

Effect of Bariatric Surgery on Obese Male Semen Parameters and Reproductive Hormones: a meta-analysis

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Abstract

Background The relation between bariatric surgery and semen parameters and reproductive hormones on obese male remains incompletely understood. **Methods** We searched PUBMED, EMBASE and the Cochrane Central Register for studies from 1999 to 2019 for studies on effect of bariatric surgery on obese male semen parameters and reproductive hormones. Three studies met the inclusion criteria for our meta-analysis. After data extraction and quality assessment, we used RevMan 5.2 to pool the data. **Results** Three studies were included in our meta-analysis. The pooled data showed that the testosterone concentration and sperm volume were higher in postoperative group than baseline with a significant difference (WMD:4.63, 95%CI 2.65 to 6.61, $P<0.05$, WMD; 0.89, 95CI 0.38 to 1.40, $P<0.05$, respectively). No significant difference was found in the postoperative sperm concentration, sperm morphology, sperm motility and estradiol concentration (WMD: -3.28, 95%CI: -38.86 to 32.29, $I^2=9\%$; $p=0.89$, WMD: -0.52, 95%CI: -5.83 to 4.79, $I^2=71\%$; $p=0.85$, (WMD; -0.01, 95%CI; -5.42 to 5.40, $I^2=0$; $p=1.00$, WMD: -2.93, 95%CI: -43.11 to 37.24, $I^2=87\%$; $p=0.89$, respectively). **Conclusions** Bariatric surgery did not interfere with sperm quality. Our study showed that the postoperation testosterone increased with statistically significance.

Background

Obesity is increasing worldwide, with recent estimates suggesting a global overwhelming clinical problem and its prevalence has doubled in the past three decades[1, 2]. Obesity in man is believed to be associated with infertility and reproductive problems[3]. It has also been showed that the relation between semen parameters and obesity may exist. Additionally, (the adipose tissue is related to the metabolism of hormones, including sex hormones in both men and women[4]. The mechanism for this may likely to involve some derangement the male reproductive hormone profile, which might also be related to obesity.

Weight loss is generally believed to be useful to maintain normal hormonal profiles and fertility for man with high BMI.

Bariatric surgery was reported to make the serious fat men or women to lose weight. It provides a useful method to achieve progressive weight loss and quantitive the relationship between weight loss and improvement in both man and woman reproductive function. Bastounis et al first reported that the bariatric surgery in maintaining hormonal imbalance and improving the sexual quality[5]. However, several studies have reported a harmful influence on rapid weight loss on male fertility and sperm function, indicating it to be due to malabsorption of nutrients that occurs after bariatric surgery [6, 7]. Other studies reported that the BMI was associated with higher semen quality. Despite the consensus on this fact have been reached, few high-quality and well-designed studies have been investigated to explore hormonal profiles and effect on semen examination.

No meta-analysis was performed to evaluate the barbita surgery to the semen quality and male sexy hormone. We aim to pool the bartical surgery on the semen quality. We performed this meta-analysis to evaluate to the effect on barbita surgery on semen parameters and reproductive hormones in obese men.

Method

Search strategy

We conducted this meta-analysis according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines(S1). We searched PUBMED, EMBASE and the Cochrane Central Register for studies published in English between 1998 and 2018. Our searching terms are: "Bariatric Surgery," "Semen Quality", "Male Obesity" "High BMI", "spermatozoa", "sperm morphology", "sperm head", semen, body weight, overweight." Then, all

titles, abstracts, or related citations were scanned and reviewed. We also used combined Boolean operators "AND" or "OR" in the Title/Abstract search field.

Inclusion and exclusion criteria

Two authors reviewed the articles. The following inclusion criteria were used: articles covering (1) studies contained of sperm concentration, sperm volume, sperm count, sperm motility; (2) studies contained BMI, weight and patients with bariatric surgery, estradiol (E2), testosterone (T), free testosterone (free T), luteinising hormone (LH) and follicle-stimulating hormone (FSH). (3) follow-up period longer than six months. The following exclusion criteria were applied: (1) editorial comments, case reports, meeting abstracts and articles without applicable data; (2) studies with insufficient data such as missing values and (3) Studies of hormones that after stimulation were excluded. We identified relevant studies as illustrated in Figure 1.

