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Book Review

Yi Sun^a, Bo Peng^b, Guo-lin Lei^b, Hong Shen^a, Qiang Wei^{a,*}, Lu Yang^{a,*}^a Department of Urology, Institute of Urology, West China Hospital, Sichuan University, No. 37 Guoxue Xiang, Chengdu, 610041, China^b Department of Urology, People's Hospital of Jianyang City, Yiyuan Road, Jianyang, China

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ABSTRACT

Background: Recently, increasing attention and controversy have focused on whether weight loss can improve female sexual function, so we performed this study to explore this question.

Methods: We searched the PubMed, Embase, and Cochrane Library databases to identify all studied variables; the search terms included “weight loss”, “bariatric surgery”, “no surgery weight loss”, and “female sexual function”. We compared the female sexual function index (FSFI) scores before and after weight loss through bariatric surgery or exercise.

Results: Ten studies comprising a total of 494 patients met the inclusion criteria. The data synthesized from these studies indicated that weight loss improved the total FSFI score ($p < 0.00001$) and the score on some individual items—desire ($p < 0.00001$); arousal ($p = 0.0005$); lubrication ($p = 0.01$); orgasm ($p < 0.0001$); and satisfaction ($p = 0.0004$)—but did not ameliorate pain experienced by women during sex ($p = 0.18$).

Conclusion: Weight loss through bariatric surgery or exercise is beneficial for sexual function in overweight women, according to the data analyzed from ten studies.

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Introduction

The worldwide prevalence of obesity is becoming significant. Over the past decades, the frequency of severe obesity among

women has increased by 44% [1]. The number of individuals with obesity has doubled recently and was over 600 million in 2014, according to the estimation of the World Health Organization (WHO) [2], and is expected to be 60% of the world population in 2030 [3]. Obesity is accompanied by many comorbidities, including type 2 diabetes, hypertension, heart disease, hyperlipidemia, and obstructive sleep apnea [4]. More importantly, the prevalence of sexual dysfunction in women with obesity is high and varies according to social and cultural factors, reaching up to 80% in some populations [5–8]. However, weight loss, typically through bariatric surgery, is associated with improvements in many aspects, including morbidity, mortality, and psychosocial status,

Abbreviations: FSFI, female sexual function index; MD, mean difference; CI, confidence interval; WHO, World Health Organization; RR, relative risk.

* Corresponding authors at: Department of Urology, West China Hospital of Sichuan University, No. 37 Guoxue Xiang, Chengdu, 610041, Sichuan, China.

E-mail addresses: weiqiang933@126.com (Q. Wei), wycleflue@163.com (L. Yang)

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in both men and women [9]. Moreover, some research has focused on the improvement of female sexual function after weight loss [10–18]. However, controversy on this topic remains, so we performed this meta-analysis to obtain a better understanding of the impact of weight loss on female sexual function.

Methods

This meta-analysis was designed in accordance with COCHRANE guidelines. We searched the following databases: PubMed (updated to current), Embase® (updated to current), the Cochrane Central Register of Controlled Trials, and the Cochrane Database of Systematic Reviews. The initial search process was designed to find all trials involving the terms “weight loss”, “bariatric surgery”, “no surgery weight loss”, and “female sexual function”. Only publications in English were included. The study inclusion criteria were as follows: 1) Studies compared female sexual function before and after weight loss using the female sexual function index (FSFI) scores were included, whereas other comparisons would be excluded; 2) Studies that defined sexual activity as self-reported partnered sexual intercourse occurring 6 months before bariatric surgery or start of weight loss through exercise were included. No cutoff value for the minimal frequency of sexual encounters was used to define the state of being sexually active. The patient inclusion criteria were as follows: 1) women’s BMI of over 27, 2) females were involved in a relationship that included sexual activity of at least 12 months’ duration. The exclusion criteria included: 1) previous or ongoing surgery or pelvic radiotherapy, 2) a history of neurological diseases, 3) the absence of sexual activity 6 months before surgery, and other pelvic floor disorders may affect the sexual function. All of the included and exclude standards are showed at Table 1. The quality of the studies included was determined according to the Cochrane Collaboration Reviewer’s Handbook and the Quality of Reporting of Meta-analysis guidelines [19,20]. The assessment tool contained six core items: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting and other bias. Each study classified as having a low, unclear, or high risk of bias was resolved by a third author. All of the included studies were also evaluated using the Jadad scale, and the trials were considered to be of high quality if the Jadad score was ≥ 3 and low quality if the score was ≤ 2 [21]. Publication bias was evaluated using a funnel plot. In addition, a sensitivity analysis was performed if low-quality trials were included in the analysis.

