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Surgically induced weight loss effects on sexual quality of life of obese men: a prospective evaluation

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Abstract

Background Sexual difficulties are common among obese patients, but only a few research studies have examined the relationship between obesity and sexual quality of life (QoL). The aim of this study is to investigate the efficacy of bariatric surgery to improve sexual function and related quality of life in obese men.

Methods Prospective study including consecutive male patients undergoing bariatric surgery procedures, both sleeve gastrectomy and Roux en Y gastric bypass, between 2013 and 2017. Anthropometric parameters, biochemical and hormonal assessment and QoL questionnaires [International Index of Erectile Function (IIEF), Sexual Desire Inventory (SDI), Short Form-36 (SF-36) health survey questionnaire] were collected before and 12 months after surgery.

Results 44 male patients were recruited in the study. 40/44 (90.91%) underwent a SG and 4/44 a RYGB (9.09%). Median age was 43.45 years. Waist Circumference, Hip Circumference, body weight and body mass index significantly decreased 12 months after surgery, with a median weight loss of 49 kg and a median BMI difference of 14.28 kg/m^2 12 months after surgery. Basal glycaemia, HbA1c, basal insulin, triglycerides, HDL cholesterol and CRP levels significantly decreased, while FSH, total testosterone and SHBG levels significantly increased. IEEF total score was significantly higher 12 months after surgery. Univariate analysis identified SHBG, estradiol and inhibin B levels, IIEF erectile function, IIEF intercourse satisfaction, IIEF total and SF-36 physical functioning scores as significant negative predictive factors of sexual improvement. None of them reached the statistical significance in the multivariate analysis.

Conclusions Sexual impairment in morbidly obese men represents an underestimated problem, with a high prevalence in the IIEF domains in our series. Bariatric surgery represents the most effective therapy of morbid obesity, having a tremendous impact on metabolic profile, sexual function and self-perceived QoL.

Keywords Obesity · Bariatric surgery · Sexual dysfunction · Hypogonadism · Quality of life

Obesity has become a public health problem of epidemic proportions in Western countries. Its associations with cardiovascular disease, hypertension, diabetes, cancer and musculoskeletal disease have a significant effect on the global disease burden. In addition to its medical consequences, obesity has been linked to impairments in health-related quality of life (QoL), including reduced physical functioning, psychosocial functioning and emotional well being.

The clinical experience suggests that sexual dissatisfaction and/or sexual difficulties are common among obese patients, but only a few research studies have examined the relationship between obesity and sexual QoL, especially in men. In male subjects, obesity has been associated with lower sexual satisfaction [1, 2], increased erectile dysfunction (ED) [3, 4], penile vascular impairment [5] and reduced fertility [6, 7]. ED, defined as the persistent or recurrent inability to achieve or maintain an erection sufficient for satisfactory sexual intercourse, represents an important cause of decreased QoL in men [8]. It has been estimated that overweight and obesity may increase the risk of ED by 30–90% compared to normal weight subjects [9–11]. The relationship between obesity and ED can be explained by the decreased testosterone levels and elevated levels of estrogens and pro-inflammatory cytokines in obese individuals [12].

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In some studies, non-surgical weight loss has been shown to improve male sexual function [13, 14], but studies of the effect of weight loss on testosterone levels have had contradictory results, with some studies showing increases [15, 16], other studies showing no change [17] and one small study showing decreases in testosterone [18]. Aim of this study is to investigate the efficacy of bariatric surgery to improve sexual function and related quality of life in obese men.

