

ORIGINAL ARTICLE

The effects of weight loss after bariatric surgery on health-related quality of life and depression

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BACKGROUND: In severe obesity, impairments in health-related quality of life (HRQoL) and dysphoric mood are reported. This is a post-surgery analysis of the relationship between HRQoL and depressive symptoms, and weight change after four different types of bariatric procedures.

METHODS: A total of 105 consented patients completed the Short-Form-36 Health Survey (SF-36), the Impact of Weight on Quality of Life-Lite (IWQOL-Lite) and the Beck Depression Inventory (BDI) before and 25 months after surgery. Analysis of variance or Kruskal–Wallis test evaluated changes.

RESULTS: Patients with Roux-en Y gastric bypass (46 patients), decreased body mass indexes (BMIs; kg m⁻²) 47–31 kg m⁻² ($P < 0.0001$); biliopancreatic diversion with duodenal switch (18 patients), decreased BMIs 57–30 kg m⁻² ($P < 0.0001$); adjustable gastric banding (18 patients), decreased BMIs 45–38 kg m⁻² ($P < 0.0001$); and sleeve gastrectomies (23 patients), decreased BMIs 58–42 kg m⁻² ($P < 0.0001$). The excess percentage BMI loss was 69, 89, 36 and 53 kg m⁻², respectively ($P < 0.0001$). Before surgery, the SF-36 differences were significant regarding bodily pain ($P = 0.008$) and social functioning ($P = 0.01$). After surgery, physical function ($P = 0.03$), general health ($P = 0.05$) and physical component ($P = 0.03$) were different. IWQOL-Lite recorded no differences until after surgery: physical function ($P = 0.003$), sexual life ($P = 0.04$) and public distress ($P = 0.003$). BDI scores were not different for the four groups at baseline. All improved with surgery, 10.6–4.4 ($P = 0.0001$).

CONCLUSIONS: HRQoL and depressive symptoms significantly improved after surgery. These improvements do not have a differential effect over the wide range of weight change.

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INTRODUCTION

Approaches to the treatment of obesity remain challenging as the percentage of severely obese individuals continues to increase.¹ Practitioners are confronted with various options for weight loss but only surgical treatments currently offer long-term success for the severely obese.² In a review of the possible surgical options, the long-term efficacy and impact on the individual's quality of life require evaluation. There is little information in the literature comparing the commonly available surgical procedures and their effects on health-related quality of life (HRQoL) and depressed mood. When weight loss treatments were primarily restricted to dietary interventions, medications and life style modifications, modest long-term changes in body weight were applauded and these limited improvements in weight status continue to be validated for their positive impact on the medical comorbidities.^{3–5} The impact on HRQoL has recently been reviewed as inconsistent in a series of randomized controlled trials of varying duration and weight loss interventions.⁶

Reports in the literature typically conclude that weight loss is associated with positive effects on HRQoL for individuals of varied age, ethnicity and gender over a wide range of body mass indexes (BMIs) and weight changes.^{7–9} What must be noted is that most interventions aside from surgery produce rather limited but still clinically significant weight changes. These weight changes do correlate positively with measurable HRQoL change. In the

early short-term literature (< 2 years), weight loss continues to correlate with positive changes in HRQoL.^{10–14} In the 10-year follow-up of the Swedish Obesity Study (SOS) observations of HRQoL seemed to follow the changes in weight loss, weight maintenance and weight regain.¹⁵ At year 1, improvements were greatest and the deterioration in HRQoL occurred with weight regain. With a 10% sustained weight loss positive long-term effects were noted in HRQoL. Only 37 patients of the 851 who were surgically operated had a gastric bypass and these patients completed the study with a maintained body weight loss of 25.1%. As surgical procedures are continually evolving, the results of weight loss and its maintenance are continually improving.² A more recent study of gastric bypass patients, Kolotkin *et al.*¹⁶ established that positive changes in HRQoL were maintained for a 6-year duration.

Comparisons of surgical outcomes are problematic as investigators perform different weight loss surgical procedures and elect to use different HRQoL instruments for their evaluations. Even with these confounding factors, severely obese patients consistently report marked improvement in mood state and HRQoL after surgery.^{16–22} Whether or not HRQoL and depressive symptoms after weight loss surgery directly relate to the amount of weight loss remains an unanswered question, as current published studies have had inconsistent results.^{23–26}

As our high volume surgical center routinely offers four laparoscopic weight loss procedures (Roux-en Y gastric bypass (GB), biliopancreatic diversion with duodenal switch (BPD/DS),

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adjustable gastric banding (LAGB) and sleeve gastrectomy (SG)), we have had a unique opportunity to compare the effect of the different levels of weight loss from these surgeries, all performed by the same surgical group, on HRQoL and symptoms of depression. Our working hypothesis was that the post-surgery level of improvement in HRQoL and depressive symptoms would be related to the amount of weight loss obtained as a result of these different surgical procedures.

