

# Health-related Quality of Life Changes and Weight Reduction After Bariatric Surgery vs. a Weight-loss Program

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## ABSTRACT

**Background:** The present study compared the outcome of bariatric surgery against a uniform high-level weight-loss program which included vigorous physical exercises, behavior modification and nutritional advice.

**Method:** 44 subjects who underwent bariatric surgery and 47 subjects participating in a weight-loss program completed the Medical Outcomes Study Short Form-36 (SF-36), the Mental Health Inventory (MHI) and the Rosenberg Self-Esteem scale, prior to surgery/diet and one year afterwards.

**Results:** Post-surgery subjects had a greater mean weight loss ( $34.70\% \pm 11.94$ ) than subjects in the weight-loss program, even though their weight reduction was also clinically significant ( $9.23\% \pm 8.31$ ). Post-surgery subjects showed significant improvements in SF-36, MHI, and self-esteem. The diet group improved in SF-36 total score, physical functioning, health perceptions, and vitality scales.

**Limitations:** Differences in background variables and short follow-up.

**Conclusions:** Surgery outcomes were significantly better in terms of both weight reduction and psychological adjustment compared to highly motivated participants in a prestigious, cutting edge weight-loss program.

## INTRODUCTION

As obesity is a continually growing problem in our society, unremitting efforts are being made to improve treatment outcome. Conventional treatments (i.e., a low calorie diet plus moderate exercise) and bariatric surgery are the two main approaches offered to people suffering from obesity. Weight-loss programs which integrate a balanced diet, behavior modification and physical activity are currently considered the most effective in weight reduction (1-3). Bariatric surgery, which has become more sophisticated and safer, produces large weight losses and has good long-term results (4, 5). Despite significant advances in both procedures, research has highlighted some unresolved difficulties. Weight-loss programs succeed in the short term, but not in the long run (6), while bariatric surgery is an invasive procedure and some subjects may experience protracted medical and/or emotional complications (7-9). Mainly for these reasons, weight-loss programs are considered inferior for people with severe obesity since their weight loss is insufficient, while bariatric surgery is not recommended for overweight or mildly obese people for whom surgery risks are considered unwarranted. Accordingly, current treatment guidelines recommend bariatric surgery for individuals with  $BMI \geq 40 \text{ kg/m}^2$  or  $BMI \geq 35 \text{ kg/m}^2$  with medical comorbidities and who failed diet programs, while weight-loss programs of diet, physical activity and behavior treatment are recommended for persons with  $BMI \geq 30 \text{ kg/m}^2$  or  $BMI \geq 25 \text{ kg/m}^2$  with medical comorbidities (10).

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The present study compared two groups of individuals who were treated according to the NIH guidelines. Our sample consisted of a two group convenience sample: a moderate to severely obese group of people who underwent bariatric surgery and an overweight to moderately obese group of people who participated in a conventional weight-loss program. The examination of outcome can be used to reflect on clinical recommendations regarding the most appropriate treatment for obese individuals. Such data are important since there are only a few studies that did such a comparison except for a large Swedish intervention study that demonstrated a dramatic improvement in the life quality of post-surgery subjects in contrast to minor improvements in conventionally treated controls (11, 12). However, in this research the treatment for the conventional cases was not standardized and treatment regimens varied according to local practices (11); hence, it was not possible to establish uniformity of treatment or to know what other component beyond the dieting part characterized the control program. A further aim of the present study was to establish a uniform treatment for the conventional weight-loss program: all participants in the conventional treatment took part in an intensive program that included vigorous physical exercises, behavior modification of eating habits, and nutritional counseling. This program was carried out in a prestigious institution – the Wingate Institute – which is also an academic center for physical education and sport. Unlike participants in the bariatric surgery group, whose operation was covered by health insurance services, participants in the dieting group had to pay for the program. Consequently, a unique contribution of the present study is the comparison of bariatric surgery against a uniform high-level treatment program accessed by motivated patients willing to engage in a very intensive program whose mild to moderate level of obesity makes their assignment to a weight-loss non-surgical intervention consonant with current treatment guidelines. In addition, the comparison of gastroplasty to a weight reduction program with an emphasis on physical exercise has not been previously reported in the literature.

