Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity (2020) 25:679–692
https://doi.org/10.1007/s40519-019-00671-2

ORIGINAL ARTICLE

Perceived social support before and after bariatric surgery: association with depression, problematic eating behaviors, and weight outcomes

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Received: 25 October 2018 / Accepted: 5 March 2019 / Published online: 12 March 2019

Abstract

Purpose Engaging in a healthy lifestyle after bariatric surgery is essential to optimize and sustain weight loss in the long term. There is promising evidence that social support of patients who undergo bariatric surgery plays an important role in promoting a better quality of life and adherence to the required behavioral changes and medical appointments. This study sought to investigate: (a) if post-operative patients experience different levels of perceived social support compared to pre-operative patients; (b) correlations between perceived social support, depression, disordered eating, and weight outcomes; (c) if social support is a moderator between psychological distress, and disordered eating behavior and weight outcomes.

Methods A group of 65 patients assessed pre-surgery and another group of 65 patients assessed post-surgery ($M = 26.12$; SD 7.97 months since surgery) responded to a set of self-report measures assessing social support, eating disorder psychopathology, disordered eating, and depression.

Results Greater social support was associated with lower depression, emotional eating, weight and shape concerns, and greater weight loss in pre- and post-surgery groups. Social support was found to be a moderator between different psychological/weight variables but only for the post-surgery group: the relation between depression and eating disorder psychopathology or weight loss was significant for patients scoring medium to high level is social support; the relation between grazing and weight regain was significant for patients scoring medium to low levels of social support.

Conclusions The associations found between perceived social support and depression, disordered eating and weight outcomes highlight the importance of considering and working with the social support network of patients undergoing bariatric surgery to optimize treatment outcomes.

Level of Evidence Level III: case-control study.

Keywords Bariatric surgery · Social support · Depression · Grazing · Weight and shape concern

Introduction

Despite the impressive weight loss experienced by individuals undergoing bariatric surgery, a variety of patterns of weight change over the course of 7 years since surgery have been observed [1]. Research suggests that a subgroup of patients presents a less accentuated weight loss and that other patients regain weight starting as soon as at 6 months post-operatively [1, 2]. In an attempt to explore factors associated with the variability of long-term outcomes, the role of medical and psychosocial factors has been investigated to identify patients with increased risk for poor weight outcomes. In particular, behavioral aspects gained great attention as the cessation of problematic eating behaviors [3] or the adherence to follow-up sessions and a healthy diet plan [4] are thought to optimize weight loss after bariatric surgery. Less explored, however, is the role of social support in facilitating behavioral change and, consequently, sustained weight loss.

Different from the objective social support received, the subjective experience of the perceived social support seems to be a better predictor of the psychological adjustment. In fact, more than the size of the support network, it appears that it is the satisfaction with the support received that best relates to the engagement in adequate coping strategies and behavioral change [5]. In agreement with these findings, some authors suggested that satisfaction

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with social support was a positive predictor of both physical and mental qualities of life in bariatric patients [6]. A recent study using a focus group suggested that bariatric surgery patients express the need for frequent, and adequate peer, dietetic and psychological support to optimize weight and health outcomes [7]. For some patients, the lack of support resulted in lower satisfaction with treatment [8] and lower quality of life [6, 9]. Social support can be obtained from different individuals, formats or platforms. For instance, 84% of bariatric patients report utilizing online platforms, such as Facebook, to receive support, share accomplishments and challenges faced with health care professionals or as a result of weight-biased comments [10].

The role of social support (from family/peer to online social support) on weight and behavioral outcomes following surgery still presents mixed results in the existing literature. Only a few studies linked social support with weight outcomes, with some authors presenting positive trends but inconclusive findings [11]. For instance, Ray and colleagues [12] suggested that there is a trend for greater weight loss for patients with a higher number (> 9) of confidants. However, these findings were non-significant, similarly to results from other studies that found no association between the number of close friends and weight loss [9, 11]. More recently, a study examining a group of severely obese patients who participated in a behavioral weight loss program suggested that greater social support, compared with other psychological determinants (e.g., "self-efficacy to initiate diet", "favorable expectations about weight loss"), was the only factor associated with improved weight loss [13].

Family members can be an important source of support or undesirable interactions. On the one hand, support received from family members is expected to facilitate engagement in physical activity [14], and physical activity of patients and family members seems to be correlated [15]. Of note, a case study suggested that partnered patients undergoing bariatric surgery together tend to present similar adherence to follow-up sessions, and to reach or exceed their weight loss goals [16]. Ter Braak and colleagues [17] also showed that perceived social support from significant others to adhere to both dietary and exercise recommendations is a good indicator of successful weight loss. On the other hand, the significant life changes and the new lifestyle that patients are encouraged to adopt may collide with their spouse's habits and family times/routine [18]. Qualitative research also proposed that the relationship quality tends to decline after surgery for couples that do not adjust together to the behavioral modifications required by this treatment [18, 19]. Accordingly, there is evidence that non-married patients are more likely to adhere to dietary and physical activity recommendation and to achieve their target weight loss than married patients [20, 21].

With the significant changes in the family/life dynamics experienced after surgery [18, 19], perceived social support would be expected to be different pre- and post-operatively, but no study investigated this aspect. Moreover, despite the potential role of social support in favoring adherence to a healthier lifestyle and optimizing weight outcomes following surgery, to our knowledge, no study has investigated its association with problematic eating behaviors and psychological distress. The presence of maladaptive eating episodes associated with loss of control eating (such as binge eating, grazing behavior or emotional eating), and high levels of depression have been linked to poorer weight outcomes [22–24]. However, no study investigated if increased social support is related to less disordered eating or psychological distress. Additionally, the role of different sources of support (family, friends or significant others) on the psychological status of patients or on the endorsement on problematic eating patterns has not been compared. Finally, family and social support, in general, have been suggested to improve weight loss following surgery by helping patients to deal with psychosocial stressors and dietary changes [11, 15]. Thus, the relationship between psychological distress and problematic eating or weight outcomes would be expected to be stronger for patients with lower social support: patients with high levels of social support under psychological stress would not engage as much in problematic eating behaviors, nor would psychological stress have a significant impact on weight outcomes when social support is high.

Considering these observations and gaps in the literature of the role of social support in bariatric surgery, the aims of this study are: (a) to investigate if post-operative patients experience different levels of perceived social support compared to pre-operative patients; (b) to investigate correlations between perceived social support from different sources (family, friends and significant others) and problematic eating behaviors, psychological distress (depression) and weight loss after surgery; (c) and to investigate if social support is a moderator between psychological distress and disordered eating behavior, or between psychological/behavioral aspects and weight outcomes.

Methods

Procedure and participants

This cross-sectional study assessed a total of 130 primary bariatric surgery patients recruited from one main hospital center in the north of Portugal ($n = 7$ patients, 5% denied participation after invitation claiming they had no time for the assessment). The sample included 65 (50%) bariatric surgery candidates and 65 (50%) post-operative bariatric patients after 18 months of surgery.

Bariatric surgery candidates were invited to the study during their pre-operative appointment and assessed on the same day. Assessment of post-operative bariatric patients took place after their follow-up appointment with a professional of the bariatric surgery's multidisciplinary team. The assessment for the study was conducted by two researchers from the university institution involved with a PhD or MSc in clinical psychology and specific training in the measures used. The information collected was confidential and was not shared with the bariatric team (unless otherwise requested by the participant). Exclusion criteria included: illiteracy or not being able to understand/read Portuguese; mental disability; current pregnancy or breastfeeding. Patients accepting to participate were interviewed by one of the trained psychologists and responded to a set of self-report measures.

