J Contemp Med 2017; 7(3): 284-297
DOI: 10.16899/gopctd.349953

REVIEW
DERLEME

Does bariatric surgery affect sexuality? A systematic review

Bariatrik Cerrahi Cinselliği Etkiler Mi? Sistematik Derleme

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ÖZ

Obezite bozulmuş vücut imajı, psikolojik bozukluklar ve hormonal bozukluklar gibi çeşitli nedenlere bağlı olarak cinsel yaşamı olumsuz olarak etkilemektedir. Bariatrik cerrahi obezite tedavisinde sıkça kullanılmaktır. Kilo kaybına bağlı fiziksel aktivitede artış ve hormonal değişiklikler gibi olumlu etkilerinin yanısıra, bariatrik cerrahinin hızlı kilo kaybına bağlı gelişen cildin sarkması ve buruşması gibi yanetkileri de bulunmaktadır. Bu çalışmanın amacı bariatrik cerrahinin cinsel fonksiyonl üzerindeki etkisini belirlemektir. 2004 ile 2015 yılları arasındaki literatür, Scopus, Science Direct, PubMed, Ebsco, Coochrane, Medline Complete, Ovid, Springer Link, Google Scholar, Taylor & Francis, PsychInfo veri tabanları, ulusal tez merkezi ve Ulakbim veritabanları taranarak gözden geçirildi; kriterlere uygun on çalışma çalışmaya dahil edildi. Çalışmaya, bariatrik cerrahi uygulanan toplam 524 hasta (152 erkek) alındı. Tüm çalışmalarda cinsel işlevin düzeldiği görülmüştür. Ayrıca her iki cinsiyette de kilo vermenin üreme hormonları üzerinde olumlu etkileri olduğu gösterilmiştir. Bariatrik cerrahi, kilo kaybı ve dolayısıyla cinsel fonksiyon ve üreme hormonları üzerinde olumlu etkilere sahiptir.

Anahtar Kelimeler: Cinsellik, bariatrik cerrahi, obezite, morbid

ABSTRACT

Obesity affects sexual health negatively due to several reasons such as impaired body image, psychological disorders and hormonal changes. Bariatric surgery is frequently used in the treatment of obesity. Besides positive effects such as an increase in physical activity due to weight loss and hormonal changes after surgery, there are some adverse effects of bariatric surgery such as sagging and wrinkling of skin due to rapid weight loss. The purpose of this study is to determine the effects of bariatric surgery on sexual function. The literature between 2004 and 2015 was reviewed by searching Scopus, Science Direct, PubMed, Ebsco, Coochrane, Medline Complete, Ovid, Springer Link, Google Scholar, Taylor & Francis, PsychInfo databases, national thesis center and Ulakbim databases; ten studies appropriate to the criteria were included in the study. A total of 524 patients (152 males) underwent bariatric surgery were included in study. Sexual function has been found to improve in all the studies. Also weight loss has been shown to have positive effects on reproductive hormones in both sexes. Bariatric surgery has positive effects on weight-loss and consequently on sexual function and reproductive hormones.

Keywords: sexuality, bariatric surgery, obesity, morbid

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Başvuru Tarihi/Received: 24-12-2016

Kabul Tarihi/Accepted: 07-04-2017

Introduction

Obesity is a serious public health problem with an increasing prevalence in all around the world, especially in the developed countries (1, 2). Although obesity can be prevented, it has increased worldwide approximately two fold since 1980 (3). More than one-third of people in the United States are obese (4). Obesity related diseases such as diabetes mellitus, chronic hypertension and respiratory diseases have been developing and distracting the quality of life (5). About 3 million people die annually due to obesity-related complications (6).

Obesity adversely affects sexual function and quality of life due to reasons such as deterioration of body image, decreased capacity of physical activity, psychological problems and decrease in sex hormone levels (7, 8). In addition, obesity has also been shown to affect sexual function adversely by causing perception of being ugly and dissatisfaction with the image of the body (9).

It has been shown that only 44% of obese women have regular and satisfactory sexual life (10). Levels of sexual dysfunction is significantly higher and sexual function scores are significantly low in obese male patients compared to non-obese men (11).

For the treatment of obesity, exercise, diet, and medication have been widely used but desired results could not been obtained, especially in morbidly obese patients. Therefore, in obese and morbidly obese patients with high risk of complications, bariatric surgery is the most effective method (12). It is known that many complications of obesity decline in the long term after bariatric surgery (13, 14). In the literature it has been shown in many studies that weight loss has positive effects on sexual function, after bariatric surgery (11, 12, 15, 16). In addition the effects of bariatric surgery on sex hormones also suggests that sexual function is affected positively after surgery (7, 8, 17, 18, 19).

The aim of this review is to review the studies in the literature, conducted through the last ten years, investigating changes in sexual function of obese patients who lost weight after bariatric surgery, in a systematic way.

