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Sexual Functioning and Sex Hormones in Persons with Extreme Obesity and Seeking Surgical and Non-Surgical Weight Loss

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Abstract

Background—Many individuals with obesity are motivated to lose weight to improve weight-related comorbidities or psychosocial functioning, including sexual functioning. Few studies have documented rates of sexual dysfunction in persons with obesity.

Objectives—This study investigated sexual functioning, sex hormones, and relevant psychosocial constructs in individuals with obesity who sought surgical and non-surgical weight loss.

Setting—University based health systems.

Methods—One hundred forty-one bariatric surgery patients (median BMI [25th percentile, 75th percentile] 44.6 [41.4, 50.1]) and 109 individuals (BMI = 40.0 [38.0, 44.0]) who sought nonsurgical weight loss participated. Sexual functioning was assessed by the Female Sexual Function Index (FSFI) and International Index of Erectile Function (IIEF). Hormones were assessed by blood assay. Quality of life, body image, depressive symptoms and marital adjustment were assessed by validated questionnaires.

Results—Fifty-one percent of women presenting for bariatric surgery reported a sexual dysfunction; 36% of men presenting for bariatric surgery reported erectile dysfunction (ED). This

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is in contrast to 41% of women who sought nonsurgical weight loss and reported a sexual dysfunction and 20% of men who sought nonsurgical weight loss and reported ED. These differences were not statistically significant. Sexual dysfunction was strongly associated with psychosocial distress in women; these relationships were less strong and less consistent among men. Sexual dysfunction was unrelated to sex hormones, except for sex hormone binding globulin (SHGB) in women.

Conclusion—Women and men who present for bariatric surgery, as compared to individuals who sought non-surgical weight loss, were not significantly more likely to experience a sexual dysfunction. There were few differences in reproductive hormones and psychosocial constructs between candidates for bariatric surgery and individuals interested in non-surgical weight loss.

Keywords

Sexual Functioning; Quality of Life; Obesity

Introduction

Many individuals with obesity are motivated to lose weight to improve weight-related medical comorbidities. Others may be just as motivated to improve psychosocial functioning. One often overlooked area is sexual functioning. Problems with sexual functioning are highly prevalent in the general population, 34% of women and 31% have been found to have a sexual dysfunction.[1] Relatively few studies have documented the rate of sexual dysfunction in obese men and women. In a recent study of adults with obesity seeking weight reduction, 29% of women met diagnostic criteria for female sexual dysfunction; erectile dysfunction (ED) was reported by 45% of men.[2] Among men with type 2 diabetes enrolled in the Look AHEAD (Action for Health in Diabetes) trial, the percentages were higher--49.8% had mild to moderate ED, and 24.8% had complete ED.[3] Among women presenting for bariatric surgery, 60% reported a sexual dysfunction.[4]

The relationship between obesity and sexual functioning can be influenced by a number of factors.[5–6] Excess adiposity can have a detrimental effect on reproductive hormones, which may, in turn, have an adverse effect on sexual functioning. For women, obesity is associated with increased androgen and estrogen production rates as well as polycystic ovary syndrome (PCOS). In men, however, obesity has been associated with a decrease in both testosterone and sex-hormone-binding globulin, as well as an increase in estradiol. These hormones are considered necessary for the expression of sexual desire and adequate erectile functioning.

Obesity-related comorbidities also may impact sexual functioning. Impaired glucose tolerance, elevated HbA1c levels, and poor glycemic control have been associated with ED in men and low sexual desire and vaginal lubrication problems in women.[7] Cardiovascular disease, including hypertension, is associated with sexual dysfunction.[8] Medications used to treat both conditions also can have a detrimental effect on sexual functioning.[2,9–10]

Psychosocial variables also may influence sexual behavior. There is a strong relationship between depression and sexual functioning.[11] Body image dissatisfaction also may detrimentally impact sexual desire and behavior. Both depressive symptoms and body image dissatisfaction are positively associated with body mass index (BMI).[12–13] At the same time, the dynamics of a romantic relationship can contribute to the development and maintenance of sexual problems.[6] Couples who are distressed often report a loss of sexual interest and/or a lack of pleasure from sexual activity. All of these variables hold the potential to detrimentally impact both health- and weight-related quality of life.[5–6] At the same time, these areas of psychosocial functioning also are believed to play a role in the decision to seek bariatric surgery.[6, 14]

The present study was undertaken to assess rates of sexual dysfunction among persons with extreme obesity. We also sought to explore the relationship between sexual functioning and relevant psychosocial constructs. Finally, we set out to investigate the relationship between sexual functioning and sex hormones and to assess how these variables may be influenced by common obesity comorbidities. The inclusion of two samples of individuals with extreme obesity, those who sought bariatric surgery and those who sought behavioral weight loss treatment, allowed us to explore the relationship between the pursuit of two different forms of weight loss treatment and the variables of interest.

Method

Study Design

This study utilized baseline data collected from an ancillary study to the Longitudinal Assessment of Bariatric Surgery (LABS) consortium (PI Sarwer, NIH/NIDDK grant #R01DK072452). The design of the main LABS study is detailed elsewhere.[15–17] Under the umbrella of LABS, the LABS-2 investigation is focused on the long term effects of bariatric surgery on patients' weight, medical status, behavior, quality of life, physical activity, and health care needs.

One hundred and forty-one individuals participating in the LABS-2 study (BS) from two of the ten LABS sites, the Neuropsychiatric Research Institute (NRI) and the University of Pittsburgh Medical Center (UPMC), were recruited for participation in the present study. For a comparison group, we recruited 109 individuals with a similar level of obesity who were not seeking bariatric surgery and who presented for lifestyle modification (LM) for weight reduction at the Center for Weight and Eating Disorders at the University of Pennsylvania. Data were collected prospectively from the BS and LM participants, except for education and comorbidity data on LM participants which was confirmed retrospectively by mailed questionnaire. The trial was approved by the Institutional Review Boards at NRI, UPMC, and the University of Pennsylvania. Informed consent was received from all participants.

Participants

Participants met all the inclusion criteria of the LABS-2 study and also met all medical and psychiatric criteria for bariatric surgery. Eleven individuals who agreed to participate in LABS-2 refused participation in this investigation. The same criteria were used to determine eligibility of the comparison group. In general, persons who were non-ambulatory, those with significant or uncontrolled medical conditions including recent history of stroke, untreated or uncontrolled hypertension, history of renal or hepatic disease, and those with untreated or uncontrolled psychiatric conditions were excluded from participation. Participants also had to report involvement in a relationship that provided them with adequate opportunity for sexual activity with a partner. All participants received a $40.00 gift card (to a local department or bookstore) in recognition of participation.