All participants were informed about the aims of the study and the voluntary nature of their participation. An informed consent form was signed by those accepting participating in our study. Ethical approval was obtained from the ethical review committees of the university and hospital involved.

Measures

Clinical interview

Socio-demographic and psychological variables were collected by a trained psychologist during a structured face-to-face clinical interview that includes questions regarding age, gender, educational level, marital, employment status, and type of surgery. Height and weight were extracted from the medical charts of the previous medical appointment.

Self-report measures

The Portuguese version of the following questionnaires was used.

Multidimensional Scale of Perceived Social Support (MSPSS) [5, 25]

This is a 21-item self-report measure designed to assess perceptions of social support adequacy from three specific sources: family (e.g., "I can talk to my family about my problems"), friends (e.g., "I can count on my friends when something goes wrong"), and significant others (e.g., "There is someone special in my life who cares about my feelings"). Items are rated from 1 ("Completely disagree") to 7 ("Completely agree"). Cronbach's α for our sample was 0.911 for the total score, 0.929 for the family, 0.876 for friends, and 0.968 for significant others' subscale.

Repetitive eating questionnaire [Rep(eat)-Q] [24]

This is a 15-item self-report measure that assesses a grazing-type eating pattern, i.e., eating repetitively small/modest amounts of food in an unplanned manner. This questionnaire generates a total score and two subscales: repetitive eating (e.g., "I eat "on and off" all day long without planning it") and compulsive grazing (e.g., "I did not want to eat, but felt that you could not avoid eating."). Items are rated from 0 ("never") to 6 ("every day") in relation to the frequency of the behavior in the previous 4 weeks. Higher scores indicate more grazing. Cronbach's α for our sample was 0.968 for the total score, 0.937 for the repetitive and 0.946 for the non-compulsive subscale.

Eating Disorder Examination—Questionnaire V17 (EDE-Q) [26, 27]

This is a 28-item self-report measure that evaluates eating disorder psychopathology. It generates a total score and four subscales: restraint (R; e.g., "(…) trying to limit the amount of food you eat to influence your shape or weight (…)"), shape concern (SC; e.g., "How dissatisfied have you been with your shape?"), weight concern (WC; e.g., "Has your weight influenced how you think about yourself (…)?") and eating concern (EC; e.g., "How concerned have you been about other people seeing you eat?"). Higher scores reveal greater eating disorder psychopathology. Cronbach's α for our sample was 0.891 for the total score, and 0.760 (R), 0.826 (SC), 0.704 (WC), and 0.724 (EC) for the respective subscales.

Three-Factor Eating Questionnaire-Revised 21 (TFEQ-R21) [28, 29]

This is a 21-item measure that assesses three cognitive and behavioral domains of eating that result on the corresponding three subscales: emotional eating, eating under strong emotions (EE; e.g., "I start to eat when I feel anxious"), uncontrolled eating, feelings of loss of control over eating (UE; e.g., "Sometimes when I start eating, I just can't seem to stop."), and cognitive restraint, intention to restraint eating (CR; e.g., "I deliberately take small helpings to control my weight."). Items are rated from 1 ("Definetily not true") to 4 ("Definitely not false"). Higher values indicate greater problematic eating. Cronbach's α for our sample was 0.858 for the total score, 0.927 for the EE, 0.905 for the UE, and 0.678 for the CR subscales.

Depression Anxiety Stress Scale (DASS-21-Dep) [30, 31]

The depression scale was used to (12 items) assesses depressive symptomatology over the previous week. Items are

rated from 0 ("Did not apply to me at all") to 3 ("Applied to me very much or most of the time"). Higher scores indicate more depressive symptoms. Cronbach's α for our sample was 0.863 for the total score.

Statistics

Differences between pre- and post-surgery scores on the self-report measures were tested with *t* test for independent sample, Mann–Whitney test or chi square depending on the nature of the distribution of each variable.

Partial correlations were used to correlate scores on social support with the other self-report measures while controlling for the assessment time (pre-/post-surgery). Spearman's correlation coefficient was used to correlate social support with weight outcomes for the post-surgery group: weight regain (current weight after surgery − lowest weight since surgery) and the percentage of total weight loss [(weight pre-surgery − current weight)/weight pre-surgery × 100]. Generalized linear models were conducted to investigate which of the variables found to be correlated with social support were significantly and independently correlated in a single model, and to test its interaction with the pre-/post-surgery assessment.

Moderation models were tested with the macro PROCESS [32] for SPSS, model 1 bootstrapping of 5000, bias corrected at the bootstrap confidence interval (CI) method, 95% CI, conditioning as pick-a-point with mean and ± 1 standard deviation. Significant interaction terms were examined by the Johnson–Neyman technique [32]. Social support was the moderator variable in all models tested. Time (number of months) elapsed since surgery was inserted as a co-variable for all models tested with the post-surgery group. Independent models were tested for patients assessed pre- and post-surgeries. Post hoc power analyses were calculated using G*Power3 software [33].

Results

Out of the 130 participants in our study, aged between 20 and 67 years ($M = 43.70$, SD 10.61), 87.7% ($n = 144$) were women and 12.3% ($n = 16$) were men. The majority ($n = 88$; 67.6%) was married or living with their partner. One hundred patients (76.9%) reported having children. A minority (3.1%; $n = 4$) had not completed any educational level, 23.1% ($n = 30$) completed primary school, 28.5% ($n = 37$) completed between primary and high school, 18.5% ($n = 24$) completed high school, and 26.9% ($n = 35$) attended or completed a college degree or more. About half of the sample was employed ($n = 74$; 56.9%), 30% ($n = 39$) was unemployed, and 13.1% ($n = 17$) was retired. The mean BMI for the pre-surgery group was 44.03 ± 5.48 and for the post-surgery group was 28.64 ± 5.12. In the post-surgery group, 36.9% ($n = 48$) of patients underwent sleeve gastrectomy and 63.1% ($n = 82$) underwent gastric bypass. The follow-up time since surgery varied from 18 to 36 months ($M = 26.12$, SD 7.97).

Perception of social support before and after bariatric surgery

Table 1 presents the pre- and post-surgery means and standard deviations of each scale and subscale scores. No significant differences were found between the pre- and post-surgery groups of patients in regard to the perception of support from friends, family or significant others (Table 1). However, it is noteworthy that post-surgery scores are lower than pre-operative scores for all types of social support. Except for the cognitive restraint subscale (TFEQ-R21_CR), the post-surgery group presented significant lower scores on most psychological/behavioral measures (depression, disordered eating psychopathology, emotional eating, uncontrolled eating and graze eating pattern).

Correlations between perceived social support and psychological aspects

Table 2 presents correlations between the MSPSS (social support) subscales, the other self-report measures, and weight outcomes. Partial correlations controlling for the variable pre/post-surgery showed that the perception of social support (total score) is significantly and inversely correlated with depression (DASS-21_Dep), emotional eating (TFEQ-R21_EE), and weight and shape concerns (EDE-Q_WC; EDE-Q_SC). The strongest correlation was found with depression ($r_s = 0.478$). No association was found with the other TFEQ-R21 and EDE-Q subscales (uncontrolled eating, cognitive restraint, restraint eating or concerns with food), nor with the Rep(eat)-Q (grazing).