We divided patients into two groups before and after weight loss in this meta-analysis. The outcome measures were based on the female sexual function index (FSFI) scores. The FSFI assesses female sexual function through 19 questions graded on a scale of 0–5 points, which encompass 6 domains: desire (questions 1 and 2), arousal (questions 3 through 6), lubrication (questions 7 through 10), orgasm (questions 11 through 13), satisfaction (questions 14 through 16), and pain (questions 17 through 19). The sum of each individual domain score is obtained, and the values of each domain are then assigned different weights to obtain a maximum final score of 36. Scores below 26.55 indicate

sexual dysfunction. Therefore, we included not only the total score but also the scores for each of the six domains.

Data were extracted independently by two authors using a predesigned data extraction form. The data extracted included the data source, eligibility criteria, methods, participant characteristics, interventions, and results. RevMan 5.1.4 software was used to extract the data from the included studies. Continuous outcomes are presented as the weighted mean difference (MD) with a 95% confidence interval (CI). Dichotomous data are presented as the relative risk (RR) with a 95% CI. The choice between fixed effects and random effects methods in this meta-analysis was based on the following rules: the fixed effects method was used to combine the results in conditions under which the heterogeneity was not significant, and the random-effects method was applied when heterogeneity was present. Statistical heterogeneity among the trials was evaluated using the I^2 test, with significance set at $p < 0.05$. Publication bias was evaluated using a funnel plot. In addition, a sensitivity analysis was performed if low-quality trials were included in the analysis.

Results

A total of 1546 reports were initially identified after we searched the database. The study of Aversa et al. included two groups [16]: first is those who lost weight through exercise, and the other is those who did so through surgery. Patients in other studies all used surgery to lose weight. As Fig. 1 shows, after redundant publications, reviews and meta-analyses were removed, the titles and abstracts of unrelated records were scanned, and the full texts were read. Ten publications involving 494 patients were included in this study; all of the women in those studies lost weight through bariatric surgery or exercise. The conditions of these studies and the clinical details of the patients are presented in Table 2. All of the included trials were assessed by Jadad score for quality; 9 (90%) trials were graded as high quality, and only one (10%) trials were graded as low quality.

All ten studies compared the total FSFI scores of the included women before and after weight loss, as shown in Table 3. The follow-up periods ranged from 4 months to 6 years. Initially, the results showed that the FSFI score can significantly increase after weight loss in obese women (MD, -4.07; 95% CI, -5.85 to -2.30; $p < 0.00001$; Fig. 2a). Of the individual FSFI items also compared in this study, nine studies compared the scores for individual FSFI domains, including desire, arousal, lubrication, orgasm, and satisfaction. We thus analyzed these items separately to better understand the impact of weight loss on the sexual function. First, we extracted the data for the desire domain and found that the desire score significantly improved after weight loss (MD, -0.54; 95% CI, -0.72 to -0.37; $p < 0.00001$; Fig. 2b). Second, we compared the arousal domain before and after weight loss and found that the arousal score improved when women acquired a thinner shape (MD, -0.85; 95% CI, -1.32 to -0.37; $p = 0.0005$; Fig. 2c). Third, we analyzed the change in lubrication in women after weight loss, and the results showed it also improved (MD, -0.71; 95% CI, -1.26 to -0.15; $p = 0.01$; Fig. 2d). Fourth, the orgasm score was also analyzed, and the results showed that the orgasm score significantly

Table 1
included and excluded standards of patients and studies.

Included standards	Excluded standards
Women’s BMI of over 27	Previous or ongoing surgery or pelvic radiotherapy
Patients who have more than 12 months’ sexual activity	History of neurological diseases
Studies compared female sexual function used FSFI	Absence of sexual activity 6 months before surgery
Sexual function recorded at 6 months before bariatric surgery or start of weight loss	Other pelvic floor disorders may affect the sexual function

FSFI = Female Sexual Function Index.