The term health-related quality of life refers to the “physical, psychological, and social domains of health, seen as distinct areas that are influenced by a person’s experiences, beliefs, expectations and perceptions” (13). Weight loss has been shown to improve the quality of life in obese persons undergoing a variety of treatments. Because changes in quality of life reflect the individual’s subjective evaluation health, and not only relates to actual weight loss, we wanted to explore the differential impact

of each technique on the psychological adjustment of the individual. According to the above-mentioned studies, we expected improvements in the quality of life following bariatric surgery. On the other hand, it might be possible that despite less weight reduction, conventional program subjects will benefit from the gradual reduction in weight, a greater sense of control and greater fitness obtained after a period of intensive physical activity.

The purpose of our study was threefold: first, to replicate with an Israeli sample and to extend previous comparative outcome studies; second, to assess the impact of weight loss on health-related quality of life and to measure this construct not only by the standard measures of quality of life (the SF-36) – the usual procedure in previous outcome studies – but also by using mental health and self esteem measures. And third, given the documented advantages of bariatric surgery in terms of greater weight loss over a short period of time, to compare the surgical procedure to a carefully chosen uniform weight-loss program that was comprehensive, intensive, and whose participants were highly motivated. We expected to replicate the finding of a greater weight loss in the surgery group but also hypothesized that benefits in terms of health-related quality of life would be observed in both groups, despite differences in weight loss.

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## METHOD

### STUDY DESIGN

The present study compared participants who underwent bariatric surgery against individuals who participated in a weight-loss program. All participants, 51 in each group, were weighed and assessed with questionnaires at the start of the study. The sampling was consecutive but not randomized: participants were recruited among applicants to bariatric surgery at the surgery department of Hadassah University Medical Center and among participants of a commercial program for weight reduction at the Wingate Institute. At the surgery department a nurse approached each surgery candidate who was fluent in Hebrew, all but one accepted to participate in the study. All participants attending the Wingate Institute program were asked to participate, 80% agreed to take part in the study. The study was approved by the Ethical Committee of the Hadassah University Medical Center. All participants signed an informed consent. Forty-four of the surgery group and 47 of the diet group were weighed and assessed one year later. No significant differences on initial measures were found between drop outs and the

others. The surgery participants underwent one of two procedures: 37 underwent Silastic Ring Vertical Banded Gastroplasty (SRVG) and 7 underwent Laparoscopic Adjustable Gastric Banding (LAGB). The weight-loss program lasted 12 months: The first one-month stage of the program took place at the Wingate Institute every morning from 7.00 am to 12.30 am and included three hours of regular strenuous physical exercises six days a week, a daily lecture on health issues, frequent nutritional advice, behavior modification training and a suggested diet of 1200-1800 kcal/day. In this program, no drugs were prescribed. Participants had breakfast and lunch at the Institute, in order to enhance adherence to the recommended diet. In the second stage, participants were instructed to perform at home four times a week any kind of physical activity, at least one hour long. Once a week, participants attended the Institute for nutritional consultation, weight monitoring, and progress evaluation.

### MEASURES

A socio-demographic questionnaire asked about age, marital status, country of origin, education, income and years of duration of obesity.

Height and weight measurements were recorded to calculate BMI (body mass index).

The Medical Outcomes Study Short Form-36 (SF-36) is a well-established measure of quality of life for people with health problems (14). This 36 item questionnaire includes eight scales: 1) limitations in physical activities because of health problems, 2) limitations in usual role activities because of physical health problems, 3) bodily pain, 4) general health perceptions, 5) vitality, 6) limitations in social activities because of physical or emotional problems, 7) limitations in usual role activities because of emotional problems and 8) general mental health. In our study, psychometric support was found for the use of a total. Higher scores reflect better health status. The Hebrew version was validated in a large community survey (15). In the present study the internal consistency of the scales varied from  $\alpha = .69$  to  $\alpha = .90$ . The total score was found to have a high internal consistency ( $\alpha = .91$ ).

The Mental Health Inventory (MHI) is a 38 item questionnaire composed of two inversely correlated scales: psychological distress, and psychological well being. Psychometric support was found for the use of a total score (16). Higher scores in the distress and well being scales reflect higher psychological distress or higher psychological well being respectively. Higher scores in the

total score reflect higher well being. The Hebrew version was tested in a large community study that confirmed its hierarchical structure and demonstrated a high internal consistency ( $\alpha = .96$ ) and external validity (17). In the present study we found the same excellent internal consistency for the total scale and the two subscales ( $\alpha = .96$ ).