Measures

Prior to bariatric surgery or non-surgical weight reduction, participants completed the following assessments, as appropriate:

Female Sexual Function Index (FSFI). The FSFI is a 19-item questionnaire which assesses six domains of female sexual functioning: desire (range: 1.2–6); arousal (0–6); lubrication (0–6); orgasm (0–6); satisfaction (0.8–6); and pain (0–6). Lower scores indicate poorer sexual function.[18] The subscales can be summed to create a total score (2–36); women with a total FSFI score ≤ 26 were categorized as having female sexual dysfunction (FSD).[19] If

the sum of the sexual desire domain items (2 questions each ranging from 1–5) was 5 or less, then a woman was classified as having hypoactive sexual desire disorder (HSDD).[20] Women were considered not sexually active if they reported no sexual activity on the majority of the 15 items where the response set included an option of reporting “no sexual activity” or “did not attempt intercourse”.

International Index of Erectile Function (IIEF). The IIEF is a widely-used, 15-item scale that assesses five domains of male sexual functioning: erectile function (range: 0–30); orgasmic function (0–10); sexual desire (2–10); intercourse satisfaction (0–15); and overall satisfaction (2–10). Lower scores indicate less satisfaction and greater dysfunction.[21] Men who scored < 26 on the erectile function subscale were defined as having erectile dysfunction (ED).[22] Men were classified as not sexually active if they reported no sexual activity on 6 or more of the 10 items where the response set included an option of reporting “no sexual activity” (operationalized on different items as “did not attempt intercourse”, “no attempts”, “no intercourse” or “no sexual stimulation/intercourse”.

Beck Depression Inventory-II (BDI-II). The BDI-II is the most widely used paper-and-pencil measure of depressive symptomatology.[23] Scores range from 0 to 63, with higher scores indicating greater symptoms.

Body Shape Questionnaire (BSQ). The Body Shape Questionnaire is a 34-item, self-report questionnaire designed to evaluate dissatisfaction with body shape. Each item is rated on a scale of 1 (“never”) to 6 (“always”) based on how the participant has been feeling over the last 4 weeks. A total score is obtained by calculating the sum of the responses. Higher scores indicate greater dissatisfaction.[24]

Body Image Quality of Life Inventory (BIQLI). The BIQLI is a 19-item self-report measure of the positive and negative impact of body image on various qualities of life. Subjects’ feelings are assessed in regard to beliefs about the self and life in general, emotional states, same and other-sex relationships, eating and exercise, grooming activities, sexual experiences, as well as family and work/school contexts. Participants respond to 19 items using a 7-point scale ranging from −3 (“Very Negative Effect”) to +3 (“Very Positive Effect”); 0 is labeled “No Effect”.[25]

The Short Form Health Survey-36 item version (SF-36). The SF-36 was used to assess health-related quality of life. Eight subscales assess separate domains of health and related functioning. Items on the physical functioning, pain, general health, physical role functioning can be used to calculate a physical health summary score. Items on the social role functioning, mental health, vitality, and perception of general health subscales can be used to calculate a mental health summary score. Higher scores indicate more positive health-related quality of life.[264]

Impact of Weight on Quality of Life-Lite (IWQOL-Lite). The IWQOL-Lite contains 31 items, with each item beginning with the phrase “Because of my weight.”[27] The measure examines five domains: physical function; self-esteem; sexual life; public distress; and work. Responses are combined to calculate a total score that ranges from 0 to 100; higher scores indicate a better quality of life.[28]

Dyadic Adjustment Scale (DAS). Relationship satisfaction was assessed by Dyadic Adjustment Survey.[29] The measure addresses four domains that measure the quality of marriage or similar dyads. In addition to a total score, the four domains measured are dyadic consensus, dyadic cohesion, dyadic satisfaction and affectional expression. Higher scores indicate higher levels of satisfaction.

For the psychometric measures, item non-response varied by form and ranged from 0% (IIEF) to 21% (DAS). For the FSFI, IIEF, BSQ, BIQLI, and DAS assessments, item non-response was addressed by calculating a prorated score (i.e. the average of the completed items was multiplied by the number of items for each scale) when less than 25% of the items were missing. If a domain consists of four or fewer items then a prorated score was not calculated. Following the IWQOL-Lite scoring manual,[30] domain scores were prorated if at least 50% of the items were completed and the total score was prorated if at least 75% of all items were completed. The BDI and SF-36 scores were only calculated using complete data.

Sex Hormones

Prior to surgery or the onset of lifestyle modification, we obtained a blood sample (20 ml) from each participant. Samples were cooled on ice and centrifuged within 15 min of drawing. Plasma was removed from the vacutainer within 15 min after centrifugation, placed into polypropylene tubes, and bulk-shipped to the Clinical Translational Research Center at the University of Pennsylvania for analysis. For men, we assessed total testosterone, free testosterone, luteinizing hormone, and sex-hormone-binding globulin (SHBG). For women, we assessed estradiol, total testosterone, follicle stimulating hormone (FSH), luteinizing hormone, SHBG, and dehydroepiandrosterone sulfate (DHEA-S). Total testosterone, free testosterone, sex-hormone-binding globulin, and DHEA-S assays were analyzed using standard enzyme-linked immuno assay (ELISA) (IBL Hamburg) assay kits. Estradiol and luteinizing hormone were analyzed by means of Chemiluminescent (Roche Elecys) laboratory assays. These were selected as the most reliable and cost-efficient assays for the current study. Sex hormone levels below detectable limits were imputed with a uniform random number between 0 and the detection limit (luteinizing hormone had the highest percentage of assays below detectable limits with 4%).

Statistical Analysis

Two sample significance tests were used to compare physical and demographic characteristics between BS and LM patients, stratified by sex. For continuous and ordinal data, the Wilcoxon test was used. Pearson's chi-square test with no continuity-correction was used for nominal data unless the expected cell count was less than 5 in at least one cell in which case Fisher's exact test was used.

Propensity scores, the probability of being in a specific group, were used to balance the covariates in the BS and LM groups. Scores were estimated separately for men and women using logistic regression to model the probability of being in the BS group. The model for males adjusted for BMI and race and the model for females adjusted for BMI, BMI squared, BMI cubed and race. Propensity scores were then divided into quintiles.