MATERIALS AND METHODS

One hundred five patients who were to receive one of four different laparoscopic surgical procedures to assist with weight loss (GB, BPD/DS, LAGB and SG) reviewed and signed an informed consent approved by the Institutional Review Board for this data collection. They completed three forms to assess HRQoL and symptoms of depression before surgery: Short-Form-36 Health Survey (SF-36), Impact of Weight on Quality of Life-Lite (IWQOL-Lite) and the Beck Depression Inventory (BDI).

More than 99% of patients who request weight loss surgery sign the approved consent to participate in providing information as a routine related to studying their surgical outcome.

It is acknowledged that all patients did not go on to surgery and those that have surgical procedures do not always follow their patient protocol and return for advised consults. On an availability basis when patients appeared for follow-up evaluation at their most recent visit, which could not be < 1 year after surgery and they had not received a surgical revision, they were weighed and again completed the three surveys.

Measures

Medical outcomes study SF-36. The SF-36²⁷ is a 36-item measure of general HRQoL, consisting of eight subscales (physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional and mental health) and two summary scores (Physical Component Summary (PCS) and Mental Component Summary (MCS)). The two summary scores represent independent indices based on factor analysis of subscale scores using the Medical Outcomes Study data. Scores on all subscales and PCS and MCS range from 0 to 100, where 100 represents the best HRQoL. Scores for PCS and MCS are norm based, with a mean of 50 and an s.d. of 10. The SF-36 has been shown to have strong psychometric properties.²⁷

Impact of weight on quality of life-lite. The IWQOL-Lite²⁸ is a 31-item measure of weight-related quality of life. There are five domain scores (physical function, self-esteem, sexual life, public distress and work) and a total score. Scores for all domains and total score range from 0 to 100, with lower scores indicating greater impairment. The IWQOL-Lite has demonstrated excellent reliability and validity.^{28,29}

Beck depression inventory. This is a 21-item scale that assesses depressive symptoms and mood dysphoria and has well-established psychometric properties.^{30,31} It has been widely used with diverse populations and is an

accepted assessment for depressed mood.³¹ Scores from 0 to 9 indicate minimal levels of depressive symptoms. Scores from 10 to 16 indicate increasing symptoms and scores 17 and over merit referral.

Data management and statistical considerations. If ongoing visits occurred 1 year after surgery, the most recent form completion was included in the data base. Trained personnel reviewed forms for completeness and performed the scoring. The effect of each of the four surgeries on weight change and excess weight loss (EWL) was calculated by assuming normalized body weight with a BMI of 25 kg m⁻²; change in BMI divided by pre-operative BMI-25 = % BMI loss, which represents the % EWL. BMI change was evaluated and compared between the surgical groups. EWL, BDI and HRQoL measures were compared among the four surgeries by the analysis of variance (ANOVA) test (for means) or the Kruskal-Wallis test (for medians), as appropriate. As a result of baseline differences in HRQoL scores between groups, HRQoL mean scores for each group post-surgery were adjusted by analysis of covariance (ANCOVA). Pairwise comparisons of mean outcomes between the four surgeries were adjusted by the Bonferroni method for multiple comparisons. Paired *t*-tests or Wilcoxon signed-rank tests were used to compare mean or median outcomes, respectively, before and after surgery within each surgical group (that is, HRQoL measures and BDI). The correlation between EWL (as represented by change in BMI) and HRQoL scores after surgery was assessed by the Spearman rank correlation coefficient. All *P*-values are two-sided with statistical significance evaluated at the 0.05 alpha level. All analyses were performed in SAS Version 9.1 (SAS Institute, Inc., Cary NC, USA) and Stata Version 10.0 (Stata Corp., College Station, TX, USA).

