

Analysis of semen parameters, and hormonal changes of FSH, LH, testosterone, and libido following bariatric surgery

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ABSTRACT

Introduction: Although studies have shown that bariatric surgery can have a positive effect on the patient's sexual function, there are still disagreements and contradictions in this regard. The present study is aimed to evaluate semen parameters, hormonal changes of FSH, LH, testosterone, and libido following bariatric surgery. **Methods:** The present research as a prospective study was performed on 20 male candidates for bariatric surgery referred to Golestan and Aria hospitals in Ahvaz in 2021. Semen parameters (volume, count, motility, and the percentage of sperm with normal morphology), hormonal profile (including FSH, LH test hormones), and sexual function were evaluated using the International Index of Erectile Function (IIEF-5) questionnaire before and 6 months after the surgery. **Results:** The results of this study indicated that semen parameters did not change significantly 6 months after surgery in comparison with before the surgery ($P < 0.05$). After the operation, just the total level of testosterone increased significantly (2.23 nmol/L vs. 2.74, $P = 0.009$). However, LH and FSH levels did not change significantly six months after surgery ($P = 0.858$ and $P = 0.287$). The results indicated significant improvement in IIEF score after the operation ($P = 0.011$). **Conclusion:** The findings of the present study indicated that the decrement of weight as a result of bariatric surgery had a favorable effect on the levels of serum testosterone and sexual performance, while semen parameters did not improve after surgery.

Keywords: Bariatric surgery, semen analysis, sexual dysfunction, testosterone

Introduction

Nowadays, obesity as a global epidemic has affected more than 400 million adults in the world.^[1] Obesity is associated with a wide range of medical and psychological disorders, including non-insulin-dependent diabetes mellitus, coronary heart disease, stroke, and hypertension. Besides, obesity has cumulative negative effects on patients' lives and healthcare systems.^[2] Obese people

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often suffer from endocrine alterations.^[3] In addition, sexual dysfunctions have also been reported following obesity.^[4] Studies have shown that obese men have lower levels of testosterone than men with a normal weight and have lower sexual satisfaction and less chance of fertility.^[5] It has also been reported that the chance of fertility in men decreases by 10% for every 9 kg of excess weight.^[6] Based on epidemiological studies, since 1995, sexual dysfunction has affected more than 150 million men in the world that will reach 322 million by 2025. Therefore, because of the high prevalence of sexual dysfunction in the general population and its close association with the decrement of life's quality, it can be a serious health problem for societies.^[5]

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The increment of body mass index (BMI) in men is associated with androgen deficiency and peripheral aromatization of androgens to estrogens through the increment of adipose tissue.^[7] This leads to a decrease in the level of sex hormone binding globulin and testosterone in plasma and the increment of blood estrogen levels. Besides, it disrupts the negative feedback of hypothalamic–pituitary–gonadal axis and decreases the function of Sertoli cells and leads to male hypogonadism.^[3,5,7,8]

Several management methods have been proposed to prevent and treatment of obesity. Nutritional interventions, medicine, and physical exercise are widely used in cases with mild to moderate obesity.^[9] However, bariatric surgery is the most effective treatment method for permanent weight loss in patients with morbid obesity, which can lead to a significant weight loss and improvement of its associated disorders.^[10] Bariatric surgery procedures including gastric bypass surgery, vertical sleeve gastrectomy, and biliopancreatic diversion all of which are recommended for class II (moderate-risk) obesity with underlying diseases (BMI between 35–39.9 kg/m²) and class III obesity (BMI >40 kg/m²).^[11] The effects of bariatric surgery on semen parameters and sex hormones in men have not yet been definitively determined. Although improvement in sexual quality of life and the hormonal profile have been observed,^[12] irreversible azoospermia after Roux-en-Y gastric bypass surgery has also been reported.^[13] Gokalp *et al.*^[14] indicated that the median IIEF score and the score of different items of the IIEF questionnaire increased significantly after bariatric surgery. Liu *et al.*^[15] also indicated that the scores of overall IIEF and all its dimensions, the score of BSFI, and its various dimensions increased significantly after bariatric surgery. Other studies also reported that weight loss through bariatric surgery has a positive effect on serum testosterone levels and semen parameters in patients with azoospermia and oligospermia before the operation.^[16]

In general, obesity is associated with several negative consequences, including sexual dysfunction. Some studies have indicated that bariatric surgery can yield positive effects on the sexual function of patients.^[14,15] Besides, permanent weight loss using bariatric surgery has significant effects on the increment of the level of male sex hormones and improving the sexual performance of them.^[17] However, there are still disagreement and contradictions regarding the effectiveness of this operation. In some studies, a significant improvement in sexual performance has been reported, but in some other the opposite has been reported.^[15,18,19] Besides, there were no studies in Iran in terms of evaluating the effect of bariatric surgery on semen parameters, sex hormones, and sexual performance of men. Therefore, since both bariatric surgery and sexual disorders are prevalent in men, having knowledge about the mechanism of action and the effectiveness this intervention on sexual performance can help the patient and the doctor to decide whether to perform bariatric surgery. So, this study is aimed to evaluate semen parameters, hormonal changes of FSH, LH, test hormones, and libido following bariatric surgery.