Linear regression was used to estimate and test the average difference in sexual functioning scores, sex hormone levels and quality of life scores between the groups separately for females and males, adjusting for propensity score quintiles. Poisson regression with a robust error variance estimator was used to estimate and test the relative risk of having a sexual dysfunction, accounting for group imbalances.

Accounting for group (BS or LM), the effect of sex hormone levels, comorbidities and quality of life scores on sexual functioning were estimated using either linear regression for continuous outcomes or Poisson regression with a robust error variance estimator for binary outcomes.

Participants who were not sexually active were excluded from all analyses involving the FSFI and IIEF. The residual plots for all linear regression models were reviewed to gauge

the legitimacy of the significance tests. Analyses were conducted using SAS (Statistical Analysis System), version 9.2, and R, version 2.11.0. All reported *P*-values are two-sided; *P*-values less than 0.05 were considered to be statistically significant.

Results

Of the 344 participants who consented (196 BS, 148 LM), there were 90 ineligible participants (53 BS, 37 LM) and 4 participants (2 BS, 2 LM) who did not provide any baseline data. Thus, 250 participants, 141 BS and 109 LM, were included in this analysis. Of the 250 participants (190 female and 60 male), there were 163 female (87 BS, 76 LM) and 47 male (27 BS and 20 LM) who were considered to be sexually active based on their responses to the FSFI and IIEF.

Demographic Characteristics

Baseline demographic and descriptive characteristics are presented in Table 1. Despite recruitment efforts to have BS and LM be similar on most demographic and health variables, a number of significant differences were observed. Surgery candidates were significantly heavier (median BMI: 44.6 kg/m^2 vs. 40.0 kg/m^2; $P<0.001$) and had a significantly larger waist circumference (median 129.5 cm vs. 115.1 cm; $P<0.001$). Nearly all surgery patients were Caucasian (97%), while only about half of the LM patients were (50.5%; $P<0.001$). Because of the difference between BS and LM patients on BMI and race, all subsequent comparisons between the groups use propensity scores to adjust for imbalances.

Rate of Sexual Dysfunction

Based on the FSFI total score, 51.4% of women who sought surgery and 40.9% who sought lifestyle modification were considered to have sexual dysfunction. After adjusting for propensity score quintiles, the rate of dysfunction between the two groups was not statistically significant (Adjusted Relative Risk (ARR) = 0.87; 95% Confidence Interval (CI) (0.54–1.40); $P = 0.56$). Similar percentages of women who sought BS (56.8%) or LM (44.9%) reported suffering from HSDD (ARR = 0.88; 95% CI (0.59–1.33); $P = 0.55$).

As shown in Table 2, female BS candidates reported greater difficulties with lubrication, than did female LM patients. The two groups did not differ significantly with respect to overall sexual functioning, desire, arousal, orgasm, satisfaction or self-reported pain during sexual behavior.

Based on the erectile function domain score of the IIEF, men who sought BS (36.4%) or LM (20.0%) did not significantly differ in the rate of ED (ARR = 0.60; 95% CI (0.21–1.66); $P = 0.32$). After adjusting for propensity score quintiles, there were no statistically significant differences between the two groups of men on any of the IIEF scales (Table 3).

Sex Hormones

Table 4 displays the sex hormone data. Prior to adjusting for propensity score quintiles, the differences between women who sought BS or LM patients with regard to estradiol and SHGB were statistically significant. However, after adjusting for propensity score quintiles, these differences did not remain statistically significant. BMI tended to explain more of the variation than race in SHGB values for females, suggesting that the difference in excess adiposity likely accounted for the differences between groups. There were no other differences between the groups.

Psychosocial Variables

Results of the psychosocial variables of interest for women are reported in Table 5a. Female LM patients reported greater symptoms of depression compared to female BS patients (*P*=0.04). Among women, BS patients had lower scores on the physical health aggregate score of the SF-36 as compared to LM patients (*P* =0.04); the two groups did not differ on the mental health aggregate score. Female BS patients reported a significantly lower IWQOL-lite total score (*P*=0.02), as well as significantly lower Physical Function and Sex Life subscale scores compared to LM patients (all *P*'s≤0.01). BS and LM female patients did not differ on the BIQLI, BSQ, DAS total score or any of the DAS subscales.

Male BS patients reported a significantly lower IWQOL-lite total score, as well as significantly lower scores on all subscales of the IWQOL-Lite except for Work and Public Distress subscale scores as compared to male LM patients (all *P*'s≤0.03) (Table 5b). There were no statistically significant differences between BS and LM male patients on the SF-36, BIQLI, BSQ, DAS or BDI.

Prior to investigating the adjusted differences between those who sought BS or LM in sexual functioning, sex hormones and psychosocial variables, residual plots were reviewed for all linear regression models. There were no gross violations of the linearity assumption and there were some cases of heteroscedasticity (especially erectile function subscale for men). Non-normal residuals were a common violation; however, regression estimates are robust to this assumption.

Correlations between Sexual Functioning, Sex Hormones and Psychosocial Variables

In the interest of space, we do not include the direction of all of the correlations that are reported. Percent change is included in the table and indicates the average percent change in the risk of sexual functioning problem per unit increase in the row variable, adjusting for type of patient (bariatric surgery patient or lifestyle modification patient). This information allows for interpretation of the direction of the relationship.

The presence of FSD was related to all of the psychosocial variables of interest with the exception of the DAS Cohesion subscale (Table 6). In women, FSD was significantly associated with SHGB (p = 0.03). The relationships between HSDD in women and the psychosocial variables of interest were in the same direction as the FSD relationships, but not as strong. There were no statistically significant relationships between HSDD and the sex hormones of interest.

Among men, ED was correlated with the Physical Component subscale of the SF-36 (*P*=0.03) and the Total Score of the IWQOL-Lite (*P*=0.04) as well as the Physical Functioning (*P*=0.03) and Sex Life (*P*=0 .002) subscales of this measure. There were no other significant relationships between the psychosocial or hormonal measures and ED.

Relationship between Sexual Functioning and Obesity-related Comorbidities

Among women and men, there were no significant relationships between sexual functioning domain scores and a history of diabetes or hypertension.

