

Generic health-related quality of life may not be associated with weight loss four years after bariatric surgery: a cross-sectional study

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Abstract

Background There seem to exist a belief that weight-loss is proportionally associated with improvement of health-related quality of life (HRQoL) after bariatric surgery. HRQoL is a complex multidimensional construct of one's perception of health and well-being and is measured through generic and disease specific questionnaires.

Objectives This study aimed to test the associations between weight-loss after bariatric surgery, and both generic and obesity-specific HRQoL, and mental distress, controlling for other patient characteristics.

Methods The study was conducted at the Department of Surgery at Haugesund Hospital (Norway) based on a cohort of bariatric surgery patients operated between 2010 and 2013. Primary outcome measures included the SF-36 (generic HRQoL), IWQoL-Lite (obesity-specific HRQoL), and HADS (mental distress). Blocks of variables (time since surgery, personal characteristics, socioeconomics, comorbidities, surgical complications, experienced life crisis, and weight-loss) were entered into hierarchical linear regression models with the four outcome measures as dependent variables. Cumulative explained variance (r^2) and increase in r^2 after entry of each block of variables is reported.

Results A total of 206 completed the outcome measures a mean (SD) of 4.4 (1.1) years after surgery. The generic SF-36 physical and mental composite scores were significantly associated ($p < .05$) with socioeconomics, baseline comorbidities and surgical complications. Obesity-specific IWQoL-Lite scores were significantly ($p < .05$) associated with weight-loss.

Conclusions The study indicates that post-operative weight loss is associated with obesity-specific HRQoL but demonstrates no associations between weight-loss and generic HRQoL, when controlling for other patient characteristics.

Introduction

Obesity is defined as a body mass index (BMI) score ≥ 30 kg/m² [1] and morbid obesity as BMI ≥ 40 kg/m² or $35 \geq$ kg/m² with at least one comorbidity [2]. Over the last several decades, obesity has become a major global health problem. The prevalence of obesity is increasing globally and has reached an epidemic level [3]. Like the rest of the world, the prevalence of obesity in Norway is increasing and approximately 20% of the population is considered obese [4]. According to Norwegian guidelines, patients classified as morbidly obese are offered bariatric surgery as a public service when other options have failed.

Bariatric surgery has been demonstrated to be the most effective treatment option to maintain weight loss and improvement of health and well-being for most patients [5, 6]. Bariatric surgery includes several techniques, with Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) being the dominant surgical techniques performed in Norway [7].

Obesity, and especially morbid obesity, is associated with impaired health-related quality of life (HRQoL) [8-12]. HRQoL is a complex multidimensional construct of an individual's perception of health and well-being and is measured through generic and disease-specific questionnaires. Bariatric surgery is associated with improved HRQoL in both the short- [8, 13-15] and long-term [9, 11, 16-19].

The International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) has concluded that HRQoL improvement following surgery is proportional to the amount of weight lost [20]. However, based on the multidimensional properties of HRQoL, which include major aspects of life, it is somewhat peculiar that weight loss is considered so crucial for improvements in all dimensions of health and well-being.

Supporting IFSO's statement there is considerable evidence demonstrating a relationship between weight loss and improvement of HRQoL [11, 21, 22]. On the other hand, studies

have also reported improvement in HRQoL with no association to weight loss [15, 18, 19, 23] and stable HRQoL despite weight gain [11]. Thus, factors other than weight loss may influence HRQoL after bariatric surgery. However, very few studies have controlled for the effects of a broad variety of potentially confounding factors on HRQoL. Therefore, the aim of this study was to explore the association between weight loss and other patient characteristics on HRQoL after bariatric surgery.

Methods

Study Design and Participants

The study was conducted in the Department of Surgery at Haugesund Hospital HF, Western Norway Regional Health Authority. The cross-sectional study was based on a cohort consisting of all living patients (n=417) from the health region operated with laparoscopic RYGB (n=383) or SG (n=34) between January 2010 and December 2013 were eligible for participation. Patients received a written invitation to participate in the study between May and October 2016. Those willing to participate (n=267, 64 %) returned the prepaid addressed envelope, with their signed informed consent and email address. Out of 267 consenting patients, 206 answered the questionnaires for a response rate of 77%.