Method

The results of the studies, conducted in the last ten years, investigating the effects of bariatric surgery on sexual function of obese patients have been reviewed between 01.02.2015 and 03.01.2015. Preferred Reporting Items for Systematic Reviews protocol and Meta-Analyses (PRISMA) statement was used as review protocol (20).

Inclusion and Exclusion Criteria

The studies evaluating preoperative and postoperative sexual function of obese patients by using scales, published in English or Turkish, between 01.01.2004 and 01.01.2015, and full text of those available were included in the study. Meta-analyzes, reviews and the studies presenting the results as qualitative data, not using the scales of sexuality, and not including sufficient data about sexuality were excluded from the study.

Research Strategy

The literature including Scopus, Science Direct, PubMed, Ebsco, Coochrane, Medline Complete, Ovid, Springer Link, Google Scholar, Taylor & Francis, PsychInfo databases and as gray literature national thesis center and Ulakbim databases were reviewed by using keywords "bariatric surgery" (obesity surgery or weight loss surgery or gastric bypass surgery) and "sexuality" (or sexual*).

Study Selection

The studies available for the review have been scanned selected by the first author by reviewing the titles and abstracts of the articles through the databases. Full texts of the selected studies examined by two independent researchers and those do not meet the criteria were excluded from the study. The remaining

studies were evaluated by using Mixed Methods Appraisal Tool (Immature) 2011 version and those meeting the criteria were included in the review (21).

Data Collection Process

The studies have been examined by the authors and the data were recorded in a systematic way by using a template prepared in advance. The data including the types of scales used in the studies, the application time of the scales, preoperative and postoperative scale scores, type of surgery, the change in weight or body mass index of the patients, demographic characteristics of the patients, sex hormone levels which are considered to indicate or affect sexuality directly as well as the scales related to sexuality, quality of life and psychiatric condition were recorded. Because the effects of bariatric surgery on depression are exclusive of the aims of the review, the results of the depression scales used in the studies evaluating the psychiatric status of patients were recorded qualitatively as increasing or decreasing of depression. Although sex hormone levels have been thought to affect sexuality, the numeric changes in sex hormone levels are outside the scope of this review.

Results

A total of 2132 studies were scanned by searching the databases. After the titles and abstracts have been examined, repeated ones (the same), those were not related to aims of the review, and meta-analyzes were excluded. Full texts of the remaining 37 studies were read and 27 more studies which do not meet the criteria for inclusion were excluded. Finally, ten studies were included in the review.

Biliopancreatic diversion with Roux-en-Y reconstruction (12, 15), sleeve gastrectomy (8, 12), laparoscopic adjustable gastric band (8), and gastric bypass surgery (8, 11, 12, 15, 16, 17, 18, 19) have been performed to patients as bariatric surgery; the types of surgery haven't been specified in two studies (3, 9). A total of 534 (162 males) morbidly obese patients have been included in the studies. Bariatric surgery has been performed in 524 patients and ten patients were included as controls. All of the studies were prospective cohort studies.

Sexual function of patients were questioned on a scale in preoperative and postoperative periods in all studies and blood tests for hormone analysis were performed in some studies (7, 8, 17, 18, 19). Preoperative sexual functions of patients were assessed using scales in all of the studies and postoperative evaluations have been performed in the first month (12, 17, 19), 3rd month (17, 19), 6^{th} month (11, 12, 16, 17, 19), first year (7, 8, 15, 17, 19) 2^{nd} year (8, 17) and in one study an average of 3,15 years later (22).

The average BMI of the patients undergoing bariatric surgery ranged between 43.1 and 51.4 kg/m^2. The comparison of the average preoperative and postoperative measurements of BMI, marital status and age are shown in table 1.

The scales used in evaluations of sexuality included The Female Sexual Function Index (FSFI) (8, 12, 15, 16, 17, 22), International Index of Erectile Function (IIEF) (7, 12) International Index of Erectile Function- 5 (IIEF-5) or Sexual Health Inventory for Men (SHIM) (18, 19), The Brief Male Sexual Inventory (BSF) (11), Pelvic Organ Prolapse / Urinary Incontinence Sexual Questionnaire (PISQ-12) (22).

Results Regarding Sexuality

Preoperative sexual functions of 342 women were evaluated in six studies and mean FSFI scores were found to be 20.68 ± 12.25 (15), 20.3 ± 10.8 (8), 21.2 ± 9.6 (17), 17.70 ± 8.3 (22), 24.0 ± 6.3 (16), 21.72 ± 10.18 (12) respectively. In the postoperative evaluation mean FSFI scores were found to be 29.4 ± 4.3 at 6th month (16), 25.02 ± 10.28 (15), 23.5 ± 10.6 (8), 27.1 ± 7.4 (17), 27.72 ± 8.06 (12), at first year, 24.8 ± 8.3 (8) at 2^{nd} year. FSFI

scores have been shown to increase after bariatric surgery in all of the studies in comparison with the preoperative period (8, 12, 15, 16, 17), except one study (22). In one study evaluating the patients an average of 3.15 (2.76-3.83) years after the surgery, the average preoperative FSFI scores of the patients were as low as 17.70 ± 8.3 and no significant changes were observed in the postoperative period. But the PISQ-12 scale scores have been shown to increase (p = 0.0193) (22).