To control for multiple testing, a GLM model was tested that included all the variables found to be significantly correlated with the MSPSS total score (DASS-21_Dep; TFEQ-R21_EE; EDE-Q_WC; EDE-Q_SC) and controlling for the variable pre-/post-surgery. The analysis produced a significant model (L.R. $\chi^2(7) = 33.1$, $p < 0.001$) in which only depression (DASS-21_Dep; Wald $\chi^2 = 25.74$, $p < 0.0001$; $\beta = -0.054$, SE 0.012) and the interaction between depression and pre/post-surgery (Wald $\chi^2 = 7.33$, $p < 0.001$; $\beta = -0.033$, SE 0.012) were independently and significantly associated with the perception of social support total score. The model suggests that higher depression is associated with significantly less perceived social support and that this relationship is stronger for the post-surgery group of patients.

Table 1 Descriptive analyses of the self-report measures responded at pre- and post-operative assessments

	M(SD)/mean rank (sum of ranks)/ (*N*/%)		Test statistic
	Pre-surgery	Post-surgery	
Employment situation[a]	63.97 (4158)	67.03 (4357)	2013
Educational level[a]	71.25 (4631)	59.75 (3884)	1739
Gender: female[b]	55 (84.6)	59 (90.8)	1.14
Marital status: married[b]	43 (66.2)	45 (69.2)	0.141
Children: yes[b]	48 (73.8)	52 (80)	0.693
Age (years)[c]	43.80 (10.48)	43.60 (10.81)	0.107
Social support			
MSPSS_total score[a]	67.73 (4334.50)	59.14 (3666.50)	− 1.33
MSPSS_Friends[a]	69.15 (4494.50)	39.71 (3761.50)	− 1.46
MSPSS_Family[a]	65.86 (4281.50)	63.10 (3975.00)	− 0.44
MSPSS_Significant Others[a]	68.38 (4376.50)	60.62 (3879.50)	− 1.30
Psychological functioning			
DASS-21_depression[c]	4.94 (4.83)	3.03 (3.31)	**2.60***
Disordered eating psychopathology/behaviors			
TFEQ-R21_UE[c]	2.39 (0.67)	1.66 (0.68)	**6.08*****
TFEQ-R21_ CR[c]	2.65 (0.60)	2.77(0.68)	− 1.08
TFEQ-R21_EE[c]	2.54 (0.83)	1.76 (0.79)	**5.40*****
Rep(eat)–Q_ total score[c]	1.74 (1.39)	0.82 (1.17)	**4.02*****
EDE-Q_global score[c]	2.62 (0.90)	1.50 (1.00)	**6.62*****
EDE-Q_R[c]	1.89 (1.45)	1.30 (1.19)	**2.51***
EDE-Q_SC[c]	3.53 (1.25)	2.12 (1.44)	**5.94*****
EDE-Q_WC[c]	3.73 (1.16)	1.94 (1.55)	**7.43*****
EDE-Q_EC[c]	1.31 (1.13)	0.72 (0.91)	**3.27***
Weight outcomes			
	N(%)/M(SD); min (max)		
%TWL	–	33.34 (9.56); − 0.96 (52.00)	–
WR (%)	–	37 (28.5%)	–
WR	–	5.11 (3.92); 1 (21)	–

Significant differences are highlighted in bold

MSPSS Multidimensional Scale of Perceived Social Support, *DASS* Depression Anxiety Stress Scale, *EDE-Q* Eating disorder examination questionnaire, *EDE-Q_R* restraint scale, *EDE-Q_SC* shape concern scale, *EDE-Q_WC* weight concern scale, *EDE-Q_EC* eating concern scale, *TFEQ-R21_ EE* Three-Factor Eating Questionnaire—emotional eating scale, *TFEQ-R21_UE* Three-Factor Eating Questionnaire—uncontrolled eating scale, *TFEQ-R21_CR* Three-Factor Eating Questionnaire—cognitive restriction scale, *Rep(eat)-Q* Repetitive Eating Questionnaire, *%TWL* percentage of total weight lost, *WR (%)* percentage of participants presenting any weight regain (> 1 kg), *WR* mean weight regain within those who presented any weight

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Mann–Whitney test

[b]Chi-square test

[c]*t* test

Association between perceived social support and weight outcomes

Considering the group of patients assessed at post-surgery, greater perception of social support (specifically support from family members and significant others) was associated with higher %TWL. Support from family members was further associated with less weight regain. However, correlations with weight outcomes were moderate to weak (≤ 0.398). Support from friends was not associated with any weight outcomes (Table 2).

The moderator role of social support: association with disordered eating psychopathology

We investigated if the perception of social support would be a moderator in the relationship between psychological distress (depressive symptoms) and disordered eating-related

Table 2 Partial correlations between the perception of social support, psychological aspects and weight outcomes

	MSPSS_ Total score	MSPSS_ Family	MSPSS_ Friends	MSPSS_ Significant others	DASS-21_ depression	TFEQ-R21_UE	TFEQ-R21_CR	TFEQ-R21_ EE	Rep(eat)-Q_total score	EDE-Q_ global score	EDE-Q_R	EDE-Q_ SC	EDE-Q_ WC	EDE-Q_ EC	PTWL
MSPSS_ Total score[a]															
MSPSS_ Family[a]	**0.80*****														
MSPSS_ Friends[a]	**0.81*****	**0.42*****													
MSPSS_ Significant others[a]	**0.75*****	**0.53*****	**0.37*****												
DASS-21_ depression[a]	**−0.48*****	**−0.33*****	**−0.38*****	**−0.44*****											
TFEQ-R21_ UE[a]	−0.15	−0.15	−0.08	−0.16	**0.45*****										
TFEQ-R21_ CR[a]	−0.004	−0.09	0.08	−0.01	−0.17	**−0.31****									
TFEQ-R21_ EE[a]	**−0.26****	**−0.28****	−0.14	**−0.23***	**0.39*****	**0.68*****	−0.16								
Rep(eat)-Q_total score[a]	0.001	−0.06	0.03	−0.10	**0.32*****	**0.65*****	**−0.28****	**0.47*****							
EDE-Q_ global score[a]	−0.17	−0.17	−0.13	−0.12	**0.42*****	**0.42*****	**0.24****	**0.42*****	**0.30****						
EDE-Q_ R[a]	−0.06	−0.17	0.06	−0.04	0.15	0.08	**0.54*****	0.14	−0.02	**0.61*****					
EDE-Q_ SC[a]	**−0.20***	−0.12	**−0.21***	−0.13	**0.34*****	**0.36*****	0.10	**0.31****	**0.26****	**0.86*****	**0.26****				
EDE-Q_ WC[a]	**−0.19***	−0.12	−0.17	−0.15	**0.38*****	**0.38*****	0.06	**0.33*****	**0.25****	**0.82*****	**0.24****	**0.76*****			
EDE-Q_ EC[a]	−0.07	−0.07	−0.04	−0.04	**0.41*****	**49*****	−0.01	**0.55*****	**0.48*****	**0.71*****	**0.31****	**0.55*****	**0.39*****		
PTWL[b]	**0.26***	**0.33****	0.11	**0.251***	**−0.34****	**−0.28***	0.12	−0.05	**−0.29***	−0.19	−0.06	−0.20	**−0.30***	−0.01	

