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Original Article

Sleeve gastrectomy vs gastric bypass in improvement of depressive symptoms following one year from bariatric surgery, Tehran Obesity Treatment Study (TOTS)

Maryam Barzin[a], Alireza Khalaj[b], Erfan Tasdighi[a], Daniel Samiei[a], Maryam Mahdavi[a], Seyedshahab Banihashem[c,**], Majid Valizadeh[a,*]

[a] Obesity Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[b] Tehran Obesity Treatment Center, Department of Surgery, Faculty of Medicine, Shahed University, Tehran, Iran
[c] Taleghani Hospital Research Development Committee (Taleghani-HRDC), Shahid Beheshti University of Medical Science, Tehran, Iran

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ABSTRACT

Background: The Beck Depression Inventory (BDI) has been frequently employed as a measure of depression in studies of obesity, with the majority of studies reporting an improvement in scores following weight loss after bariatric surgery. However, the effects of different bariatric techniques on depression score improvement is uncertain.
Method: The study included 685 obese patients who underwent laparoscopic sleeve gastrectomy (SG) (n = 443) or gastric bypass (GB) (n = 242) and completed BDIs at baseline and 1 year after surgery.
Results: Mean age of the patients was 38.7 ± 10.9 (84.8% female), and mean body mass index (BMI) was 45.1 ± 6.0 kg/m^2. One year after surgery, excess weight loss (EWL %) in the GB group was more than the SG group (65.4% vs 62.8% $P = 0.02$). At baseline, 29.9% of patients had BDI scores in the normal range (0–9), and respectively 32.4 %, 28.3 % and 9.3 % had mild (10–18), moderate (19–29) and sever (+30) depression score; these corresponding values after 1 year were 60.6, 23.2, 11.8 and 4.4%. Overall, BDI scores fell in both surgery groups after 1 year, in the GB group it was 17.2 ± 10.5 vs 11.1 ± 9.6, and for the SG group 16.1 ± 10.2 vs 9.6 ± 8.9. However BDI score change (ΔBDI) was not significantly different between two surgery groups (−6.04 ± 10.6 vs −6.4 ± 9.5, $P = 0.149$).
Conclusion: Bariatric surgery had a beneficial effect on weight reduction and BDI score regardless of its type. Further studies with longer follow-up and more samples are needed to clarify the differences between bariatric procedures.

Introduction

The prevalence of obesity is increasing in the Middle East and Iran [1,2]. Severe obesity, characterized by a body mass index (BMI) of 35 kg/m^2 or greater, is associated with significantly increased mortality, basically from cardiovascular disease, type 2 diabetes, and several cancers [3]. Studies on adults suffering from severe obesity reveal a high incidence of psychiatric comorbidity. The point prevalence of a clinical mental disorder reported in different studies ranges from 20 to 60% [4]. Although psychiatric problems such as depression are common among severely obese patients [5,6], a substantial decrease in such symptoms has been possible with weight loss [7].

Bariatric surgery is the only intervention that can reliably induce and maintain significant weight loss in severely obese patients [8]. Although weight loss and its effects on medical comorbidities are the most common primary outcomes in bariatric surgery, according to recent studies, a remarkable decrease in depression symptoms was observed after weight loss due to bariatric surgery [9–11]. There are two major types of bariatric surgery, sleeve gastrectomy (SG) and gastric bypass (GB) which are being widely used across the world.

* Corresponding author at: Obesity Research Center, Research Institute for Endocrine Sciences, Shahid Beheshti University of Medical Science, P.O. Box: 19395-4763, Tehran, Iran.
** Corresponding author at: Taleghani Hospital Research Development Committee (Taleghani-HRDC), Shahid Beheshti University of Medical Science, Tehran, Iran.
E-mail addresses: shbbanihashem@sbmu.ac.ir (S. Banihashem), valizadeh@endocrine.ac.ir (M. Valizadeh).