Data extraction

Two authors extracted data. The two authors extracted data on sperm morphology", "sperm volume", "semen motility", "estradiol (E2)", "testosterone (T)". Baseline comparative data, data on clinical outcomes, and data on postoperative complications were also recorded.

Statistical analysis

We used Review Manager Version 5.2 software (The Cochrane Collaboration, Oxford, UK) to perform the analysis of the included data. We used Cochran`s Q to evaluate the heterogeneity; if the value of $Q < 50\%$ or $P > 0.01$, we believed little heterogeneity was present. However, if $Q > 50\%$, $P < 0.01$, evident heterogeneity existed. If $I^2 > 50\%$, the random effects model was applied. For quantitative data, we used weight mean difference (WMD) or standard mean difference (SMD) to calculate continuous data. We used OR and 95% confidence interval (CI) to evaluate binary data. All tests were 2-tailed, and the statistical significance level was set at 0.05.

Results

Three studies were included in our study[8-10]. The searching process is summarized in Figure 1. From the selected databases, we obtained 33 studies. With reading the titles and abstracts, we excluded 2 studies. For detailed processing, 28 reports were excluded. Finally, we included 3 studies in the meta-analysis. Table 1 summarizes basic characteristics of the included studies.

Quality assessment

The New-Ottawa Scale (NOS) was used to assess the included nonrandomized studies. An NOS score of 7-9 or above was considered high quality, an NOS score of 4–6 was considered medium quality, and an NOS score of 0-4 or below was considered low quality. Two reviewers assessed the quality of the included studies. Table 2 Quality assessment of the included studies

Sperm volume

Three studies reported the sperm volume. The pooled data showed that postoperative perm volume indicated statistical differences between the postoperative and baseline group (WMD: 0.89, 95%CI: 0.38 to 1.40, $I^2=0$; $p < 0.05$ fixed-effects model, Fig. 2).

Sperm concentration

Data related to the sperm concentration were available in three studies. The pooled data of postoperative and baseline sperm concentration indicated no statistical differences between the postoperative and baseline group (WMD: -3.28, 95%CI: -38.86 to 32.29, $I^2=9\%$; $p=0.86$ random-effects model, Fig. 3).

Sperm morphology

The pooled data of preoperative sperm morphology indicated no statistical differences between the baseline and postoperative group (WMD: -0.52, 95%CI: -5.83 to 4.79, $I^2=71\%$; $p=0.85$ random-effects model, Fig. 4).

Sperm motility

Three studies reported the sperm motility. No statistical difference was found in the sperm motility between the postoperative and baseline group (WMD: -0.01, 95%CI: -5.42 to 5.40, $I^2=0$; $p=1.00$, fixed-effects model, Fig. 5).

Testosterone concentration

The pooled data of postoperative testosterone concentration indicated statistical differences between the postoperative and baseline group (WMD: 4.63, 95%CI: 2.65 to 6.61, $I^2=52\%$; $p<0.05$ fixed-effects model, Fig. 6).

Estradiol concentration

Three studies reported the estradiol concentration. No statistical difference was found in estradiol concentration between the postoperative and baseline group (WMD: -2.93, 95%CI: -43.11 to 37.24, $I^2=87\%$; $p=0.89$ random-effects model, Fig. 7).