Methods

A prospective study including consecutive male patients undergoing bariatric surgery procedures, both sleeve gastrectomy (SG) and Roux en Y Gastric Bypass (RYGB), between October 2013 and June 2017 was conducted at a single Institution. All male patients scheduled for SG or RYGB able to give informed consent were eligible. Data including anthropometric parameters, biochemical and hormonal assessment and quality of life (QoL) questionnaires were collected before and 12 months after surgery. Anthropometric measures included waist circumference (WC) [cm], hip circumference (HC) [cm], waist to hip ratio (WHR), body weight [kg] and body mass index (BMI) [kg/m^2]. Biochemical and hormonal assessment included basal glycaemia [mg/dL], haemoglobin A1c (HbA1c) [mmol/mol], basal insulin [μIU/mL], total cholesterol [mg/dL], high density lipoprotein cholesterol (HDL) [mg/dL], low density lipoprotein cholesterol (LDL) [mg/dL], triglycerides [mg/dL], iron [μg/dL], ferritin [ng/mL], zinc [mg/L], albumin [g/dL], C-reactive protein (CRP) [mg/L], luteinizing hormone (LH) [IU/L], follicle-stimulating hormone (FSH) [IU/L], total testosterone [ng/dL], sex hormone binding globulin (SHBG) [nmol/L], estradiol [pg/mL], prolactin [ng/dL], inhibin B [pg/mL]. Blood samples were always collected between 8 and 10 AM. QoL questionnaire administered included both general QoL evaluation questions by means of SF36 short form (SF-36) [19] and specific sexual QoL evaluation questions by means of the International Index of Erectile Function (IIEF) [20] and the Sexual Desire Inventory (SDI) [21] questionnaires. The SF-36 questionnaire involves 36 questions (1–6 points) about patients' general health across 8 domains: physical functioning (PF) (question 3), physical role functioning (RP) (question 4), bodily pain (BP) (questions 7–8), general health perceptions (GH) (question 1 + 11), vitality (VT) (questions 9a + 9e + 9 g + 9i), social role functioning (SF) (questions 6 + 10), emotional role functioning (RE) (question 5), mental health (MH) (questions 9b + 9c + 9d + 9f + 9h). The IIEF is a multidimensional test, including a series of 15 questions on sexual function across 5 domains: erectile function (EF) (questions 1–5 + 15), orgasmic function (OF) (questions 9–10), sexual desire (SD) (questions 11–12), intercourse satisfaction (IS) (questions 6–8) and overall satisfaction (OS) (questions 13–14). The SDI questionnaire includes 14 questions (0–8 points) on sexual desire. The final score is expressed through dyadic factor (couples sexual desire; questions 1–9) and solitary factor (self-pleasuring desire; questions 10–13). The question 14 is treated separately because it represents the time during which an individual can feel comfortable even if abstaining from sexual activity.

Every patient was counselled by one of the investigators in the Outpatient Department. Patients who signed the informed consent were recruited and filled out the questionnaires.

The study was approved by the local Ethical Committee, with the following registration number: CS/496. The study was founded by the European Association for Endoscopic Surgery (EAES).

Statistical analysis

The primary endpoint was IIEF total score modification 12 months after surgery. Assuming an average IIEF total score ≤ 55 in obese male patients before surgery and an expected postoperative IIEF total score > 60, 40 patients were needed to ensure a power of 88.5% with a two sides alpha error of 0.05.

Continuous variables, both with a normal or a non-normal distribution, are reported as median and inter-quartile range (IQR). Categorical variables are reported as events number and percentages. Normality distribution was tested with the Shapiro–Wilk normality test.

Differences between preoperative and postoperative data were tested with the chi-squared test for categorical variables (with Fisher's correction when needed). Continuous variables were tested with the Student's *t* test if normally distributed or with the non-parametric Wilcoxon signed rank test if the distribution was not normal.

Patients subgroups analysis was performed by means of the Student's *t* test for continuous variables with normal distribution and the non-parametric Mann–Whitney test for continuous variables without normal distribution.

Several Spearman's correlations were calculated to investigate any potential relationship between anthropometric measures and biochemical/hormonal data or questionnaire scores.

A logistic regression model was used to carry out uni- and multivariate analysis in order to identify negative predictive factors of clinical success (IIEF total score ≤ 60) All reported *p* values were two-sided, at the conventional 5% significance level. Data were analysed by Stata15/SE statistical software (Stata Corp, College Station, TX).

Results

Between October 2013 and June 2017 44 male patients were recruited in the study. 40/44 (90.91%) underwent a SG and 4/44 a RYGB (9.09%). Median age was 43.45 years (IQR 40.89–46.92). 4 patients who underwent a SG were lost at follow-up. Anthropometric measures are reported in Table 1: WC, HC, body weight and BMI significantly decreased 12 months after surgery, with a median weight loss of 49 kg and a median BMI difference of 14.28 kg/m^2.