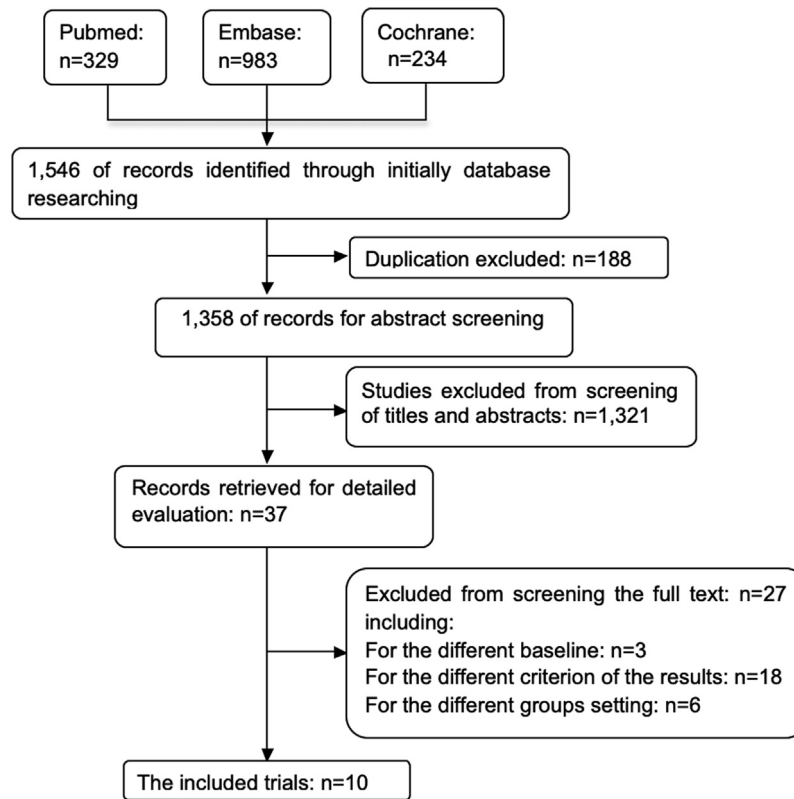


Fig. 1. The search flow diagram.

Table 2
Baseline characteristics of women before loss weight.

Research	Year	Quality	No.	Age	Follow up time	Pre-FSFI	Pre-desire	Pre-arousal	Pre-lubrication	Pre-orgasm	Pre-satisfaction	Pre-pain
<i>Sarwer</i>	2018	High	106	41	4 years	20.6 ± 10.9	3.2 ± 2.0	3.7 ± 2.3	2.8 ± 1.3	3.4 ± 2.4	3.5 ± 1.9	4.1 ± 2.5
<i>Oliveira</i>	2018	High	62	36.8 ± 9.5	6 months	22.8 ± 22.2	3.6 ± 3	3.6 ± 3.5	4.1 ± 3.9	3.4 ± 3.8	3.6 ± 3.4	4.8 ± 4.2
<i>Janik</i>	2015	High	23	41 ± 9.0	18 months	26.9 ± 27.5	4.2 ± 3.6	3.9 ± 4.2	5.1 ± 5.1	4.8 ± 4.4	4.8 ± 4.7	6.0 ± 4.8
<i>Goitein</i>	2015	High	34	38.4 ± 9.1	6 months	24.0 ± 9.6	3.6 ± 1.2	3.8 ± 1.8	4.4 ± 2.0	4.2 ± 2.0	4 ± 1.9	3.8 ± 2.5
<i>Efthymiou</i>	2015	High	50	37.2 ± 10.7	18 months	21.72 ± 10.2	2.74 ± 1.2	2.89 ± 2.15	3.27 ± 2.55	3.17 ± 2.4	3.78 ± 1.71	3.31 ± 2.7
<i>B. Sarwe</i>	2014	High	106	41	6 years	20.3 ± 10.8	2.7 ± 1.3	3.1 ± 2	3.7 ± 2.3	3.3 ± 2.3	3.5 ± 1.9	4.1 ± 2.5
<i>Averssa</i>	2013	High	21	36 ± 13	4 months	14.0 ± 1.8	2.4 ± 0.8	2.1 ± 0.7	2.1 ± 0.8	2.3 ± 1.1	2.1 ± 0.6	3.1 ± 1.3
<i>A. Averssa</i>	2013	High	23	37 ± 11	1 year	15.0 ± 1.3	2.2 ± 1.2	2.3 ± 0.6	2.2 ± 0.9	2.6 ± 0.8	2.4 ± 0.9	3.5 ± 0.6
<i>Hernandez</i>	2013	High	80	43.5 ± 9.2	6 months	19.9 ± 1.6	-	-	-	-	-	-
<i>Olivera</i>	2012	Low	36	41.28 ± 12.28	1 year	17.70 ± 8.38	3.43 ± 1.2	3.43 ± 1.92	2.67 ± 1.45	2.83 ± 1.7	3.8 ± 2.32	1.54 ± 1.2
<i>Assimakopoulos</i>	2011	High	59	-	1 year	20.68 ± 12.3	3.25 ± 1.4	3.13 ± 2.09	3.62 ± 2.33	3.5 ± 2.27	3.55 ± 2.46	3.76 ± 2.6

FSFI = Female Sexual Function Index.