Discussion

Slightly more than half (51%) of the women presenting for bariatric surgery reported a sexual dysfunction; more than one-third (36%) of men presenting for bariatric surgery reported ED. In contrast, 41% of women and 20% of men seeking lifestyle modification for weight loss reported a sexual dysfunction. While these differences are in the anticipated

direction, particularly given the differences in BMI between those seeking BS and those interested in LM, they did not reach statistical significance. The experience of female sexual dysfunction was strongly associated with psychosocial distress. Female HSDD was associated with a lesser degree of psychosocial distress. In contrast, ED was correlated with measures of physical function and weight-related quality of life, but otherwise unrelated to psychosocial distress.

The rate of sexual dysfunction in women who sought bariatric surgery in this sample was somewhat smaller, but still comparable to that reported by Bond and colleagues, who also used the FSFI.[4] This leads to greater confidence in the conclusion that a majority of women who present for bariatric surgery report impairments in sexual behavior. Patients may not readily articulate these concerns to their surgeons or other providers while going through the preoperative evaluation process. Nonetheless, the experience of sexual dysfunction is associated with a range of impairments in quality of life and other relevant areas of psychosocial functioning, as seen in the present investigation, as well as other, recent studies of women with less severe obesity.[2]

Thirty-six percent of men presenting for bariatric surgery and 20% of men presenting for LM reported ED. These observations are comparable to a recent study of 53 men with a mean BMI of 39.3 + 5.2 kg/m^2 and enrolled in a clinical trial of weight loss delivered in a primary care setting, where 45% were found to have ED.[2] We attribute this difference in ED rates in the lifestyle modification groups to the difference in age between the two groups, as participants in the current study are, on average, 5 years younger.

In conducting this study, we attempted to recruit individuals for LM treatment who were equivocal in BMI to our BS candidates, in part as we wanted the two groups to be similar with regard to reproductive hormones. Unfortunately, our surgery candidates had a significantly greater BMI and the racial composition of the two groups differed. Once we controlled for this difference, the differences in estradiol and SHGB for females were no longer significant, suggesting that BMI, and perhaps race, rather than interest in bariatric surgery, accounted for the differences.

In general, BS candidates reported less positive physical health-related quality of life, as well as weight-related quality of life, than those individuals who presented for LM. This finding is consistent with a large body of research that has shown significant detriments in quality of life among those individuals presenting for bariatric surgery.[6] Somewhat surprisingly, women who presented for LM had higher BDI scores than those who were candidates for bariatric surgery. This may be an artifact of the enrollment procedures for the two groups. Candidates for bariatric surgery underwent a psychological evaluation that may have identified patients with high levels of depressive symptoms and who may have been recommended for treatment of these symptoms prior to surgery and their baseline assessment. Patients who presented for LM did not undergo a psychological evaluation prior to completion of the study assessments. We caution against over-interpretation of this difference, as the occurrence of depressive symptoms is similar to our previous studies of bariatric patients.[31]

Collapsing across the two treatment groups, we observed numerous, robust relationships between female sexual dysfunction and psychosocial functioning. The presence of sexual dysfunction was associated with impairments in numerous domains of health- and weight-related quality of life, body image dissatisfaction, depressive symptoms and lower levels of romantic relationship satisfaction. The presence of female hypoactive sexual desire disorder also was associated with psychosocial functioning, but the relationships were not as universal or as strong. While these results do not allow us to comment on the causal or

temporal aspects of these relationships, they are likely bidirectional. That is, women with a sexual dysfunction may experience other features of psychosocial distress; at the same time, the experience of increase symptoms of depression or substantial body image dissatisfaction may contribute to a loss of interest or pleasure in sexual activity.

ED was associated with lower scores on the Physical Component Summary score of the SF-36, the Total score on the IWQOL-Lite, as well as the Physical Functioning and Sex Life subscales. Consistent with other studies, the presence of ED was associated with perceived impairments in physical functioning.[6] Surprisingly, ED was otherwise unrelated to psychosocial functioning. Taken together, it appears that the presence of a sexual dysfunction is related to a wider range of psychosocial domains for women, including body image, depressive symptoms and relationship satisfaction, as compared to men. It may be that the experience of sexual dysfunction for women exacts a more psychological toll, whereas for men they experience the presence of ED as a more physical limitation that has less of an impact on their psychosocial functioning.

Previous studies have shown an association between sexual dysfunction and sex hormones.[32] In the present study, we were surprised to only observe a relationship between FSD and SHGB. It may be that the relationship between sexual dysfunction and sex hormones is most profound in individuals with a wide range of BMIs and less likely to be observed in “truncated” samples of individuals with extreme obesity. As noted above, previous studies also have found a relationship between sexual dysfunction and obesity-related comorbidities such as diabetes and hypertension. Those relationships were not found in the present investigation. Nevertheless, future studies should continue to investigate the relationship between sexual behavior and obesity-related health problems as well as the changes that occur in both areas following weight loss.

The present study has a number of limitations. As noted above, the two groups differed in several relevant demographic and descriptive variables, namely BMI and race. While the median BMI for both groups met the minimum criteria for bariatric surgery, our surgical candidates had significantly greater BMIs. In addition, the two groups differed in racial composition; 97% of surgery candidates were Caucasian, compared to only 51% of control participants. The percentage of surgery candidates who were Caucasian is larger than seen in most studies and limits our ability to comment on sexual functioning in non-Caucasian individuals. While we selected widely-used, psychometrically sound measures of psychosocial and sexual functioning, with the exception of the SF-36 and IWQOL-Lite, we are not aware of studies that have specifically validated these measures for those with extreme obesity. At the same time, the racial diversity of our LM participants, as well as our relatively large sample size of surgery patients, recruited from multiple sites, are believed to be methodological strengths of the study.

Conclusion

In summary, the study provides new information on the relationship between sexual functioning and psychosocial status in persons with extreme obesity. Given the negative association between BMI and sexual functioning, future studies may consider how both small and large weight losses impact sexual functioning, sex hormones and psychosocial status, as well as the inter-relationships between these variables. Weight loss is likely to have a positive effect on these variables, although changes in obesity-related comorbidities may moderate this relation.

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Table 1

Physical and demographic characteristics stratified by sex.