Figure 1 approximately here

Data Source

Demographic variables (gender, age at the time of surgery) and socioeconomics (education level, employment status, marital status) and medical history (weight, height, comorbidities, years with obesity, surgery type and complications during the 24 months after surgery) were collected from the hospital electronic medical records. Weight was measured using a Seca

877 scale at baseline (the day before surgery), and at scheduled appointments at the outpatient clinic at 12 and 24 months after surgery. Weight and height were measured with patients in a standing position wearing light clothing and no shoes.

Consenting patients received an email with a link to the online questionnaires. The study was explained one more time, vocally by another link in the email. The questionnaires were administered using Survey-Xact software (Ramboll Management Consulting). There were two email reminders, and non-responding patients received one telephone call.

Questionnaires

Generic HRQoL was assessed using the Norwegian version of the SF-36 [24-26], which has been validated in a general Norwegian population [27], as well as in morbidly obese patients [28]. This 36-item measure of general HRQoL assesses eight health domains (physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional and mental health), which constitute two composite scores: a physical component summary (PCS) and a mental component summary (MCS) [26]. Calculations were performed as recommended by the scale authors [29] using Norwegian norms [30] and oblique factor scores to account for the correlation between the two HRQoL-dimensions. The scores were calculated by multiplying each subject's SF-36 subscale z score by its respective gender factor coefficient and then standardizing each to a T score with a mean of 50 and a standard deviation of 10 [29]. Scores range 0-100, where higher scores indicate better HRQoL.

Obesity-specific HRQoL was assessed using The Impact of Weight on Quality of Life (IWQoL-Lite) questionnaire. This is a weight-related quality of life instrument consisting of 31 items assessing five domains of HRQoL (physical function, self-esteem, sexual life, public distress and work) [31-33]. Domains scores and a total score 0-100, with higher scores indicating better HRQoL. The questionnaire has shown good reliability and validity [11, 34].

The Hospital Anxiety and Depression Scale (HADS) [35] was used to assess mental distress. HADS is a commonly used screening instrument for anxiety and depression also for patients undergoing bariatric surgery [36]. The instrument has 14 items on a four-point scale ranging from 0 (nothing) to 3 (very much), yielding anxiety and depression subscores (each ranging from 0-21), and a total score (range 0-42). The tool is validated for the Norwegian population [37].

Additional questions from the Norwegian HUNT-study [38] assessed whether the participant had experienced a life crisis (death of a close family member, imminent danger to life, marriage/partner breakup, or other traumatic events) and change of marital status. Finally, participants were asked to fill in their current weight (self-report) in kilograms.

Outcomes

The main outcomes were HRQoL as measured by the SF-36 component summary scores and IWQoL-Lite, and mental distress by the HADS.

Statistical Analysis

Missing values (1.9-14.4 %) were imputed using multiple imputations (MI). Little's test of randomness for missing data was not significant ($p=.593$) indicating the dataset was suitable for MI. The imputation model consisted of the following predictor variables: sex, age, baseline weight and BMI, time in years since surgery, baseline marital status, educational and work status, attendance at 1- and 2-year follow-up appointments, all registered comorbidities, and surgical complications. The following variables were combined predictor and imputation variables: change in BMI (1 and 2 years), years with obesity, experienced life crisis, subjective health status, surgical complications, and all scales from the SF-36, IWQoL-Lite,

and HADS. Through a fully conditional specification model, applying linear regression as the prediction method for scale variables and two-way interactions for categorical variables, 5 complete datasets were generated. The statistical analyses were performed within each complete dataset, and thereafter the multiple analysis results were combined to achieve single estimates. The combined estimates are presented.

