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ORIGINAL ARTICLE

Mental Illness Has a Negative Impact on Weight Loss in Bariatric Patients: a 4-Year Follow-up

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Abstract

Background Mental health disorders are highly prevalent among bariatric surgery patients. Bariatric surgery induces weight loss with continuous health improvements. However, long-term follow-up data on weight loss and quality of life data of patients who have a mental illness after bariatric surgery are scarce, and it is not clear whether mental illness is associated with more pronounced weight regain. The aim was to investigate the impact of preoperative mental illness on the course of long-term weight changes after bariatric surgery.

Methods Patients with sleeve gastrectomy (SG) or Roux-en-Y gastric bypass surgery (RYGB) between 2005 and 2013 with a follow-up of at least 3 years were included. The study population was divided into two groups: patients with mental illness (MI) and patients without (No-MI). Weight loss outcomes over time were compared using mixed models up to 4 years after surgery.

Results In total, 254 patients (RYGB 61.0%, SG 39%) were included. The distribution of baseline characteristics was similar between the MI ($n = 108$) and No-MI groups ($n = 146$). The most prevalent mental illness was depressive disorder (63.9%). In the MI group, the percent of total weight loss (%TWL) was significantly smaller over the study period. After 36 months, the predicted mean group-difference of %TWL was 4.6% (95% CI 1.9, 7.2; $p = 0.001$), and the predicted odds ratio for weight regain was 4.9 (95% CI 1.6, 15.1) for patients in the MI group.

Conclusion Preoperative mental illness leads to lower long-term weight loss and an increased risk of weight regain after bariatric surgery.

Keywords Mental illness · Bariatric surgery · Depression · Weight loss outcomes · Weight change · Long-term

Introduction

Bariatric surgery has become a widely accepted option for promoting sustained weight loss and improving obesity-associated comorbidities and quality of life in a large percentage of patients.[1,2] Mental health disorders, such as binge-eating disorder, anxiety, depression, and personality disorders are common comorbidities of the obesity syndrome,[3,4] and

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depression is the most common psychiatric diagnosis among bariatric surgery patients. Concerns about severe psychiatric side effects (suicidal ideation, substance abuse) after bariatric surgery have been raised in the recent literature.[5] These mental health concerns are reasonable and important since they have been associated with compromised surgical results and success,[6,7] and there may be an uncertainty regarding which candidates with mental illness qualify for bariatric surgery to achieve sustainable long-term weight loss.[8,9]

Previous research underlined the efficacy and the viability of treatment with bariatric surgery in patients with a history of (severe) mental illness.[6,10] Nevertheless, a significant limitation was the short duration (≤ 12 months), excluding the period with longer follow-up after surgery when variability in weight change ("honeymoon phase") was seen, decreased dietary adherence, and increased risk of weight regain increases.[4,11–13]

The influence of mental illness and the predictive value on longer-term weight loss outcomes after different types of bariatric procedures has been less consistently evaluated, leading to either conflicting or insufficiently proved results; psychiatric disorders may account for some of the variability in postoperative weight loss.[14–16] Several factors appeared to be associated with weight regain in patients who have a mental illness, including hormonal and metabolic alterations, psychological and behavioral factors, and the weight gain-promoting effects of psychotropic medication.[17,18] Only a few studies used structured diagnostic instruments examining the relationship of pre-surgery mental illness and post-surgery weight loss outcomes[19,20] specific for sleeve gastrectomy (SG),[21] currently the most commonly performed bariatric operation in most countries. Therefore, we examined the impact of preoperative mental illness and use of psychotropic medications on weight outcomes in patients undergoing SG and Roux-en-Y gastric bypass (RYGB) over a long-term follow-up of at least 3 years and compared these results to those without mental illness.

Methods

This retrospective single-center analysis was conducted in a referral center for bariatric surgery. Three experienced bariatric surgeons performed all surgical procedures. For statistical analysis, data of patients undergoing bariatric surgery between January 2005 and December 2013 were entered into a research database. The independent local ethics committee approved this study.

Bariatric Surgery Patients

The following criteria were used for inclusion: patients ≥ 18 years of age, who underwent SG or RYGB, with at least 3 years of post-surgical follow-up. Exclusion criteria were bariatric surgery other than LSG and RYGB, pregnancy during follow-up, revisional surgery during follow-up, and missing follow-up after 36 months. All subjects were assessed prior to surgery and at 6 and 12 months, and then annually after surgery as part of the routine bariatric work-up. Patients with standard gastric banding or vertical gastric banding procedures, those with revision procedures, and patients who became pregnant during the follow-up period were excluded. All study subjects were divided into two groups. The mental illness group (MI) consisted of patients with a diagnosed mental illness. All other patients were grouped in the no mental illness group (No-MI).