Methods

The present research as a prospective study was performed on men candidates for bariatric surgery who were referred to Golestan and Aria hospitals in Ahvaz in 2021. The sample size was equal to 20 people, and participants were selected based on purposive sampling. At first, an informed consent document was obtained from the participants, and in this regard, objective of the study was fully explained to them. Then, the desired procedures and parameters required for performing the study were fully explained to them. Inclusion criteria comprise age of 20–45 years, candidate for bariatric and weight loss surgery as well as patient's consent to participate in the study. On the other hand, the exclusion criteria comprise the presence of medical or genetic disorders with a negative effect on fertility, such as testicular trauma, testicular cancer, open surgery, testicular atrophy, and history of pituitary and hypothalamus surgery. Ethics committee approval by IR.AJUMS.HGOLESTAN.REC.1401.105.

Grouping and intervention

At first, the medical history of all eligible patients was evaluated and the required data was recorded in the patients' personal information checklist. The data about the age, weight, height, and BMI of the patients was collected. Tests of serum levels of sex hormones including LH, FSH, and total testosterone of patients before surgery and six months after bariatric surgery were evaluated and recorded. All the tests and analyses were performed based on standard protocols and guidelines. Hormonal tests were performed based on the immunoassay method. Analysis of semen parameters, including volume, count, motility, and percent of sperm with normal morphology, was also performed before and six months after the operation. These analyses were performed based on WHO standard values.^[20] Besides, the IIEF-5 questionnaire was used to check the sexual function of patients before and six months after the operation.

All bariatric surgeries, including gastric bypass surgery and sleeve gastrectomy, were performed based on standard techniques and by an experienced surgical team. Also, all patients underwent nutritional counseling during 6 months following bariatric surgery. Finally, the results of laboratory investigations, sexual function, and BMI variations of patients before and six months after the operation were compared.

Data analysis

SPSS (SPSS Inc., Chicago, IL, U.S.A.) V22 was used to perform statistical analysis. The *P* value ≤0.05 was considered as the significant level in our analysis.

Results

This study consisted of 20 men aged between 25 and 40 who underwent bariatric surgery. The basic characteristics of the patients who participated in this study are presented in Table 1.

The results of comparing semen parameters, hormonal profile, evaluation of sexual function, and BMI variations are shown in Table 2. The findings indicated that semen parameters did not change significantly six months after the operation compared to their preoperative values. Total testosterone increased significantly after the operation (23.2 nmol/l vs. 2.74 nmol/l, $P = 0.009$). However, LH and FSH levels did not show significant variations six months after the operation. Besides, the overall IIEF score of patients increased significantly six months after the operation compared to before the operation ($P = 0.011$). On the other hand, patients' BMI decreased significantly six months after the operation in comparison with before the operation ($P < 0.0001$). The difference in BMI before and after the operation was 10.43 ± 2.14 [Table 2]. Moreover, the comparison of IIEF questionnaire scores before and 6 months after bariatric surgery is reported in Figure 1.

The results of the correlation test for evaluation of the association between BMI decrease and changes in semen parameters, hormonal profile, and changes in sexual performance of patients are presented in Table 3. The results indicated that the amount of BMI reduction had no significant association with the amount of hormonal changes after the operation. The amount of BMI reduction was not significantly related to changes in semen parameters after the

operation. Besides, there was no significant association between BMI reduction and changes in the sexual function of patients (the score of the IIEF-5 questionnaire) after the operation.