The statistical significance of differences between groups was estimated with independent samples T-test for normally distributed variables, and Mann-Whitney U-test for non-normal distributions. Categorical variables were analyzed with Chi-square test or Fisher Exact tests (2x2). Mean (SD), range and median [25% and 75% quartile (IQR)] are reported. When preparing for regression analyses we found potential consequential multicollinearity between variables measuring weight-loss at 1 and 2 years attendance at hospital follow up (correlation coefficient = .81). These two variables seem to measure the same phenomenon and were summed into an index [39]. Hierarchical multiple linear regressions were employed to determine the significance of blocks of related variables on generic (SF-36) and obesity-specific (IWQoL-Lite) HRQoL, and psychological distress (HADS). The variable 'time since surgery' was entered first as a control variable, since studies have shown that time affects HRQoL [16] after bariatric surgery. Block 2 -personal characteristics (gender, age, years with obesity, baseline BMI) was then added into the model, followed by block 3 -baseline socioeconomics [marital status (married yes/no), level of education, work status (employed yes/no)], block 4 -baseline comorbidities (diagnosis of type 2 diabetes, coronary disease, reflux symptoms, obstructive sleep apnea, muscle pain, or mental disorders), block 5 -surgical complications (yes/no), block 6 -major life events (experienced life crisis yes/no: change of marital status, death in near family, imminent danger to life), and block 7 -weight loss (%BMI loss-index of baseline to 1 and 2-year follow-up, %BMI loss baseline to self-reported weight in current survey). Squared regression coefficients (r^2) estimate the explained

variance of each block of variables and r^2 -change estimates the associated strengthening of the explained variance when a new block is introduced.

Level of statistical significance was set to a two-tailed $p < .05$. Data were analyzed using SPSS, version 23.0 (IBM Corp, Armonk, NY USA).

Ethical considerations

The study protocol was approved by the Norwegian Regional Ethical Committee for Medical Research (ref. 2381-2015), South-Eastern Norway. Written informed consent was obtained from all participants before enrollment. All procedures were in accordance with the institutional research guidelines of Fonna Health Trust and with the 1964 Helsinki declaration and later amendments.

Results

There were no significant differences at baseline between those who answered the questionnaires ($n=206$) and those who did not ($n= 61$) in age, gender, baseline weight and BMI, years with obesity, marital status, education level, work status, BMI-change from baseline to 1- and 2-year follow-up, baseline comorbidities, surgical complications and experienced life crisis (data not shown). None of the 2-year participants had GS and only 1 of the 6-year participants had GS. Over all, we did not find significant differences between RYGB and GS participants in our sample.

The reliability of HRQoL scales as measured by the Cronbach's alpha was 0.85 and 0.87 for the SF-36 PCS and MCS, respectively, and 0.86, and 0.72 for the total scores of IWQoL-Lite, and HADS, respectively.

A total of 9 (4.4%), 42 (20.4%), 57 (27,7%), 59 (28,6%) and 39 (18,9%) participants completed the survey 2, 3, 4, 5 and 6 years after bariatric survey, giving a mean response

time (SD) of 4.4 (1.1) and median (IQR) 4.0 (3.8-5) years. The majority of respondents (73%) were women and due to reported gender differences in HRQoL [11] gender baseline characteristics are shown in table 1. Male respondents were on average three years older and twenty kilograms heavier than female respondents, but there were no gender differences in BMI. Women had significantly more weight loss than men, as measured with BMI-change, from baseline to the 1- and 2-year follow-ups. The overall comorbidity rate was 74%.

Table 1 approximately here

Outcome measures are presented in Table 2. The SF-36 PCS and MCS scores are below Norwegian norms, and 25% of the patients had lowest scores on the Bodily pain, General health and Vitality subscales (25% quartile scores below scores below 41, 47 and 31 points, respectively). The IWQoL-Lite total score indicated high obesity-specific HRQoL, with the lowest scores being on the Self-esteem subscales, where 25% of respondents scored below 60. The HADS total score indicated low overall levels of anxiety and depression, although 25% of the sample had scores above 8 on the anxiety subscale, which is indicative of clinically significant symptom burden.