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increased after weight loss in females classified as obese (MD, -0.49; 95% CI, -0.74 to -0.25; $p < 0.0001$; Fig. 2e). Fifth, the satisfaction domain was also improved in women after BMI decline (MD, -0.79; 95% CI, -1.23 to -0.35; $p = 0.0004$; Fig. 2f). Lastly, we extracted data on pain scores from the included studies; in contrast to some findings, our analysis revealed that weight loss failed to decrease the level of pain experienced by women during sexual activity (MD, -0.26; 95% CI, -0.63 to 0.12; $p = 0.18$; Fig. 2g). The above data are shown in Table 2. About the condition of sexual dysfunction in females, five studies reported the decline of sexual dysfunction rate after the weight loss [7,10,12,17,18].

Discussion

The findings of our study indicate that weight loss could improve the quality of sexual function in women. As we all know,

obesity has been reported to have a serious impact on quality of life and to impose heavy social and economic burdens [22]. Moreover, obesity is related to numerous chronic diseases and appears to be associated with decreased convenience and poor quality of life [23–27]. Additionally, some reports have demonstrated that statistically significant improvements in the levels of reproductive hormones could occur [28] and that general sexual function improves after weight loss via either accepted surgical methods or nonsurgical treatment [29]. Bariatric surgery is a natural candidate for the treatment of obesity in overweight individuals and is the current treatment of choice for this condition, even though some studies have reported that women can lose weight through nonsurgical methods such as diet or exercise. In this study, the research focused on the impact of bariatric surgery on female sexual function, although some studies have demonstrated that nonsurgical treatment could improve female sexual function.

Table 3

Compared the Sexual function of women after and before loss weight.

Research	Pre-BMI	After-BMI	Pre-SD	After-SD	Pre-FSFI	After-FSFI	After-desire	After-arousal	After-lubrication	After-orgasm	After-satisfaction	After-pain
Sarwer	44.5	–	100%	100%	20.6 ± 10.9	21.9 ± 10.5	3.4 ± 2.1	3.8 ± 2.1	3.1 ± 1.6	3.5 ± 2.2	3.8 ± 1.8	4.2 ± 2.2
Oliveira	42.0 ± 3.9	30.7 ± 5.4	62%	19%	22.8 ± 22.2	27.2 ± 28.05	4.2 ± 4.5	4.5 ± 4.6	4.8 ± 4.8	4.4 ± 4.8	4.8 ± 5.1	5.2 ± 5
Janik	46.6	26 ± 3	50%	50%	26.9 ± 27.5	26.9 ± 26.3	4.8 ± 4.8	5.7 ± 5.4	4.6 ± 4.8	4.4 ± 4.6	4.8 ± 4.4	4.0 ± 4.4
Goitein	44.4 ± 5.5	32.5 ± 5.1	59%	12%	24.0 ± 9.6	30 ± 4.5	4.2 ± 1.1	4.9 ± 1.2	5.5 ± 0.7	5.2 ± 0.9	5.4 ± 1	5.1 ± 1.4
Efthymiou	50.66 ± 7.9	–	–	–	21.72 ± 10.2	27.72 ± 8.06	3.97 ± 1.22	4.13 ± 1.83	4.39 ± 1.91	4.41 ± 1.88	5.07 ± 1.17	4.41 ± 2.29
B. Sarwe	44.5	–	100%	100%	20.3 ± 10.8	24.8 ± 8.3	3.3 ± 1.3	3.9 ± 1.8	4.4 ± 1.8	4.0 ± 2.1	4.1 ± 1.6	4.6 ± 2.1
Aversa	45 ± 2	38.8 ± 8	–	–	14.0 ± 1.8	20 ± 1.5	2.6 ± 1	4.0 ± 0.5	4.1 ± 0.3	2.6 ± 1.3	3.9 ± 1.1	2.9 ± 1.1
A. Aversa	43.5 ± 3	42.2 ± 3	–	–	15.0 ± 1.3	16 ± 1.7	2.6 ± 1	2.8 ± 0.8	2.3 ± 0.4	2.9 ± 1.2	2.5 ± 1.1	3.4 ± 0.9
Hernandez	52.2 ± 8.2	–	100%	25%	19.9 ± 1.6	25.4 ± 4.1	–	–	–	–	–	–
K. Oliveira	45.76 ± 6.48	–	100%	86%	17.70 ± 8.38	19.61 ± 9.75	3.63 ± 1.52	3.28 ± 2.25	2.46 ± 1.55	2.79 ± 1.91	3.53 ± 2.59	1.22 ± 0.96
Assimakopoulos	51.9 ± 9.92	31.8 ± 4.9	58%	30%	20.68 ± 12.3	25.02 ± 10.28	3.74 ± 1.21	3.92 ± 1.84	4.48 ± 1.93	4.04 ± 2.07	4.26 ± 2.07	4.61 ± 2.23