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The association between weight loss and depression improvement following surgery has not yet been fully elucidated. The severity of depression symptoms is evaluated by Beck Depression Inventory (BDI) which is the most widely used tool to measure symptoms of depression in obesity [12]. The primary aim of this study was to assess BDI score in severely obese patients before and one year after bariatric surgery. The secondary aim was to compare the two most commonly performed types of bariatric surgery, SG and GB, in decreasing the BDI score.

Methods

Study population

Tehran Obesity Treatment Study (TOTS) is a prospective study of patients with severe obesity referring to our specialized bariatric center to undergo surgery. Details of the study protocol are available elsewhere [13]. Briefly, an obesity expert examines the severely obese patients who refer to the Tehran Obesity Treatment Center, to determine whether they meet the inclusion criteria. After providing a written informed consent, patients proceed with individualized comprehensive sessions, and decisions are made about the suitability of surgery and the specific technique.

Of the 724 patients, those aged 17–65 years who underwent a primary bariatric procedure from March 2014 to March 2016, and had completed the 1- year follow-up data, were selected. After exclusion of subjects with self-reported pre-surgical diagnosis of depression (n = 12), currently using psychiatric medications (n = 25) and those who had substance abuse (n = 2), 685 patients were included in the analysis.

BDI score was recorded in patients by self-report and using the BDI questioner conducted pre and post-operative (1 year).

Measurements

Trained investigators collected data according to the study protocol. Pre-surgical data including demographic details, anthropometrics, co-morbidities and blood tests were obtained. BMI was calculated as weight in kilograms divided by height in meters squared. For evaluating weight loss outcomes, the percentage of excess weight loss (EWL%), the percentage of total weight loss (TWL%) and BMI change (ΔBMI) were calculated: EWL% = [(Initial weight) – (Post-operation weight)]/[(Initial weight) – (Ideal weight)] × 100, in which the ideal weight is defined by the weight corresponding to a BMI of 25 kg/m^2, TWL% = [(Initial weight) – (Post-operation weight)]/[(Initial weight)] × 100 and ΔBMI = (Post-operation BMI) – (Initial BMI). Following surgery, patients of both groups received a standard diet and were prescribed daily vitamin and mineral supplementations.

Blood samples were taken from all participants as part of pre-surgical assessments to determine the micronutrient status and assess serum concentrations of vitamin B12, zinc, hemoglobin, iron concentration, and ferritin. Serum vitamin B12 and zinc were measured using chemiluminescent enzyme immunoassay and 5 bromo-2-paridylase, respectively. Serum hemoglobin and ferritin levels were measured using the cyan met hemoglobin method and human ferritin enzyme immunoassay test, respectively. Serum iron concentration was assessed using the spectrophotometric and colorimetric methods.

Procedures

All procedures were completed through laparoscopy and by a single surgical team at three university hospitals. For SG procedure, 80% of the stomach was excised. The gastric tube was created over a 36-F bougie using multiple firings of the stapler. For GB procedures, Roux-en-Y (using an alimentary limb of 150 cm and a biliopancreatic limb of 50 cm) or mini-gastric bypass (a loop gastroenterostomy of 150–200 cm) were performed.

Definitions

The BDI is a 21-item questioner evaluating the severity of depression symptoms in a four-point scale. Scores 0–9 are considered normal, 10–18 mild to moderate 19–29 moderate to severe and 30–63 severe depressive symptomology.

A confirmatory factor analysis (CFA) of the BDI in obese patients is a particular structure distinguishing three factors; negative attitude, impaired performance, and somatic symptoms. Each of these factors include different items in the BDI questionnaire. Negative attitude subscale comprises the following items: sadness, pessimism, past failures, guilty feeling, punishment, self-dislike, suicidal thoughts, worthlessness, self-criticism. Impaired performance subscale consists of loss of energy, loss of interest, indecisiveness, loss of pleasure, irritability, lack of concentration and fatigue. Somatic symptoms were agitation, crying, sleep pattern, appetite, sex interest [14].