RESULTS

As patients appeared for follow-up at least 1 year after surgery, the three surveys were completed by 105 patients 24.6 ± 13.6 months after surgery. Forms were completed 19.4 months after GB (*N* = 46), 26.0 months for BPD/DS (*N* = 18), 22.1 months for LAGB (*N* = 18) and 36.1 months for SG (*N* = 23) (*P* < 0.0001 by ANOVA test; Table 1). The four patient groups were not different in regard to age (*P* = 0.30) and gender distribution (*P* = 0.42; Table 1). Mean BMI after surgery varied between the surgery groups (*P* < 0.0001 by ANOVA test), with all pairwise group comparisons statistically significant (*P* = < 0.0001). GB patients had a reduction in mean BMI from 46.6 to 31.0 kg m⁻² (*P* < 0.0001). BPD/DS patients had a reduction in mean BMI from 56.9 to 29.7 kg m⁻² (*P* < 0.0001). LAGB patients had a reduction in mean BMI from 45.3 to 38.3 kg m⁻² (*P* < 0.0001). SG patients had a reduction in mean BMI from 58.0 to 41.7 kg m⁻² (*P* < 0.0001; Table 1). The mean BMI before surgery varied between the surgery groups (*P* < 0.0001 by ANOVA test), with all pairwise group comparisons statistically significant (*P* ≤ 0.0001). EWL as calculated based on BMI changes varied between the surgical groups (GB, 70.1%; BPD/DS, 86.2%; LAGB, 33.0%; and SG, 48.7%; *P* < 0.0001 by ANOVA test; Table 1).

Table 1. Patient characteristics by surgery type

Surgery	<i>N</i>	Gender (%)	Age (years)	Months post-surgery	Pre-BMI	Post-BMI	%EBMIL ^a
GB	46	M = 30.4 F = 69.6	43.5 ± 9.9	19.4 ± 9.5	46.6 ± 5.1	31.0 ± 4.5 ^b	70.1
BPD/DS	18	M = 38.9 F = 61.1	41.4 ± 7.4	26.0 ± 11.5	56.9 ± 12.4	29.7 ± 5.9 ^b	86.2
LAGB	18	M = 16.7 F = 83.3	41.3 ± 11.0	22.1 ± 8.3	45.3 ± 3.9	38.3 ± 4.6 ^b	33.0
SG	23	M = 21.7 F = 78.3	46.9 ± 13.9	36.1 ± 18.4	58.0 ± 10.3	41.7 ± 7.7 ^b	48.7
Total	105	M = 27.6 F = 72.4	43.5 ± 10.8	24.6 ± 13.6	50.7 ± 9.6	34.3 ± 7.3 ^b	61.8%
Significance		<i>P</i> = 0.42	<i>P</i> = 0.30	<i>P</i> < 0.0001 ^c	<i>P</i> < 0.0001 ^c	<i>P</i> < 0.0001 ^c	<i>P</i> < 0.0001 ^c

Abbreviations: ANOVA, analysis of variance; BMI, body mass index; BPD/DS, biliopancreatic diversion with duodenal switch; %EBMIL, % excess BMI loss; F, female; GB, gastric bypass; LAGB, adjustable gastric band; SG, sleeve gastrectomy. ^a% Excess BMI Loss ^b*P* < 0.0001 by paired *t*-test for each group pre- and post-surgery. ^c*P* < 0.0001 by ANOVA test.

The SF-36 indicated that there were statistically significant differences among groups (by the ANOVA test) for pre-surgery bodily pain ($P=0.008$) and social functioning ($P=0.001$). After surgery, there were group differences by ANOVA for physical functioning ($P=0.03$), general health ($P=0.05$) and the physical component ($P=0.03$). When post-surgery scores were adjusted for baseline SF-36 differences between groups, physical functioning by ANCOVA had a P -value of 0.038 with pairwise comparisons with the SG being significant for the GB, $P=0.02$ and the BPD/DS, $P=0.02$. General health responses were of increased significance, $P=0.02$ by ANCOVA. For all other domains, the differences between groups were not significant. What can be observed is that before surgery the patients in all surgical groups had an impaired quality of life as assessed by the SF-36, which markedly improved to resemble community norms approximately 2 years after surgery (Table 2).

The IWQOL-Lite confirmed no differences across groups before surgery, but again an impaired quality of life as measured by this survey directly related to the impact of weight (Table 3). After surgery, four of the five domains were significantly different as was the total score: physical function, $P=0.003$ (by ANCOVA $P=0.01$

with pairwise comparisons for the sleeve significantly different than the other three procedures); self-esteem, $P=0.07$; sexual life, $P=0.04$; public distress, $P=0.003$ and total score, $P=0.002$. The quantification of community norms allows for a strong image of the normalization of quality of life with weight change.