Discussion

Bariatric surgery, which includes gastric bypass surgery and sleeve gastrectomy, is an effective method for permanent weight loss.^[19] The results of this study indicated that the patients' BMI decreased significantly six months after bariatric surgery. The results of the meta-analysis conducted by Xu *et al.*^[21] indicated that bariatric surgery significantly decreases BMI (between 10.73 and 10.2). A reduction of 11.6 kg/m² in BMI after bariatric surgery was also reported in Wood's study.^[18] In other studies, it has also been reported that bariatric surgery can decrease weight and BMI in a permanent way for at least 10 years after the operation.^[19] The results of the present study indicated that the analysis of semen parameters six months after the operation did

Table 1: Basic characteristics of patients undergoing bariatric surgery	
Variables	Numbers as frequency (%) or average (\pm) standard deviation
Age (year)	(24–40) 34.74 \pm 3.54
Type of operation	
Gastric bypass surgery	3 (15.0%)
Sleeve gastrectomy	17 (85.0%)

Numbers are reported as frequency (percentage) or mean \pm standard deviation (minimum–maximum)

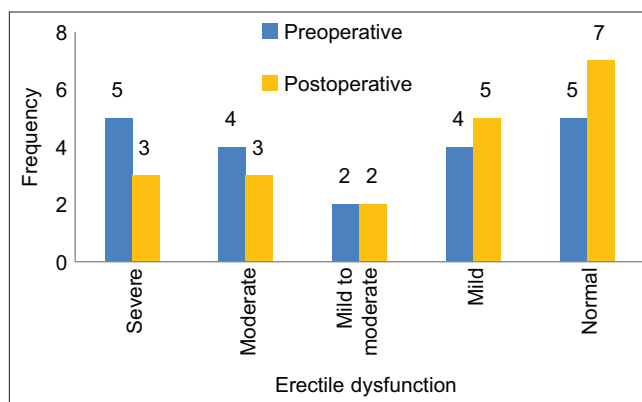


Figure 1: Comparison of IIEF questionnaire scores before and six months after bariatric surgery

Table 2: Comparison of changes in semen parameters, hormonal profile, evaluation of sexual function (IIEF questionnaire) and changes in BMI of patients before and 6 months after bariatric surgery			
Parameter	Before the operation	After the operation	P
Semen parameters			
Volume (ml)	2.68 \pm 1.200	2.46 \pm 0.84	0.472
Count (million/ml)	47.63 \pm 22.95	44.11 \pm 18.43	0.161
Total motility (%)	48.79 \pm 20.82	47.00 \pm 19.92	0.248
Normal morphology (%)	45.58 \pm 22.37	43.95 \pm 16.66	0.492
Hormonal profile			
LH (IU/L)	3.68 \pm 0.74	3.71 \pm 0.85	0.858
FSH (IU/L)	3.66 \pm 0.58	3.46 \pm 0.73	0.287
Testosterone (nmol/L)	2.23 \pm 0.78	2.74 \pm 0.97	0.009
Variable			
Kg/m ² , MBI	42.45 \pm 3.11	32.02 \pm 2.76	<0.0001
Sexual Function Index			
Total score	13.58 \pm 4.99	16.89 \pm 4.5595	
Severe erectile dysfunction (Score 5–7)	5 (25%)	3 (15%)	0.011
Moderate erectile dysfunction (Score 8–11)	4 (20%)	3 (15%)	
Moderate erectile dysfunction (Score 12–16)	2 (10%)	2 (10%)	
Mild erectile dysfunction (Score 17–21)	4 (20%)	5 (25%)	
No erectile dysfunction (Score 22–25)	5 (25%)	7 (35%)	

Table 3: Association between BMI reduction and changes in semen parameters, hormonal profile and sexual performance of patients after bariatric surgery

Parameter	Pearson correlation coefficient	P
Semen analysis		
Volume	0.058	0.809
Count	0.403	0.078
Total motility	0.183	0.440
Normal morphology	0.339	0.144
Hormonal profile		
LH	0.295	0.206
FSH	0.225	0.340
Testosterone	0.063	0.792
Sexual performance		
Score of IIEF questionnaire	0.237	0.315

not reveal significant changes compared to preoperative values. In the study of El Bardisi *et al.*,^[16] semen analysis was evaluated before and 12 months after sleeve gastrectomy. The results of their study indicated that the number, volume, motility (total and progressive), and normal morphology of semen did not change significantly before and after the operation.

In their meta-analysis in China, Wei *et al.*^[19] evaluated the effect of bariatric surgery on semen parameters. The results of their study based on six articles which consisted of 90 patients who underwent bariatric surgery showed that the volume of semen increased significantly in patients after gastric bypass surgery. However, count, progressive motility, and normal morphology of sperm remained unchanged after the operation. However, the normal morphology of sperm increased somewhat in the subgroup of patients underwent sleeve gastrectomy. In this study, because of the limited number of samples in different types of operation, it was not possible to compare the effect of various types of bariatric surgery on semen parameters. In a meta-analysis study by Lee *et al.*,^[17] there was no change in semen parameters after bariatric surgery. In a study by Legro *et al.*,^[22] semen parameters, including volume, count, motility and normal morphology, did not change significantly in 1, 3, 6, and 12 months after bariatric surgery compared to the preoperative values.^[22] In the study of Samavat *et al.*,^[23] it was reported that severe weight loss (unintentional weight loss) after six months of Roux-en-Y (roo-en-wy) gastric bypass-modified some semen parameters (semen volume). Besides, the association between the amount of weight loss and the changes in semen parameters including morphology, number, and volume was significant. However, in this study, there was no significant relationship between BMI reduction and changes in semen parameters, hormonal profile, as well as changes in the sexual performance of patients.