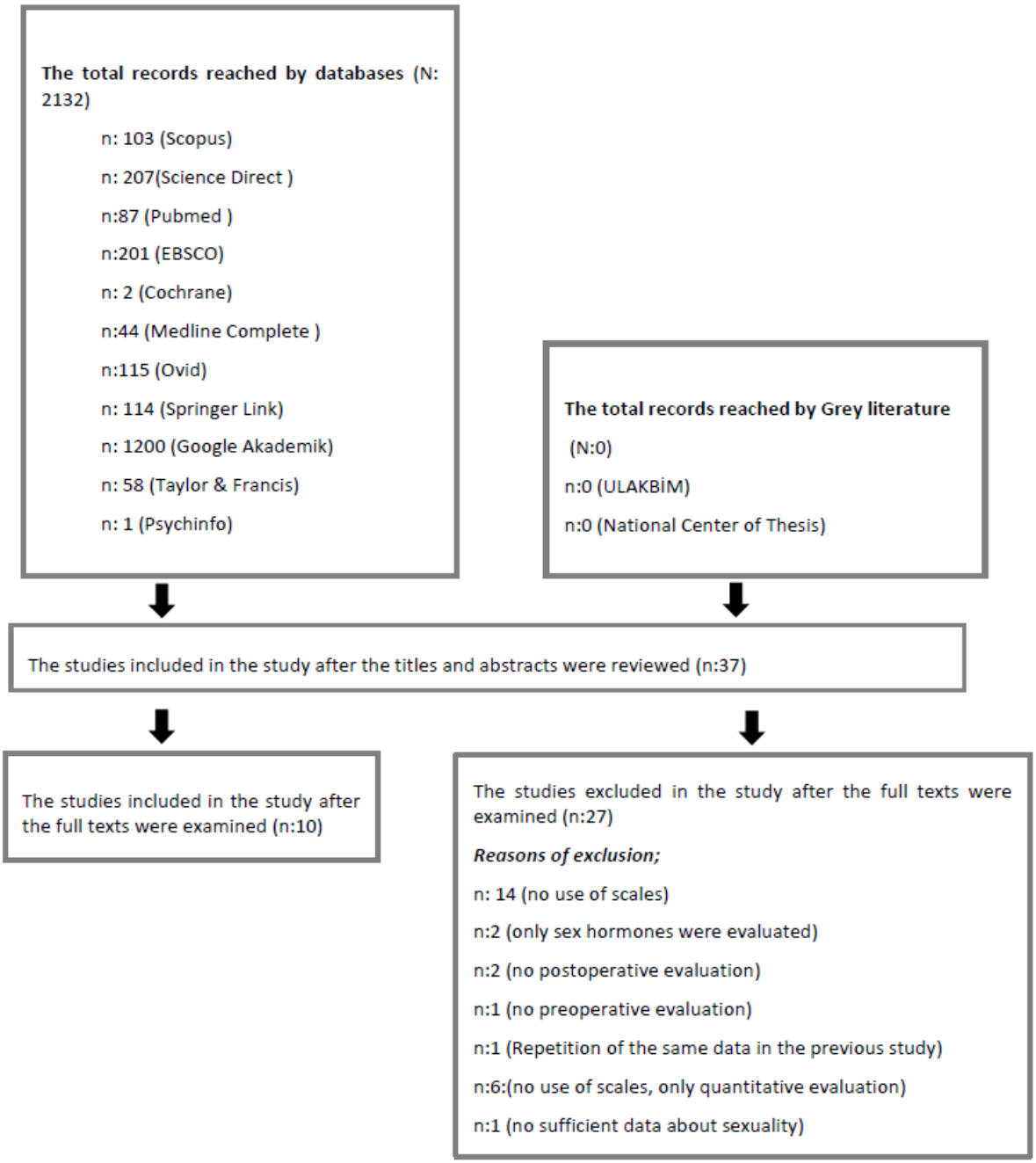

Figure1. Flow diagram of literature scanning

Table 1. Descriptive information of the studies included

Study and year	Aim of the study	Sample Size	Design/Method	Preoperative BMI (kg/m^2)	Postoperative BMI (kg/m^2)
Assimakopoulos et al. (2011) (15)	To investigate the effects of bariatric surgery on BMI, anxiety, depressive symptoms, and sexuality in female patients	59 females	Prospective cohort/ Face to face interview	Median BMI=51.9 SD=9.92	**After one year Pos** Median BMI=31.8 kg/m^2 SD=4.92
Sarwer et al. (2014) (8)	To investigate the changes of sexual functions, sex hormones, and psychosocial structures in women undergoing bariatric surgery	106 females	Prospective cohort/ Face to face interview	Median BMI=44.5 IQR=41.4-49.7	**After one year Pos** Women lost a mean 32.7% CI, 30.7%-34.7%) of preop weight **After two years Pos** Women lost a mean 33.5 31.5%-35.6%) of preope weight
Legro et al. (2012) (17)	To investigate the changes of frequency and quality of ovulation and improvements in sexual functions in women undergoing bariatric surgery	29 females	Prospective cohort/ Face to face interview	Mean BMI=49 SD=7	**After one month Pos** Delta BMI=-6kg/m^2 **After 3months Postopera** BMI=-11 kg/m^2 **After 6 months Postopera** BMI=-15 kg/m^2 **After one year Postopera** BMI=-18 kg/m^2 **After 2 years Postopera** BMI=-19 kg/m^2
Olivera et al. (2012) (22)	To investigate the effects of bariatric surgery on pelvic base related quality of life, in morbidly obese women	44 females	Prospective cohort/ Face to face interview, interview by telephone or e-mail	Mean BMI=45.76 SD=6.48	**After an average of Postoperatively** Delta BMI = -14.21 kg/m^2 SD=7.31
Bond et al. (2011) (16)	To investigate whether sexual function disorders have been improved after bariatric surgery in women	54 females	Prospective cohort/ interview (type has not been specified)	Mean=45 Range=35-67 **LAGB** 44.6 ± 6.4 **RYGB** 46.1 ± 7.7	**After 6 months Postoperat** % Excess weight loss (Mean 34.6 ± 15.7 **RYGB** % Excess weight loss (Mean 60.0 ± 21.2