The Rosenberg Self Esteem (RSE) scale (18) is a 10 item questionnaire by which respondents evaluate their characteristics, abilities, self-satisfaction, self respect and self-dignity. Higher scores reflect poor self-esteem. The RSE has excellent psychometric properties. It was translated into Hebrew (19) and has been frequently used in Israeli studies. In the present study, we found high internal consistency ( $\alpha = .89$ ).

### RESULTS

Demographic data and initial measures of participants who completed annual follow up are presented in Table 1. As can be seen, the surgery and the diet group differed in

**Table 1.** Initial differences in socio-demographic and outcome measures between the surgery and the diet group

	Surgery (n=44)	Diet (n=47)	p
<b>Gender, (%)</b>			
Female	38 (86.4%)	31 (66.0%)	0.03
Male	6 (13.6%)	16 (34.0%)	
Age, mean years (SD)	33.8 (9.5)	43.7 (11.3)	<0.001
<b>Marital status, (%)</b>			
Married	27 (61.4%)	34 (72.3%)	ns
Single	14 (31.8%)	9 (19.1%)	
divorced/widowed	3 (6.8%)	4 (8.6%)	
Education, mean years (SD)	13.1 (1.7)	14.6 (2.2)	<0.001
<b>Country of origin, (%)</b>			
Israel	31 (70.5%)	42 (89.3%)	ns
Asia-Africa	6 (13.6%)	1 (2.1%)	
Western countries	5 (11.4%)	2 (4.3%)	
East Europe	2 (4.5%)	2 (4.3%)	
Income (SD)	3.11 (1.0)	4.2 (0.9)	<0.001
Years of obesity (SD)	12.5 (6.7)	14.4 (7.7)	ns
Weight in kg (SD)	126.32 (24.98)	100.60 (24.02)	<0.001
Weight range (kg)	98 - 230	63 - 170	
BMI (SD)	45.50 (8.11)	35.32 (6.73)	<0.001
MHI (SD)	172.95 (29.56)	168.30 (27.70)	ns
SF-36 (SD)	64.18 (17.00)	70.43 (12.63)	0.049
RSE (SD)	1.75 (0.56)	1.87 (0.48)	ns

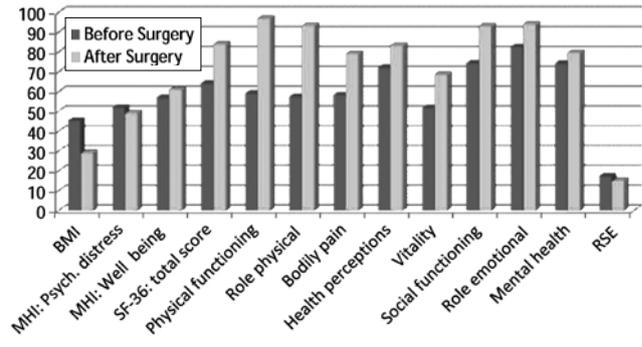
Two-tailed Student t tests for independent samples and  $\chi^2$  tests were used. SD: standard deviation, ns: not significant, MHI: Mental Health Inventory, SF-36: Medical Outcomes Study Short Form-36, RSE: Rosenberg Self Esteem scale.

a number of socio-demographic variables: in the surgery group subjects were younger, more likely to be women, less educated and with lower income as compared to the diet group. The surgery participants weighed more and their quality of life was poorer than participants in the weight loss group.

Participants who underwent surgery had a mean weight loss of 34.7% (45 kg or 16 BMI units). SRVG participants lost significantly more weight ( $M = 48.05$  kg,  $SD = 23.02$ ) compared to the LAGB group ( $M = 29.29$  kg,  $SD = 23.62$ ), Mann-Whitney:  $Z = 2.46$ ,  $p = .015$ . Since there were no significant differences between these procedures in other outcome variables, all surgery participants were considered for statistical analyses as one group.