Before surgery, the mean BDI score was elevated to 10.6 and reduced to 4.4 after surgery. The four groups were not different by ANOVA before surgery ($P=0.65$) or after surgery ($P=0.44$), however, all post scores were significantly improved for each surgical group, (Table 4).

In regard to all the positive changes in quality of life and mood state, there was not a strong correlation with the percentage excessive weight loss. The correlation of the SF-36 change with EWL were $R=0.11$ with a $P=0.36$. For the IWQOL-Lite, the total score was similar with an $R=0.15$ with a $P=0.321$. Only the social functioning domain had an $R=0.23$ with a $P=0.05$. Weight loss with the assistance of surgery positively had changed the lives of these patients but over the wide range of weight change from 33 to 86% of excess weight being lost, but the responses to these physical changes on HRQoL and depression were not different.

Table 2. Pre- and Post- SF36 Scores by Surgery Type

Surgery	GB	BPD/DS	LAGB	SG	Total	Comm. norms
<i>Physical function</i>						
Pre	59.0 ± 25.8	56.1 ± 27.0	52.5 ± 33.9	46.2 ± 30.9	54.2 ± 28.7	84.2 ± 23.3
Post ^a	87.1 ± 21.9	93.1 ± 8.5	80.6 ± 28.8	71.6 ± 27.4	83.3 ± 24.0	
<i>Physical role</i>						
Pre	59.6 ± 36.3	55.4 ± 40.6	66.7 ± 38.9	41.7 ± 44.3	55.2 ± 39.9	80.9 ± 34.0
Post	85.0 ± 32.4	87.5 ± 27.4	91.2 ± 24.9	67.0 ± 37.3	82.4 ± 32.4	
<i>Bodily pain</i>						
Pre ^b	49.8 ± 22.6	73.4 ± 26.5	66.3 ± 25.3	49.2 ± 26.2	56.3 ± 26.1	75.2 ± 23.7
Post	75.2 ± 26.9	75.1 ± 20.9	77.4 ± 25.6	65.2 ± 29.6	73.3 ± 26.4	
<i>General health</i>						
Pre	47.7 ± 23.1	51.4 ± 22.2	61.6 ± 21.3	50.7 ± 22.5	50.9 ± 22.6	71.9 ± 20.3
Post ^c	70.2 ± 20.2	77.8 ± 21.5	68.6 ± 22.1	58.0 ± 24.3	68.3 ± 22.3	
<i>Vitality</i>						
Pre	43.1 ± 19.9	47.6 ± 26.9	50.0 ± 20.2	37.4 ± 20.8	43.4 ± 21.6	60.9 ± 21.0
Post	63.0 ± 18.3	63.8 ± 20.1	63.1 ± 20.7	54.1 ± 19.3	61.1 ± 19.4	
<i>Social functioning</i>						
Pre ^d	65.2 ± 25.1	72.3 ± 21.5	81.3 ± 20.3	52.5 ± 26.7	65.5 ± 25.7	83.3 ± 22.7
Post	79.7 ± 26.5	89.1 ± 15.1	86.8 ± 17.4	75.0 ± 25.0	81.5 ± 23.3	
<i>Emotional role</i>						
Pre	69.7 ± 42.0	66.7 ± 41.3	80.6 ± 38.8	55.6 ± 47.5	67.1 ± 42.9	81.3 ± 33.0
Post	84.2 ± 32.0	77.1 ± 33.8	88.9 ± 19.8	69.7 ± 39.7	80.6 ± 32.7	
<i>Mental health</i>						
Pre	69.4 ± 16.6	65.1 ± 18.4	62.4 ± 17.1	68.0 ± 17.6	67.3 ± 17.1	74.7 ± 18.1
Post	77.0 ± 14.7	75.3 ± 18.4	70.9 ± 19.7	71.8 ± 17.3	74.4 ± 16.9	
<i>Physical component</i>						
Pre	38.1 ± 10.0	41.1 ± 11.9	40.6 ± 11.8	34.7 ± 11.3	38.1 ± 11.0	50.0 ± 10.0
Post ^e	50.2 ± 8.1	53.1 ± 5.7	50.1 ± 12.6	44.0 ± 12.9	49.2 ± 10.3	
<i>Mental component</i>						
Pre	47.6 ± 10.0	46.6 ± 12.8	49.7 ± 7.1	44.9 ± 11.3	46.9 ± 10.5	50.0 ± 10.0
Post	50.3 ± 8.5	49.4 ± 10.0	50.4 ± 10.9	48.2 ± 10.0	49.7 ± 9.4	