SD=Sexual Dysfunction.

However, those studies did not use FSFI scores and were thus excluded.

In this meta-analysis, we found that weight loss indeed improves female sexual function, a result opposite to a recent review suggesting that weight loss does not significantly affect female sexual function [22]. We suggest that this discrepancy is because of the relatively small sample size that they included and the method they performed to compare sexual activity. In contrast, we are aware that the FSFI questionnaire assesses a wider range of sexual function, including both emotional (desire, arousal) and physical (lubrication, orgasm, dyspareunia) aspects [11], which is why we have chosen the FSFI to compare female sexual function. The previous review included only two studies that used the FSFI to assess female sexual function, whereas the other studies they included used other questionnaires, such as the Sexual Quality of Life–Female, which consists mainly of questions referring to the emotional aspect of sexual life [13]. For this reason, we believe that the findings of that review should be interpreted with caution. In contrast, our study includes 10 different studies to acquire stronger evidence. In addition to the small sample size, there are other reasons why we disagree with the conclusions of the earlier review. When they performed their study, some patients were not necessarily comfortable discussing sexuality issues with their physicians, which may bias the analysis of the sexual function scores. Nonetheless, in our study, pain score did not seem to be affected by weight loss. Similarly, Efthymiou et al. found no significant difference in the desire and pain domain scores on the FSFI [13]. But these studies still confirmed that the total FSFI scores improved after weight loss. Additionally, the increased FSFI scores were suggested to result from hormonal changes that occur when the amount of weight loss reaches 33% of the total body weight [10]. However, 8 of the 10 studies included are still classed as sexual dysfunction. But the FSFI score actually increased, five studies reported the decline of the sexual dysfunction rate, that means this method is able to provide some helpful. Because the bariatric surgery could decrease the number of patient with sexual dysfunction, this method is good enough to be considered as an option in clinic treatment. But since it still has some flaws, if we need to acquire better improvement in the sexual function, further works are necessary, sexual dysfunction and some medicine treatment method maybe the answer for obesity patients who also suffered the sexual dysfunction.

According to certain reports sexual dysfunction are strongly related to older age, postmenopausal status and some pelvic floor

disorders [30,31]. But, in this review, most recorded women in the including studies are under 45 years old, so the age and menopausal status may not play the role of confounding factors to impact the sexual function. And the patients with some pelvic floor disorders which may affect the sexual function will be excluded as we described in the method section, so this factor may be confounder either.

Patients who have undergone bariatric surgery are expected to achieve an improvement in several physical variables and health status, general well-being, and quality of life [32]. As Hout et al. demonstrated, the decline in the quality of sexual activity due to obesity may be because the psychological and social effects of obesity influence self-esteem and the behavioral aspects of avoidance and initiation of sexual encounters [33]. These effects may also explain the reason why weight loss positively influences sexual function in the obese population, which is likely due to amelioration of both medical and psychosocial impairments. Since the mechanism underlying the relationship between obesity and sexual dysfunction is multifactorial, some reports demonstrated that impaired hormonal regulation may contribute to women sexual function [12]. In addition, the role of psychogenic factors, such as body image and depression, has also been studied in women, but unfortunately, the impact of such factors on sexual function remains unclear [34–36]. In addition, as Castellini et al. have reported that after women successfully lose weight, their sexual function, which is associated with high levels of emotional eating, impulsivity, and body shape concerns, will improve [37]. This explanation is also rational. However, more studies focusing on factors modified by bariatric surgery (i.e., mental health status, depression and anxiety scores, sex hormone serum levels, and urinary tract symptoms) are needed to explain the means by which weight loss surgery leads to improvements in sexual function and overall quality of life [13].