Biochemical and hormonal blood tests results are shown in Table 2. Basal glycaemia, HbA1c, basal insulin, triglycerides, HDL cholesterol and CRP levels significantly decreased, while FSH, total testosterone and SHBG levels significantly increased. Before surgery a serum testosterone level ≥ 4 ng/ mL (eugonadism) was found in only 10% of patients, while 12 months after surgery in 67.5%.

IIEF questionnaire results are listed in Table 3. Prevalence of preoperative sexual dysfunction in all domains was: 36.4% in EF, 54.6% of OF, 65.9% in SD, 81.8% in IS and 75.0% in OS. Total score was significantly higher 12 months after surgery; OF, IS and OS showed the highest improvement. No differences in the global IIEF score were found between hypogonadal (serum total testosterone ≤ 4 ng/mL) and no hypogonadal (serum total testosterone between 4 and 8 ng/mL) patients. SDI questionnaire scores (Table 4) significantly improved after surgery. SF-36 questionnaire scores (Table 5) significantly increased after surgery in all of the eight domains.

Spearman's correlation coefficient was calculated to investigate any significant association between anthropometric measures, blood tests results and SF-36, IIEF and SDI questionnaire scores before and after surgery. A significant negative correlation with SF-36 total score was found for basal insulin, iron and zinc serum levels before surgery and for WC, HC, body weight and BMI 12 months after surgery (Table 6). A significant negative correlation with IIEF total score was found for basal insulin and LH levels before surgery; no significant correlations were found 12 months after surgery. Considering only IIEF EF score, a significant negative correlation with SF-36 score was found for basal glycaemia, basal insulin, iron and LH levels before surgery and for WC 12 months after surgery. Age showed a significant negative correlation with SDI total score before surgery and 12 months after surgery; also prolactin levels were negatively associated with SDI total score after surgery. A significant positive correlation between SF-36 total score and IIEF was found before and after surgery, while the correlation between SF-36 and SDI didn't reach the level of significance.

In order to identify negative predictive factors of sexual function improvement, patients were divided in two groups: with a postoperative IIEF total score ≤ 60 (failure) and > 60 (success). A univariate analysis was conducted using a logistic regression model (Table 7): SHBG, estradiol and inhibin B levels, IIEF erectile function, IIEF intercourse satisfaction, IIEF total and SF-36 physical functioning scores were identified as significant negative predictive factors of success and included in a multivariate analysis. None of them reached the statistical significance in the multivariate analysis.

Discussion

Sexual impairment in morbidly obese male patients represents an underestimated reality. It reflects a condition of hypogonadotropic hypogonadism, with low testosterone and gonadotropins serum levels. This study underlines the

Table 1 Anthropometric measures

Variable	Time	Median (IQR)	Range	*p* value
Waist circumference [cm]	PRE	139 (130; 145.5)	113–167	< 0.001*
	POST	113.5 (107; 127.5)	86–155	
Hip circumference [cm]	PRE	137.5 (130; 147.5)	114–188	< 0.001**
	POST	117.5 (107.5; 125.5)	95–150	
Waist/hip ratio	PRE	1.02 (0.94; 1.05)	0.82–1.23	0.177*
	POST	0.99 (0.94; 1.04)	0.82–1.19	
Body weight [kg]	PRE	136.75 (125.5; 157.5)	97–185	< 0.001**
	POST	96.9 (87; 111)	76–146	
BMI [kg/m^2]	PRE	44.25 (40.37; 48.18)	36.06–56.50	< 0.001**
	POST	31.06 (28.03; 35.37)	25.10–45.20	

PRE preoperative, *POST* postoperative assessment

*Paired *t*-test

**Wilcoxon signed rank test

Table 2 Biochemical and hormonal assessment. PRE (preoperative), POST (postoperative assessment)