Table 2 approximately here

Hierarchical multiple linear regressions were employed to determine the significance of blocks of related variables on the generic HRQoL (SF-36, PCS and MCS), obesity-specific HRQoL (IWQoL-Lite total score), and mental distress (HADS total score) (table 3).

Table 3 approximately here

Neither time since surgery nor personal characteristics (gender, age, years with obesity, baseline BMI) were associated with HRQoL or mental distress. Baseline socioeconomics

(marital status, level of education, work status) significantly increased the explained variance in both physical (7.4%) and mental (11%) generic HRQoL, as well as mental distress (5.7%).

When baseline comorbidities (diagnoses of type 2 diabetes, coronary disease, reflux symptoms, obstructive sleep apnea, muscle pain, or mental disorders) were added to the model, we found significant increases in explained variance for generic physical HRQoL (3.6%) and mental distress (2.9%). The introduction of surgical complications (complication yes/no) further increased the explained variance in generic HRQoL (physical [5.4%] and mental [3.8%]), surgical satisfaction (3.7%) and mental distress (5.0%).

Introduction of major life events (experienced life crisis, change of marital status, death of a close family member, or imminent danger to life) significantly increased the explained variance in mental distress (7.5%).

Introducing weight loss (index of %BMI loss baseline to 1 and 2 year and %BMI loss baseline to self-reported weight loss in survey) as the last block significantly increased the explained variance in obesity-specific HRQoL (13.4%). Neither the generic HRQoL nor mental distress models reached statistical significance for change in explained variance after introducing weight loss block.

Some of the variables included in the blocks were drivers of the changes shown in table 3. Standardized regression coefficients for all individual variables included in the model are shown in table 4.

Table 4 approximately here

Male gender, lower baseline BMI, marriage and weight-loss were significantly associated with higher obesity specific HRQoL, and weight-related factors (Baseline BMI and weight-loss) had the highest impact. Being married and not experiencing surgical complications were

associated with higher physical and mental generic HRQoL. Experiencing dramatic life events was associated with lower mental generic HRQoL. Surgical complication had the highest impact on physical HRQoL and marital breakdowns on mental HRQoL. Experiencing surgical complications and dramatic life events was associated with higher mental distress, where dramatic life events had the highest impact.

Several studies have shown that time since surgery seems to predict changes in HRQoL. The 9 respondents answering 2 years after surgery have higher (better) scores on health-related quality of life and anxiety/depression compared to those answering 6 years out from surgery. However, there is nonsignificant differences between respondents answering 3, 4, 5 and 6 years after surgery

Discussion

Weight loss mean (SD) 4.4 (1.1) after bariatric surgery was associated with obesity-specific HRQoL, but not with generic HRQoL or mental distress. The success of bariatric surgery has mostly focused on the amount of weight loss, although in recent years, HRQoL has gained increased attention. HRQoL includes a multitude of dimension of an individual's perception of health and well-being, and thus, the association between weight loss and HRQoL may not be linear as suggested by many authors. The findings from the present study highlights that, from a patient's perspective, dimensions in life other than weight loss seems to be important in relation to their generic HRQoL. On the other, hand when it comes to the obesity-specific HRQoL, weight loss may be an important predictor of increased well-being. However, even this association is probably not linear.

The lack of associations between weight loss and generic HRQoL is consistent with prior published research [15, 18, 19]. Flølo et al. [18] demonstrated a relatively high percentage (39%) of weight regain and yet no significant association to decreased generic HRQoL in a

study of 168 patients 5 years after sleeve gastrectomy. Our study did reveal an association between generic HRQoL and socioeconomic factors, which may point to the importance of factors, such as marriage/cohabitation [23] and employment status [19, 40, 41], on general well-being and HRQoL among bariatric surgery patients.