	Females (n=190)			Males (n=60)		
	Bariatric Surgery (n = 106)	**Lifestyle Modification (n = 84)**	**P-value**	**Bariatric Surgery (n = 35)**	**Lifestyle Modification (n = 25)**	**P-value**
Age[a] (years)						
Median (Q1, Q3)	40.5(34.0, 47.8)	(29.0, 38.5 47.0)	0.08	49.0(40.0, 56.0)	(35.8, 46.0 54.0)	0.54
Range	25.0– 60.0	20.0– 64.0		24.0– 64.0	25.0– 63.0	
Race - n (%)			<0.001			<0.001
Caucasian	10 2 (96.2)	37(44.0)		35 (100.0)	18 (72.0)	
African American	3 (2.8)	42 (50.0)		0 (0.0)	4 (16.0)	
Other	1 (0.9)	5 (6.0)		0 (0.0)	3 (12.0)	
Ethnicity - n (%)			0.01			0.30
Hispanic	1 (0.9)	8 (9.5)		1 (2.9)	3 (12.0)	
Non-Hispanic	10 5 (99.1)	76 (90.5)		34 (97.1)	22 (88.0)	
Highest education level[b] - n (%)			0.02			0.59
Some high school	2 (1.9)	1 (1.5)		1 (3.0)	0 (0.0)	
High school diploma or GED	22 (21.4)	6 (9.0)		3 (9.1)	3 (15.8)	
Some college	22 (21.4)	19 (28.4)		9 (27.3)	4 (21.1)	
Other post high school education	21 (20.4)	2 (3.0)		11 (33.3)	4 (21.1)	
College diploma	21 (20.4)	23 (34.3)		4 (12.1)	4 (21.1)	
Graduate or professional degree	15 (14.6)	16(23.9)		5 (15.2)	4 (21.1)	
Body mass index (kg/m^2)						
Median (Q1, Q3)	44.5 (41.4, 49.4)	39.5 (37.0, 45.0)	<0.001	44.9 (41.8, 51.4)	41.0 (38.0, 43.0)	<0.001
Range	36.4– 66.5	35.0 – 60.0		37.3 – 64.6	35.0 – 58.0	
BMI group (kg/m^2) - n (%)			<0.001			0.004
35 to <40	19 (17.9)	42 (50.0)		5 (14.3)	10 (40.0)	
40 to<50	61 (57.5)	31 (36.9)		20 (57.1)	14 (56.0)	
50 to <60	19 (17.9)	10 (11.9)		6 (17.1)	1 (4.0)	
60 to 66.5	7 (6.6)	1 (1.2)		4 (11.4)	0 (0.0)	

	Females (n=190)			Males (n=60)		
	Bariatric Surgery (n = 106)	**Lifestyle Modification (n = 84)**	**P-value**	**Bariatric Surgery (n = 35)**	**Lifestyle Modification (n = 25)**	**P-value**
Waist circumference[c] (cm)						
Median (Q1, Q3)	126.5 (117.0, 134.7)	112.5 (106.6, 121.0)	<0.001	144.0 (135.2, 154.4)	119.2 (118.3, 128.0)	<0.001
Range	102.8 – 162.2	93.0 – 130.5		122.3 – 183.0	114.0 – 132.2	
History of Diabetes[d] - n (%)			0.25			0.79
No	88 (83.0)	59 (89.4)		24 (68.6)	13 (65.0)	
Yes	18 (17.0)	7 (10.6)		11 (31.4)	7 (35.0)	
History of Hypertension[e] - n (%)			0.01			0.27
No	59 (55.7)	49 (74.2)		13 (37.1)	10 (52.6)	
Yes	47 (44.3)	17 (25.8)		22 (62.9)	9 (47.4)	

Q1 = 25th percentile; Q3=75th percentile; BMI = body mass index

[a] Missing data: males, 1 lifestyle modification

[b] Missing data: females, 3 bariatric surgery and 17 lifestyle modification; males, 2 bariatric surgery and 6 lifestyle modification

[c] Missing data: females, 3 bariatric surgery and 17 lifestyle modification; males, 2 bariatric surgery and 6 lifestyle modification

[d] Missing data: females, 18 lifestyle modification; males, 5 lifestyle modification

[e] Missing data: females, 18 lifestyle modification; males, 6 lifestyle modification

Table 2

Female Sexual Function Index

	Total† (n=163)	Bariatric Surgery† (n=87)	Lifestyle Modification† (n=76)	Adjusted Difference* (BS – LM)	95% CI	P-value
Total FSFI score (n=136)						
Median (Q1, Q3)	(23.0, 26.8 30.9)	(21.9, 26.0 30.0)	28.1 (23.9, 31.6)	−2.16	(−4.81, 0.49)	0.11
Arousal (n=142)						
Median (Q1, Q3)	(3.3, 4.2 5.4)	4.2 (3.0, 5.1)	4.8 (3.6, 5.7)	−0.48	(−1.04, 0.09)	0.10
Lubrication (n=141)						
Median (Q1, Q3)	(4.2, 5.4 6.0)	5.1 (4.2, 6.0)	5.6 (4.8, 6.0)	−0.75	(− 1.25, – 0.25)	0.004
Desire (n=143)						
Median (Q1, Q3)	(2.4, 3.0 4.2)	2.4 (2.4, 3.6)	3.6 (2.4, 4.8)	−0.48	(−1.02, 0.07)	0.08
Orgasm (n=140)						
Median (Q1, Q3)	(3.6, 4.8 5.6)	4.4 (3.6, 5.8)	5.2 (3.6, 5.6)	−0.53	(−1.18, 0.12)	0.11
Satisfaction (n=140)						
Median (Q1, Q3)	(3.1, 4.8 5.6)	4.4 (2.8, 5.2)	4.8 (3.2, 5.7)	−0.27	(−0.94, 0.40)	0.43
Pain (n=139)						
Median (Q1, Q3)	(4.8, 6.0 6.0)	6.0 (4.8, 6.0)	6.0 (4.8, 6.0)	0.20	(−0.45, 0.85)	0.54

Q1 = 25th percentile; Q3 = 75th percentile; CI = Confidence Interval; BS = Bariatric Surgery patients; LM = Lifestyle Modification patients; FSFI = Female Sexual Function Index

† The 27 females (19 bariatric surgery and 8 lifestyle modification patients) who reported not being sexually active are excluded from this analysis.

* The 27 females (19 bariatric surgery and 8 lifestyle modification patients) who reported not being sexually active are excluded from this analysis.