Efthymiou et al. (2015) (12)	To investigate the effects of bariatric surgery on HRQOL and sexual functions and predictors of these effects	A total of 80 patients (50 females)	Prospective cohort/ interview (type has not been specified)	Mean BMI=50.66 SD=7.9	BMI significantly decreased time (p<0.001).
Mora et al. (2013) (7)	To investigate whether sexual functions improved after bariatric surgery	39 males	Prospective cohort/ interview (type has not been specified)	Mean BMI=46.90 SD=7.77	**After one year Postopera** BMI=30.88 SD=5.04 Delta BMI=-16.02

Reis et al. (2010) (18)	To investigate the effects of lifestyle changes and bariatric surgery on sexual functions and levels of sex hormones in morbidly obese men	20 morbidly obese males allocated into two groups **Group A:** 10 patients underwent bariatric surgery after 4 months of lifestyle change (exercise and diet) **Group B:** 10 patients only follow up	Randomized Controlled Prospective cohort/ interview (type has not been specified)	***For groupA:*** ***Evaluation at the time of surgery*** Mean BMI=43.1 SD=4.7 ***For group B:*** ***Evaluation at the time of surgery*** Mean BMI= 51.9 SD= 5.7	***For group A:*** **After 20 months Pos** Mean BMI= 31.0 SD=5.3 Delta BMI=-12.1 kg/m^2 ***For group B:*** **After 20 months Pos** Mean BMI= 52.3 SD=5.5 Delta BMI=0.4 kg/m^2
Legro et al. (2015) (19)	To investigate the effects of bariatric surgery on changes of androgen and semen parameters in men	6 males	Prospective cohort/ interview (type has not been specified)	Mean BMI=48 SD=7	**After one month Pos** Mean BMI=43 SD=7 Delta BMI=-5 kg/m^2 **After 3 months Postopera** BMI=39 SD=8 Delta BMI=-9 kg/m^2 **After 6 months Postopera** BMI=35 SD=7 Delta BMI=-13 kg/m^2 **After one year Postopera** BMI=32 SD=7 Delta BMI=-16 kg/m^2
Dallal et al. (2008) (11)	To investigate the effects of bariatric surgery on sexual functions	97 males	Prospective cohort/ interview (type has not been specified))	Mean BMI= 51.4 Range= 36- 89	**After at least 6 Postoperatively** Mean BMI = 31.8 Delta BMI=-19.6

BMI: Body Mass Index, Delta BMI: The difference between the first and last measurements of BMI, HRQOL: health-related quality of life, IQR: Interquartile range, SD: Standard deviation