A large proportion of our patients (74%) had preoperative comorbidities, which were associated with generic HRQoL. Bariatric surgery seems to improve obesity-related diseases, both physical and psychological [19]. However, the association between comorbidities and HRQoL is not clearly understood. Like other studies [40] finding no associations between baseline comorbidities and generic HRQoL, Risstad et al. [41] found that two years after surgery, patients with no comorbidity at baseline had similar positive changes in HRQoL as patients with one or more comorbidities. Nonetheless, Raoof et al. [19] reported that concurrent comorbidity (metabolic disease, musculoskeletal disease and depression) 7-17 (mean 11.5) year after gastric bypass surgery was negatively associated with both physical and mental HRQoL in an observational, cross-sectional study of 486 patients. Thus, ongoing comorbidities and factors other than obesity-related diseases at baseline may be important determinants of impaired HRQoL among severely obese patients.

It has been reported that improvement in HRQoL following bariatric surgery is proportional to the amount of weight loss [20]. HRQoL is a complex multidimensional construct that includes major aspects of life and can be divided into both broad generic concepts and narrower obesity-specific concepts. In the current study, the differential findings related to obesity-specific HRQoL and generic HRQoL demonstrates the importance of differentiating between those two aspects of HRQoL in both obesity research and clinical practice. In research, both concepts of HRQoL should be assessed using validated instruments [42] to cover the broad and narrower scopes of HRQoL. In clinical practice, it is important to distinguish between the possible effect of weight loss per se and the effects of broader

personal, socioeconomic, and other characteristics of the patients on HRQoL and well-being after bariatric surgery. The study explored the association between weight loss and obesity-specific HRQoL. Our findings strengthen the purpose of the instruments, generic HRQoL-instruments assess much broader aspects of HRQoL than obesity-specific HRQoL instruments.

The study has several weaknesses. First, 151 of 417 eligible patients (34%) did not consent to participate, which raises concerns about potential selection bias. Due to ethical considerations, a comparison between consenting and non-consenting patients could not be conducted. In addition, 61 of 267 consenting patients (23%) did not complete the questionnaires, although we found no differences between responders and non-responders.

Follow-up studies after bariatric surgery commonly show a high rate of missing cases [36, 43]. Nonparticipants analyses from large epidemiological studies suggests that responders in general are healthier than non-responders [44], as could be the case in our study. Physical and mental disorders are important negative factors for HRQoL in obese persons [45], and the response rate of 49,4% could reflect that those with lower HRQoL to a less extent responded the query. Also, the study lacked a preoperative HRQoL assessment, and thus, the analyses could not control for baseline values of HRQoL. As a result, we cannot rule out the phenomenon of regression towards the mean [46, 47]. Another possible limitation is the use of self-reported weight as the basis of weight loss calculations. However, prior studies have reported high degrees of consistency between self-reported and measured weight in bariatric surgery candidates [48-50].

Strengths of this study includes a relatively large sample size (n=206) and use of both generic and obesity-specific HRQoL instruments, as well as measures of mental distress. All patients received surgical treatment at a public hospital using standard operation techniques. The

sample is likely representative of the Caucasian morbidly obese bariatric surgery patients. Further generalizability to differing cultures and ethnicities may be limited.

Conclusions

This study suggests that, when controlling for other factors, weight loss is significantly associated with obesity-specific HRQoL, but not generic HRQoL. The results also points to the importance of other factors (socioeconomics, comorbidities, surgical complications and life crises) associated with HRQoL in bariatric patients. Our findings would suggest that since patients undergoing bariatric surgery might overestimate the impact of weight loss on their future well-being, patient discussions could potentially moderate this expectation.

Conflict of interest Authors declares no conflict of interest in relation to the conducted study.

Ethical statement All procedures involving participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and later amendments.