Table 2 (continued)

	MSPSS_ Total score	MSPSS_ Family	MSPSS_ Friends	MSPSS_ Significant others	DASS-21_ depression	TFEQ-R21_UE	TFEQ-R21_CR	TFEQ-R21_EE	Rep(eat)-Q_total score	EDE-Q_ global score	EDE-Q_R	EDE-Q_ SC	EDE-Q_ WC	EDE-Q_ EC	PTWL
WR[b]	−0.23	**−0.36****	−0.07	−0.195	**0.34****	**0.40****	0.02	0.23	**0.36****	**0.29***	**0.25***	0.14	**0.32****	0.16	**−0.41***

Significant differences are highlighted in bold

MSPSS Multidimensional Scale of Perceived Social Support, *DASS-21* Depression Anxiety Stress Scale, *EDE-Q* Eating Disorder Examination Questionnaire, *EDE-Q_R* restraint scale, *EDE-Q_SC* shape concern scale, *EDE-Q_WC* weight concern scale, *EDE-Q_EC* eating concern scale, *TFEQ-R21_EE* Three-Factor Eating Questionnaire—emotional eating scale, *TFEQ-R21_UE* Three-Factor Eating Questionnaire—uncontrolled eating scale, *TFEQ-R21_CR* Three-Factor Eating Questionnaire—cognitive restriction scale, *Rep(eat)-Q* Repetitive Eating Questionnaire, *PTWL* Percentage of total weight lost, *WR* mean weight regain within those who presented any weight

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Partial correlation coefficient

[b]Spearman's Rank coefficient

behaviors/psychopathology. Different moderation models were tested with the perception of support from friends, family and significant others as moderators in the relation between depressive symptoms and the different disordered eating variables (emotional eating, uncontrolled eating, cognitive restraint, grazing), and eating disorder psychopathology (EDE-Q). No moderator effect was found for the pre-surgery group. For the post-surgery group of patients, perceived support from family and significant others was significant moderators in the relationship between depression, weight concern and shape concern subscales. To simplify our results, we tested a final model in which the moderator was the mean of the perceived support from family + significant others, and the dependent variable was the mean of the weight + shape concern EDE-Q subscales (combined Cronbach's $\alpha = 0.885$). This model was significant [$F(4,58) = 3.45$, $p = .013$, $R^2 = 0.22$] and is depicted in Fig. 1. The corresponding statistics are presented in Table 3. Post hoc power analyses considering $R^2 = 0.22$, effect size = 0.28; $\alpha < 0.05$ and 3 predictors resulted in an excellent power = 0.94 for this model. The model showed a significant interaction effect between depression and perceived support from family/significant others, suggesting that for low levels of perceived support (< 4.81) there is not a significant relationship between depression and weight/shape concerns, with rather high values of weight/shape concern regardless of the depression scores. On the other hand, for medium to high levels (≥ 4.81) of perceived support, the levels of depression are associated with the scores of weight/shape concerns being that the greater the depression scores, the greater the weight/shape concerns. Generally, these findings suggest that when perceived support from family/significant others is high, low levels of depression are associated with significantly lower levels of weight/shape concerns compared to patients with high levels of depression (Fig. 1).

The moderator role of social support: association with weight outcomes

We further investigated if the relation between psychological/behavioral aspects and weight outcomes would be moderated by the perception of social support. Different models were tested with each source of perceived social support as a moderator in the relation between the different psychological variables assessed and weight outcomes (%TWL and WR).

A significant model [$F(4,58) = 3.97$, $p = .006$, $R^2 = 0.18$] showed that the relation between depressive symptoms and the %TWL is moderated by the perceived support from family (see Table 3 for the statistics). Post hoc power analyses considering $R^2 = 0.18$, effect size = 0.22; $\alpha < 0.05$ and 3 predictors resulted in a very good power = 0.88 for this model. For patients with lower levels of perceived support from family (< 5.6), the %TWL is low independently of

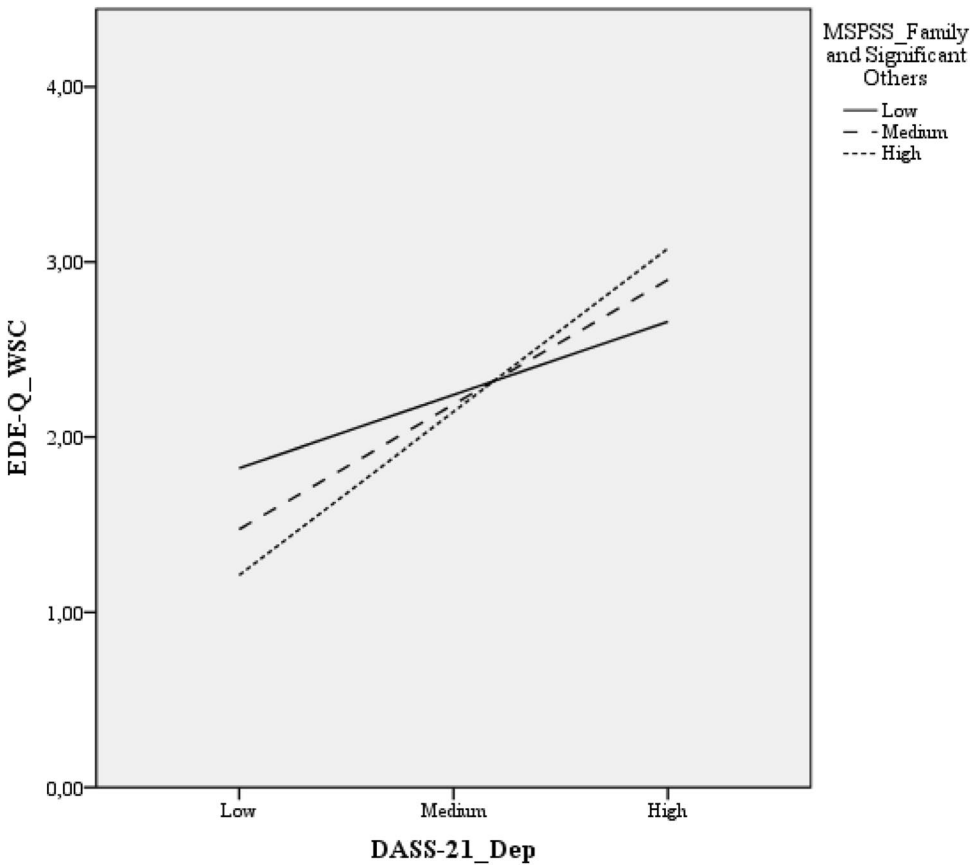

Fig. 1 Model 1: association between depressive symptoms (axis X) and weight/shape concerns (axis *Y*) in relation to different levels of perceived support from family and significant others (Moderator). *EDE-Q_WSC* Eating Disorder Examination Questionnaire_Weight and Shape Concern Scales, *DASS-21_Dep* Depression Anxiety Stress Scale_Depression Scale, *MSPSS* Multidimensional Scale of Perceived Social Support

the levels of depression. On the other hand, for medium to high levels of perceived support from family (≥ 5.6), less depressive symptoms are associated with significantly greater %TWL compared to patients with high levels of depression. Generally, these results indicate that the association between depressive symptoms and %TWL is significant for patients with medium to high levels of social support, and the perceived support from family is particularly important and associated with the greater %TWL for patients with lower levels of depression (Fig. 2).