This study has some limitations. First, we need to include more trials in the future to strengthen the evidence. Second, we focus only on female sexual function, yet male sexual function is also important, and the impact of weight loss on other health problems in women, such as urinary incontinence and pelvic organ prolapse, also needs to be explored. Third, the included studies did not discuss the impact of premenopause on lubrication, since the mean age of the sample shows that the majority of patients were premenopausal while lubrication had improved. Nonetheless, in future we may study the different of impact of weight loss between menopausal and postmenopausal women.

Research involving human participants and/or animals: no human and animals participants.
 Informed consent: No.

Contribution statement

Protocol/project development: Sun, Wei, Shen and Yang.
Data collection or management: Sun and Wei.
Data analysis: Sun, Wei, Shen and Yang.
Manuscript writing/editing: Sun, Peng, Lei and Wei.

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Yi Sun and Bo Peng contributed equally to this work and should share the co-first author.

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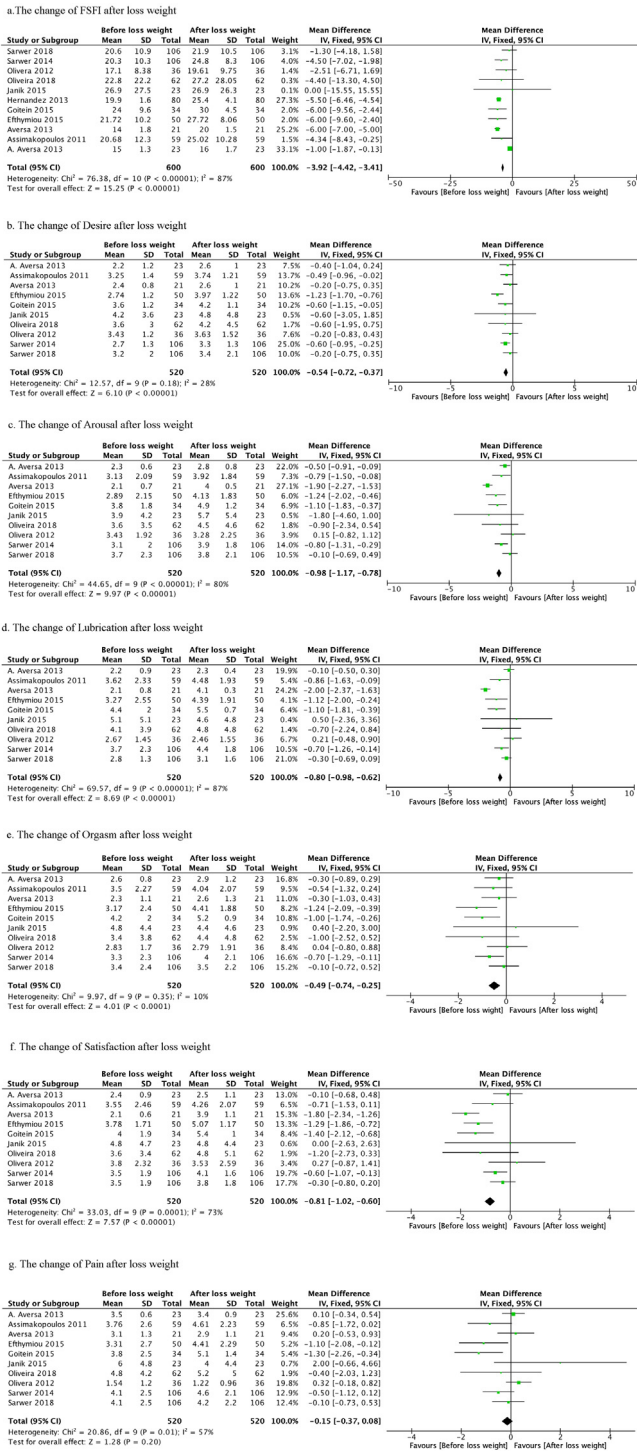


Fig. 2. The change of total FSFI score and each item after weight loss.

Conclusion

Weight loss through bariatric surgery or exercise was associated with a significant improvement in female sexual function for obese women even though pain did not appear to improve.

Ethical statements before the reference section

Disclosure of potential conflicts of interest: There are no conflicts of interest between authors.

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