The surgery group improved significantly in all outcome measures except psychological distress which remained

Graph 1. Means preoperatively and after one year follow-up



unchanged (see Table 2 and Graph 1). Comparisons between the surgery group and a representative Israeli sample (17) in MHI scores yielded no significant differences at onset. However, at one-year follow-up, the total MHI and the well being scores of the surgery group were higher than those of the community sample ( $t(647) = 2.22$ ,  $p < .05$  and  $t(647) = 3.62$ ,  $p < .001$  respectively).

The comparisons in SF-36 quality of life scores at the start of the study between the surgery group and a representative Israeli sample (15) showed lower scores in the surgery group on three scales: physical functioning, role physical, and bodily pain ( $t(2,072) = 4.4$ ,  $p < .001$ ,  $t(2,072) = 1.24$ ,  $p < .05$  and  $t(2,072) = 2.93$ ,  $p < .001$ , respectively). The surgery group also scored higher on two scales: health perceptions and mental health ( $t(2,072) = -2.55$ ,  $p < .02$ , and  $t(2,072) = -2.14$ ,  $p < .05$ , respectively). After one year, the surgery group showed higher scores than the community norm in all SF-36 scales: physical functioning, role physical, bodily pain, health perception, vitality, social functioning, role emotional, and mental health ( $t(2,072) = -4.86$ ,  $p < .001$ ,  $t(2,072) = -3.55$ ,  $p < .001$ ,  $t(2,072) = -1.65$ ,  $p < .05$  one-tailed,  $t(2,072) = -5.63$ ,  $p < .001$ ,  $t(2,072) = -3.36$ ,  $p < .01$ ,  $t(2,072) = -2.73$ ,  $p < .01$ ,  $t(2,072) = -2.38$ ,  $p < .02$ , and  $t(2,072) = -3.78$ ,  $p < .001$ , respectively).

Individuals who participated in the weight-loss program had a significant mean weight loss of 9.23% (10 kg or 4 BMI units). There was no significant improvement in their well being or psychological distress. Improvement was significant in three of the eight SF-36 scales, and in the total SF-36 score. There was no significant

Table 2. The surgery group: Means (and standard deviations) preoperatively and after one year follow-up (n=44)

	Before surgery	1-year follow-up	Mean difference	95% CI	p	Community norm
Weight (kg)	126.32 (24.98)	81.25 (15.91)	45.07 (23.87)	37.8 - 52.3	<.001	
BMI	45.50 (8.11)	29.30 (5.51)	16.19 (8.41)	13.6 - 18.8	<.001	
MHI: total score	172.95 (29.56)	179.73 (29.79)	-6.77 (24.39)	-14.2 - 0.6	.036 <sup>a</sup>	169.87 (28.32)
MHI: Psych. distress	51.98 (16.62)	49.32 (17.22)	2.66 (13.84)	-1.6 - 6.9	ns	49.91 (18.23)
MHI: Well being	56.93 (14.31)	61.05 (13.51)	-4.11 (12.76)	-8.0 - -0.2	.038	53.71 (12.96)
SF-36: total score	64.18 (17.00)	83.78 (10.19)	-19.59 (14.92)	-24.1 - -15.1	<.001	
Physical functioning	59.09 (24.00)	96.82 (6.39)	-37.23 (22.11)	-44.4 - -31.0	<.001	77.3 (26.6)
Role physical	57.39 (40.56)	93.18 (21.13)	-35.80 (42.93)	-48.8 - -22.7	<.001	71.3 (40.8)
Bodily pain	58.33 (27.75)	79.04 (26.38)	-20.71 (32.02)	-30.4 - -11.0	<.001	71.6 (29.8)
Health perceptions	72.16 (23.73)	83.18 (15.06)	-11.02 (20.13)	-17.1 - -4.9	<.001	62.9 (23.8)
Vitality	51.82 (22.00)	68.52 (18.57)	-16.70 (20.32)	-22.9 - -10.5	<.001	56.9 (2.8)
Social functioning	74.43 (34.09)	92.90 (17.96)	-18.47 (31.72)	-28.1 - -8.8	<.001	81.8 (26.8)
Role emotional	82.58 (36.29)	93.94 (20.68)	-11.36 (35.90)	-22.3 - -0.4	.042	81.1 (35.7)
Mental health	74.18 (20.26)	79.55 (17.83)	-5.36 (20.68)	-11.7 - 0.9	.046 <sup>a</sup>	67.1 (21.7)
RSE	1.75 (0.56)	1.53 (0.56)	0.21 (0.51)	0.06 - 0.37	.009	