Table 2. The results of the included studies related with sexuality

Study and year	Applied surgery	The time of evaluation/ used scale/test related with sexuality	Scale score	Results
Assimakopoulos et al. (2011) (15)	BPD-RYR RYGB with long limb SG	One week before and one year after the surgery/ FSFI	**1 week before** Mean±SD 20.68±12.25 **1 year after** Mean ±SD 25.02±10.28	A significant increase in sexual function (P = 0.003) was observed together with significant reduction in BMI <0.001) After 1 year postoperatively significant increase in desire; (p = 0.005), arousal, (p = 0.001), lubrication; (p = 0,012), decrease in pain levels (p = 0.014) were found, no difference in orgasm score was found (p = 0.067). Married women showed better sexual functioning than singles both preoperatively (23.8 ± 10.2 vs. 1 postoperatively (27.9 ± 7.1 vs. 21.2 ± 12.4, p = 0.015) Postoperative FSFI scores were found to be increased in patients with better sexual function and lower BMI init
Sarwer et al. (2014) (8)	RYGB LAGB	Preoperatively and 1 and 2 years after the surgery / FSFI, IWQOL-Lite score, Blood samples	***Baseline*** Mean ±SD 20.3±10.8 **1 year after** Mean±SD 23.5 ±10.6 ***2 years after*** Mean±SD 24.8± 8.3	Significant increases in total sexual function (P = 0.04) were observed at the end of 1st year, but no significant 2nd years were observed(p = 0.59). But total sexual function was found to be increased significantly at the baseline (p = 0.002). **Desire** significant increase at the end of 1st and 2nd years (p <0.001); **Arousal**, significant increase only at the end of 2nd year (p <0.01) **Lubrication** significant increase only at the end of 2nd year (p = 0.045) **Orgasm** increased over time but not statistically significant. **Satisfaction** significant increase at the end of 1st and 2nd years (p <0.001), no significant differences in the last ye **Pain** no significant differences at the end of 1st year (p <0.54), at the end of 2nd year (p = 0.23) and in the last ye According to IWQOL-Lite score sexual life improved significantly at the end of 1st and 2nd years (p <0.001). N seen in the last year (p> 0.99). • Estradiol levels significantly decreased at the end of 1st and 2nd years (P = 0.01), no significant differences we and 2nd years • TT levels significantly decreased at the end of the 1st and 2nd years (p <0.001), and between the 1st and 2nd ye • FSH levels significantly increased at the end of the 1st and 2nd years (p <0.001) and between the 1st and 2nd yea • LH levels significantly increased at the end of the 1 st year (p = 0.01) and 2nd year (p <0.001), no significant di the 1st and 2nd years • SHBG levels significantly increased at the end of the 1st and 2nd years (p <0.001), no significant differences w 2nd years • DHEA-S levels significantly decreased at the end of the 2nd year, no significant differences were seen at the en the 1st and 2nd years
Legro et al. (2012) (17)	RYGB	1 month before and 1,3,6,12,and 24 months after the surgery/ FSFI, Fasting blood tests	***Baseline*** Mean ±SD 21.2 ± 9.6 **1 year after** Mean±SD 27.1 ± 7.4	A 28% increase was seen in female sexual function at the end of the 1st year (P = 0.02). The biggest increases were seen in sexual desire and arousal. • SHBG increased in the first month (P <0.001) • Testosterone decreased in the first 3 months (P = 0.002) • Estrogen decreased only after the 6th month (P = 0.03) • No significant differences were seen in progesterone levels