Diabetes was defined as fasting plasma glucose (FPG) ≥126 mg/dL or hemoglobin A1c% (HbA1c%) ≥6.5% or receiving medication [15]. Hypertension was defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg or medication [16]. Dislipidemia was defined as low density cholesterol(LDL) ≥130 mg/dL, high density cholesterol (HDL) below 40 mg/dL or amount of triglycerides (TG) more than 150 mg/dL or medication [17]. Metabolic syndrome (MetS) was defined based on the joint interim statement (JIS) definition [18]; and was considered as having ≥3 of the following 5 parameters: waist circumference (WC) ≥89/91 cm in men/women based on national cut-offs [19], TG ≥ 150 mg/dL or medication, HDL < 40/50 mg/dL in men/women or medication, SBP and/or DBP ≥ 135/85 mmHg or medication, FPG ≥ 100 mg/dL or medication.

Anemia and iron deficiency anemia were defined as hemoglobin (Hb) <11/12 g/dL in women/men and ferritin <9 ng/dL, respectively. Vitamin B12 < 21 Pmol/L was considered as deficient. Fe < 50 μg/dL and Zn < 70 μg/dL were defined as iron and zinc deficiencies.

Statistics

Continuous variables are reported as mean ± standard deviation (SD) and categorical variables as frequencies and percentages. These variables were compared according to GB and SG group using *t*-test for continuous variables and Chi square-test for categorical variables. Differences between pre-operative and post-operative BDI score in each surgery group were evaluated using paired *t*-test. Comparison of ΔBDI score were analyzed using ANCOVA between surgery groups after adjusting for potential confounders including age, sex, EWL% and baseline BDI score. The same analyses were performed for patients with obesity related comorbidities as well. CFA with Maximum Likelihood (ML) estimation method was performed to test whether the data fit the hypothesized measurement model. Goodness of fit indices and reasonable threshold levels of these indices for CFA were considered as root mean square error of approximation (RMSEA = 0.085) and standardized root mean square residual (SRMR = 0.060), as well as comparative fit index (CFI = 0.93), goodness of fit index (GFI = 0.87), normed fit index (NFI = 0.92). Statistical analysis was performed using SPSS 20.0 (SPSS Inc., Chicago, IL) and LISREL 8.80 (Scientific Software International Inc., 2007). Statistical significance was set at P < 0.05.

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Table 1
Baseline characteristics of study sample.

Characteristics[a]	Total	SG	GB	*P*-value
Age (year)	38.7 ± 10.9	38.9 ± 11.3	38.3 ± 10.1	0.420
Height (m)	162.7 ± 8.2	163.1 ± 8.6	162.0 ± 7.4	0.090
Initial weight (kg)	119.4 ± 19.9	119.4 ± 20.3	119.4 ± 19.3	0.999
Initial BMI (kg/m^2)	45.1 ± 6.0	44.8 ± 6.0	45.4 ± 6.0	0.217
Initial BDI (score)	16.5 ± 10.3	16.8 ± 10.2	17.2 ± 10.5	0.175
Sex (female), n (%)	581 (84.8)	364 (82.2)	217 (89.7)	0.009
MetS, n (%)	410 (66)	264 (65.7)	146 (66.7)	0.802
Hypertension, n (%)	162 (23.6)	108 (24.4)	54 (22.3)	0.543
Diabetes mellitus, n (%)	163 (26.1)	88 (21.8)	75 (33.8)	0.002
Dyslipidemia, n (%)	107 (15.6)	64 (14.4)	43 (17.8)	0.252

SG, sleeve gastrectomy; GB, gastric bypass; BMI, body mass index; BDI, Beck Depression Inventory Score; MetS, metabolic syndrome.
[a] Values are expressed as mean ± SD or number (%).

Results

In this prospective cohort study, of the initial 724 subjects, 685 individuals with no prior psychiatric disorders were included. The mean age was 38.7 ± 10.9 years (range 17–65 years) and the majority of patients were women (84.8%). Participants were categorized by type of surgery: SG (64.7%) and GB (35.3%). Among all participants, 66% had MetS and most prevalent comorbidities were diabetes (26.1%), hypertension (23.6%) and dyslipidemia (15.6%) (Table 1).