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

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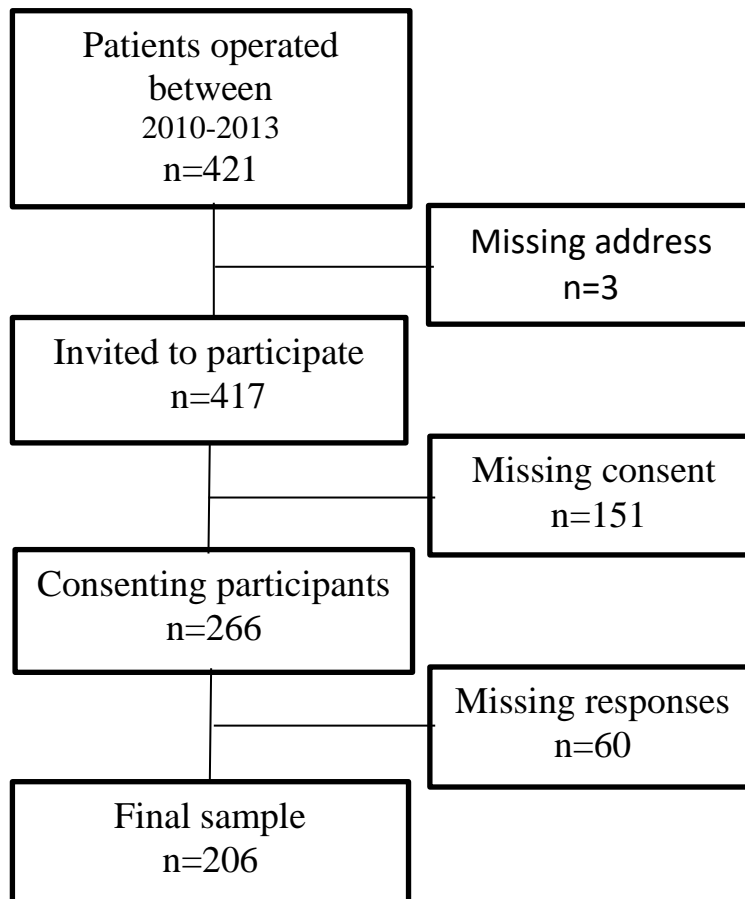
Figure 1: Inclusion of patients and responses

Table 1 Baseline characteristics of participants in the study

	Gender			p-value
	Total n=206	Female n=151	Male n=55	
Age, mean (SD)	42.1 (10.4)	41.2 (10.4)	44.7 (9.9)	.030
Years with obesity, mean (SD)	18.0 (8.0)	18.5 (9.5)	17.0 (10.5)	.359
Baseline weight in kg., mean (SD)	122.3 (18.6)	116.6 (15.5)	137.7 (17.8)	<.001
Baseline BMI, mean (SD)	42.3 (5.1)	42.3 (4.9)	42.3 (5.4)	.997
Percent weight loss in kg. from baseline, mean (SD)	29.5 (11.8)	30.3 (12.6)	27.2 (9.2)	.108
Time in years since surgery, mean (SD)	4.4 (1.1)	4.3 (1.2)	4.5 (1.1)	.538
Percent BMI-change. from baseline-1 year, mean (SD)	13.5 (3.8)	13.9 (3.6)	12.6 (3.8)	.023
Percent BMI-change from baseline-2 year, mean (SD)	14.0 (4.4)	14.3 (3.9)	12.9 (4.8)	.029
Marital status, n (%)				
Married/cohabitant	146 (70.9)	105 (69.5)	41 (74.5)	.603
Singel	57 (27.7)	43 (28.5)	14 (25.5)	.727
Widow/widower	3 (1.5)	3 (100.0)	0 (0.0)	.566
Change in marital status, n (%) yes	38 (19.0)	27 (18.4)	11 (20.8)	.688
Change from married/cohabitant to singel, n (%) yes	34 (16.5)	20 (13.2)	14 (25.5)	.054
Education, n (%)				
Primary education	21 (10.4)	18 (11.9)	3 (5.5)	.204
Secondary educaion	124 (61.7)	93 (61.6)	31 (56.4)	.523
University/University College	56 (27.9)	35 (23.2)	21 (38.2)	.051
Work status, n (%)				
Employed	152 (73.8)	105 (69.5)	47 (85.5)	.021
Unemployed	16 (7.8)	12 (7.9)	4 (7.3)	.999
Disability pension	32 (15.5)	28 (18.5)	4 (7.3)	.052
Student/home dwelling	6 (2.9)	6 (4.0)	0 (0.0)	.345
Attendance at 1y control, n (%) yes	196 (95.1)	146 (96.7)	50 (90.9)	.135
Attendance at 2y control, n (%) yes	183 (88.8)	133 (88.1)	50 (90.9)	.803
Comorbidities at baseline, n (%) yes	152 (73.8)	105 (69.5)	47 (85.5)	.021
Type 2 diabetes	37 (18.0)	25 (83.4)	12 (78.2)	.414
Coronary disease	85 (41.3)	53 (35.1)	32 (58.2)	.004
Reflux symptoms	41 (19.9)	28 (18.5)	13 (23.6)	.434
Obstructive sleep apnea	32 (15.5)	19 (12.6)	13 (23.6)	.080
Muscle pain	39 (18.9)	34 (22.5)	5 (9.1)	.029
Joint pain	78 (37.9)	60 (39.7)	18 (32.7)	.418
Mental disorders	40 (19.4)	33 (21.9)	7 (12.7)	.167
Surgical complications, n (%) yes	33 (16.0)	22 (14.6)	11 (20.0)	.392
Experienced life crisis, n (%) yes	114 (55.3)	69 (53.5)	26 (57.8)	.728
Death in near family	57 (31.8)	42 (31.3)	15 (33.3)	.854
Imminent danger to life	16 (9.1)	7 (5.3)	9 (20.0)	.006
Marriage/cohabitation breakups	29 (16.0)	19 (14.3)	10 (20.8)	.358
Other dramatic events	56 (29.8)	40 (29.0)	16 (32.0)	.720