Olivera et al. (2012) (22)	-	Preoperatively and an average of 3,15 years after the surgery/ FSFI, PISQ-12	***Baseline:*** Mean±SD 17.70±8.3 (FSFI) 35.78±6.06(PISQ-12) ***3.15 years after(2.76 – 3.83)*** Mean±SD 16.91±9.7(FSFI) 38.22±6.03(PISQ-12)	Basal FSFI scores were initially low and did not increase despite weight loss PISQ-12 scores (developed specially for only patients with urinary incontinence and pelvic organ prolapse) situation was thought to develop secondary to improvement in urinary incontinence considered. No significant differences were found in the comparison of preoperative and postoperative FSFI, sexual desire, satisfaction, and pain scores (p> 0.05).
Bond et al. (2011) (16)	LAGB RYGB	Preoperatively and 6 months after the surgery/ FSFI	***Baseline*** Mean±SD 24.0 ± 6.3 ***6 months after*** Mean ± SD 29.4 ± 4.3	FSFI scores ≤26.55 have been evaluated as sexual dysfunction, according to this 63% of patients had sexual dy period while this ratio had declined to 22.2% in the postoperative evaluation. Therefore sexual dysfunction im after the surgery The degree of sexual dysfunction in women found to be decreased within 6 months. Being young, being married has been found effective in improvement of postoperative and preoperative sexual formed by using the data in the study of Rosen at al. and was compared to study group. Significant differe subscales of FSFI scores in preoperative comparison (p> 0.20) and similar results were found in postoperative lubrication (p <0.05). Means and standard deviations for controls are derived from Rosen et al. (2000). The increases of sexual function was similar when analyzed according to different types of surgery, although p different
Efthymiou et al. (2015) (12)	SG RYGB BPD-RYR	Preoperatively and, 1 monthh, 6 months, and 1 year after the surgery/ FSFI, IIEF	***Baseline*** Mean± SD***/1 year after Mean***± SD FSFI **Total** 21.72±10.18 /27.72±8.06 IIEF **Total** 43.69/61.28 **Erectile function** 18.63±9.63/ 24.85±8.17 **Orgasm function** 8.33±2.64/ 8.59±2.90 **Desire** 6.29±2.27/ 8.18±1.92 **Intercourse satisfaction** 5.15±5.26 / 11.07±4.51 **Total satisfaction** 5.29±2.91/ 8.59±1.32	Significant increases have been found in FSFI (p = 0.001)and IIEF (P <0.001) scores after bariatric surgery Significant increases have been found in total FSFI, sexual desire, arousal, lubrication, orgasm, satisfaction, and first year postoperatively (p <0.05). Lubrication: after decreasing during the 1st month postoperatively (p <0.001) started to increase and reached (p = 0.04). Orgasm: similarly after significantly decreasing in the 1st month postoperatively, increased significantly 6 month Satisfaction: the decrease was not significant in the 1st month postoperatively (p = 0.246), increased in 6th mon to preoperative scores (p <0.001), whereas it remained stable between 6th and 12th months postoperatively (p = Arousal after decreasing at the end of 1st month postoperatively (p <0.001), increased significantly compared t 0.02) and it was found to continue increasing in the in the evaluation at the end of the 1st year (p = 0.004). The IIEF scale, erectile function, desire, intercourse satisfaction and total satisfaction have been found to incre the 1st year (p <0.05). Orgasm decreased significantly after the 1st month postoperatively (p = 0.031), but increased significantly However, no significant differences were observed at the end of the first year (p> 0.05).
Mora et al. (2013) (7)	-	Preoperatively and postoperative first year/ IIEF, Venous blood test	***Baseline*** Mean ±SD 54.85 ± 16.59 ***Postoperative 1st year*** Mean ±SD 61.21 ± 14.10	Bariatric surgery has been found to be effective in improving sexual functions as well as losing weight improven IIEF total score (p = 0.006), erectile function (p = 0.002), overall satisfaction (p = 0.047), and sexual desire (p year. But no significant changes were observed in intercourse satisfaction (p = 0.083) and orgasmic function (p = 0.84 • Gonadal hormones, TT, SHGB, FT, FSH, and bioavailable testosterone levels increased (p <0.001); • No significant changes were observed in estrogen levels (p = 0.200) • Significant decreases in prolactin levels were observed (p = 0.019).
Reis et al. (2010) (18)	GB	4 months before and immediately before the surgery and postoperative 20th month / IIEF-5, Blood tests	***Fro group A:*** ***At the time of surgery*** Mean±SD 20.1 ± 5.0 ***Postoperative 20th month*** Mean (SD) 23.0 ± 2.3 ***For group B:*** ***At the time of surgery*** Mean±SD 17.1 ± 8.0 ***Postoperative 20th month*** Mean±SD 17.3 ± 6.7	IIEF-5 scores (p = 0.0469) and sexual functions increased significantly 20 months after bariatric surgery compare • TT and FSH levels increased (p = 0.0349 and 0.0025 respectively) • PRL levels decreased (p <0.0001) • In the comparison of groups A and B IIEF-5, TT and FT levels were found to be significantly increased (p = respectively), no significant changes were observed in prolactin levels in the 20th month postoperatively

Legro et al. (2015) (19)	RYGB	Preoperatively and 1,3,6, and 12 months after the surgery/ SHIM=IIEF-5, Fasting blood tests	***Baseline*** Mean±SD 13.5 ± 8.9 ***Postoperative 12th month*** Mean±SD 18.0 ± 8.4	Male erectile function was found to be tending to develop for 12 months after surgery. • Serum TT levels increased significantly in 1st and 6th months when compared to the initial values (P = 0.01). • SHBG levels increased at all time points in postoperative measurements (P <0.01 to P = 0.02). • No significant differences were observed in postoperative serum estradiol levels
Dallal et al. (2008) (11)	GB	Preoperatively (30- 90 days) and at least 6 months after the surgery/ BSFI	***Baseline Mean± SD/ at least 6 months after the surgery Mean± SD*** ***sexual drive*** 3.9± 0.3/5.3±0.3 ***erectile function*** 6.4±0.5/8.9±0.5 ***ejaculatory function*** 4.9±0.4/6.3±0.4 **problem assessment** 7.4 ±0.5/9.6 ±0.5 ***sexual satisfaction*** 1.6±0.2/ 2.3 ± 0.2	In morbidly obese patients the degree of preoperative sexual dysfunction levels were found to be significantly compared to reference values (normal control group) (p <0.001). Sexual scores were found to be decreased as body weight increased In the comparison of the scale scores in the postoperative period with normal control group it has been foun each other except overall sexual satisfaction and ejaculatory function scores in patients between 60 and 69 yea Significant increases were observed in all subscales (sexual drive, erectile function, ejaculatory function, satisfaction) in the postoperative evaluation when compared to preoperative values (p <0.01).