Discussion

Our meta-analysis was performed to compare bariatric surgery on semen parameters and reproductive hormones. This study reported that the semen volume had significantly difference between the postoperative operation group and baseline group ($p=0.0006$). Contrary, HaithamEl Bardis et al found that the semen volume had no significant difference between the two groups ($p>0.05$). Eisenberg et al, found that the semen volume had significant relation with BMI ($p=0.005$). Additionally, they found no significant difference between the BMI and semen concentration ($p=0.564$). Similarly, Samavat et al conducted a prospective study included the bariatric surgery group and non-bariatric group. They found the changes of BMI was associated with in sperm volume ($r=0.618$, $p<0.05$) with statically significant. MacDonald et al performed a cross-sectional study recruit 514 men suggested that the sperm volume ($r=0.02$, $p>0.05$)[8].

Additionally, they found that the sperm concentration had a negative correlation with bariatric surgery without statically significantly ($r=-0.05$, $p>0.05$). The meta-analysis showed that the semen concentration had no difference between the preoperative and postoperative group ($p=0.86$). Haithamm et al demonstarted that no significant difference between the two pre and postoperative group[11].

Hammiche et al involved 450 men of subfertile couples with subfertility demonstrated that the BMI was an independent factor to affect the sperm motility ($r=-0.62$, $p<0.05$)[12]. Kort et al conducted a study involving 520 healthy men reported that the BMI of male partners had a negative relation with motile sperm count ($p<0.05$)[13]. Consistently, Richard et al also found that man with bartriatic surgery had no relation with sperm motility 12-month

post-surgery ($p=0.60$). Similarly, Macdonald et al performed a meta-analysis included 31 studies found that the no correlation between the semen parameters and BMI [14]. The present study also found that no correlation between the sperm motility and bariatric surgery ($p=1.00$). However, Samavat et al conducted a study included 23 patients found that the the number and progressive or total sperm motility was in increase with statistically significant. Additionally, they found that after the age-adjusted multivariate analysis indicated that the BMI changes were related with sperm morphology. These results were not accordance with ours. MacDonald et al also found that the BMI was not correlate with sperm motility with adjusted RR (0.96 95%CI: 0.38-2.47 $p>0.05$). This is consistent with ours. Several studies which were included larger than 500 men indicated that the BMI had no significant difference with sperm parameters ($p>0.05$). Reis et al performed a prospectively study concluding that the bariatric surgery could not change the sperm motility, which was consistently with our meta-analysis[9].

Our study illustrated that the bariatric surgery had no relation with the semen morphology ($P=0.85$). Jensen et al recruit 1,558 volunteers using the strict morphological criteria found no association between BMI ($>25 \text{ kg/m}^2$) and sperm morphology [9]. Buchwald et al conducted a meta-analysis almost 70% of patients had an abnormal semen analysis, the sperm concentration, morphology and total motility, 63% and 33%, respectively[15].

Our study also found that the testosterone level was higher in postoperative group than baseline with a significant difference (WMD:4.63, 95%CI 2.65 to 6.61, $P<0.05$). Similarly, Linn et al performed a cohort study recruit 43 participants (with BMI $>33\text{kg/m}^2$) with a weight loss programme indicating that a significant increase in testosterone ($p = 0.02$)[16].

The hormonal profile in obese men assessed in this study was characterized by abnormalities in sex hormones, and weight loss improved with the change of the hormone levels, however, they were not normalized. In our meta-analysis, the hormones were also pooled directly without transformation. However, the men were severely obese at baseline and may stay obese or overweight after the weight loss surgery. However, postoperative changes in sex hormone levels cannot be contributed to reduction of adipose tissue. Contrary to this, several reports have highlighted negative consequences with worsening of semen parameters after bariatric surgery, indicating that nutrient malabsorption may lead to long-term effects on male fertility[7].

Sermondade et al conducted a meta-analysis involving 13077 men from the attending fertility clinic and general population found that BMI is associate with increased prevalence oligozoospermia or azoospermia the odds ratio (95% confidence interval) for azoospermia was 1.15 (0.93–1.43) or oligozoospermia for underweight, 1.11 (1.01–1.21) for overweight, 1.28 (1.06–1.55) for obese and 2.04 (1.59–2.62) for morbidly obese men[17]. Haitham El Bardisi et al found that the sperm quality could be better after the loss of weight especially in oligosperm man.