Two-tailed paired Student t tests were used.  
<sup>a</sup>one-tailed test

**Table 3.** The diet group: Means (and standard deviations) before the program and after one year follow-up (n=47)

	Before surgery	1-year follow-up	Mean difference	95% CI	p	Community norm
Weight (kg)	100.60 (24.02)	90.60 (20.03)	10.00 (10.85)	6.8 - 13.2	<.001	
BMI	35.32 (6.73)	31.88 (5.79)	3.44 (3.61)	2.4 - 4.5	<.001	
MHI: total score	168.30 (27.70)	168.45 (27.44)	-0.14 (22.19)	-6.7 - 6.4	ns	169.87 (28.32)
MHI: Psych. distress	52.04 (14.24)	51.11 (15.32)	0.94 (12.54)	-2.7 - 4.6	ns	49.91 (18.23)
MHI: Well being	52.34 (14.48)	51.55 (13.71)	0.79 (11.48)	-2.6 - 4.2	ns	53.71 (12.96)
SF-36: total score	70.43 (12.63)	75.46 (15.74)	-5.03 (10.74)	-8.2 - -1.9	.002	
Physical functioning	79.79 (20.38)	84.79 (20.43)	-5.00 (17.23)	-10.1 - -0.06	.026 <sup>a</sup>	77.3 (26.6)
Role physical	76.06 (30.38)	82.98 (30.44)	-6.91 (35.24)	-17.3 - 3.4	ns	71.3 (40.8)
Bodily pain	76.36 (20.28)	76.36 (23.24)	0.00 (23.63)	-6.9 - 6.9	ns	71.6 (29.8)
Health perceptions	68.51 (21.21)	75.74 (20.95)	-7.23 (22.36)	-13.8 - -0.7	.032	62.9 (23.8)
Vitality	56.17 (19.54)	62.66 (23.68)	-6.49 (17.90)	-11.7 - -1.2	.017	56.9 (2.8)
Social functioning	80.59 (26.17)	81.91 (24.42)	-1.33 (28.34)	-9.7 - 7.0	ns	81.8 (26.8)
Role emotional	70.21 (38.22)	76.60 (35.38)	-6.38 (39.71)	-18.0 - 5.3	ns	81.1 (35.7)
Mental health	70.89 (19.70)	72.09 (22.01)	-1.19 (14.61)	-5.5 - 3.1	ns	67.1 (21.7)
RSE	1.87 (0.48)	1.84 (0.52)	0.04 (0.34)	-0.07 - 0.14	ns	

Two-tailed paired Student t tests were used.  
<sup>a</sup>one-tailed test

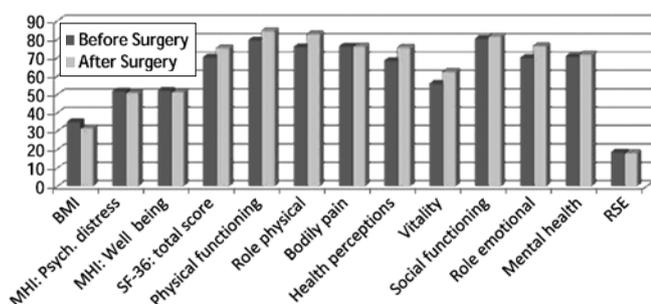
change in self-esteem (see Table 3 and Graph 2). No significant differences in MHI were found between the diet group and the community at onset and one-year follow-up. Also, there were no differences in the SF-36 scores at the beginning (except role emotional, which was lower in the diet group,  $t(2,075) = 2.06, p < .05$ ) and at one-year follow-up (except health perceptions which was higher in the diet group,  $t(2,075) = -3.67, p < .001$ ).

As shown in Table 4, the surgery group had a greater weight loss in absolute (kg) and relative terms (percentage of weight loss and BMI). There was a significant difference in well being due to a greater improvement in the surgery group compared to no improvement in the diet group. The same results were found for self-esteem. Although the two groups improved in the SF-36 total score, physical functioning, and vitality scales (see Tables 2 & 3), improvement in the surgery group was greater. As for the pain and role physical scales that indicated problems at onset only for surgery participants, follow-up scores showed their significant improvement.