There was no significant difference in baseline weight and BMI between surgery groups. Post-operative weight (77.6 ± 13.4 vs 80.3 ± 13.9, P = 0.017) and BMI (29.5 ± 4.5 vs 30.2 ± 4.8 P = 0.087) were lower in the GB group. Weight change (−41.8 ± 12.3 vs −39.2 ± 12.5, P = 0.01) and ΔBMI (−15.9 ± 4.2 vs −14.6 ± 4.0, P < 0.001) after 1 year of follow up were more prominent in the GB group. The mean EWL% in the GB and the SG groups was 65.4 ± 15.7 and 62.8 ± 15.1, respectively (P = 0.02) (Table 2).

Baseline BDI score was not different between GB and SG groups (17.2 ± 10.5 vs 16.1 ± 10.2, P = 0.190). In both groups the BDI score reduced significantly 1 year after surgery (p < 0.001). ΔBDI score was not different between two surgery groups (−6.04 ± 10.6 vs −6.4 ± 9.5, P = 0.149). Compared to the GB group, post-operative BDI score was lower in the SG group (11.1 ± 9.6 vs 9.6 ± 8.9–P = 0.045) (Table 2).

According to BDI score subgroups, normal individuals in the GB and SG groups were 25.6% and 32.3%, pre-surgery, which turned to 55.8% and 63.2% at follow up. Percentage of all the other categories which include mild, moderate and severe depression, have decreased in both groups, after 1 year from surgery. Comparing GB and SG groups, no difference was observed in BDI score subgroups at the follow up (mild, 26% vs 21.7%, P = 0.09; moderate, 12% vs 11.5%, P = 0.36 and severe 9% vs 3.6% P = 0.92) (Fig. 1).

CFA evaluates the correlation between three BDI subscale score and its magnitude. There is no difference in baseline subscale scores between two surgery groups, except the somatic symptoms score which was slightly higher in the GB group (4.8 ± 2.9 vs 4.4 ± 2.8, P = 0.061). Post-operative subscale scores declined significantly in all individuals; however, impaired performance (4.0 ± 3.9 vs 3.4 ± 3.5, P = 0.039) and somatic symptoms (4.4 ± 2.9 vs 3.8 ± 2.7 P = 0.009) were greater in the GB group (Table 3).

The effect of obesity comorbidities on BDI score improvement in the two surgery groups has been presented in Table 4. BDI score decline significantly in both surgery groups and none of these obesity comorbidities altered the efficacy of bariatric surgery regarding BDI score improving (P < 0.001). Comparison of ΔBDI score between two surgery groups revealed that, there was no difference between GB and SG groups regarding BDI score reduction in patients with obesity comorbidities (Fig. 2).

Nutritional deficiencies have been compared between GB as a mal-absorptive and SG as a restrictive surgery, in Table 5. There was no difference in baseline amounts except for ferritin and Hb which were lower in the GB group. Iron, zinc, Hb and ferritin were lower in the GB group at 1 year follow up. A relatively high proportion of nutritional deficiencies were found in the GB group after 1 year, including iron (25.7% vs 14.8%, P = 0.006), zinc (30.1% vs 15.0%, p < 0.001), Hb (16.5% vs 7.8%, P < 0.001) and ferritin (21.9% vs 9.0%, P < 0.001). Vitamin D and blood copper deficiencies were also compared between the two groups which were not significantly different (data not shown).

Discussion

In this prospective cohort study, weight loss and depression improvement were evaluated, in 685 morbid obese patients following two types of bariatric surgery (GB and SG). The two types of surgery have shown different results regarding weight loss, with the GB group demonstrating greater weight loss. BDI score declined in all patients 1 year after the surgery; however, ΔBDI score was not significantly different between the GB and SG groups. Nevertheless, the SG group had a slightly lower BDI score one year after the operation. As expected, micronutrient deficiency and anemia, which have an association with depression, were more prevalent in the GB group (mal-absorptive surgery) than the SG group (restrictive surgery). We also found that obesity related comorbidities have no consequence on beneficial effect of bariatric surgery on BDI score improvement.