Abbreviations: ANOVA, analysis of variance; BPD/DS, biliopancreatic diversion with duodenal switch; GB, gastric bypass; LAGB, adjustable gastric band; SF-36, Short-Form-36 Health Survey; SG, sleeve gastrectomy. ^a $P=0.03$ by ANOVA test for four groups post-surgery. ^b $P=0.008$ by ANOVA test for four groups pre-surgery. ^c $P=0.05$ by ANOVA test for four groups post-surgery. ^d $P=0.01$ by ANOVA test for four groups pre-surgery. ^e $P=0.03$ by ANOVA test for four groups post-surgery. For the other domains, differences between the groups were nonsignificant.

Table 3. Pre- and post-IWQOL-Lite scores by surgery type

Surgery	GB	BPD/DS	LAGB	Sleeve	Total	Comm. norms
<i>Physical function</i>						
Pre	42.6 ± 21.7	41.2 ± 30.5	58.0 ± 31.4	42.0 ± 25.4	44.0 ± 25.9	90.0 ± 14.9
Post ^a	89.7 ± 12.9	93.2 ± 7.6	82.8 ± 20.9	72.2 ± 26.7	84.6 ± 19.6	
<i>Self-esteem</i>						
Pre	52.1 ± 31.3	37.0 ± 27.3	47.3 ± 34.4	43.7 ± 30.2	46.0 ± 30.4	87.5 ± 19.4
Post ^b	75.3 ± 24.3	91.1 ± 9.0	72.4 ± 27.8	60.5 ± 25.8	73.4 ± 25.2	
<i>Sexual life</i>						
Pre	68.3 ± 33.7	46.9 ± 33.8	75.0 ± 25.8	48.6 ± 34.4	58.8 ± 34.3	95.1 ± 13.0
Post ^c	76.8 ± 28.1	89.1 ± 23.1	92.1 ± 11.2	67.6 ± 30.1	78.3 ± 27.3	
<i>Public distress</i>						
Pre	51.0 ± 29.7	38.2 ± 27.8	60.0 ± 41.7	40.8 ± 29.4	46.4 ± 30.8	96.5 ± 10.9
Post ^d	89.4 ± 14.7	95.8 ± 11.4	77.3 ± 32.0	69.3 ± 31.2	83.4 ± 24.3	
<i>Work</i>						
Pre	67.0 ± 24.6	60.6 ± 34.6	78.6 ± 27.0	53.9 ± 28.9	63.5 ± 28.7	95.4 ± 11.5
Post	90.9 ± 15.6	96.9 ± 7.8	94.4 ± 10.4	81.9 ± 23.9	89.8 ± 17.4	
<i>Total</i>						
Pre	56.9 ± 23.1	44.4 ± 26.8	61.4 ± 25.0	47.4 ± 22.9	52.2 ± 24.4	91.8 ± 12.0
Post ^e	84.9 ± 14.5	93.1 ± 8.8	81.6 ± 20.3	69.7 ± 23.2	81.7 ± 18.9	

Abbreviations: ANOVA, analysis of variance; BPD/DS, biliopancreatic diversion with duodenal switch; GB, gastric bypass; IWQOL-Lite, Impact of Weight on Quality of Life-Lite; LAGB, adjustable gastric band. ^a $P=0.003$ by ANOVA test for four groups post-surgery. ^b $P=0.007$ by ANOVA test for four groups post-surgery. ^c $P=0.04$ by ANOVA test for four groups post-surgery. ^d $P=0.003$ by ANOVA test for four groups post-surgery. ^e $P=0.002$ by ANOVA test for four groups post-surgery.

Table 4. Pre- and post-BDI scores by surgery type

Surgery	Pre-BDI	Post-BDI	P-value ^a
GB	11.1 ± 8.6	4.5 ± 4.0	0.0001
BPD/DS	11.7 ± 9.3	3.3 ± 4.4	0.0001
LAGB	8.3 ± 6.9	3.7 ± 2.8	0.04
Sleeve	10.5 ± 8.9	5.5 ± 5.9	0.01
Total	10.6 ± 8.5	4.4 ± 4.4	0.0001

Abbreviations: ANOVA, analysis of variance; BDI, Beck Depression Inventory; BPD/DS, biliopancreatic diversion with duodenal switch; GB, gastric bypass; LAGB, adjustable gastric band. ^aPaired *t*-test for each group pre- and post-surgery. Pre-surgery $P=0.65$ by ANOVA test; post-surgery $P=0.44$ by ANOVA test.