BPD-RYR: Biliopancreatic diversion with Roux-en-Y reconstruction, FSFI: The Female Sexual Function Index, FSH: follicle-stimulating hormone , FT: Free testosterone, GB: gastric bypass, IIEF: International Index of Ere Lite :The Impact of Weight on Quality of Life–Lite, LAGB: Laparoscopic adjustable gastric banding, DHEA-S: dehydroepiandrosterone sulfate,

Five studies included a total of 192 male patients, except 10 patients allocated in the control group 182 patients underwent bariatric surgery. In one of two studies using IIEF scale the average total IIEF score was reported to be 54.85 ± 16:59 (7), the other study did not reported the total score (12), both studies reported significant increase in the total IIEF score at the end of the first year of the surgery ($p = 0.006$, $p < 0.001$, respectively). IIEF-5 scale was used in two studies in the review (18, 19). Mean preoperative IIEF-5 scores were found to be 20.1 ± 5.0 (18) and 13.5 ± 8.9 (19) and mean scores in postoperative 20th month were 23.0 ± 2.3 and 18.0 ± 8.4 (19) respectively.

In one study, using BSFI scale, it was found that scores of subscales of sexual drive was 3.9 ± 0.3, erectile function 6.4 ± 0.5, ejaculatory function 4.9 ± 0.4, problem assessment 7.4 ± 0.5, and sexual satisfaction 1.6 ± 0.2 preoperatively and sexual drive was 5.3 ± 0.3, erectile function 8.9 ± 0.5, ejaculatory function 6.3 ± 0.4, problem assessment 9.6 ± 0.5, and sexual satisfaction 2.3 ± 0.2 at least 6 months after the operation; the scores of all subscales were found to increase significantly postoperatively ($p < 0.01$). The levels of preoperative sexual dysfunction in morbidly obese patients has been compared with reference values obtained from normal subjects and were found to be significantly higher ($p < 0.001$); it has been reported that the sexual dysfunction increases as body weight increases. In patients between the ages of 60 and 69, the scores of all subscales except overall sexual satisfaction and ejaculatory function have been found to approximate each other (11).

Results Regarding Hormone Levels

In two studies, hormone levels have been evaluated in female patients (8, 17). In the study of Sarwer et al (2014) estradiol, TT (total testosterone), FSH (follicle-stimulating hormone), LH (luteinizing hormone), SHBG (serum sex hormone-binding globulin), and DHEA-S (dehydroepiandrosterone sulfate) levels of female patients were evaluated. It has been found that estradiol ($p = 0.01$) and TT ($p < 0.001$) levels decrease significantly at the end of 1st and 2nd years when compared to preoperative levels; estradiol levels did not change significantly between the 1st and 2nd years, while TT levels continued decreasing ($p = 0.02$). SHBG ($p < 0.001$), FSH ($p < 0.001$), and LH ($p = 0.01$) levels were found to increase significantly, FSH levels continued increasing, and SHBG and LH levels did not change significantly at the end of the 1st and 2nd years. It has been reported that DHEA-S levels decreased significantly at the end of the 2nd year when compared to initial levels and no significant differences were observerd at the end of the 1st year and between the first and second years (8). Legro et al (2012) in their study, reported that SHBG levels increased during the first month ($p <0.001$), testosterone levels decreased in the 3rd month ($p = 0.002$), estrogen levels decreased in 6th month ($p = 0.03$), and progesterone levels did not change significantly (17).

In three studies conducted on male patients investigated hormone levels (3) (18) (19). In the first study it has been reported that gonadal hormones TT, SHGB, FT, FSH, and bio-available testosterone levels increased ($p < 0.001$), estrogen levels did not change significantly ($p = 0.200$), and prolactin levels decreased significantly ($p = 0.019$) after bariatric surgery (3). In the second study it has been reported that TT and FSH levels increased ($p = 0.0349$ and 0.0025 respectively) and PRL levels decreased significantly in the 20th month postoperatively ($p < 0.0001$) when compared to the preoperative levels; in the comparison of the patients undergoing surgery and the control group it has been found that TT and FT levels increased significantly ($p = 0.0224$, 0.0043 and 0.0149) and there were no significant changes in prolactin levels in the 20th month postoperatively (18). In the third study it has been reported that serum TT levels

increased significantly in the first and sixth months ($p = 0.01$), SHBG levels increased at all time points of postoperative measurement ($p < 0.01$ to $p = 0.02$), there was no significant change in serum estradiol levels (19).

Discussion

It has been suggested that the changes in reproductive hormones, as well as co-morbidities such as physical limitations, impaired body image, and depression caused by obesity may lead to sexual dysfunction (23, 24). Several studies supporting that obesity may lead to sexual dysfunction are available in the literature (10, 11, 16, 24, 25). Sexual dysfunction is one of the important factors which reduce patient's quality of life (11, 25). Bariatric surgery have often been resorted to improve obesity and obesity-related complications (8, 10, 26). On the other hand rapid loss of weight after bariatric surgery may lead to deteriorated sexual activity due to nutritional deficiency and physical defects such as sagging breasts and wrinkled skin (10). In this review we found that bariatric surgery affects sexuality and sex hormones positively both in men and women.