Since the two groups differed in a number of demographic variables, regression analyses, with control for age, education and income, were used to predict difference scores of the outcome variables. We also controlled initial weight, which was correlated with improvement in quality of life and self-esteem but not for gender and country of origin because they were not correlated with the outcome variables. Since differences between groups may occur due to error variance of difference scores and differences at baseline,

we made a correction for this bias by first entering the baseline level of the predicted outcome variable; in the second step we entered the treatment (surgery vs. diet) as a dummy variable and then the interaction between them. A significant treatment variable therefore means that the difference between the groups does not stem from error variance due to the use of difference scores. The regression analyses confirmed the results presented in Table 4 except for bodily pain.

**Graph 2.** Means before diet and after one year follow-up



## DISCUSSION

The results of this study showed greater improvement following bariatric surgery vs. a conventional treatment. The

**Table 4.** Comparison between the surgery and the diet group in difference scores<sup>a</sup>

	Surgery (n=44)	Diet (n=47)	p
% of weight loss	34.70 (11.94)	9.23 (8.31)	<0.001
Weight (kg)	-45.07 (23.87)	-10 (10.85)	<0.001
BMI	-16.19 (8.41)	-3.44 (3.61)	<0.001
MHI: total score	6.77 (24.39)	0.15 (22.19)	ns
MHI: Psych. distress	-2.66 (13.84)	-0.94 (12.54)	ns
MHI: Well being	4.11 (12.76)	-0.78 (11.48)	0.028 <sup>b</sup>
SF-36: total score	19.59 (14.92)	5.03 (10.74)	<0.001
Physical functioning	37.73 (22.11)	5.00 (17.23)	<0.001
Role physical	35.80 (42.93)	6.91 (35.24)	<0.001
Bodily pain	20.71 (32.02)	0.00 (23.63)	<0.001
Health perceptions	11.02 (20.13)	7.23 (22.36)	ns
Vitality	16.70 (20.32)	6.49 (17.90)	0.013
Social functioning	18.47 (31.72)	1.33 (28.34)	0.008
Role emotional	11.36 (35.90)	6.38 (39.71)	ns
Mental health	5.36 (20.68)	1.19 (14.61)	ns
RSE	-0.21 (0.51)	-0.04 (0.34)	0.027 <sup>b</sup>

Two-tailed Student t tests for independent samples were used. ns, not significant.

<sup>a</sup>the score after one-year follow-up minus the score before surgery/diet  
<sup>b</sup>one-tailed test

superior effects of surgery over the weight-loss program related not only to weight loss but were consistent across all outcome measures. Post-surgery subjects improved in terms of mental health, self-esteem and the physical and emotional aspects of quality of life, while the diet group only reported improvement in their physical condition. The enhanced effects of surgery were essentially unchanged when controlling for group differences in initial weight, age, education and income. These findings are especially significant since it is the first time that bariatric surgery has been compared to a uniform high-level weight-loss program, whose participants were highly motivated treatment seekers with mild to moderate level of obesity that was fitting with their assignment to a conventional weight-loss program.

The mean weight loss following bariatric LAGB is similar to previous findings but the weight loss after SRVG is greater than previously reported (5). These bariatric procedures were the most popular when the study was carried out. While LAGB is still a very common technique, SRVG has been found to have long-term complications – mainly staple line disruption (20) – and is now rarely done. However, as our study was only one-year follow-up, no medical complications were reported

in this short lapse of time and great weight losses were obtained – similar to the weight losses attained nowadays by the more advanced techniques. Moreover, we must emphasize that the quality of the weight-loss program rather than the quality of the bariatric techniques was the focus of our study and that the conclusions reached refer to bariatric surgeries in general.

As for the weight-loss program, the mean loss of 10 kg at one-year follow-up is better than usually reported for such programs, indicating that it is indeed a high-quality program. By comparison, commercial programs like “Weight Watchers” reported a mean weight loss of 5 kg at one-year follow-up (21). Our better results might reflect the general improvements in the field of weight-loss programs and specific qualities of this program such as the intensity of the initial phase and the high emphasis on physical exercise.

Our findings are similar to those of the Swedish study (11): weight loss differences between the groups were large (30 kg after surgery vs. 1.2 kg after diet). Hence, our study shows that group differences remain meaningful even when bariatric surgery is compared with an updated weight reduction program that incorporates the latest advances in obesity treatment.