DISCUSSION

In contrast to earlier studies of HRQoL and assessment of mood state for individuals enrolled in dietary and life style interventions for weight loss, the HRQoL and depressive symptoms reported after weight loss surgery were not directly related to the amount of EWL as we had hypothesized. We can only conjecture on several possible reasons for this difference. The Swedish study¹⁵ followed a response similar to those receiving more customary interventions, but it should be noted that the long-term follow-up was on a limited sample of patients with approximately a 25% weight change. In fact, one of the interventions, the vertical banded gastroplasty is no longer used because of a significant failure of sustained weight loss and its effect on patients satisfaction.³²

The level of efficacy was set at 10% of total body weight in the Swedish study in contrast to the patients in this study who maintained EWLs from 33 to 86%. It is possible that patient's capacity to effectively lose weight and maintain weight loss and consciously feel in control of their bodies allowed for the observed improvements. Perhaps 'more is not better' and indeed 33% EWL

was sufficient to positively impact on the lives of those patients who had received a LAGB. The LAGB patients who had the least optimal responses in terms of percentage of EWL reported a similar level of HRQoL and depressive symptoms as the other surgeries. Obesity researchers in anecdotal reports acknowledge the concerns of 'successful' patients who are concerned about their self-identity if they would become 'too thin' with an operative procedure. What must be noted here is that all patients lost between 33 and 86% of their excess weight. All were successful by the standards accepted by most obesity researchers. More detailed studies are indicated if these findings are replicated.

The information on the responses to those receiving an SG as a sole procedure merits additional comment. Originally this procedure was used as the first step in a staged surgical procedure for weight loss.³³ As most of these early patients progressed to a second surgery within a year or so, the available sample with only an SG from this surgical center is limited. However, in the interim it was noted that some patients were able to achieve satisfactory weight loss with only the SG, and we now provide this operation to larger and older patients who may be at greater surgical risk. It is of note that these larger people receiving the SG reported similar, but not significant different, functioning on the SF-36, although as may be expected for larger individuals, physical function, social interactions and sexual life were rated lower.

The depressive symptoms generally associated with severe obesity are reported with less frequency in this population after surgery. It is acknowledged that a certain percentage of individuals have an endogenous depression, but depressed mood is no longer impairing the life of a high percentage of patients after surgery. The definition of successful surgery improving the HRQoL of the bariatric patient cannot be solely defined on the resultant weight loss as Dixon has previously discussed.¹⁹ In the study of Dixon and co-workers, patients who had undergone gastric banding surgery experienced improved HRQoL and a decrease in depressive symptoms in spite of remaining

obese even when compared with a control group of weight-matched obese individuals who had not undergone the surgery.

When we examine the information provided by these post-surgery patients, it can be seen that on both the SF-36 and IWQOL-Lite patients are functioning close to the community norms. They have not achieved the idealized BMI levels that are suggested for the population in general, but after weight loss their HRQoL and mood state are not different from the general population although they may remain overweight or obese.

The literature is replete with references reporting positive improvement in HRQoL and mood with weight change over the short term, usually up to 2 years.^{13,14,17,19,22,26} No reports have compared outcomes for the four surgical procedures from a single clinical site. Our recently published data brings to the foreground questions about the sustainability of these positive effects. When we evaluated our SG patients 5 years after surgery, some weight regain was noted and symptoms of mood dysphoria increased.³⁴ Such observations highlight the importance of continued observation to better understand the longer-term impact of bariatric procedures and facilitate appropriate interventions that may improve the welfare of patients. Much longer longitudinal follow-up is required to comprehend the life time effects of these bariatric procedures.

The observations reported here have significant limitations. All measures were collected from an availability sample. Those who returned for follow-up provided the opportunity to assess changes. It should be noted that there were significant differences in the numbers of patients in each group, baseline and follow-up BMIs, the amount of weight change, and the months after surgery when the information was collected. These factors were statistically adjusted to correct for baseline differences to make group comparisons possible. The different HRQoL responses for different patient groups are compared at different intervals after surgery. Nonetheless, it is acknowledged that the rates and amount of weight loss are characteristic for specific procedures and a plateau in weight can be observed at different time intervals for the different procedures. Future work should help define the importance of this variability and aid in its interpretation. Larger patients samples may modify these observations. However, in the light of the reported findings, the surgeon who at the specific request of his patient performs an acknowledged less effective procedure for weight loss should have less concern knowing there is a high probability that his patient's life will be positively affected.