Bariatric surgery included gastric bypass and alimentary reconstruction which induce substantial weight loss. The decline of body weight had association of the level of reproductive hormone concentrations. The hormone level may associate with the spermatogenesis process. This may result the change of the semen quality. MacDonald et al performed a meta-analysis contained 31 studies found that the BMI was not associated with estradiol and BMI, which was coincidental with our study. However, Pasquali et al did find statistically significant positive relationships between BMI and estradiol. Such a relationship is might due to increased peripheral conversion of androgen to estrogen associated with the surplus adipose tissue present at man with higher BMI[18]. Our study showed that no significant difference was found with bariatric surgery. However, Jensen et al. (2004) believed that a statistically significant negative relation between BMI and both sperm concentration

21.6% (95% CI 4.0%-39.4%)[19].

Our study had several limitations. Firstly, the small number of patients in our meta-analysis. Secondly, the included studies were non-RCTs. Thirdly, we could not exclude selection bias existing the three studies. The included studies lack of FSH, LH, sex-hormonebinding-Globulin (SHBG) to pool and explore the association between bariatric surgery and hormones.

Conclusions

In our meta-analysis, bariatric surgery induced massive weight loss did not interfere with sperm quality. Our study showed that the postoperation testosterone increased with statistically significance. More multi-center high quality RCTs with large sample size are needed to verify the association of bariatric surgery on obese male semen parameters and reproductive hormones.

Abbreviations

T: Testosterone E2: estradiol LH: Luteinising Hormone FSH: Follicle-Stimulating Hormone WMD: Weight Mean Difference I CI: Confidence Interva

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

Funding

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Authors Contributions

YLJ and LJQ designed the study. YLJ wrote the manuscript. YLJ and LJQ

analyzed the data. LJQ and YLJ searched the articles. YCH supervised

all aspects of study design, literature review, manuscript creation, and critically appraised the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1 Basic Characteristics of the Included Studies

Study	Year	Design	Sample Size		Median Age (years)		Follow-up (months)	
			P	B	Pre	B	Pre	B
Legro	2015	P,S	6	6	37.5	37.5	12	12
Reis	2012	P,S	10	10	NA	NA	6	6
Samavat	2017	P,S	23	23	NA	NA	6	6

B baseline *Pre* preoperative, *S* single center *P* prospective study

Table 2 Quality assessment of the included studies

Study	Design	Selection				Comparability	Outcome			Total
		Representativeness of exposed cohort	Selective of nonexposed Cohort	Ascertainment of exposure	Outcome not present at start		Assessment of outcome	Adequate follow-up length	Adequacy of follow-up	
Reis	P, S	*	*	*	*	*	*	*	*	8
Samavat	P, S	*	*	*	*	*	*	*	*	7
Legro	P, S	*	*	*	*	*	*	*	*	6