Psychiatric Comorbidity

Prior to surgery, a multidisciplinary evaluation including psychosocial-behavioral evaluation was performed by a psychiatrist as part of the standard of care assessment using a structured clinical interview to diagnose mental illness. Mental illness as diagnosed before the bariatric intervention was categorized based on the International Classification of Diseases (ICD-10).[22] Psychotropic medication was grouped as antipsychotics, antidepressants, anxiolytics, tranquilizers, and mood stabilizers.

Patients with acute psychotic disorders or otherwise unstable psychiatric illness were excluded from any bariatric intervention. Patients with a mild mental illness who did not receive a specific psychotropic medication for a specified mental illness were assigned to the No-MI group. If mental illness developed after the bariatric intervention, the patient remained in the No-MI group.

Data Collection

Pre- and postoperative visits were routinely conducted in the outpatient clinic at least 3 months before and 1, 3, 6, 12, 18, 24, 36, 48, and 60 months after surgery. The following data were collected from reports and electronic patients' charts: demographic and clinical information, obesity-related comorbidities, and any medication before and after bariatric surgery.

Outcome Measures

The primary outcome was the difference of percent of total weight loss (%TWL), between the study groups over time. Secondary outcomes were the odds of weight regain as well as the difference between BMI change, and percent of excess BMI loss between the study groups over time. Weight regain at an evaluation point was defined as positive if the weight difference from the nadir was more than 25% of the highest weight loss from baseline weight.[23]

Postoperative success was defined as %TWL > 20 maintained for at least 1 year.[24]

Statistical Analysis

The statistical analysis was performed with Stata® 13.1 (StataCorp, College Station, Texas, USA). The distribution of continuous variables was described by mean and standard deviation or 95% confidence interval (CI). Categorical variables were shown as the total number and percent. In univariate analysis, unpaired Student's *t* tests or chi-squared tests, respectively, were used between MI and No-MI groups.

A mixed restricted cubic spline model was used to model the course of %TWL in MI compared to No-MI group over time adjusted for type of surgery, age, intake of weight gain medication, and gender. The results were presented as the predicted mean difference between MI and No-MI groups accompanied with 95% CI. A mixed-effect logistic regression was used, adjusted for the same cofounder to evaluate a group effect (No-MI vs. MI) regarding weight regain over the study period. A p value of < 0.05 was considered significant.

Results

Baseline Characteristics

Of 386 patients with primary bariatric surgery within the period of observation, 39 patients were excluded due to bariatric procedures other than LSG and RYGB. Another 93 patients were excluded because of pregnancy during follow-up (6 patients), revisional surgery during follow-up (67 patients), and lost to follow-up after 36 months (20 patients). In total, 254 were included in the analysis (Supplement Fig. S1). Of these, 108 (42.5%) met the criteria for MI, whereas the remaining 146 (68.5%) patients had no MI.

Among the MI group patients, 25.9% ($n = 28$) had two and 1.9% ($n = 2$) had three psychiatric diagnoses leading to a total of 140 psychiatric diagnoses:

i. Mood disorder diagnoses (F30-F39, 57.1%), including bipolar disorders (F31, 3.6%) and depressive disorders (F32-F33, 50.7%);
ii. Neurotic, stress-related and somatoform disorders (F40-F48, 26.4%), including phobic and other anxiety disorders (F40-F41, 8.6%);
iii. Disorders of adult personality and behavior (F60-F69, 5.0%) including personality disorders (F60, 4.3%);
iv. Schizophrenia, schizotypal, and delusional disorders (F20-F29, 3.6%); and
v. Other diagnoses (7.9%).

A depressive disorder (F32-F33) was found in 63.9% ($n = 69$) of the patients.

The most common psychotropic medication type in patients with mental illness was antidepressants (72.2%), followed by neuroleptics (12%) and tranquilizers (7.4%). Psychotropic medications known to be associated with promotion of weight gain (tricyclic and atypical antidepressants, and neuroleptics) were taken by 30.6% of the MI group patients.

The mean age of all patients was 40.7 years (SD 11.4) and 73.6% of the patients were female. Mean preoperative baseline weight was 129.7 kg (SD 23.4) and mean preoperative BMI was 45.4 kg/m^2 (SD 7.1).

RYGB was performed in 61.0% of the patients, and SG was performed in 39%.

Both groups had similar somatic comorbidities at baseline. There were no significant differences between the two groups regarding baseline characteristics (Table 1).