Previous studies have demonstrated that obesity has a connection to depression and a strong psychosocial burden as well [20]. Both, physiological mechanisms such as obesity related comorbidities, and psychological mechanisms such as low self-esteem and body dissatisfaction have been suggested for this association [5,21]. Moreover, bariatric surgery, as a competent way of weight reduction, has shown depression improvement in early follow-up (2 years) [12,22,23]. Hayden et al. [12], using the BDI score, showed a remarkable decrease in depressive symptoms following weight loss, one year after adjustable gastric banding (AGB) (16.2 vs 7.7).

Longer periods of follow up have shown inconsistent results [9,24–26]. Gill et al. [9] reported that bariatric surgery is associated with long-term (2–3 years) reduction of depressive symptoms. On the other hand, Ribeiro et al. [26] reported that BDI score improved significantly 23 month after surgery but it was deteriorated after 5 year post-surgery, which could be explained by gradual weight

Table 2
Weight loss results and total body fat mass change 12 months postoperatively.

	RYGB	OAGB-160	OAGB-200	P (RYGB vs. OAGB-160)	P (RYGB vs. OAGB-200)	P (OAGB-160 vs. OAGB-200)
Δ BMI, kg/m^2	−13.92 ± 4.71	−15.47 ± 4.08	−16.54 ± 4.35	**0.002**	**<0.001**	**0.012**
TWL, %	30.92 ± 8.97	33.83 ± 6.75	35.31 ± 6.91	**0.001**	**<0.001**	0.056
EWL, %	73.13 ±23.20	78.15 ± 18.22	79.32 ± 17.11	**0.039**	**0.011**	>0.999
Δ FM, kg	−29.26 ± 10.56	−31.08 ± 9.73	−34.81 ± 10.37	0.449	**<0.001**	**<0.001**

BMI, body mass index; TWL, total weight loss; EWL, excess weight loss; FM, fat mass.

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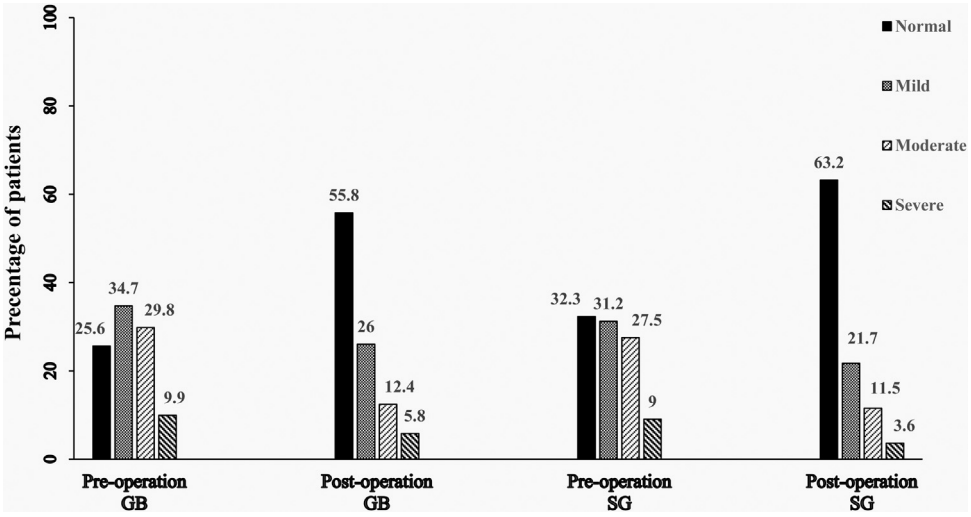

Fig. 1. Percentage of BDI score subgroups at baseline and 1 year post-surgery, in two type of bariatric surgery (GB vs SG). BDI score subgroups were based on BDI score: Normal = 0–9, Mild = 10–18, Moderate = 19–29 and Sever = 30–63.

Table 3
Means and SD for subscales scores at baseline and after 1-year of follow up according to surgery types.