P prospectively study; *S* single center

Additional Material

S1 PRISMA checklist

Figures

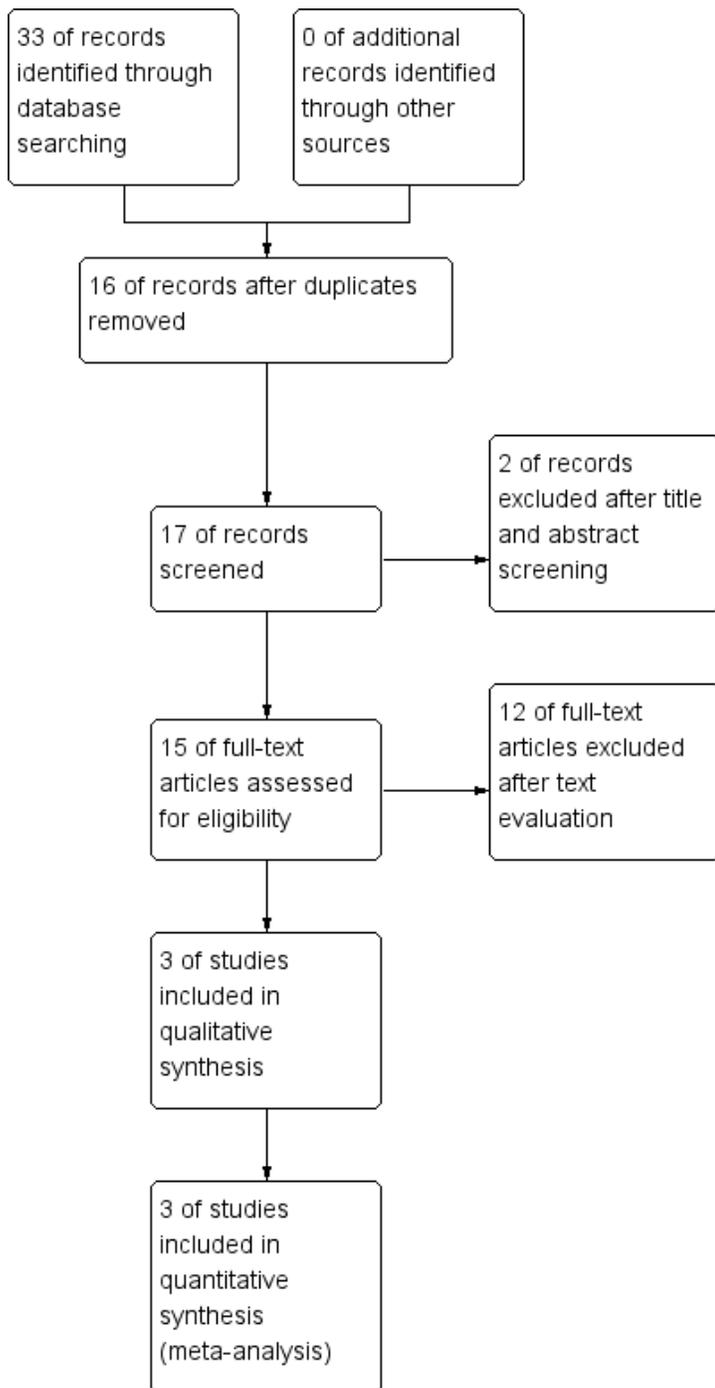


Figure 1

Flow diagram of the process for the selection of relevant studies

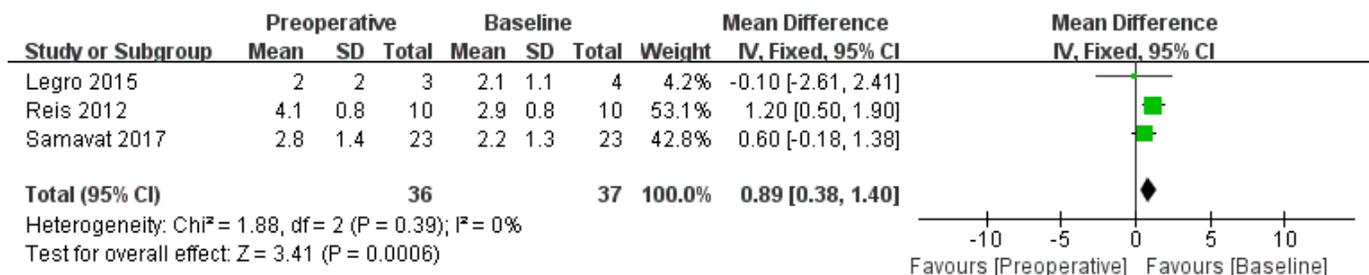


Figure 2

Forest plot for the sperm volume between the postoperative and baseline group

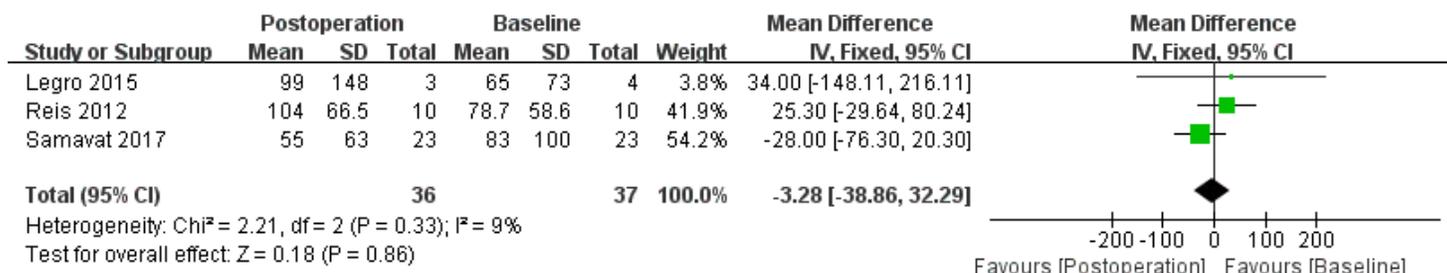