Table 2 Health related Quality of Life, satisfaction with surgery and mental distress mean (SD) 4.4 (1.1) years after bariatric surgery

	Instrument	Scale	Mean (SD)	Range	Median (IQR)
Health related quality of life	Impact of weight on quality of life (IWQoL-lite)	Total score	84.7 (16.1)	0-100	89.5 (78.3-96.3)
		Physical QoL	86.7 (15.7)	0-100	90.9 (81.8-95.8)
		Self esteem	75.3 (26.4)	0-100	82.1 (59.7-100.0)
		Sexual life	81.0 (27.6)	0-100	93.8 (72.1-100.0)
		Public distress	91.8 (15.9)	0-100	100.0 (92.5-100.0)
		Work	91.1 (17.5)	0-100	100.0 (87.5-100.0)
	Generic health related quality of life (SF-36)	Physical Composite Score	47.8 (9.3)	0-100	49.3 (42.4-55.8)
		Mental Composite Score	46.9 (9.6)	0-100	48.3 (41.5-53.6)
		Physical functioning	87.2 (18.6)	0-100	95.0 (83.8-100.0)
		Role Physical	79.3 (27.2)	0-100	93.8 (63.7-100.0)
		Bodily pain	63.8 (28.8)	0-100	62.0 (41.0-100.0)
		General health	67.4 (25.1)	0-100	72.3 (46.6-87.8)
		Vitality	47.5 (24.0)	0-100	50.0 (31.3-62.5)
		Social functioning	77.4 (27.8)	0-100	87.5 (62.5-100.0)
		Role emotional	83.0 (26.9)	0-100	100.0 (75.0-100.0)
Mental health	72.5 (19.5)	0-100	75.0 (60.0-85.0)		
Mental health	Anxiety and depression (HADS)	Anxiety and depression	9.0 (7.1)	0-42	8.0 (4.0-12.0)
		Anxiety	5.6 (4.6)	0-21	5.0 (2.0-8.0)
		Depression	3.4 (3.4)	0-21	2.0 (1.0-5.0)

Table 3. Factors associated with health related quality of life and mental distress mean 4.4 (1.1) years after bariatric surgery. Accumulated and change in explained variance (r^2)