	Type of Surgery	Pre-operative	Post-operative(1-year)	$P_{\text{Within group}}$
Negative attitude	SG	5.3 ±4.8	2.5 ±3.8	<0.001
	GB	5.6 ±4.7	2.7 ±3.9	<0.001
	$P_{\text{Between group}}$	0.506	0.421	–
Impaired performance	SG	6.7 ±4.0	3.4 ±3.5	<0.001
	GB	6.8 ±4.2	4.0 ±3.9	<0.001
	$P_{\text{Between group}}$	0.180	0.039	–
Somatic symptoms	SG	4.4 ±2.8	3.8 ±2.7	<0.001
	GB	4.8 ±2.9	4.4 ±2.9	0.035
	$P_{\text{Between group}}$	0.061	0.009	–

SG, sleeve gastrectomy; GB, gastric bypass; **Negative attitude** subscale include sadness, pessimism, past failures, guilty feeling, punishment, self-dislike, suicidal thoughts, worthlessness, self-criticism; **Impaired performance** subscale include loss of energy, loss of interest, indecisiveness, irritability, concentration, fatigue; **Somatic symptoms** include agitation, crying, sleep pattern, appetite, sex interest.

Table 4
Obesity related comorbidities and BDI score alteration in each surgery group.

	Co-morbidity status	Δ	Pre-operative	Post-operative	$P^{**}_{\text{Within group}}$
Diabetes mellitus	SG	−5.4 ± 10.7	16.0 ± 9.9	9.5 ± 9.3	<0.001
	GB	−6.5 ± 10.2	16.0 ± 10.2	10.6 ± 9.4	<0.001
	$P^{*}_{\text{Between group}}$	0.548	0.990	0.742	–
Hypertension	SG	−6.1 ± 12.3	16.8 ± 11.2	9.9 ± 9.8	<0.001
	GB	−6.8 ± 10.1	16.9 ± 9.7	10.8 ± 9.7	0.001
	$P^{*}_{\text{Between group}}$	0.827	0.963	0.607	–
Dyslipidemia	SG	−7.6 ± 10.3	15.8 ± 11.6	10.4 ± 9.8	<0.001
	GB	−5.2 ± 10.6	16.8 ± 10.5	9.1 ± 9.2	<0.001
	$P^{*}_{\text{Between group}}$	0.474	0.652	0.472	–
MetS	SG	−5.6 ± 10.9	16.6 ± 10.5	10.1 ± 9.1	<0.001
	GB	−6.4 ± 9.7	16.8 ± 10.3	11.2 ± 10.0	<0.001
	$P^{*}_{\text{Between group}}$	0.200	0.823	0.275	–

SG, sleeve gastrectomy; GB, gastric bypass; MetS, metabolic syndrome.
* ANCOVA analysis was performed with adjustment for age, sex, EWL% and preoperative BDI score.
** Comparison of pre and post-operative BDI score.

regain after 60 months. These results confirm the complex connection between weight fluctuation and depression.

Few studies have investigated weight loss and depression improvement in different types of bariatric surgery. Castellini et al. [27] compared three types of bariatric surgery (AGB, GB and Biliopancreatic diversion) and showed that BDI score decreased in all groups after 1 year, and AGB, as a restrictive surgery, had the highest reduction in BDI score despite its lower BMI decline. This was consistent with our results that the SG group, with a lower EWL%, had a lower BDI score post-surgery. On the other hand, by measuring change in clinical depression prevalence or anti-depressant medication, Booth et al. [25] reported that there was no difference between surgery groups (AGB, GB, and SG) regarding reduction in depression.

Nutritional deficiencies which have an association with depression are concerning issues after bariatric surgeries, especially the mal-absorptive ones [28,29]. Previous studies have reported that vitamin B12 and trace element deficiencies are more prevalent after mal-absorptive surgeries [30–33]. In our study, the GB group had a higher prevalence of anemia and trace elements deficiencies which according to the previous studies could be related to the higher BDI score in this group one year after surgery.