In the Swedish study (11) the weight loss in the diet group was minimal while in our study it was meaningful: the reason might be that since the Swedish study followed group matching procedures, the conventionally treated participants had a mean BMI of 39.3 at baseline, and thus their referral to a weight-loss program was not their best option according to accepted clinical recommendations. In comparison, participants in the present study conventional treatment had a mean BMI of 35 at baseline, thus making their assignment to a weight-loss program more appropriate, i.e., raising their chances to succeed in this treatment. Including lower BMI individuals in this program was also dictated by the fact that this was a strenuous exercise program which was not suitable for seriously obese individuals.

The lack of differences in mental health between participants in both groups and a normative community sample is consonant with community studies that did not find considerable psychopathology among obese individuals in general (22, 23). Interestingly, studies of obese persons seeking dietary or surgical treatments showed them to be generally more depressed and anxious than their normal weight counterparts (24, 25), especially women with class III obesity (BMI  $\geq$  40) (26). In this study such an effect was not present. Our contrasting

results may be explained by the argument that obesity is a chronic condition that often begins in childhood or adolescence, and consequently, people adapt to it in the same way that they adapt to other chronic conditions (27). This reasoning fits the present study since our participants have been obese for more than 10 years on the average.

Curiously, even though the mental health scores of the surgery participants were similar at onset to community norms, their psychological well being was significantly higher than the norm at one-year follow-up. This finding, which is consistent with previous reports (11, 28), appears to reflect an elevation in mood that usually follows the large weight loss and improved physical functioning that occurs after bariatric surgery.

The surgery group's improvement in all quality of life measures corroborates previous research that used the SF-36 (25, 28) or similar scales (11). These results support the hypothesis that poor quality of life, especially in terms of physical functioning, is a consequence of obesity and consequently, and can be meaningfully improved by bariatric surgery. Participants in the weight-loss program mainly improved in the total score of quality of life, but, on the whole, their scores remained in the normative range. The improvement in vitality, physical functioning, and health perceptions underlines the importance of weight loss, even if moderate compared to bariatric surgery. The diet group reported a weight loss of 9.23% of their initial body weight. It is known that even modest weight loss (i.e., 5%-10% of initial body weight) significantly improves the metabolic disorders associated with obesity by reducing insulin, blood pressure, fatty acids and triglycerides, and protects against certain cancers, osteoarthritis, and cardiovascular disease (29).

The group comparison showed that the surgery participants had lower initial and higher follow-up scores in the physical measures of quality of life than those who participated in the weight-loss program. On emotional measures, the superior effects of surgery were found in scales that assessed positive mood (well being and vitality), self-esteem, and social functioning. Together with previous findings of improved self-image following bariatric surgery (30) and the lack of similar improvement following a weight-loss program (31), these findings suggest that moderate weight loss is insufficient for improvement in self-esteem, mental health and other emotional aspects of quality of life.

In conclusion, at one-year follow-up, both approaches were effective to a different degree: bariatric surgery led to a large weight loss, while the effect of a dieting and

physical exercise program was moderate but clinically significant. Surgery patients also experienced a greater improvement in terms of physical and emotional aspects of health-related quality of life. Moderate weight losses, although health-improving, did not enhance self-esteem and mental health. These results were obtained in spite of the differences between the groups: the diet group included highly motivated participants, paying out of pocket for their program, while the surgery participants were of lower socio-economic status and their surgery was covered by insurance. Furthermore, participants in the study received the treatment of choice according to present guidelines for the treatment of obesity.

The results should be cautiously interpreted in lieu of the present study's limitations. There were differences in demographic variables, and despite the fact that we controlled for them, still it may have had an impact on the results. The normative samples might have been also different in terms of background variables, but we have no data to adjust for them. The short extent of follow-up may explain the mood elevation in the surgery group, which could reach its zenith at the one-year follow-up. At one-year, large weight losses in the surgery group had a greater impact on health-related quality of life including self-esteem and mental health, and we did not find any psychological advantage for the diet program's gradual weight loss. It will be of interest in future studies to examine whether participants of a long-term diet program who show large weight loss comparable to the post-surgery weight loss manifest similar or even greater improvement in their physical and/or mental health than their bariatric surgery counterparts.

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### Disclosure

The authors declare that they have no conflict of interest.

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