Weight Loss Outcomes—Univariate Analysis

The course of mean percentages of total weight change in the two groups during the 4-year follow-up period is presented in Fig. 1.

Total weight loss was maximal after 1 to 2 years in both study groups (No-MI group 32.1% at y2, MI group 27.5% at y1, respectively). An increase in weight was observed in both groups in the following years. After 4 years, %TWL was 28.8 and 25.1% in the No-MI and the MI groups, respectively. Patients in the No-MI group showed a more pronounced BMI change and a higher %EBMIL than did patients in the MI group over the 4-year observation period (Supplement Table S1 and Supplement Fig. S2).

Surgical weight loss success was achieved for significantly more patients in the No-MI group than in the MI group 4 years after bariatric surgery (98.1% versus 88.5%; $P = 0.009$).

During the 4-year follow-up period, the number of patients in the MI group with medication associated with weight gain dropped continuously (30.6% at baseline versus 18.3% at y4, $p = 0.045$).

Multivariate Analysis

The multivariate analysis (restricted cubic spline model) adjusted for type of surgery, age, gender, and weight-promoting medication revealed a significantly better %TWL over time in patients in the No-MI group than that in patients in the MI group ($p < 0.001$).

The predicted mean difference of %TWL between the MI and No-MI group after 36 months was 4.6% (95% CI 1.9, 7.2; $p = 0.001$), and after 48 months, it was 3.9% (95% CI 10.2, 7.5; $p = 0.037$) (see Table 2). The coefficients of this analysis are shown in the supplement (Table S2).

A highly significant group effect ($p < 0.001$) over the study period was also found in all studied secondary weight loss outcomes using BMI change and %EBMIL (see supplement Table S3).

Table 1 Patient characteristics in mental illness (MI) and without (No-MI)

	Total ($n = 254$)		No-MI ($n = 146$)		MI ($n = 108$)		p value*
Baseline values							
Age (years) [mean (SD)]	40.7	(11.4)	41.2	(12.0)	40.1	(10.6)	0.475
Sex (female) [n, (%)]	187	(73.6)	103	(70.5)	84	(77.8)	0.196
Weight (Kg) [mean (SD)]	129.7	(24.2)	130.9	(25.5)	128.1	(22.3)	0.366
BMI (kg/m^2) [mean (SD)]	45.4	(7.1)	45.3	(7.4)	45.5	(6.6)	0.823
Type of surgery [n, (%)]							
Sleeve gastrectomy	99	(39.0)	53	(35.3)	46	(42.6)	
Gastric bypass	155	(61.0)	93	(63.7)	62	(57.4)	0.309
Comorbidities [n, (%)]							
Diabetes mellitus	59	(23.5)	40	(28.0)	19	(17.6)	0.055
Hypertension	115	(45.8)	72	(50.3)	43	(39.8)	0.097
Dyslipidemia	75	(29.9)	48	(33.6)	27	(25.0)	0.142
Obstructive sleep apnea	55	(21.9)	28	(19.6)	27	(25.0)	0.304
Orthopedic disorders	99	(39.6)	51	(35.9)	48	(44.4)	0.172

BMI body mass index

*p values are for the comparison between groups. Calculations performed with paired two-sided Student's t test or chi-square tests as appropriate

Weight Regain Analysis

Weight regain was present in 11.9% of the No-MI group compared to 31.5% in the MI group at 36 months, and 25.5% versus 37.9% at 48 months after surgery, respectively.

A mixed-effect logistic regression showed a significant between-group effect ($p < 0.001$) with significantly higher odds of weight regain in the MI group than in the No-MI group over time (predicted odds ratio (OR) 4.9, 95% CI 1.6, 15.1 after 3 years). The analysis was controlled for age, gender, type of surgery, and intake of weight promoting medication.

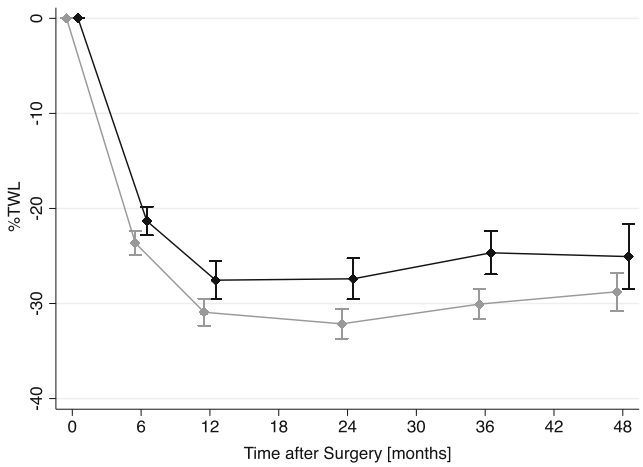

Fig. 1 Time course after surgery of mean percent total weight loss (%TWL) in patients with mental illness (black) and without mental illness (gray) with 95% confidence interval