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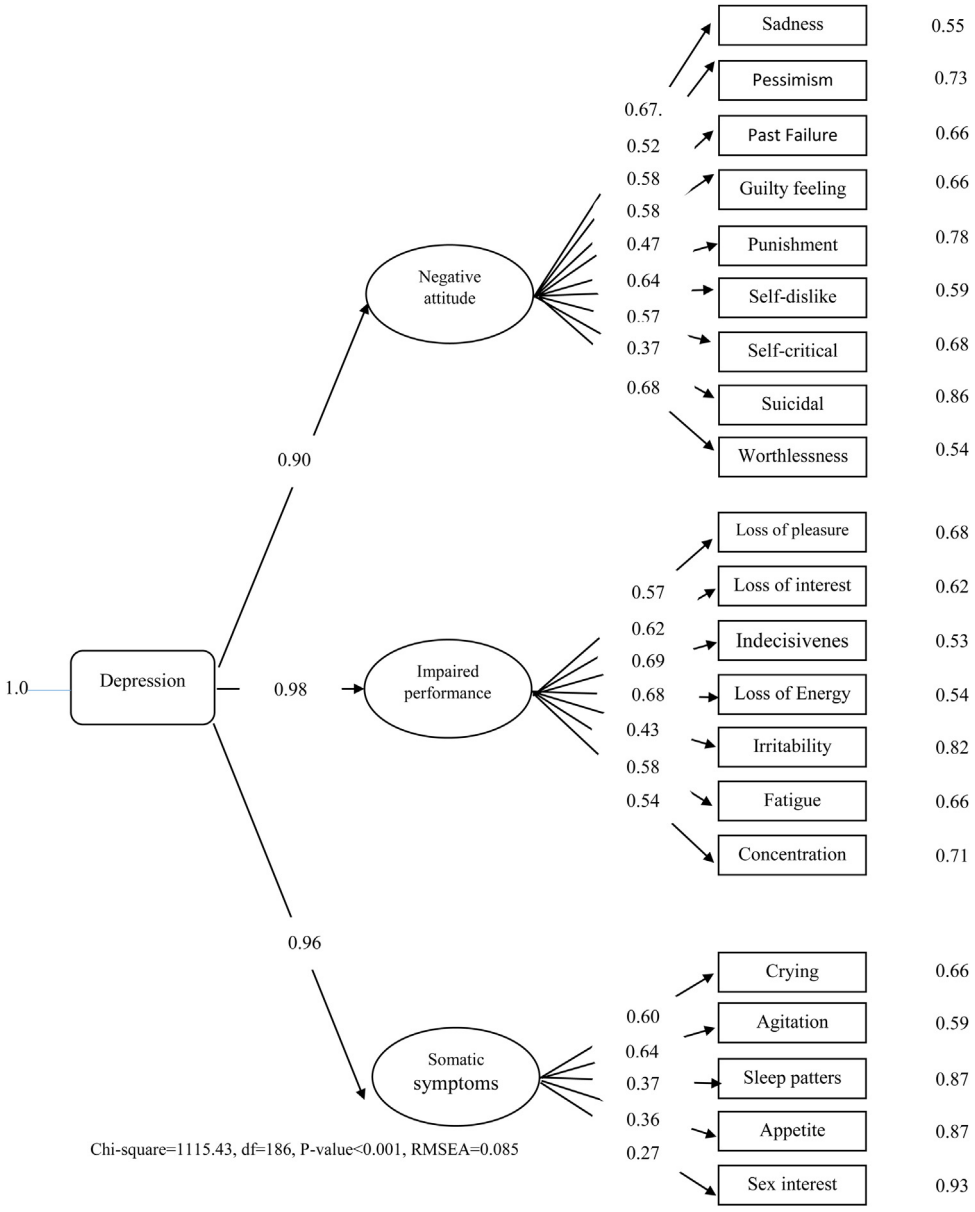

Fig. 2. The 21 items of BDI are divided into 3 sub-scales to evaluate the improvement in different categories of depression symptoms after surgery.

According to our findings, somatic symptoms which are a subscale for depression symptoms were reported more often in the GB group. Moreover, Karen et al. [34] found that patients with postoperative complications had more severe depression symptoms and a higher prevalence of clinically significant depression. Therefore, the modest effect of GB surgery on improvement of depression could be explained by the higher rate of complications and some specific problems following this type of surgery [35–37].