CONCLUSION

HRQoL and mood dysphoria were evaluated in four groups of patients who had received four different weight loss procedures that resulted in significant differences in EWL. The groups were similar in age and gender distribution, but different in BMI pre- and post-surgery, percentage EWL and months after surgery. HRQoL assessments and mood dysphoria as assessed by the BDI indicated that, although weight loss was significantly different, HRQoL and mood dysphoria were not different in the four groups after their surgical procedures. An impaired HRQoL and dysphoria that were reported before surgery had resolved to resemble community norms 2 years after surgery. There was no correlation of the amount of weight change with the positive changes in HRQoL and mood.

CONFLICT OF INTEREST

Dr Kolotkin receives consulting fees from the University of Utah and as a developer of the IWQOL-lite receives royalties from Duke University. The remaining authors declare no conflict of interest.

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REFERENCES

- 1 Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999-2010. *JAMA* 2012; **307**: 491-497.
- 2 Buchwald H, Avidor Y, Braunwald E, Jensen MD, Pories W, Fahrenbach K *et al*. Bariatric surgery- a systematic review and meta-analysis. *JAMA* 2004; **292**: 1724-1737.
- 3 Jakicic JM, Jaramillo SA, Balasubramanyam A, Bancroft B, Curtis JM, Mathews A *et al*. Effect of a lifestyle intervention on change in cardio-respiratory fitness in adults with type 2 diabetes: results from the Look AHEAD Study. *Int J Obes (Lond)* 2009; **33**: 305-316.
- 4 Pi-Sunyer X, Blackburn G, Brancati FL, Bray GA, Bright R, Clark JM *et al*. (Look AHEAD Research Group). Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: one-year results of the look AHEAD trial. *Diabetes Care* 2007; **30**: 1374-1383.
- 5 Gregg EW, Williamson DF. The relationship of intentional weight loss to disease incidence and mortality. In: Wadden TA, Stunkard AJ eds. *Handbook of Obesity Treatment*. Guilford Publications: New York, NY, 2002; 125-143.
- 6 Maciejewski ML, Patrick DL, Williamson DF. A structured review of randomized controlled trials of weight loss showed little improvement in health-related quality of life. *J Clin Epidemiology* 2005; **58**: 568-578.
- 7 Kolotkin RL, Meter K, Williams GR. Quality of life and obesity. *Obes Rev* 2001; **2**: 219-229.
- 8 Williamson DA, Rejeski J, Lang W, Dorsten BV, Fabricatore AN, Toledo K (Look Ahead Research Group). Impact of a weight management program on health related quality of life in overweight adults with type 2 diabetes. *Arch Intern Med* 2009; **169**: 163-171.
- 9 Crosby RD, Kolotkin RL, Williams GR. An integrated method to determine meaningful changes in health-related quality of life. *J Clin Epidemiol* 2004; **57**: 1153-1160.
- 10 Kolotkin RL, Crosby RD, Williams GR, Hartley GG, Nicol S. The relationship between health related quality of life and weight loss. *Obes Res* 2001; **9**: 564-571.
- 11 Engel SG, Crosby RD, Kolotkin RL, Hartley gg, Williams GR, Wonderlich SA *et al*. Impact of weight loss and regain on quality of life: mirror image or differential effect? *Obes Res* 2003; **11**: 1207-1213.
- 12 Faulconbridge LF, Wadden TA, Berkowitz RI, Sawyer DB, Womble LG, Hesson LA *et al*. Changes in symptoms of depression with weight loss: Results of a randomized trial. *Obesity* 2009; **17**: 1009-1016.
- 13 Fabricatore AN, Wadden TA, Higginbotham AJ, Faulconbridge LF, Nguyen AM, Heymsfield SB *et al*. Intentional weight loss and changes in symptoms of depression: a systemic review and meta-analysis. *Int J Obes* 2011; **35**: 1363-1376.
- 14 Fabricatore AN, Wadden TA, Sarwer DB, Faith MS. Health-related quality of life and symptoms of depression in extremely obese persons seeking bariatric surgery. *Obes Surg* 2005; **15**: 304-309.
- 15 Karlsson J, Taft C, Ryden A, Sjostrom L, Sullivan M. Ten year trends in health related quality of life after surgical and conventional treatment for severe obesity: the SOS intervention study. *Int J Obes* 2007; **31**: 1248-1261.
- 16 Kolotkin RL, Davidson LE, Crosby RD, Hunt SC, Adams TD. Six- year changes in health-related quality of life in gastric bypass patients versus obese comparison groups. *Surg Obes Related Dis* 2012; **8**: 625-633.
- 17 De Zwaan M, Lancaster KL, Mitchell JE, Howell LM, Monson N, Roerig JL *et al*. Health-related quality of life in morbidly obese patients: effect of gastric bypass surgery. *Obes Surg* 2002; **12**: 773-780.
- 18 Gabriel SG, Karaindos CA, Papaioannou MA, Tassioulis AA, Gabriel SG, Sigalas VI *et al*. Biliopancreatic diversion with duodenal switch combined with laparoscopic adjustable banding. *Obes Surg* 2005; **15**: 517-522.
- 19 Sanchez-Santos R, Del Barrio MJ, Gonzalez C, Madico C, Terrado I, Gordillo ML *et al*. Long-term health related quality of life following gastric bypass: influence of depression. *Obes Surg* 2006; **16**: 580-585.
- 20 Dixon JB, Dixon ME, O'Brien PE. Depression in association with severe obesity; changes with weight loss. *Arch Intern Med* 2003; **163**: 2058-2065.
- 21 Brancatisano A, Wahlroos S. Improvement in comorbid illness after placement of the Swedish Adjustable Band. *Surg Obes Relat Dis* 2008; **4**: S39-S46.
- 22 Dixon JB, Dixon ME, O'Brien PE. Quality of life after lap-band placement: influence of time, weight loss, and comorbidities. *Obes Res* 2001; **9**: 713-721.

