bariatric surgery and lower rates of depression postoperatively.

ARTICLE INFORMATION

Author Affiliations: Department of Surgery, David Geffen School of Medicine at UCLA, Los Angeles, California (Dawes, Maggard-Gibbons); Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California (Dawes, Maggard-Gibbons, Miake-Lye, Beroes, Shekelle); Veterans Affairs/Robert Wood Johnson Clinical Scholars Program, UCLA, Los Angeles, California (Dawes); Department of Health Policy and Management, UCLA Fielding School of Public Health, Los Angeles, California (Dawes, Miake-Lye); Southern California Evidence-Based Practice Center, RAND Corporation, Santa Monica (Maggard-Gibbons, Maher, Booth, Shekelle); Akasha Center for Integrative Medicine, Santa Monica, California (Maher).

Author Contributions: Drs Dawes and Shekelle had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Dawes, Maggard-Gibbons, Maher, Shekelle.
Acquisition, analysis, or interpretation of data: Dawes, Maggard-Gibbons, Maher, Booth, Miake-Lye, Beroes, Shekelle.
Drafting of the manuscript: Dawes, Maggard-Gibbons, Booth.
Critical revision of the manuscript for important intellectual content: Dawes, Maher, Booth, Shekelle.
Statistical analysis: Dawes, Booth.
Obtained funding: Shekelle.
Administrative, technical, or material support: Dawes, Miake-Lye, Beroes.
Study supervision: Maggard-Gibbons, Shekelle.

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Funding/Support: The publication is based on a systematic review conducted by the Evidence-based Synthesis program funded by the Department of Veterans Affairs. Dr Dawes was supported by the VA Office of Academic Affiliations through the VA/Robert Wood Johnson Clinical Scholars Program.

Role of the Funder/Sponsors: The Department of Veterans Affairs (VA) had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: The findings and conclusions in this article are those of the authors, who are responsible for its contents. The findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the US government. Therefore, no statement in this article should be construed as the official position of the Department of Veterans Affairs. Dr Livingston, *JAMA* Deputy Editor, was not involved in the editorial review of or decision to publish this article.

Additional Contributions: We would like to thank the members of our technical expert panel: David E. Arterburn, MD, MPH (Group Health Research Institute), Sarah P. Catanese, PhD (Northwestern University Feinberg School of Medicine), Edward H. Livingston, MD (*JAMA*), Matthew L. Maciejewski, PhD (Durham VA Medical Center), James E. Mitchell, MD (University of North Dakota School of Medicine and Health Sciences), John Morton, MD, MPH (Stanford University School of Medicine), Karen Oliver, PhD (Providence VA Medical Center), Thomas Rutledge, PhD (VA San Diego Healthcare System), and Bruce M. Wolfe, MD (Oregon Health and Sciences University). None of these individuals were compensated in association with their contributions to this article.

REFERENCES

1. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. *JAMA*. 2004;292(14):1724-1737.

2. Maggard MA, Shugarman LR, Suttorp M, et al. Meta-analysis: surgical treatment of obesity. *Ann Intern Med*. 2005;142(7):547-559.

3. Adams TD, Gress RE, Smith SC, et al. Long-term mortality after gastric bypass surgery. *N Engl J Med*. 2007;357(8):753-761.

4. Arterburn DE, Olsen MK, Smith VA, et al. Association between bariatric surgery and long-term survival. *JAMA*. 2015;313(1):62-70.

5. Substance Abuse and Mental Health Services Administration. *Results From the 2013 National Survey on Drug Use and Health: Mental Health Findings*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014.

6. Centers for Disease Control and Prevention. QuickStats: prevalence of current depression* among persons aged≥ 12 years, by age group and sex—United States, National Health and Nutrition Examination Survey, 2007-2010. MMWR Morb Mortal Wkly Rep. 2012;60(51):1747. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6051a7.htm?s_cid=mm6051a7_w. Accessed November 16, 2015.

7. Hudson JI, Hiripi E, Pope HG Jr, Kessler RC. The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. *Biol Psychiatry*. 2007;61(3):348-358.

8. National Eating Disorders Association. Binge Eating Disorder. https://www.nationaleatingdisorders.org/binge-eating-disorder. Accessed February 4, 2015.