This is one of the few studies that comparing two popular types of bariatric surgery in improving depression symptoms, with an acceptable patient population. Moreover, all patients underwent surgery and were followed by a single team and under the same protocol. Our study had some limitations as well. We did not apply the clinical diagnosis of depression by DSM IV, and severity of depression symptoms was evaluated by a self-reported questionnaire; thus, subjective bias is possible. Follow up duration was only 12 months which is short for evaluating psychological problems like depression. Additionally, we did not have the measurement of all nutrients which could be related with depression, such as folate and selenium. Furthermore, the effect of nutritional deficiencies on the ΔBDI score was not analyzed due to the few number of patients.

In conclusion, GB and SG are the two most common types of bariatric surgery, which have a beneficial effect on improvement of psychological state. In this study, while mean BDI score was slightly lower in the SG group at the end of follow up, ΔBDI was not significantly different between GB and SG groups. According to these results, anemia, nutrient deficiencies and complications were less common after SG which might have an effect on improvement of depression. However, further long term studies are required to compare effects of different bariatric surgeries on depression improvement.

Ethical approval

This study was approved by the institutional review board (no. IR.SBMU.ENDOCRINE.REC 1397.0592018-05-08). Informed consent was obtained from all the participants included in the study. All procedures performed were in accordance with the ethical stan-

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Table 5
Micronutrient laboratory testing and deficiency outcomes at baseline and 1 year post-surgery.

	Type of Surgery	Pre-operative	Post-operative(1-year)	P $_{Withingroup}$
Iron (μg/dL)	***GB***	70.9 ±30.5	72.5 ±32.6	0.568
	SG	74.0 ±37.5	93.1 ±37.7	<0.001
	P $_{Betweengroup}$	0.32	0.004	–
Iron deficiency, n (%)	***GB***	50 (25.6)	43 (25.7)	0.626
	SG	93 (25.6)	41 (14.8)	0.020
	P $_{Betweengroup}$	0.996	0.006	–
VitB12 (mol/L)	***GB***	255.5 ±225.7	380.9 ±323.1	<0.001
	SG	232.6 ±198.7	321.5 ±285.1	<0.001
	P $_{Betweengroup}$	0.217	.042	–
Vit B12 deficiency n (%)	***GB***	2 (1.0)	2 (1.2)	>0.99
	SG	2 (0.6)	1 (0.4)	>0.99
	P $_{Betweengroup}$	0.554	0.290	–
Zinc (μg/dl)	***GB***	87.7 ±20.1	78.1 ±17.4	<0.001
	SG	88.8 ±16.1	85.5 ±17.8	0.052
	P $_{Betweengroup}$	0.467	<0.001	–
Zinc deficiency n (%)	***GB***	32 (15.8)	52 (30.1)	0.002
	SG	40 (10.7)	43 (15.0)	0.120
	P $_{Betweengroup}$	0.081	<0.001	–
Hemoglobin, (g/dL)	***GB***	13.3 ±1.4	12.3 ±1.5	<0.001
	SG	13.3 ±1.4	13.2 ±1.6	<0.001
	P $_{Betweengroup}$	0.017	<0.001	–
Anemia, n (%)	***GB***	13 (5.7)	36 (16.5)	<0.001
	SG	18 (4.3)	28 (7.8)	0.001
	P $_{Betweengroup}$	0.419	0.001	–
Ferritin (ng/mL)	***GB***	58.4 ±55.3	56.5 ±79.5	0.133
	SG	78.6 ±89.7	83.8 ±98.2	<0.001
	P $_{Between\ group}$	0.044	<0.001	–
Iron deficiency anemia, n (%)	***GB***	9 (7.0)	37 (21.9)	<0.001
	SG	11 (5.4)	22 (9.0)	0.006
	P $_{Betweengroup}$	.553	<0.001	–

SG, sleeve gastrectomy; GB, gastric bypass; Iron deficiency, Fe<50μg/dL; Vitamin B12 deficiency, B12 <21Pmol/L; zinc deficiency, Zn<70 μg/dl <9 ng/mL.

dards of the institutional and/or national research committee and 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflicts of interest

The authors claim that they have no potential conflicts of interest to disclose.

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