Variable	Time	Median (IQR)	Range	*p* value
Basal glycaemia [mg/dL]	PRE	98 (86.5; 114.5)	45–191	0.004**
	POST	86.5 (81; 92.5)	58–129	
HbA1c [mmol/mol]	PRE	42.5 (39.5; 47.5)	32–112	< 0.001**
	POST	35 (33; 37)	26–63	
Basal insulin [μIU/mL]	PRE	14.2 (9.8; 19.9)	2–71.1	0.010**
	POST	8.4 (5.55; 16)	2–174	
Total cholesterol [mg/dL]	PRE	190 (160; 205)	131–255	0.462*
	POST	181 (164.5; 194)	83–289	
HDL cholesterol [mg/dL]	PRE	38 (33; 46)	16–88	< 0.001**
	POST	51 (46.5; 59.5)	32–81	
LDL cholesterol [mg/dL]	PRE	101.5 (85.5; 127)	50–182	0.996*
	POST	109.5 (91.5; 118.5)	28–202	
Triglycerides [mg/dL]	PRE	181.5 (127.5; 223.5)	62–400	< 0.001**
	POST	106 (61; 135)	35–236	
Iron [μg/dL]	PRE	93 (75; 122.5)	32–190	0.197*
	POST	93 (80; 101.5)	27–156	
Ferritin [ng/mL]	PRE	224.5 (86.5; 307.5)	17–1292	< 0.001**
	POST	138.5 (51; 210)	7–494	
Zinc [mg/L]	PRE	0.88 (0.80; 0.95)	0.59–1.35	0.016*
	POST	0.80 (0.72; 0.88)	0.56–1.1	
Albumin [g/dL]	PRE	4.05 (3.9; 4.30)	2.7–5.30	< 0.001*
	POST	4.4 (4.2; 4.6)	4.1–5	
C-reactive protein [mg/L]	PRE	6.10 (4.3; 8.60)	0.6–67	< 0.001**
	POST	2.15 (0.85; 4.5)	0.3–13.9	
LH [IU/L]	PRE	4.10 (3.05; 60)	1.7–20.20	0.057**
	POST	5.2 (3.95; 6.35)	2.8–19.5	
FSH [IU/L]	PRE	3.70 (2.4; 5.05)	0.9–36.20	< 0.001**
	POST	5 (3.6; 6.5)	1–45	
Total testosterone [ng/dL]	PRE	2.30 (1.75; 3.36)	0.73–5.70	< 0.001**
	POST	4.74 (3.36; 5.99)	2.19–10.59	
Free testosterone [ng/dL]	PRE	7.70 (6.60; 9.60)	2.90–17.90	0.538**
	POST	9.7 (6.5; 11.8)	4–23.3	
SHBG [nmol/L]	PRE	16.45 (12.65; 24.45)	5.40–58	< 0.001**
	POST	35.85 (25.45; 53.5)	15.4–71.3	
Estradiol [pg/mL]	PRE	29.50 (19; 41)	5–72	0.155*
	POST	26.5 (20.5; 30.5)	8–53	
Prolactin [ng/dL]	PRE	17.55 (11; 27.05)	3.40–165.9	< 0.001**
	POST	7 (5.7; 10.4)	3.5–17.1	
Inhibin B [pg/mL]	PRE	114.6 (79; 146.35)	4.4–346.2	0.081**
	POST	119.1 (89.7; 168.65)	2.4–586.4	

*Paired *t*-test

**Wilcoxon signed rank test

prevalence of sexual impairment in morbidly obese male patients scheduled for SG or RYGB and shows that post surgical weight loss significantly improves both the biochemical and hormonal profile and the erectile function and sexual desire. No significant differences were found between SG or RYGB groups in all recorded parameters. The disproportion between the two groups (90.91% vs 9.09% of patients) is due to the fact that SG is the most common bariatric procedure performed at our Institution since 2009. This study aims to emphasize how morbid obesity could worsen sexual function in male patients and how surgery-induced weight loss has a huge impact on biochemical, functional and psychological aspects. The problem is underestimated and there are only few

Table 3 Dysfunction classification based on IIEF scores

Variable	PRE [*n* (%)]	POST [*n* (%)]	*p* value
Erectile function			0.444**
No dysfunction	28/44 (63.64%)	32/40 (80.00%)	
Dysfunction (mild to severe)	16/44 (36.36%)	8/40 (20.00%)	
Orgasmic function			0.011**
No dysfunction	20/44 (45.45%)	29/40 (72.50%)	
Dysfunction (mild to severe)	24/44 (54.55%)	11/40 (27.50%)	
Sexual desire			0.103**
No dysfunction	15/44 (34.09%)	23/40 (57.50%)	
Dysfunction (mild to severe)	29/44 (65.91%)	17/40 (42.50%)	
Intercourse satisfaction			0.014**
No dysfunction	8/44 (18.18%)	18/40 (45.00%)	
Dysfunction (mild to severe)	36/44 (81.82%)	22/40 (55.00%)	
Overall satisfaction			0.028**
No dysfunction	11/44 (25.00%)	19/40 (47.50%)	
Dysfunction (mild to severe)	33/44 (75.00%)	21/40 (52.50%)	