9. Hsu LK, Benotti PN, Dwyer J, et al. Nonsurgical factors that influence the outcome of bariatric surgery: a review. *Psychosom Med*. 1998;60(3):338-346.

10. van Hout GC, Verschure SK, van Heck GL. Psychosocial predictors of success following bariatric surgery. *Obes Surg*. 2005;15(4):552-560.

11. Livhits M, Mercado C, Yermilov I, et al. Preoperative predictors of weight loss following bariatric surgery: systematic review. *Obes Surg*. 2012;22(1):70-89.

12. Müller A, Mitchell JE, Sondag C, de Zwaan M. Psychiatric aspects of bariatric surgery. *Curr Psychiatry Rep*. 2013;15(10):397.

13. Ryden A, Torgerson JS. The Swedish Obese Subjects Study–what has been accomplished to date? *Surgery Obes Related Dis*. 2006;2(5):549-560.

14. Mitchell JE, King WC, Chen JY, et al. Course of depressive symptoms and treatment in the longitudinal assessment of bariatric surgery (LABS-2) study. *Obesity (Silver Spring)*. 2014;22(8):1799-1806.

15. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med*. 2009;151(4):264-269, W64.

16. Malik S, Mitchell JE, Engel S, Crosby R, Wonderlich S. Psychopathology in bariatric surgery candidates: a review of studies using structured diagnostic interviews. *Compr Psychiatry*. 2014;55(2):248-259.

17. Nyaga VN, Arbyn M, Aerts M. Metaprop: a Stata command to perform meta-analysis of binomial data. *Arch Public Health*. 2014;72(1):39.

18. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557-560.

19. Thompson SG, Higgins JP. How should meta-regression analyses be undertaken and interpreted? *Stat Med*. 2002;21(11):1559-1573.

20. Hayden JA, Côté P, Bombardier C. Evaluation of the quality of prognosis studies in systematic reviews. *Ann Intern Med*. 2006;144(6):427-437.

21. Whiting P, Rutjes AW, Reitsma JB, Bossuyt PM, Kleijnen J. The development of QUADAS: a tool for the quality assessment of studies of diagnostic accuracy included in systematic reviews. *BMC Med Res Methodol*. 2003;3(1):25.

22. Balshem H, Helfand M, Schünemann HJ, et al. GRADE guidelines 3: rating the quality of evidence. *J Clin Epidemiol*. 2011;64(4):401-406.

23. Kessler RC, Chiu WT, Demler O, Merikangas KR, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005;62(6):617-627.

24. Legenbauer T, De Zwaan M, Benecke A, Muhlhans B, Petrak F, Herpertz S. Depression and anxiety: their predictive function for weight loss in obese individuals. *Obes Facts*. 2009;2(4):227-234.

25. Crémieux PY, Ledoux S, Clerici C, Cremieux F, Buessing M. The impact of bariatric surgery on comorbidities and medication use among obese patients. *Obes Surg*. 2010;20(7):861-870.

26. Legenbauer T, Petrak F, de Zwaan M, Herpertz S. Influence of depressive and eating disorders on short- and long-term course of weight after surgical and nonsurgical weight loss treatment. *Compr Psychiatry*. 2011;52(3):301-311.

27. Petasne Nijamkin M, Campa A, Samiri Nijamkin S, Sosa J. Comprehensive behavioral-motivational nutrition education improves depressive symptoms following bariatric surgery: a randomized, controlled trial of obese Hispanic Americans. *J Nutr Educ Behav*. 2013;45(6):620-626.

28. Hayden MJ, Dixon JB, Dixon ME, Shea TL, O'Brien PE. Characterization of the improvement in depressive symptoms following bariatric surgery. *Obes Surg*. 2011;21(3):328-335.

29. King WC, Chen JY, Mitchell JE, et al. Prevalence of alcohol use disorders before and after bariatric surgery. *JAMA*. 2012;307(23):2516-2525.

30. Tindle HA, Omalu B, Courcoulas A, Marcus M, Hammers J, Kuller LH. Risk of suicide after

long-term follow-up from bariatric surgery. *Am J Med*. 2010;123(11):1036-1042.

31. Lapidoth JD, Ghaderi A, Norring C. Binge eating in surgical weight-loss treatments: long-term associations with weight loss, health related quality of life (HRQL), and psychopathology. *Eat Weight Discord*. 2011;16(4):263-269.