Table 3

International Index of Erectile Function

	Total† (n=47)	Bariatric Surgery† (n=27)	Lifestyle Modification† (n=20)	Adjusted Difference* (BS – LM)	95% CI	P-value
Erectile Function (n=42)						
Median (Q1, Q3)	(25.0, 28.0 30.0)	(25.0, 29.0 30.0)	27.5 (26.0, 30.0)	−1.78	(−5.99, 2.43)	0.40
Orgasmic Function (n=42)						
Median (Q1, Q3)	(8.0, 10.0 10.0)	10.0 (8.0, 10.0)	10.0 (8.0, 10.0)	0.45	(−1.04, 1.95)	0.54
Sexual Desire (n=42)						
Median (Q1, Q3)	(7.0, 8.0 9.0)	7.0 (6.2, 8.0)	8.0 (7.0, 10.0)	−0.78	(− 1.99, 0.43)	0.20
Intercourse Satisfaction (n=4						
Median (Q1, Q3)	(9.0, 10.0 12.0)	10.0 (8.2, 12.0)	11.0 (9.5, 12.0)	−1.04	(−3.63, 1.54)	0.42
Overall Satisfaction (n=42)						
Median (Q1, Q3)	(5.2, 8.0 8.8)	8.0 (5.2, 8.8)	7.5 (5.8, 8.2)	−0.41	(−2.16, 1.34)	0.64

Q1 = 25th percentile; Q3 = 75th percentile; CI = Confidence Interval; BS = Bariatric Surgery patients; LM = Lifestyle Modification patients

† The 13 males (8 bariatric surgery and 5 lifestyle modification patients) who reported not being sexually active are excluded from this analysis.

* Propensity score adjusted differences

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Table 4

Baseline sex hormone levels for female and male participants

	Total	Bariatric Surgery	Lifestyle Modification	Adjusted Difference (BS - LM)*	95% CI	P-value
Baseline sex hormone levels for **female** participants						
Estradiol (pg/ml) (n=179)						
Median (Q1, Q3)	51.5 (33.0, 89.7)	57.0 (37.8, 99.3)	49.3 (28.1, 75.6)	25.46	(−6.82, 57.73)	0.12
Total Test. (ng/dL) (n=179)						
Median (Q1, Q3)	38.3 (25.1, 58.0)	41.1 (26.4, 59.6)	37.4 (24.5, 55.4)	−0.89	(−16.12, 14.33)	0.91
FSH (miu/mL) (n=178)						
Median (Q1, Q3)	6.0 (4.2, 14.4)	5.6 (3.8, 14.1)	6.8 (4.5, 14.5)	−4.72	(−13.98, 4.54)	0.32
LH (miu/mL) (n=177)						
Median (Q1, Q3)	5.8 (3.2, 14.6)	6.0 (3.2, 11.7)	5.7 (3.0, 16.0)	−4.08	(−8.63, 0.46)	0.08
SHBG (nmol/L) (n=179)						
Median (Q1, Q3)	38.8 (25.2, 61.5)	31.1 (22.6, 43.5)	52.3 (29.3, 77.1)	−11.55	(−27.17, 4.08)	0.15
DHEA-S (ug/dL) (n=179)						
Median (Q1, Q3)	101.0 (64.5, 156.7)	98.3 (69.8, 154.5)	103.7 (62.8, 156.6)	−8.49	(−44.62, 27.63)	0.64
Baseline sex hormone levels for male participants						
Total Test. (ng/dL) (n=55)						
Median (Q1, Q3)	347 (265.0, 423.4)	296.0 (264.0, 404.0)	382.0 (311.0, 436.8)	3.00	(−83.09,89.09)	0.94
Free Test. (pg/ml) (n=55)						
Median (Q1, Q3)	8.2 (6.4, 9.9)	7.8 (6.2, 9.2)	8.7 (7.0, 10.3)	−0.22	(−2.38, 1.94)	0.84
LH (miu/mL) (n=55)						
Median (Q1, Q3)	3.4 (2.3, 4.9)	3.0 (1.7, 4.7)	4.2 (2.5, 4.9)	−1.93	(−5.24, 1.39)	0.25
SHBG (nmol/L) (n=55)						
Median (Q1, Q3)	25.0 (18.2, 31.1)	20.5 (17.2, 27.5)	26.5 (22.0, 38.2)	−7.18	(−16.88, 2.52)	0.14

Q1 = 25th percentile; Q3 = 75th percentile; CI = Confidence Interval; BS = Bariatric Surgery patients; LM = Lifestyle Modification patients; Total Test. = Total Testosterone; FSH = Follicle Stimulating Hormone; LH = Leutenizing Hormone; SHBG = Sex Hormone Binding Globulin; DHEA-S = Dehydroepiandrosterone Sulfate; Free Test. = Free Testosterone

*Propensity score adjusted differences

Table 5

a. Psychosocial Variables for Women

	Total (n=190)	Bariatric Surgery (n=106)	Lifestyle Modification (n=84)	Adjusted Difference (BS - LM)*	95% CI	P-value
SF-36						
PCS (n=175)						
Median (Q1, Q3)	(33.7, 40.3 46.0)	(30.6, 37.7 43.5)	(36.8, 43.6 51.2)	−3.88	(−7.57, −0.19)	0.04
MCS (n=175)						
Median (Q1, Q3)	(39.8, 50.0 55.3)	(40.0, 50.7 55.8)	(39.2, 47.7 55.1)	0.73	(−3.71, 5.16)	0.75
IWQOL						
Total (n=177)						
Median (Q1, Q3)	(37.9, 50.0 66.9)	(34.7, 46.8 56.5)	(46.0, 62.9 77.6)	−8.82	(−16.11, −1.52)	0.02
Work (n=168)						
Median (Q1, Q3)	(50.0, 71.9 81.2)	(43.8, 68.8 81.2)	(56.2, 75.0 100.0)	−8.35	(−18.58, 1.88)	0.11
Physical Function (n=177)						
Median (Q1, Q3)	(31.8, 47.7 63.6)	(22.7, 40.9 54.5)	(43.2, 58.0 73.3)	−11.15	(−19.28, −3.03)	0.01
Public Distress (n=177)						
Median (Q1, Q3)	(45.0, 65.0 85.0)	(40.0, 55.0 75.0)	(55.0, 75.0 100.0)	−3.71	(−12.93, 5.50)	0.43
Sex Life (n=176)						
Median (Q1, Q3)	(31.2, 56.2 75.0)	(25.0, 50.0 68.8)	(50.0, 62.5 87.5)	−16.68	(−27.65, −5.71)	0.003
Self-esteem (n=177)						
Median (Q1, Q3)	(21.4, 39.3 64.3)	(17.9, 32.1 57.1)	(27.7, 50.0 67.9)	−7.25	(−17.76, 3.26)	0.18
BIQLI (n=170)						
Median (Q1, Q3)	(−1.3, −0.6 0.6)	−0.8 (−1.5, 0.3)	−0.5 (−1.2, 0.8)	0.19	(−0.32, 0.70)	0.47
BSQ (n=170)						
Median (Q1, Q3)	(94.0, 116.0 135.8)	(94.0, 120.0 138.0)	(94.0, 110.0 133.0)	5.78	(−6.05, 17.62)	0.34
DAS						
Total (n=169)						
Median (Q1, Q3)	(96.0, 111.0 123.0)	(100.0, 112.0 120.2)	(91.0, 110.0 124.0)	2.58	(−5.95, 11.12)	0.55
Consensus (n=169)						
Median (Q1, Q3)	(41.2, 46.0 50.0)	(42.0, 46.0 50.0)	(40.0, 46.0 50.8)	1.17	(−2.02, 4.35)	0.47