In regard to weight regain, a significant model [$F(4,57) = 11.9$, $p < .001$, $R^2 = 0.45$] showed that the relation between grazing behavior and weight regain is moderated by the perceived support from family (see Table 3 for the statistics). Post hoc power analyses considering $R^2 = 0.45$, effect size = 0.82; $\alpha < 0.05$ and three predictors resulted in an excellent power = 0.99 for this model. For patients with high levels (> 4.7) of perceived support from family, weight regain is low independently of the Rep(eat)-Q scores. However, for low to medium scores (≤ 4.7) of perceived support from family, the higher the scores in the Rep(eat)-Q, the greater the weight regain experienced by patients. These results suggest that graze eating is associated with weight regain specifically for patients reporting low to medium levels of perceived support from family, for whom greater grazing is associated with greater weight regain (Fig. 3).

Discussion

This study sought to bring further evidence for the role of social support in patients undergoing bariatric surgery and its association with psychological aspects and weight outcomes. We should note that both groups were similar on the relevant socio-demographic variables, but that significant differences were found between the pre- and post-surgery groups for the psychological variables expected to be lower for the post-operative group (depression, disordered eating). However, perceived social support was not significantly different in patients assessed at pre- and post-surgery. One explanation could be that undesirable interactions and challenges that result in less perceived support after surgery may steam, to a great extent, from marital relationships [18, 19]. In this study, we have assessed support from family and significant others in general which might produce different results. The published literature suggests a difference in perceived support from friends post-operatively considering that patients frequently report an increase in their social life after surgery [34]. However, the results showed no

Table 3 Moderation analyses statistics for the three models tested

	Coefficient	SE	*t* test	*p*
Model 1	X = DASS-21_Depression Y = EDE-Q_WSC M = MSPSS_Family and significant others			
MSPSS_Family and significant others	− 0.038	0.166	− 0.231	0.818
DASS-21_Depression	0.213	0.079	2.699	**0.009**
MSPSS_Family and significant others × DASS-21_Depression	0.061	0.029	2.062	**0.044**
FU_time	0.023	0.024	0.962	0.339
	Conditional effects			
Low	0.125	0.073	1.713	0.092
Median	0.213	0.079	2.699	**0.009**
High	0.279	0.096	2.894	**0.005**
Model 2	X = DASS-21_Depression Y = %TWL M = MSPSS_Family			
MSPSS_Family	1.101	0.879	1.253	0.215
DASS-21-Depression	− 0.828	0.399	− 2.072	**0.043**
MSPSS_Family × DASS-21_Depresion	− 0.404	0.126	− 3.209	**0.002**
FU_time	− 0.174	0.169	− 1.021	0.311
	CONDITIONAL EFFECTS			
Low	− 0.123	0.332	− 0.369	0.713
Median	− 0.829	0.399	− 2.072	**0.043**
High	− 1.334	0.505	− 2.643	**0.010**
Model 3	X = Rep(eat)-Q Y = WR M = MSPSS_ Family			
MSPSS_Family	− 0.459	0.239	− 1.918	**0.060**
Rep(eat)-Q	1.698	0.409	4.156	**0.000**
MSPSS_Family × Rep(eat)-Q	− 0.939	0.349	− 2.689	**0.009**
FU_time	0.227	0.052	4.339	**0.000**
	Conditional effects			
Low	3.339	0.913	3.657	**0.000**
Median	1.698	0.409	4.156	**0.000**
High	0.546	0.379	1.440	0.155

Statistical significant differences are highlighted in bold

DASS-21_Depression Depression Anxiety Stress Scales, *EDE-Q_WSC* Eating Disorder Examination Questionnaire_Weight and Shape Concern Scales, *Rep(eat)-Q* Repetitive Eating Questionnaire, *MSPSS* Multidimensional Scale of Perceived Social Support, *FU_time* follow-up time, *%TWL* percentage of total weight lost, *WR* mean weight regain within those who presented any weight

significant difference between patients pre- and post-surgery. These findings raise the question as to whether the quality of the new relationships established follows the increase of new friendships and social life. Notwithstanding, Pereira and colleagues [6] found that patients report increased satisfaction with social support post-operatively compared to pre-surgery scores. These finds highlight the fact that perceived social support seems to be different from the satisfaction with the support system, and it may be that these two concepts play different roles in the bariatric surgery outcomes.

The psychological variable that showed the strongest correlation with perceived social post-surgery support was depression. Our findings indicate that perceived social support tends to be lower in patients scoring higher in depression symptoms and that this relation is particularly significant for post-surgery patients. Additionally, higher scores on emotional eating and weight/shape concerns were associated with lower levels of perceived social support although the strength of these correlations was moderate to low.

Depressive symptoms and disordered eating behaviors have been linked with poor weight outcomes [35, 36], and we sought to investigate if perceived social support would moderate the relationship between these aspects in a way that this relationship would be weaker for people with

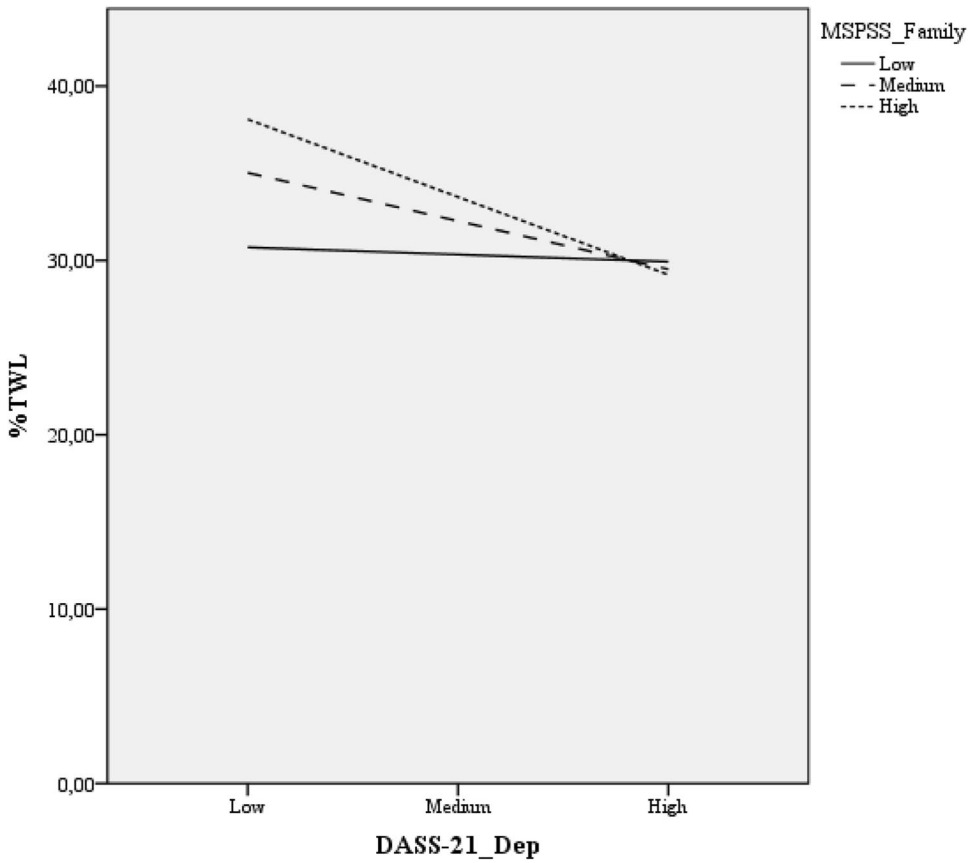

Fig. 2 Model 2: association between depressive symptoms (*X*-axis) and percentage of total weight loss (*Y*-axis) in relation to different levels of perceived support from family (moderator). *%TWL* percentage of total weight lost, *DASS-21_Dep* Depression Anxiety Stress Scale_Depression Scale, *MSPSS* Multidimensional Scale of Perceived Social Support