Subgroup Analysis

Restriction of patients in the MI group to patients with a depressive disorder ($n = 69$) showed a significantly higher ($p = 0.001$) %TWL over time after bariatric surgery compared to patients in the No-MI ($n = 146$) group. The mean difference of %TWL between the MI and No-MI group was 4.2% (95% CI 7.0, 1.4, $p = 0.004$) after 3 years.

Discussion

Short-term outcome of bariatric patients with mental disorders has been studied extensively, but long-term follow-up weight

Table 2 Predicted mean differences of %TWL in patients with mental illness compared to those without (MI vs. No-MI) after bariatric surgery obtained by the mixed restricted cubic spline model controlled for type of surgery, age, the intake of weight promoting medication, and sex

Months after surgery	%TWL-diff. [%]	95% CI		p value
6	1.6	0.4,	2.8	0.008
12	3.5	2.1,	4.9	< 0.001
18	4.5	2.8,	6.3	< 0.001
24	4.9	2.9,	6.9	< 0.001
30	4.9	2.6,	7.1	< 0.001
36	4.6	1.9,	7.2	0.001
42	4.2	1.1,	7.3	0.008
48	3.9	0.2,	7.5	0.037

%TWL percent total weight loss, *CI* confidence interval

loss outcomes, especially after SG, are scarce. Results conflict, with some studies showing an influence of mental disorder on weight loss[19] and others not showing an influence.[16,25] The present study demonstrated a significantly smaller long-term weight loss in patients with a preoperative diagnosis of mental illness compared to those patients without mental illness. Mental illness patients not only reached a lesser nadir weight, but they also showed a higher proportion of weight regain.

In line with previously published results, the primary weight loss in our study was observed during the first 2 years (No-MI group 32.1% TWL at y2, MI group 27.5% TWL at y1, respectively). The prospective Swedish Obesity Study (SOS) reported a peak in weight loss and improvement of the quality of life show during the first year and a decline in the following years.[26] Our study revealed that within this initial period of observation, patients with a mental illness lost less weight compared to those without psychiatric diagnoses. Both our study groups had a %TWL loss of more than 27% during the so-called "honeymoon period," more than other reported values.[27] This finding stands in contrast to several other reports that did not demonstrate a significant difference between these two populations in the short-term[25,28] and through 3 years after bariatric surgery.[16] A reason for this might be the different criteria applied for the diagnosis of mental illness and the restriction to patients undergoing RYGB and gastric banding (LAGB) in these study populations.

Our long-term analysis revealed that the difference in weight loss between the two study groups persisted over time. These findings are in agreement with a study from de Zwaan et al. who showed that a history of anxiety and depressive disorders pre-surgery was negatively associated with weight loss at 24 to 36 months after surgery, but not for depressive disorders alone.[19] Legenbauer et al. also showed less weight loss 4 years after bariatric surgery in patients with preoperative depression or anxiety (BMI decrease of 7.9 vs. 12.5 kg/m^2).[29] However, these results differ with those of the present report: the results were limited to restrictive surgical procedures (LAGB, vertical gastroplasty) and did not include RYGB and SG, the most common interventions currently performed worldwide. To better compare our results with the data of Legenbauer and de Zwaan et al., we performed a subgroup analysis including only those patients with depression. In that analysis, the significant difference between the two studied groups persisted ($p = 0.001$). Therefore, future studies are needed to clarify the impact of mood, anxiety, and depression disorders on postoperative weight loss.

Importantly, in our study, long-term weight loss in patients without mental illness was comparable with values from previous studies of patients undergoing SG and RYGB.[30]

Reasons for the less noticeable weight loss and for the increased weight regain in patients with MI are complex and not fully understood. In addition to the well-known behavioral factors (eating disorders or emotional/uncontrolled eating), patients with depressive disorders might exhibit different behaviors regarding adherence to the postoperative regimen and sports activities.[17] Furthermore, some biological pathways might play an essential role in the elucidation of the association between depression and obesity.[19] Neuroendocrine disturbances including hypothalamic-pituitary-adrenal axis (HPA axis) dysregulation[31] or reduced levels of peripherally released neuropeptides that regulate centrally acting neuropeptide Y after RYGB associated with depression or addiction may play an important role.[32] Recent investigations suggested that changes in brain activity and behavior could be influenced by weight loss and the altered signaling of gut hormones after metabolic surgery.[33] The presence of a differential weight regulation mechanism in mental illness may be responsible for the impaired weight change after bariatric surgery.