32. Ahmed AT, Warton EM, Schaefer CA, Shen L, McIntyre RS. The effect of bariatric surgery on psychiatric course among patients with bipolar disorder. *Bipolar Disord*. 2013;15(7):753-763.

33. Hayden MJ, Murphy KD, Brown WA, O'Brien PE. Axis I disorders in adjustable gastric band patients: the relationship between psychopathology and weight loss. *Obes Surg*. 2014;24(9):1469-1475.

34. Svensson PA, Anveden Å, Romeo S, et al. Alcohol consumption and alcohol problems after bariatric surgery in the Swedish obese subjects study. *Obesity (Silver Spring)*. 2013;21(12):2444-2451.

35. Odom J, Zalesin KC, Washington TL, et al. Behavioral predictors of weight regain after bariatric surgery. *Obes Surg*. 2010;20(3):349-356.

36. Dixon JB, Dixon ME, O'Brien PE. Depression in association with severe obesity: changes with weight loss. *Arch Intern Med*. 2003;163(17):2058-2065.

37. Adams TD, Davidson LE, Litwin SE, et al. Health benefits of gastric bypass surgery after 6 years. *JAMA*. 2012;308(11):1122-1131.

38. Morseth MS, Hanvold SE, Rø Ø, et al. Self-reported eating disorder symptoms before and after gastric bypass and duodenal switch for super obesity-a 5-year follow-up study [published online July 15, 2015]. *Obes Surg*. doi:10.1007/s11695-015-1790-8.

39. Dixon JB, Eaton LL, Vincent V, Michaelson R. LAP-BAND for BMI 30-40: 5-year health outcomes from the multicenter pivotal study [published online August 18, 2015]. *Int J Obes (Lond)*. doi:10.1038/ijo.2015.156.

40. Bhatti JA, Nathens AB, Thiruchelvam D, Grantcharov T, Goldstein BI, Redelmeier DA. Self-harm emergencies after bariatric surgery: a population-based cohort study [publshed online October 7, 2015]. *JAMA Surg*. doi: 10.1001/jamasurg.2015.3414.

41. Kalarchian MA, King WC, Devlin MJ, et al. Psychiatric disorders and weight change in a prospective study of bariatric surgery patients: a 3-year follow-up [published online November 13, 2015]. *Psychosom Med*. doi:10.1016/j.soard.2015.08.483.

42. Gade H, Friborg O, Rosenvinge JH, Småstuen MC, Hjelmesæth J. The impact of a preoperative cognitive behavioural therapy (CBT) on dysfunctional eating behaviours, affective symptoms and body weight 1 year after bariatric surgery: a randomised controlled trial. *Obes Surg*. 2015;25(11):2112-2119.

43. Booth H, Khan O, Prevost AT, Reddy M, Charlton J, Gulliford MC; King's Bariatric Surgery Study Group. Impact of bariatric surgery on clinical depression: interrupted time series study with matched controls. *J Affect Disord*. 2015;174(174):644-649.

44. Sockalingam S, Wnuk S, Kantarovich K, et al. Employment outcomes one year after bariatric surgery: the role of patient and psychosocial factors. *Obes Surg*. 2015;25(3):514-522.

45. Wise ES, Hocking KM, Kavic SM. Prediction of excess weight loss after laparoscopic Roux-en-Y gastric bypass: data from an artificial neural network [published online May 28, 2015]. *Surg Endosc*. doi:10.1007/s00464-015-4225-7.

46. Fuchs HF, Laughter V, Harnsberger CR, et al. Patients with psychiatric comorbidity can safely undergo bariatric surgery with equivalent success [published online April 7, 2015]. *Surg Endosc*. doi:10.1007/s00464-015-4196-8.

47. Lavender JM, Alosco ML, Spitznagel MB, et al. Association between binge eating disorder and changes in cognitive functioning following bariatric surgery. *J Psychiatr Res*. 2014;59(59):148-154.

48. White MA, Kalarchian MA, Levine MD, Masheb RM, Marcus MD, Grilo CM. Prognostic significance of depressive symptoms on weight loss and psychosocial outcomes following gastric bypass surgery: a prospective 24-month follow-up study [published online October 25, 2015]. *Obes Surg*. doi:10.1007/s11695-015-1631-9.