a. Psychosocial Variables for Women

	Total (n=190)	Bariatric Surgery (n=106)	Lifestyle Modification (n=84)	Adjusted Difference (BS - LM)*	95% CI	P-value
Satisfaction (n=169)						
Median (Q1, Q3)	(33.0, 39.0 43.0)	(34.0, 39.0 43.0)	(32.0, 37.8 42.0)	1.20	(−1.96, 4.36)	0.45
Cohesion (n=169)						
Median (Q1, Q3)	(13.0, 16.0 18.0)	(13.0, 16.0 18.0)	(13.0, 16.0 19.0)	−0.38	(−2.12, 1.36)	0.66
Affection Expression (n=165)						
Median (Q1, Q3)	(6.0, 8.0 10.0)	8.0 (6.0, 10.0)	(6.0, 8.0 10.0)	0.37	(−0.91, 1.65)	0.57
BDI n=166)						
Median (Q1, Q3)	(4.0, 9.0 13.0)	8.0 (4.0, 12.0)	(4.0, 9.5 15.0)	−3.13	(−6.17, −0.08)	0.04

b. Psychosocial Variables for Men

	Total (n=60)	Bariatric Surgery (n=35)	Lifestyle Modification (n=25)	Adjusted Difference (BS - LM)*	95% CI	P-value
SF-36						
PCS (n=55)						
Median (Q1, Q3)	37.7 (31.5, 45.0)	35.0 (29.5, 41.6)	43.4 (33.2, 51.6)	−7.10	(−14.22, 0.01)	0.0504
MCS (n=55)						
Median (Q1, Q3)	52.5 (44.5, 57.6)	52.5 (45.6, 58.2)	53.3 (44.3, 57.2)	0.73	(−5.43, 6.89)	0.81
IWQOL						
Total (n=55)						
Median (Q1, Q3)	58.1 (41.5, 75.0)	50.0 (38.7, 61.3)	77.0 (59.1, 90.1)	−16.23	(−28.60, −3.86)	0.01
Work (n=49)						
Median (Q1, Q3)	68.8 (62.5, 93.8)	65.6 (57.8, 79.7)	93.8 (71.9, 100.0)	−14.05	(−29.45, 1.35)	0.07
Physical Function (n=55)						
Median (Q1, Q3)	45.5 (31.8, 64.8)	36.4 (27.3, 56.8)	67.0 (43.8, 83.0)	−17.02	(−31.16, −2.88)	0.02
Public Distress (n=55)						
Median (Q1, Q3)	65.0 (42.5, 90.0)	60.0 (30.0, 75.0)	85.0 (60.0, 98.8)	−8.55	(−24.96, 7.85)	0.30
Sex Life (n=55)						
Median (Q1, Q3)	75.0 (50.0, 96.9)	68.8 (37.5, 87.5)	93.8 (76.6, 100.0)	−25.69	(−46.10, −5.28)	0.01

b. Psychosocial Variables for Men

	Total (n=60)	Bariatric Surgery (n=35)	Lifestyle Modification (n=25)	Adjusted Difference (BS - LM)*	95% CI	P-value
Self-esteem (n=55)						
Median (Q1, Q3)	60.7 (39.3, 78.6)	46.4 (35.7, 67.9)	76.8 (60.7, 85.7)	−19.08	(−36.41, −1.74)	0.03
BIQLI (n=56)						
Median (Q1, Q3)	−0.4 (−1.0, 0.6)	−0.6 (−1.2, 0.0)	−0.2 (−0.4, 1.1)	−0.53	(−1.38, 0.32)	0.22
BSQ (n=56)						
Median (Q1, Q3)	83.0 (59.8, 109.2)	89.0 (64.0, 111.0)	81.0 (59.0, 104.0)	10.53	(−10.97, 32.02)	0.33
DAS						
Total (n=55)						
Median (Q1, Q3)	111.0 (97.0, 121.0)	114.0 (96.2, 119.0)	111.0 (103.0, 123.0)	−6.00	(−18.46, 6.46)	0.34
Consensus (n=55)						
Median (Q1, Q3)	47.0 (42.8, 49.5)	46.5 (42.1, 48.8)	47.0 (43.0, 50.0)	−0.86	(−5.56, 3.84)	0.72
Satisfaction (n=55)						
Median (Q1, Q3)	38.0 (34.0, 43.0)	38.0 (33.2, 43.0)	40.0 (35.0, 42.0)	−2.77	(−7.22, 1.68)	0.22
Cohesion (n=55)						
Median (Q1, Q3)	16.0 (12.5, 18.5)	16.0 (12.0, 18.0)	17.0 (14.0, 19.0)	−2.03	(−4.94, 0.88)	0.17
Affection Expression (n=54)						
Median (Q1, Q3)	8.5 (6.2, 10.0)	9.0 (7.0, 10.0)	8.0 (6.0, 9.2)	0.43	(−1.45, 2.30)	0.65
BDI (n=53)						
Median (Q1, Q3)	7.0 (3.0, 11.0)	5.5 (1.2, 9.8)	9.0 (4.5, 12.0)	−2.00	(−6.80, 2.80)	0.41

Q1 = 25th percentile; Q3 = 75th percentile; CI = Confidence Interval; BS = Bariatric Surgery patients; LM = Lifestyle Modification patients; PCS = Physical Component Summary score; MCS = Mental Component Summary score; SF-36 = Short Form Health Survey; IWQOL = Impact of Weight on Quality of Life-lite; BIQLI = Body Image Quality of Life; BSQ = Body Shape Questionnaire; BDI = Beck Depression Inventory –II; DAS = Dyadic Adjustment Scale

*Propensity score adjusted

Q1 = 25th percentile; Q3 = 75th percentile; CI = Confidence Interval; BS = Bariatric Surgery patients; LM = Lifestyle Modification patients;
SF-36 = Short Form Health Survey; PCS = Physical Component Summary; MCS = Mental Component Summary IWQOL = Impact of Weight on Quality of Life-lite; BIQLI = Body Image Quality of Life;
BSQ = Body Shape Questionnaire; BDI = Beck Depression Inventory – II; DAS = Dyadic Adjustment Scale

*Propensity score adjusted

Table 6

Relationship between sexual functioning, quality of life scores, and sex hormone levels.