- 23 Kinzl JF, Schrattenencker M, Traweger C, Mattesich M, Fiala M, Biebl W. Psychosocial predictors of weight loss after bariatric surgery. *Obes Surg* 2006; **16**: 1609–1614.
- 24 Dixon JB, Anderson M, Cameron-Smith D, O'Brien PE. Sustained weight loss in obese subjects has benefits that are independent of attained weight. *Obes Res* 2004; **12**: 1895–1902.
- 25 Legenbauer T, Burgmer R, Senf W, Herpetez S. Psychiatric comorbidity and quality of life in obese individuals- a prospective controlled study. *Psychother Psychol Med* 2007; **57**: 435–441.
- 26 Ballantyne GH. Measuring outcomes following bariatric surgery: weight loss parameters, improvement in co-morbid conditions, change in quality of life and patient satisfaction. *Obes Surg* 2003; **13**: 954–964.
- 27 Ware J, Snow K, Kosinski M, Gandek B. *SF-36 Health Survey: Manual and Interpretation Guide*. The Health Institute, New England Medical Center: Boston, MA, 1993.
- 28 Kolotkin RL, Crosby RD, Kosloski KD, Williams GR. Development of a brief measure to assess quality of life in obesity. *Obes Res* 2001; **9**: 102–111.
- 29 Kolotkin RL, Crosby RD. Psychometric evaluation of the impact of weight on quality of life-lite questionnaire (IWQOL-Lite) in a community sample. *Qual Life Res* 2002; **11**: 157–171.
- 30 Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Arch Gen Psychiatry* 1961; **4**: 561–571.
- 31 Beck AT, Steer RA, Garbin MG. Psychometric properties of the Beck Depression Inventory: twenty-five years of evaluation. *Clin Psychol Rev* 1988; **8**: 77–100.
- 32 Balsiger BM, Poggio JL, Mai J, Kelly KA, Sarr MG. Ten and more years after vertical banded gastroplasty as primary operation for morbid obesity. *Gastrointest Surg* 2000; **4**: 598–60.
- 33 Regan JP, Inabnet WB, Gagner M, Pomp A. Early experience with two-stage laparoscopic Roux-en-Y gastric bypass as an alternative in the super-super obese patient. *Obes Surg* 2003; **13**: 861–864.
- 34 Strain GW, Saif T, Gagner M, Rossidis M, Dakin G, Pomp A. Cross sectional review of effects of laparoscopic sleeve gastrectomy at 1, 3, and 5 years. *Surg Obes Relat Dis* 2011; **7**: 714–719.



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