In this review, in one of the five studies examining woman sexual functions by using FSFI scale alone, it has been shown that sexual functions deteriorated in the first month postoperatively (12); and in one study it has been shown that sexual function did not change in an average of 3.15 (2.76-3.83) years postoperatively, while it has been shown to increase over time in all evaluations in other times (8, 12, 15, 11, 17). The increase of sexuality may be related to resolvement of the physical problms. Kinzl et al (2001) in their study found that more than half of obese women experience problems such as lack of sexual desire (11.2%), very rare sexual intercourse or escape from sexuality (23.3%), and constrainment in sexual intercourse due to physical problems (11.0%) (10). In the study that used both FSFI and PISQ-12 scales, it is reported that sexual functions did not change according to the FSFI scale but PISQ-12 score was increased postoperatively. The increase of PISQ-12 score was suggested to be due to improvement of urinary incontinence (22). In a study supporting this opinion, it has been shown that genital prolapse rate is higher in patients with higher BMI and these patients have been staying away from sexual intercourse due to fear of incontinence during sexual intercourse (27). Obesity-induced sexual dysfunction may also occur due to changes in reproductive hormone levels (23). Obesity-induced hormonal changes in women often include increase in androgen hormones and estradiol and decrease in sex hormone binding globulin (SHBG) (2, 28). In one study in this review, it has been shown that estradiol and TT (total testosterone) levels decreased in the 1^{st} and 2^{nd} years and dehydroepiandrosterone sulfate (DHEA-S) levels decreased at the end of 2^{nd} year postoperatively, while FSH (follicle stimulating hormone) and SHBG levels increased (8). In another study in this review, it has been shown that SHBG levels increased in the first month, testosterone levels decreased in the first 3 months, and estrogen levels decreased in the 6th month, postoperatively, whereas progesterone levels did not change (17). These results indicate that postoperative hormonal changes in women are in a positive direction and may affect sexuality positively. It was shown that patients' quality of life, psychological status, body image, and self-esteem have been improved after bariatric surgery (29). In this review two of the studies suggested that depressive symptoms improved in women after bariatric surgery (8, 15). We suggest that these changes may affect sexuality positively. On the other hand rapid loss of weight after bariatric surgery may lead to both positive and negative effects on sexuality. In a study it has been found that in half of female patients sexual activity improved due to increased self confidence after bariatric surgery, increased libido as a result of good assessment of the body and increased physical activity and in the other half of the patients

sexual activity deteriorated due to nutritional deficiency and physical defects such as sagging breasts and wrinkled skin (11). In this review none of the studies evaluated these negative effects of bariatric surgery.

In this review all studies investigating sexual functions in men by using different scales, reported an overall increase in sexual function (7, 11, 12, 18, 19). Other studies evaluating sexual life according to quality of life scale rather than using a sexual function scale directly, similarly reported that sexual functions have improved (30, 31). There is a negative correlation between increased BMI and testosterone levels and sexual function (2). Reduction of testosterone and SHBG levels and increase of estradiol levels are expected, due to obesity (23, 24). In addition, suppression of secretion of SHBG in the liver and conversion of testosterone into estradiol in adipose tissues as a result of developing hyperinsulinism due to increase of body weight also adversely affect the sexual functions (2). In a meta-analysis it has been found that, SHBG, LH, FSH, and free and bound testosterone levels increased, and estrogen levels decreased due to weight loss in men after bariatric surgery (6). In another study, increased prolactin and decreased testosterone levels have been associated with decreases in sexual arousal (32). In this review it has been found that lelves of SHBG (7), TT (7, 18, 19), FSH (7, 18), and FT (7), increased and levels of prolactin decreased (7, 18), whereas there was no significant changes in estrogen levels (7, 19) after bariatric surgery. These results indicate that postoperative hormonal changes in men are in a positive direction.

Conclusion

In this review, investigated the effects of bariatric surgery on sexual function, we found that bariatric surgery leads to effective weight loss as well as improved sexual functions. Besides physical effects such as improved body image and increased physical activity, also physiological changes like improvement of reproductive hormone levels are thought to be the main causes of improvement of sexual functions and life quality after weight loss.

Limitations

This review has some limitations. Looking for the studies conducted on both women and men and limiting time span for the scanning between 2004 and 2015 has limited the number of studies for both groups. Therefore, reviews screening women and men individually and enlarging the time span will provide access to more number of studies and will yield more reliable results.

The availability of different scales for women and men and many different scales for each gender prevented to produce homogeneous results. Although the scores of the scales have been given quantitatively, a meta-analysis was not possible due to lack of homogeneity.

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