PRE preoperative, *POST* postoperative assessment

**Chi-square test

published data showing the benefits of surgery-induced weight loss on male sexual function [22]. Reis et al. [23] showed in a RCT how IIEF score and total and free testosterone significantly increased in male patients who underwent RYGB. Other studies have shown that weight loss through gastroplasty was associated with correction of the abnormal hormonal profile in obese men, with increase in SHBG and total testosterone levels [24].

However, bariatric surgery has also been reported to have a negative impact on sexual function. There are two main reasons to explain this finding:

1. insufficient weight loss, as in a study by Ranasinghe et al. [25] reporting data about patients who underwent laparoscopic adjustable gastric banding obtaining a mean BMI decrease of 7.5 kg/m^2 (in our study mean BMI decrease was 14.8 kg/m^2);
2. malabsorption of nutrients, especially zinc, as a result of duodenojejunal exclusion. Zinc deficiency has been found to subsist in up to 68% of patients who underwent biliopancreatic diversion [26]. In men, zinc deficiency may lead to impaired testosterone synthesis, which results in hypogonadism and impotence [27]. In our study serum zinc levels significantly decreased 12 months after surgery, without reaching deficiency levels in the IQR. Interestingly a significant negative Spearman's correlation was found between preoperative serum zinc, iron, insulin levels and SF-36 scores, suggesting how serum concentration of these molecules reflects a metabolic condition affecting patients' QoL. An epidemiological Finnish study found a significant association between serum zinc and later development of metabolic syndrome [28] and T2D [29] in middle aged and older men.

Table 4 SDI questionnaire scores

Variable	Time	Median (IQR)	Range	*p* value**
SDI one factor model, total SDI	PRE	66 (59; 80)	0–101	< 0.001
	POST	78 (64.5; 86)	13–101	
SDI two factor model (b), dyadic factor	PRE	49.5 (44.5; 55.5)	0–64	< 0.001
	POST	55 (51; 60)	13–70	
SDI two factor model (b), solitary factor	PRE	17.5 (9; 26.5)	0–37	0.022
	POST	22 (13; 26.5)	0–36	
SDI two factor model (c), dyadic factor	PRE	49.5 (44.5; 55.5)	0–64	< 0.001
	POST	55 (51; 60)	13–70	
SDI two factor model (c), solitary factor	PRE	23.5 (15.5; 32.5)	0–44	< 0.001
	POST	30.5 (19; 35)	4–44	
SDI three factor model, dyadic factor	PRE	40 (35; 43.5)	0–51	0.002
	POST	43.5 (39; 46)	9–54	
SDI three factor model, solitary factor	PRE	13 (8; 21)	0–31	0.084
	POST	17 (9; 21.5)	0–29	
SDI three factor model, mixed factor	PRE	15 (12; 18)	0–21	< 0.001
	POST	17.5 (16; 18.5)	4–24	

PRE preoperative, *POST* postoperative assessment

**Wilcoxon signed rank test

Table 5 SF-36 questionnaire scores

Variable	Time	Median (IQR)	Range	*p* value
Physical functioning	PRE	70 (57.5; 80)	35–100	< 0.001**
	POST	95 (92.5; 100)	70–100	
Physical role functioning	PRE	50 (0; 100)	0–100	< 0.001**
	POST	100 (100; 100)	50–100	
Bodily pain	PRE	61 (41; 74)	12–100	< 0.001**
	POST	100 (84; 100)	51–100	
General health perceptions	PRE	56 (46; 72)	25–100	< 0.001**
	POST	83.5 (72; 94.5)	40–100	
Vitality	PRE	55 (40; 62.5)	15–90	< 0.001*
	POST	75 (62.5; 80)	35–90	
Social role functioning	PRE	62 (50; 75)	25–100	< 0.001**
	POST	100 (75; 100)	50–100	
Emotional role functioning	PRE	83 (33; 100)	0–100	0.006**
	POST	100 (66; 100)	0–100	
Mental health	PRE	68 (50; 78)	20–96	< 0.001**
	POST	84 (72; 88)	44–100	
Total	PRE	60.63 (46.38; 73.13)	25.75–92.38	< 0.001**
	POST	88.57 (79.82; 91.69)	42.63–97.13	