Another critical point is the weight-promoting effect of many psychopharmacological substances[27] that are often prescribed to patients with mental illness, particularly those with more severe disease (psychotic or schizophrenia spectrum disorders). Interestingly, we found that the use of weight-promoting psychotropic medication decreased over the years in the study population with mental illness (30.6% versus 18.3%, $p = 0.045$). This outcome is in contrast with other publications, e.g., a large American multicenter study showing no decrease of reported treatment for depression 3 years after bariatric surgery.[34] Relatively little is known about the effect of bariatric surgery and the pharmacological profile of psychotropic drugs that may influence the absorption, due to the physiological changes following surgery that may potentially affect efficacy and safety.[27]

While there were significant differences regarding the use of psychotropic medications, there were no differences in the use of other types of medications (e.g., antihypertensive drugs, statins, antidiabetic medication) at baseline (Supplement Table S4).

Acute alcohol disorder with no guaranteed abstinence of more than 6 months and other chronic substance abuse are contraindications for bariatric surgery according to the guidelines of the Swiss Society for the Study of Morbid Obesity and Metabolic Disorders (SMOB). Therefore, patients with acute alcohol or chronic substance abuse were a priori excluded from bariatric surgery. In our study population, there was one patient in each study group with a history of alcohol dependence and a relapse after the bariatric intervention. Due to the low number of patients with alcohol addiction, no further alcohol-related analyses were performed.

It is important to mention that a history of mental illness is not a contraindication to bariatric surgery. However, patients should be aware that mental illness could lead to suboptimal longer-term weight loss after bariatric surgery. Nevertheless, the overall %TWL for the group with mental illness is still in a good range 4 years after bariatric surgery. Careful patient selection including optimized preoperative psychiatric care has the potential to improve outcomes. As mentioned by Kouidrat et al., the focus on pre-surgical evaluation should be on the

severity of psychiatric symptoms, mental stability, and psychotropic medication, since these factors have a relevant influence on the surgical outcome[35]. Special attention should be paid to a closer monitoring and tailored, supportive psychological therapy with the aim of improving weight loss outcomes in patients with known mental illness. Future studies should include standardized instruments to identify and characterize patients at risk. Especially assessment of self-esteem, mental image, and support networks play an important role in the outcome after bariatric surgery, as previous reviews suggested[4]. Furthermore, specific follow-up intervals for the evaluation of mental health in patients at risk should be defined and evaluated.

In summary, the findings of our study suggested that patients with mental illness preoperatively are among those at risk of suboptimal weight loss following the first four postoperative years. However, it seems clinically relevant that the overall %TWL for the group with pre-surgical mental illness was still quite impressive, especially when considering that behavioral and pharmacological treatments did not achieve that level of weight loss, on average. Although appropriate recommendations were made by professional surgical societies advocating preoperative psychological evaluation as a prerequisite before bariatric surgical procedures, there may be an underestimated and under-treated number of patients with mental illness before and after bariatric surgery. There is also no clear consensus on how to define suitability for bariatric surgery candidates with mental illness, in particular for those with severe illness.[36–38]

A limitation of this study is the retrospective cohort design. However, to date, no long-term prospective evaluation addressing bariatric patients with mental illness is available.

Patients lost to follow-up 3 years after bariatric surgery were excluded as per exclusion criteria. Since the number of excluded patients due to missing follow-up after 36 months was low (20 patients, 7.3%) and patients with and without MI were almost equally distributed (11 vs. 9), we do not expect a significant influence of these patients on the outcome of this study. In contrast, other studies reported follow-up rates below 50% after 1 to 2 years.[39]

Another limitation of this study was the heterogeneity of the bariatric procedures in this observational study, in which the selection of the type of surgery was made based on subjective and patient-based criteria. Therefore, the results of our study do not answer the question as to which type of bariatric procedure might be preferable for which kind of mental illness in bariatric candidates.

Conclusions

The results of this study indicated that preoperative mental illness was associated with a decreased weight loss over a 4-year follow-up period when adjusted for type of surgery, gender, age, and use of psychotropic weight-promoting medications. Furthermore, the risk of postoperative weight regain in the mental illness group was higher than in patients without mental illness. These data may serve as the basis for discussion when counseling patients with mental illness in a pre- and postoperative setting.

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Author Contribution Each author has participated significantly in the work and takes public responsibility for it.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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