greater social support. In our study, social support was not a moderator between depression and problematic eating such as uncontrolled eating, emotional eating, cognitive restraint or grazing. However, we found a significant moderator effect for perceived support from family/significant others between depression and weight/shape concerns in the post-surgery group. Surprisingly, post-operatively, there was a significant relationship between depression and weight/shape concerns for high levels of support: more depressive symptoms are associated with more shape/weight concerns, but only for people reporting medium to high levels of perceived support from family/significant others. It is possible that high levels of depression and associated compromised functioning (such as high levels of weight/shape concerns) elicit higher levels of support from families for a subgroup of post-operative patients.

On the other hand, for the post-surgery patients, high levels of support seem to have a particularly important role for individuals with low levels of depressive symptoms, being associated with the lowest weight/shape concerns. Research has shown that a subgroup of patients develops important body image concerns after surgery and the development of eating disorders has also been reported [37–39]. Some patients experience an intense (and legitimate) fear of weight regain [37–40], and frequently, the resulting excessive hanging skin after significant weight loss is thought to be associated with the development of weight/shape concerns, eating disorder psychopathology and depressive symptoms, and, ultimately, poor weight outcomes [39]. Thus, promoting adequate support from family and significant others may have a role in helping patients to deal with the changes in their body faced post-surgery. Notwithstanding, aspects suggesting disordered eating psychopathology, such as high levels of psychological impairment or weight/shape concerns, should be a target of specialized clinical attention in post-operative patients. Under clinically significant circumstances, general social support may have a limited effect.

For the post-surgery group, social support was further associated with weight outcomes in a way that greater social support was correlated with both more weight loss and less weight regain. We investigated if social support would be a moderator in the relationship between psychological/behavioral aspects and weight outcomes. Our data supported this assumption showing that lower levels of social support were associated with less %TWL independently of the depression levels. On the other hand, for medium to high levels of social support, there is a significant and positive correlation between depression and weight loss, in which lower levels of depressive symptoms are associated with the highest %TWL.

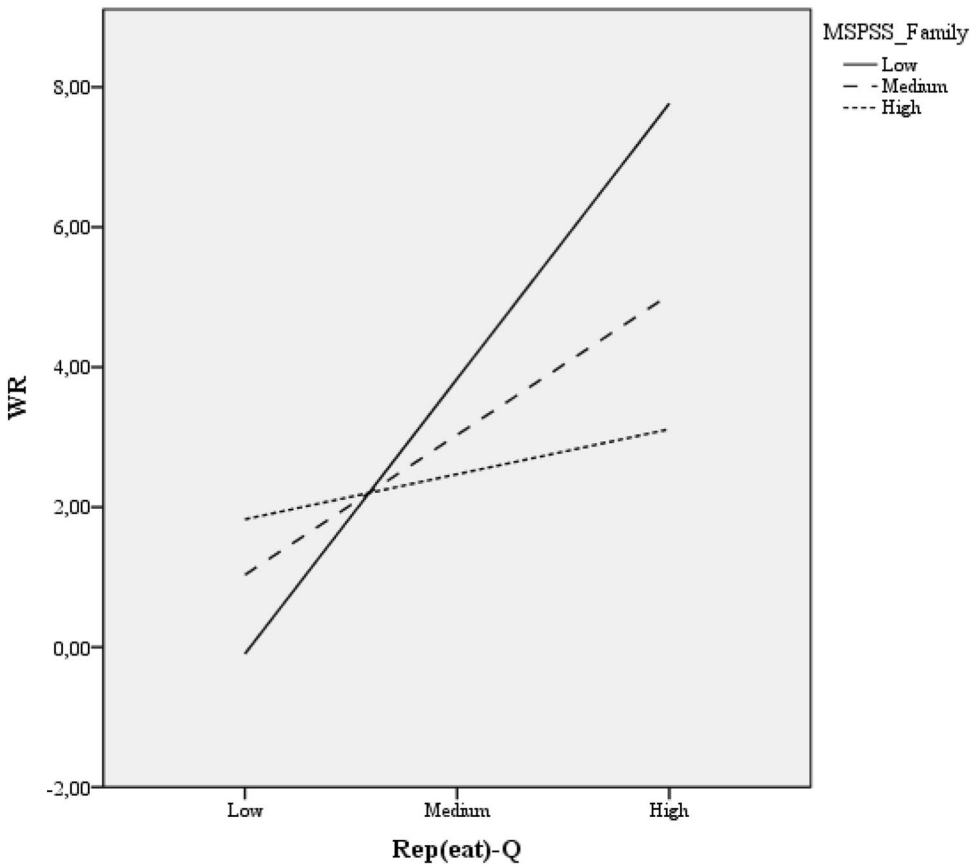

Fig. 3 Model 3: association between grazing behavior (*X*-axis) and weight regain (*Y*-axis) in relation to different levels of perceived support from family (moderator). *WR* mean weight regain within those who presented any weight, *Rep(eat)-Q* Repetitive Eating Questionnaire, *MSPSS* Multidimensional Scale of Perceived Social Support

Regarding weight regain, only assessed for the post-surgery group, our results point in a different direction. Perceived support from family was found to be a moderator in the relationship between grazing behavior and weight regain. Accordingly, weight regain was low for patients with higher levels of perceived family support, independently of the scores in graze eating patterns. However, for patients with medium to low levels of perceived support from family, an increase in grazing was significantly associated with more weight regain. Our results show that the association between the presence of problematic eating behaviors and weight regain seems to be of particular concern when perceived support from family is low, and higher levels of perceived support from family may have a buffering effect in this relation. Previous research suggested that social support may optimize adherence to healthy behaviors [14, 15, 20] and these findings suggest that social support may also aid patients to deal with the tendency to engage in problematic eating behaviors such as grazing. Unfortunately, we were not able to establish this relationship to other disordered eating behaviors such as emotional eating, uncontrolled eating or cognitive restraint, and future research is needed to produce further data on this matter.

Importantly, perceived social support from family members showed the strongest correlation with weight outcomes, only assessed in the post-surgery group, when compared to other types of social support. Family environment/support, more than support from friends and significant others, may establish the grounds for a better adherence to the lifestyle changes required after surgery. However, the mechanisms through which family support operates to result in better weight outcomes are widely unknown and warrant further investigation. These findings highlight the potential role of good social support from family members particularly after surgery. Accordingly, involving family members in the post-operative appointments, assessing their concerns and struggles with the new lifestyle of the person who received bariatric surgery, and encouraging attitudes that facilitate adaptive behaviors have been suggested by other authors [15]. Finally, it is noteworthy that, despite the correlations found between social support and the other self-report measures for pre- and post-surgery patients, the moderation role of social support was only found for the post-surgery group. It might be that the pre-operative compromise of psychological/behavioral functioning is a result of several other factors associated with the condition of severe obesity in which social support plays a minor role.