	Male Erectile Dysfunction (n=47)				Female Sexual Dysfunction (n=163)				Female Hypoactive Sexual Dysfunction Disorder (n=163)			
	n	% Change	95% CI	P-value	n	% Change	95% CI	P-value	n	% Change	95% CI	P-value
SF-36												
PCS	41	−4.27	(−8.00, −0.40)	0.03	131	−2.34	(−4.23, −0.41)	0.02	138	−1.64	(− 3.31, 0.06)	0.06
MCS	41	−0.44	(− 5.83, 5.27)	0.88	131	−3.07	(− 4.21, −1.91)	<0.001	138	−1.89	(− 3.11, −0.65)	0.003
IWQOL												
Total	41	−3.23	(− 6.19, −0.17)	0.04	133	−2.67	(− 3.60, −1.73)	<0.001	140	−1.59	(−2.46, −0.72)	<0.001
Work	38	−1.21	(− 3.30, 0.91)	0.26	126	−1.15	(− 1.75, −0.55)	<0.001	133	−0.74	(− 1.31, −0.16)	0.01
Phys Func	41	−2.33	(− 4.44, −0.19)	0.03	133	−1.55	(− 2.48, −0.62)	0.001	140	−1.11	(− 1.91, −0.30)	0.01
Distress	41	−1.38	(− 2.98, 0.24)	0.09	133	−0.83	(− 1.61, −0.04)	0.04	140	−0.14	(− 0.83, 0.56)	0.70
Sex Life	41	−2.19	(− 3.53, −0.83)	0.002	133	−2.64	(− 3.25, −2.02)	<0.001	140	−1.82	(− 2.38, −1.26)	<0.001
SE	41	−0.95	(− 2.77, 0.89)	0.31	133	−1.73	(− 2.43, −1.03)	<0.001	140	−0.89	(− 1.54, −0.24)	0.01
BIQLI												
Total	42	−1.84	(− 34.31, 46.68)	0.93	136	−23.43	(− 34.42, −10.60)	<0.001	143	−15.00	(− 25.60, −2.88)	0.02
BSQ Total	42	1.06	(− 0.65, 2.81)	0.23	136	1.20	(0.61, 1.80)	<0.001	143	0.50	(− 0.04, 1.04)	0.07
DAS												
Total	42	0.69	(− 1.63, 3.07)	0.56	135	−1.56	(− 2.17, −0.94)	<0.001	142	−0.76	(− 1.38, −0.14)	0.02
Consensus	42	3.90	(− 2.18, 10.36)	0.21	135	−3.53	(− 5.22, −1.81)	<0.001	142	−0.73	(− 2.60, 1.17)	0.45
Satisfaction	42	1.90	(− 4.67, 8.91)	0.58	135	−4.19	(− 5.73, −2.61)	<0.001	142	−2.23	(− 3.81, −0.61)	0.01
Cohesion	42	0.49	(− 9.74, 11.89)	0.93	135	−3.89	(− 7.63, 0.01)	0.051	142	−3.29	(− 6.43, −0.06)	0.046
Affection Exp	42	−5.75	(− 21.42, 13.03)	0.52	133	−13.49	(− 17.62, −9.15)	<0.001	139	−10.99	(− 14.84, −6.96)	<0.001
BDI Total	37	5.34	(− 0.85, 11.91)	0.09	125	4.19	(2.66, 5.74)	<0.001	130	3.06	(1.54, 4.60)	<0.001
Sex Hormones												
Estradiol*	-	-	- -	-	127	−0.10	(− 0.34, 0.14)	0.43	133	−0.21	(− 0.47, 0.05)	0.12
Total Test†	39	0.03	(− 0.47, 0.54)	0.90	127	0.25	(− 0.34, 0.84)	0.41	133	0.25	(− 0.27, 0.78)	0.34
Free Test*	39	−13.34	(− 29.09, 5.92)	0.16	-	-	- -	-	-	- -	-	-
FSH‡	-	-	- -	-	126	−0.04	(− 0.92, 0.84)	0.93	132	−0.22	(− 1.06, 0.64)	0.62

	Male Erectile Dysfunction (n=47)				Female Sexual Dysfunction (n=163)				Female Hypoactive Sexual Dysfunction Disorder (n=163)			
	n	% Change	95% CI	P-value	n	% Change	95% CI	P-value	n	% Change	95% CI	P-value
LH‡	39	4.03	(− 2.59, 11.09)	0.24	125	0.36	(− 1.17, 1.91)	0.65	131	−0.24	(− 1.89, 1.44)	0.78
SHBG§	39	−2.00	(− 7.86, 4.24)	0.52	127	−0.71	(−1.35, −0.07)	0.03	133	−0.32	(− 0.86, 0.23)	0.25
DHEA-S//	-	-	- -	-	127	−0.04	(− 0.20)	0.74	133	−0.17	(− 0.09)	0.20

n is the total number of participants used in each analysis

Percent change is the average percent change in the risk of sexual functioning problem per unit increase in the row variable, adjusting for type of patient (bariatric surgery patient or lifestyle modification patient) CI denotes the confidence interval

SF-36 = Short Form Health Survey; PCS = Physical Component Summary; MCS = Mental Component Summary; IWQOL = Impact of Weight on Quality of Life-Lite; Phys Func = IWQOL Physical Function subscale score; SE = IWQOL Self-esteem subscale score; BIQLI = Body Image Quality of Life; BSQ = Body Shape Questionnaire; DAS = Dyadic Adjustment Scale; Affection Exp = DAS Affectional Expression subscale score; BDI = Beck Depression Inventory-II; Total Test = Total Testosterone; Free Test = Free Testosterone; FSH = Follicle Stimulating Hormone; LH = Luteinizing Hormone; SHBG = Sex Hormone Binding Globulin; DHEA-S = Dehydroepiandrosterone Sulfate; N/A = Not applicable.

*pg/mL;

†ng/dL;

‡miu/mL;

§nmol/L;

//ug/dL