Variable groups	IWQoL-Lite total score			SF-36 Physical Composite Score			SF-36 Mental Composite Score			HADS Anxiety and depression total score		
	r^2 acc.	r^2 - change	sig. for change	r^2 acc.	r^2 - change	sig. for change	r^2 acc.	r^2 - change	sig. for change	r^2 acc.	r^2 - change	sig. for change
1. Time since surgery	.020	.020	.066	.008	.008	.255	.004	.004	.444	.002	.002	.591
2. Personal characteristics	.070	.049	.105	.019	.012	.755	.040	.037	.254	.057	.055	.077
3. Socioeconomic at baseline	.107	.037	.089	.094	.074	.006	.150	.110	<.001	.114	.057	.023
4. Comorbidities at baseline	.118	.010	.186	.130	.036	.013	.165	.015	.094	.143	.029	.023
5. Surgical complications	.122	.005	.373	.184	.054	.002	.204	.038	.008	.193	.050	.002
6. Life crisis	.154	.032	.229	.207	.023	.356	.243	.040	.105	.268	.075	.005
7. Weight loss	.288	.134	<.001	.210	.003	.742	.257	.014	.259	.278	.011	.334

Variables included in the regression: 1. Time since surgery in years, 2. Personal characteristics (gender, age, years with obesity, baseline BMI), 3. Socioeconomics at baseline [marital status (married with obesity, baseline BMI), 3. Socioeconomics at baseline [marital status (married yes/no), level of education, work status (employment status)], 4. Comorbidities at baseline (type 2 diabetes, coronary disease, reflux symptoms, obstructive sleep apnea, muscle pain, or mental disorders), 5. surgical complications (yes/no), 6. Life crisis (experienced life crisis: death in near family, imminent danger to life, marriage/cohabitant break ups, other dramatic events), 7. Weight loss (index of %BMI loss at pre-1 year and pre-2y, %BMI loss pre-self reported weight loss at survey registry)

Table 4. Items applied in the regression model on health related quality of life scores and scores on mental distress.

Block	Variable	IWQoL-Lite total		SF-36 physical		SF-36 mental		HADS	
		Coeff. ¹	Sig.	Coeff. ¹	Sig.	Coeff. ¹	Sig.	Coeff. ¹	Sig.
1	Years since surgery	-.071	.364	-.083	.308	-.039	.631	.007	.929
	Gender ²	.206	.009	.039	.639	-.028	.729	-.039	.630
2	Age	.000	.999	-.091	.377	-.040	.703	-.040	.683
	Years with obesity	.145	.144	.070	.539	.185	.091	-.165	.097
	Baseline BMI	-.434	<.001	-.041	.677	-.055	.575	.045	.643
	Married ³	.145	.047	.176	.020	.258	<.001	-.094	.200
3	Level of education ⁴	.045	.539	-.050	.512	.003	.965	.033	.659
	Unemployed ⁴	-.019	.805	-.149	.064	-.144	.067	.149	.061
4	Comorbidities at baseline ⁴	-.145	.068	-.152	.070	-.082	.301	.103	.198
5	Surgical complications ⁴	-.117	.124	-.217	.007	-.175	.025	.188	.014
	Death in near family ⁴	-.036	.622	.028	.716	.003	.970	-.026	.724
	Imminent danger to life ⁴	.058	.471	-.018	.825	-.052	.522	.052	.526
6	Marriage/cohabitation breakups ⁴	-.073	.325	-.046	.555	-.063	.401	.088	.247
	Other dramatic events ⁴	-.060	.437	-.152	.059	-.186	.018	.263	.001
	BMI-change (baseline-self-reported weight in survey)	.304	.003	.080	.452	.164	.115	-.139	.176
7	BMI-change (index of baseline-follow up at 1 and 2 years)	.234	.046	-.062	.613	-.064	.607	.145	.228

1) Standardized regression coefficients; 2) female=0, male=1; 3) primary=0, secondary=1, university/university college=2; 4) no=0, yes=1