49. Reeves WC, Strine TW, Pratt LA, et al; Centers for Disease Control and Prevention (CDC). Mental illness surveillance among adults in the United States. *MMWR Surveill Summ*. 2011;60(suppl 3):1-29.

50. Bagalman E, Napili A. *Prevalence of mental illness in the United States: data sources and estimates: Congressional Research Service;February 28, 2014.*

51. Center for Behavioral Health Statistics and Quality. *State estimates of adult mental illness from the 2011 and 2012 National Surveys on Drug Use and Health. NSDUH report*. Rockville, MD: Substance Abuse and Mental Health Services Administration. doi:10.3886/ICPSR34481.v1;2014.

52. Maggard Gibbons MA, Maher AM, Dawes AJ, et al. Psychological clearance for bariatric surgery: a systematic review. VA-ESP project #05-2262014.

53. Buchwald H, Estok R, Fahrbach K, et al. Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. *Am J Med*. 2009;122(3):248-256.

54. Christou NV, Lieberman M, Sampalis F, Sampalis JS. Bariatric surgery reduces cancer risk in morbidly obese patients. *Surg Obes Relat Dis*. 2008;4(6):691-695.

55. Kokkinos A, Alexiadou K, Liaskos C, et al. Improvement in cardiovascular indices after Roux-en-Y gastric bypass or sleeve gastrectomy for morbid obesity. *Obes Surg*. 2013;23(1):31-38.

56. Maggard-Gibbons M, Maglione M, Livhits M, et al. Bariatric surgery for weight loss and glycemic control in nonmorbidly obese adults with diabetes: a systematic review. *JAMA*. 2013;309(21):2250-2261.

57. Spadola CE, Wagner EF, Dillon FR, Trepka MJ, De La Cruz-Munoz N, Messiah SE. Alcohol and drug use among postoperative bariatric patients: a systematic review of the emerging research and its implications. *Alcohol Clin Exp Res*. 2015;39(9):1582-1601.

58. Thanos PK, Subrize M, Delis F, et al. Gastric bypass increases ethanol and water consumption in diet-induced obese rats. *Obes Surg*. 2012;22(12):1884-1892.

59. Polston JE, Pritchett CE, Tomasko JM, et al. Roux-en-Y gastric bypass increases intravenous ethanol self-administration in dietary obese rats. *PLoS One*. 2013;8(12):e83741.

60. Peterhansel C, Petroff D, Klinitzke G, Kersting A, Wagner B. Risk of completed suicide after bariatric surgery: a systematic review [published online January 9, 2013]. *Obes Rev*. doi: 10.1111/obr.12014.

61. Marek RJ, Ben-Porath YS, Ashton K, Heinberg LJ. Impact of using DSM-5 criteria for diagnosing binge eating disorder in bariatric surgery candidates: change in prevalence rate, demographic characteristics, and scores on the Minnesota Multiphasic Personality Inventory–2 restructured form (MMPI-2-RF). *Int J Eat Disord*. 2014;47(5):553-557.

62. Le Mont D, Moorehead MK, Parish MS, Reto CS, Ritz SJ. Suggestions for the Pre-Surgical Psychological Assessment of Bariatric Surgery Candidates: American Society for Bariatric Surgery;October 2004. https://asmbs.org/wp/uploads/2014/05/PsychPreSurgicalAssessment.pdf. Accessed November 19, 2014.

63. Department of Veterans Affairs/Department of Defense. DoD clinical practice guideline for screening and management of overweight and obesity. VA; 2014. http://www.healthquality.va.gov/guidelines/CD/obesity/VADoDCPGManagementOfOverweightAndObesityFinal.pdf. Accessed November 19, 2014.

64. Bauchowitz AU, Gonder-Frederick LA, Olbrisch ME, et al. Psychosocial evaluation of bariatric surgery candidates: a survey of present practices. *Psychosom Med*. 2005;67(5):825-832.

65. Santry HP, Chin MH, Cagney KA, Alverdy JC, Lauderdale DS. The use of multidisciplinary teams to evaluate bariatric surgery patients: results from a national survey in the U.S.A. *Obes Surg*. 2006;16(1):59-66.

66. Livhits M, Mercado C, Yermilov I, et al. Is social support associated with greater weight loss after bariatric surgery? a systematic review. *Obes Rev*. 2011;12(2):142-148.