Despite the effectiveness of weight loss on the modification of fertility parameters including the improvement of semen quality,^[24] there are conflicting results regarding the effect of bariatric surgery on semen parameters. These conflicting results are mainly including the occurrence of azoospermia

after Roux-en-Y (roo-en-wy) gastric bypass^[25] and the deterioration of semen parameters after bariatric surgery such as Oligoasthenoteratozoospermia.^[26] The negative effect of weight loss after bariatric surgery and abnormality in semen parameters is probably influenced by various factors including the lack of nutrients such as iron and calcium and B group vitamins (B1, B12, and B9)^[27] as well as the release of toxins and fat-soluble substances in the adipose tissue of patients.^[25] The difference in the results and ineffectiveness bariatric surgery on semen parameters in this study can be justified through the initial BMI before the operation, the time of evaluation of semen parameters after surgery, BMI after surgery, doing physical activities and exercise, pharmacological treatments or weight loss diet after bariatric surgery.^[4,19] Therefore, the heterogeneity in the findings of the conducted studies in this regard is due to the differences in the sample size, the characteristics of the examined people, and the type of bariatric surgery. Therefore, a definite conclusion about the effect of bariatric surgery on semen parameters requires more investigations.

The findings of this study indicated that total testosterone increased significantly after the operation, but LH and FSH levels did not change significantly six months after the operation. The findings of the study performed by El Bardisi *et al.*^[16] regarding evaluating the effect of sleeve gastrectomy surgery on the level of sex hormones revealed that, of the examined hormones (LH, FSH, testosterone, estrogen, and prolactin), only the serum testosterone level after the operation (12 months later) increased significantly.^[16] The increment of total and free testosterone levels after bariatric surgery has also been reported in other studies.^[21] The findings of a meta-analysis consisting of 24 articles indicated that bariatric surgery significantly increases the total testosterone and gonadotropins level and decreases estradiol.^[28] Another meta-analysis by Wen *et al.*^[29] also revealed that the improvement in sex hormone levels means the increment of total and free testosterone levels, the decrement of estradiol, and the increment of LH and FSH after bariatric surgery in men. In general, these findings revealed a significant relationship between bariatric surgery and improved hormonal profile. Although the present study only examined the levels of LH, FSH, and total testosterone hormones, only testosterone levels improved after bariatric surgery. Differences in sample size, type of bariatric surgery, and follow-up period can be the cause of some differences in the findings of the studies conducted in this regard.

The findings of this study indicated that the mean score of IIEF increased significantly after bariatric surgery. The findings of a study done by Gokalp *et al.*^[14] in Turkey on 31 obese patients indicated that the sexual performance of patients based on the IIEF questionnaire improved significantly after bariatric surgery in comparison with it before surgery. Besides, the findings of a meta-analysis conducted by Lee *et al.*^[17] in Canada in 2018 indicated that bariatric surgery significantly improves sexual function (increment of the score of IIEF).^[17] In a prospective cohort study by Sarwer *et al.*,^[30] improvement in sexual function (evaluated by the IIEF score) in obese men

three years after Roux-en-Y (roo-en-wy) gastric bypass was also reported. In their study, Ranasinghe *et al.*^[31] reported the improvement of sexual function (the increment of IIEF score) after bariatric surgery.^[31] These findings in line with the results of the present study indicate that the sexual performance of men, including erectile function, sexual desire, and overall satisfaction with sex, improves after bariatric surgery. So, bariatric surgery is an effective method of improving the sexual performance of obese men. However, the underlying mechanism of obesity-related sexual dysfunction is not still specified well. Previous studies indicated that the social and psychological appearance of men including body image and depression have a negative effect on self-esteem and compulsive sexual behavior.^[32] Finally, the findings through the IIEF questionnaire indicate that bariatric surgery improves sexual performance in men.

Conclusion

The findings of this research indicated that weight loss by bariatric surgery has a favorable effect on the levels of serum testosterone and sexual performance of obese patients. However, semen parameters and levels of LH and FSH hormones did not modify after surgery.

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Conflicts of interest

There are no conflicts of interest.

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