The limitations of this study should be considered when interpreting these findings. First, perceived support might differ from actual support received or the number of

supporting members. Thus, despite the non-differences in perceived social support, actual support received may be different pre- and post-surgery. Furthermore, the MSPSS is highly centered in emotional support (e.g., "There is a special person in my life who cares about my feelings") which may differ from the role of instrumental support (e.g., help with logistics to maintain a regular eating pattern) or informative support (e.g., access to information on how to cope with problematic eating behaviors) in facilitating adjustment to an adaptive lifestyle. Instrumental and informative support may vary significantly as patients need to change life habits and there is a great deal of information communicated by professionals and other patients (particularly in online social networks). Second, our study has a cross-sectional design, and our results may be biased by the fact that we compared two different groups of patients. Thus, despite the non-significant differences found in social support between the two groups of patients, whether perceived social support changes from pre- to post-surgery is yet to be investigated. Additionally, our sample was mainly constituted by female participants, and social support may be perceived differently across genders, for which we should not generalize our results to the male patients. Although no studies have investigated gender differences in social support in the bariatric population, studies with college students suggest that perceived social support in women presents stronger correlations with depression than in men [5]. Women also report greater perceived support from friends and significant others than men [5]. However, studies with a cohort of healthy civil servant workers showed that social support may be protective against weight gain over time, particularly in men [41]. Thus, studies on gender differences in social support remain inconclusive, and future research is necessary to fully explore these differences in the bariatric population. Finally, the time elapsed after surgery ranged from 18 to 36 months, and a more homogenous sample with follow-up times of more than 24 months of surgery may be required to produce stronger associations [1, 2].

Conclusion

Despite the changes in family or social life experienced by patients after surgery, perceived social support does not seem to be significantly different between a group of patients assessed pre-surgery and a group assessed post-surgery. The significant correlations found between perceived social support and depression, disordered eating and weight outcomes highlight the importance of considering and working with the social support network of patients undergoing bariatric surgery. Additionally, perceived support from family seems to play an essential role in explaining variations in weight loss and weight regain, particularly for patients with high depressive symptomatology and high graze eating patterns. Family members may provide the emotional support or the structure to help patients optimize their weight loss when depression is low, or to deal with the tendency to engage in disordered eating patterns. Finally, for high levels of depression or disordered eating psychopathology, perceived social support may not be enough to explain these psychological states and specialized interventions should be available.

Acknowledgements The authors wish to acknowledge Dr. Isabel Brandão and the AMTCO group (Avaliação Multidisciplinar do Tratamento Cirúrgico da Obesidade) at the Hospital of São João, Porto, for facilitating access to the patients and conducting the multidisciplinary treatment as usual of the participants of this study.

Funding This study was partially conducted at Psychology Research Centre (PSI/01662), University of Minho, and supported by the Portuguese Foundation for Science and Technology and the Portuguese Ministry of Science, Technology and Higher Education through national funds, and co-financed by FEDER through COMPETE2020 under the PT2020 Partnership Agreement (POCI-01-0145-FEDER-007653), by the following grants to Eva Conceição (IF/01219/2014 and POCI-01-0145-FEDER-028209), and doctoral scholarship to Ana Pinto-Bastos (SFRH/BD/104159/2014) and to Sofia Ramalho (SFRH/BD/104182/2014), and post-doctoral grant to Ana R. Vaz (SFRH/BPD/94490/2013). The funding body had no role in the design, collection, analysis, and interpretation of data; the writing of the manuscript; or the decision to submit the manuscript for publication.

Compliance with ethical standards

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

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Courcoulas AP, King WC, Belle SH, Berk P, Flum DR, Garcia L et al (2017) Seven-year weight trajectories and health outcomes in the longitudinal assessment of bariatric surgery (LABS) Study. JAMA Surg 15213:1–8
2. Conceição EM, Mitchell JE, Pinto-Bastos A, Arrojado F, Brandão I, Machado PPP (2017) Stability of problematic eating behaviors and weight loss trajectories after bariatric surgery: a longitudinal observational study. Surg Obes Relat Dis 13(6):1063–1070. https://doi.org/10.1016/j.soard.2016.12.006
3. Mitchell JE, Christian NJ, Flum DR, Pomp A, Pories WJ, Wolfe BM et al (2016) Postoperative behavioral variables and weight change 3 years after bariatric surgery. JAMA Surg 151(8):752–757. https://doi.org/10.1001/jamasurg.2016.0395
4. Galioto R, Gunstad J, Heinberg LJ, Spitznagel MB (2013) Adherence and weight loss outcomes in bariatric surgery: does cognitive