PRE preoperative, *POST* postoperative assessment

*Paired *t*-test

**Wilcoxon signed rank test

Table 6 Spearman's correlation between anthropometric and biochemical variables and SF-36 total score

Variable	PRE		POST	
	r_s, correlation coefficient	*p* value	r_s, correlation coefficient	*p* value
Waist circumference	0.01	0.953	−0.33	0.036
Hip circumference	−0.11	0.477	−0.35	0.025
Body weight	−0.06	0.715	−0.34	0.032
BMI	−0.04	0.777	−0.39	0.012
Basal insulin	−0.34	0.025	−0.29	0.074
Iron	−0.41	0.006	0.30	0.064
Zinc	−0.44	0.003	−0.12	0.470

Only significant correlations are shown

PRE preoperative, *POST* postoperative assessment

Our study highlights the correspondence between biochemical markers of metabolic syndrome and self-perceived QoL. 12 months after surgery a negative correlation was found between WC, HC, body weight, BMI and SF-36, reflecting patients' expectations on weight loss and body image. The lower the weight, the higher the perceived QoL. This is a key point, underlining how psychological aspects strongly influence the perception of well being and consequently sexual function. SF-36 scores positively correlate with IIEF scores, showing how problems linked to sexual sphere are not only the expression of hormonal dysfunctions, but include psychological aspects difficult to measure and quantify. A recently published meta-analysis [30] concluded that weight loss benefits on sexual function occurring after surgery are beyond the parallel improvement in hormonal and metabolic profiles.

Two subjects in our series (5%) still presented severe sexual dysfunction 12 months after surgery. Postoperative blood tests showed a persistence of hypogonadism, with total testosterone levels below 4 ng/mL. It could be argued that in these cases hypogonadism was independent of morbid obesity, but the lack of further data makes this assumption only hypothetical. On the other hand 10 patients with postoperative total IIEF score > 60 had total testosterone levels below 4 ng/mL 12 months after surgery, suggesting

Table 7 Univariate analysis

Preoperative variable	Failure (total IIEF ≤ 60) $n=9$	Success (total IIEF > 60) $n=31$	p value
SHBG	26.83 ± 17.64	16.63 ± 6.27	0.009*
Estradiol	40.22 ± 18.06	25.87 ± 13.47	0.013*
Inhibin B	81.8 (46.1; 123.8)	117.6 (84.4; 173.1)	0.038**
IIEF, erectile function score	20 (15; 28)	28 (23; 29)	0.046**
IIEF, intercourse satisfaction score	8 (5; 10)	11 (9; 13)	0.006**
IIEF, total score	48 (34; 60)	61 (54; 67)	0.036**
SF36, physical functioning	58.33 ± 19.69	73.39 ± 16.50	0.027*

Only significant correlations are shown

*Student *t*-test

**Mann–Whitney test

that sexual dysfunction is strongly associated with a range of impairments in quality of life and other relevant areas of psychosocial functioning.

This study has some limitations: follow-up period is relatively short and only 9% of patients included underwent a procedure with duodenojejunal exclusion. RYGB-induced malabsorption could worsen in the long period sexual function (e.g. due to zinc deficiency). Nevertheless our data showed the huge impact of surgically induced weight loss on sexual impairment of morbid obese males.

Conclusions

Sexual dysfunction in morbidly obese men represents an underestimated problem, with a prevalence ranging from 36 to 82% in the IIEF domains in our series. Bariatric surgery represents the most effective therapy of morbid obesity, having a tremendous impact on metabolic profile and self-perceived QoL. The present study confirms the significant benefits of bariatric surgery on sexual function. These benefits are only partially explained by the improvement of metabolic and hormonal profile induced by weight loss. Rapid and substantial changes in body image, improvements in daily activity performance and self-perception of well being strongly influence sexual function, beyond biochemical modifications. These aspects are difficult to measure, but it would be interesting to focus further study on psychosocial aspects of weight loss.

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Compliance with ethical standards

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