function play a role? Obes Surg 23(10):1703–1710. https://doi.org/10.1007/s11695-013-1060-6
5. Zimet GD, Powell SS, Farley GK, Werkman S, Berkoff K (1990) Psychometric characteristics of the multidimensional scale of perceived social support. J Pers Assess 55(3–4):610–617. https://doi.org/10.1207/s15327752jpa5503&%23x0026;4_17
6. Pereira MG, Faria S, Lopes H. Quality of life one year after bariatric surgery: the moderator role of spirituality. Obeity Surg. 2019;1–9. https://doi.org/10.1007/s11695-018-03669-4
7. Sharman M, Hensher M, Wilkinson S, Williams D, Palmer A, Venn A et al (2017) What are the support experiences and needs of patients who have received bariatric surgery? Heal Expect 20(1):35–46. https://doi.org/10.1111/hex.12423
8. Valley V, Grace DM (1987) Psychosocial risk factors in gastric surgery for obesity: identifying guidelines for screening. Int J Obes 11(2):105–113
9. Sabbioni MEE, Dickson MH, Eychmuller S, Francke D, Goetz S, Hurny C et al (2002) Intermediate results of health related quality of life after vertical banded gastroplasty. Int J Obes 26:277–280. https://doi.org/10.1038/sj/ijo/0801879
10. Koball AM, Jester DJ, Domoff SE, Kallies KJ, Grothe KB, Kothari SN (2017) Examination of bariatric surgery Facebook support groups: a content analysis. Surg Obes Relat Dis 13(8):1369–1375. https://doi.org/10.1016/J.SOARD.2017.04.025
11. Livhits M, Mercado C, Yermilov I, Parikh JA, Dutson E, Mehran A et al (2011) Is social support associated with greater weight loss after bariatric surgery?: a systematic review. Obes Rev 12:142–148. https://doi.org/10.1111/j.1467-789X.2010.00720.x
12. Ray EC, Nickels MW, Sayeed S, Sax HC, Matthews JB, Maher JW et al (2003) Predicting success after gastric bypass: the role of psychosocial and behavioral factors. Surgery 134(4):555–564. https://doi.org/10.1016/S0039-6060(03)00279-4
13. Funk LM, Grubber JM, Mcvay MA, Olsen MK, Yancy WS, Voils CI et al (2018) Patient predictors of weight loss following a behavioral weight management intervention among US Veterans with severe obesity. Eat Weight Disord Stud Anorexia Bulim Obes 23(5):587–595. https://doi.org/10.1007/s40519-017-0425-6
14. Treiber FA, Baranowski T, Braden DS, Strong WB, Levy M, Knox W (1991 Nov) Social support for exercise: relationship to physical activity in young adults. Prev Med (Baltim) 20(6):737–750. https://doi.org/10.1016/0091-7435(91)90068-F
15. Lent MR, Bailey-Davis L, Irving BA, Wood GC, Cook AM, Hirsch AG et al (2016) Bariatric surgery patients and their families: health, physical activity, and social support. Obes Surg 26(12):2981–2988. https://doi.org/10.1007/s11695-016-2228-7
16. Mehta A, Hutfless S, Blair AB, Karcher M, Nasatka S, Schweitzer M et al (2017) Outcomes of partnered individuals undergoing bariatric surgery together: a single institution case series. Obes Surg 27(8):2207–2210. https://doi.org/10.1007/s11695-017-2728-0
17. Ter Braak UBJM, Hinnen C, De Jong MMC, Van De Laar A (2018) Perceived postoperative support differentiates responders from non-responders 3 years after laparoscopic Roux-en-Y gastric bypass. Obes Surg 28:415–520. https://doi.org/10.1007/s11695-017-2852-x
18. Ferriby M, Pratt KJ, Balk E, Feister K, Noria S, Needleman B (2015) Marriage and weight loss surgery: a narrative review of patient and spousal outcomes. Obes Surg 25:2436–42. https://doi.org/10.1007/s11695-015-1893-2
19. Wallwork A, Tremblay L, Chi M, Sockalingam S (2017) Exploring partners' experiences in living with patients who undergo bariatric surgery. Obes Surg 27(8):1973–1981. https://doi.org/10.1007/s11695-017-2594-9
20. Lutfi R, Torquati A, Sekhar N, Richards WO (2006) Predictors of success after laparoscopic gastric bypass: a multivariate analysis of socioeconomic factors. Endosc Other Interv Tech 20(6):864–867. https://doi.org/10.1007/s00464-005-0115-8
21. Wheeler E, Prettyman A, Lenhard MJ, Tran K (2008) Adherence to outpatient program postoperative appointments after bariatric surgery. Surg Obes Relat Dis 4(4):515–20. https://doi.org/10.1016/J.SOARD.2008.01.013
22. Nasirzadeh Y, Kantarovich K, Wnuk S, Okrainec A, Cassin SE, Hawa R et al (2018) Binge eating, loss of control over eating, emotional eating, and night eating after bariatric surgery: results from the Toronto Bari-PSYCH Cohort Study. Obes Surg. https://doi.org/10.1007/s11695-018-3137-8
23. Fischer S, Chen E, Katterman S, Roerhig M, Bochierri-Ricciardi L, Munoz D et al (2007) Emotional eating in a morbidly obese bariatric surgery-seeking population. Obes Surg 17(6):778–784. https://doi.org/10.1007/s11695-007-9143-x
24. Conceição E, Mitchell J, Machado P, Vaz A, Pinto-Bastos A, Ramalho S et al (2017) Repetitive eating questionnaire [Rep(eat)-Q]: enlightening the concept of grazing and psychometric properties in a Portuguese sample. Appetite 117:351–358. https://doi.org/10.1016/j.appet.2017.07.012
25. Carvalho S, Pimentel P, Maia D, Mota-pereira J (2011) Características psicométricas da versão portuguesa da Escala Multidimensional de Suporte Social Percebido. Psychologica 54:309–358
26. Fairburn CG, Cooper Z, O'Connor M (2014) The eating disorder examination (edition 17.0)
27. Machado PP, Martins C, Vaz A, Conceição E, Bastos AP, Gonçalves S (2014) Eating disorder examination questionnaire (EDE-Q): psychometric properties and norms for the portuguese population. Eur Eat Disord Rev 22(6):448–453. https://doi.org/10.1002/erv.2318
28. Cappelleri J, Bushmakin A, Gerber R, Leidy N, Sexton C, Lowe M et al (2009) Psychometric analysis of the Three-Factor Eating Questionnaire-R21: Results from a large diverse sample of obese and non-obese participants. Int J Obes 33(6):611–620. https://doi.org/10.1038/ijo.2009.74
29. Moreira P, Almeida L, Sampaio D, Almeida MD (1997) Escala para avaliação do comportamento alimentar: Adaptação portuguesa em jovens universitários saudáveis. In: Gonçalves M, Ribeiro I, Araujo S, Al E (eds) Avaliação psicológica: Formas e contextos. V. Apport, Braga, pp 641–658
30. Lovibond SH, Lovibond PF (1995) Manual for the depression anxiety stress scales, 2nd edn. Psychology Foundation, Sydney
31. Pais-Ribeiro J, Honrado A, Leal I (2004) Contribuição Para O Estudo Da Adaptação Portuguesa Das Escalas De Ansiedade, Depressão E Stress (Eads) De 21 Itens De Lovibond E Lovibond. Psicol Saúde Doenças 5(2):229–239. https://doi.org/10.1080/13548500500524088
32. Hayes AF (2013) Introduction to mediation, moderation, and conditional process analysis. A regression-based approach. Guilford, New York, pp 79–81
33. Faul F, Erdfelder E, Lang A-G, Buchner A (2007) G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods 39(2):175–191. https://doi.org/10.3758/BF03193146
34. Ficaro I (2018) Surgical weight loss as a life-changing transition: the impact of interpersonal relationships on post bariatric women. Appl Nurs Res 40(2017):7–12. https://doi.org/10.1016/j.apnr.2017.12.003
35. Conceição EM, Utzinger LM, Pisetsky EM (2015) Eating disorders and problematic eating behaviours before and after bariatric surgery: characterization, assessment and association with treatment outcomes. Eur Eat Disord Rev 23:417–425. https://doi.org/10.1002/erv.2397
36. Mitchell J, King W, Chen J, Devlin M, Flum D, Garcia L et al (2014) Course of depressive symptoms and treatment in the longitudinal assessment of bariatric surgery (LABS-2) study. Obesity 22(8):1799–1806. https://doi.org/10.1001/jamasurg.2016.0395

37. Conceição E, Orcutt M, Mitchell J, Engel S, Lahaise K, Jorgensen M et al (2013) Eating disorders after bariatric surgery: a case series. Int J Eat Disord 46(3):274–279. https://doi.org/10.1002/eat.22074
38. Pona AA, Heinberg LJ, Lavery M, Ben-Porath YS, Rish JM (2016 Jan) Psychological predictors of body image concerns 3 months after bariatric surgery. Surg Obes Relat Dis 12(1):188–193. https://doi.org/10.1007/s11695-018-03669-4
39. Ramalho S, Pinto-Bastos A, Silva C, Vaz A, Brandão I, Machado P et al (2015) Excessive skin and sexual function: relationship with psychological variables and weight regain in women after bariatric surgery. Obes Surg 25(7):1149–1154. https://doi.org/10.1007/s11695-014-1514-5
40. Conceição E, Vaz A, Pinto-Bastos A, Ramos A, Machado P (2013) The development of eating disorders after bariatric surgery. Eat Disord 21(3):275–282. https://doi.org/10.1080/10640266.2013.779193
41. Tymoszuk U, Kumari M, Batterham R, Stafford M (2018) Social support and trajectories of body mass index and waist to hip ratio from mid-adulthood to old age. J Epidemiol Community Health 73(2):1–6. https://doi.org/10.1136/jech-2018-210525