Figure 3

Forest plot for the sperm concentration between the postoperative and baseline group

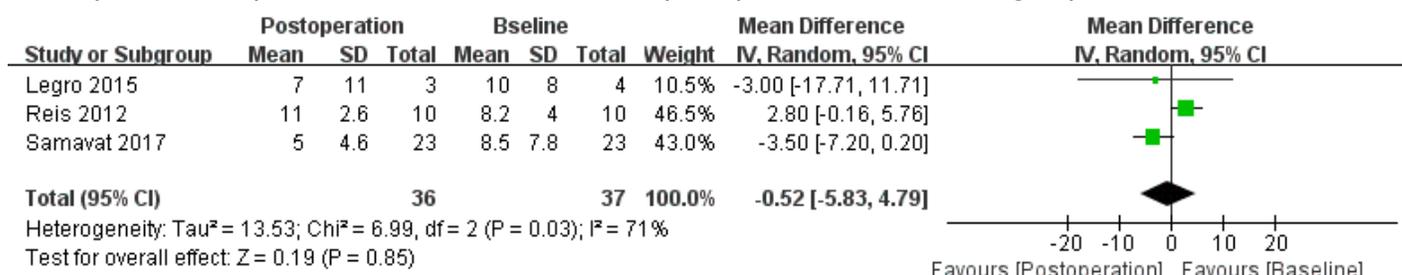


Figure 4

Forest plot for the sperm morphology between the postoperative and baseline group

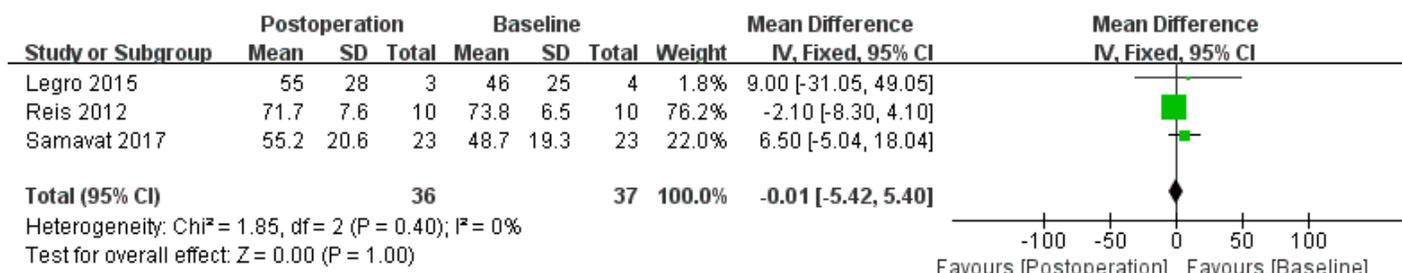


Figure 5

Forest plot for the sperm motility between the postoperative and baseline group

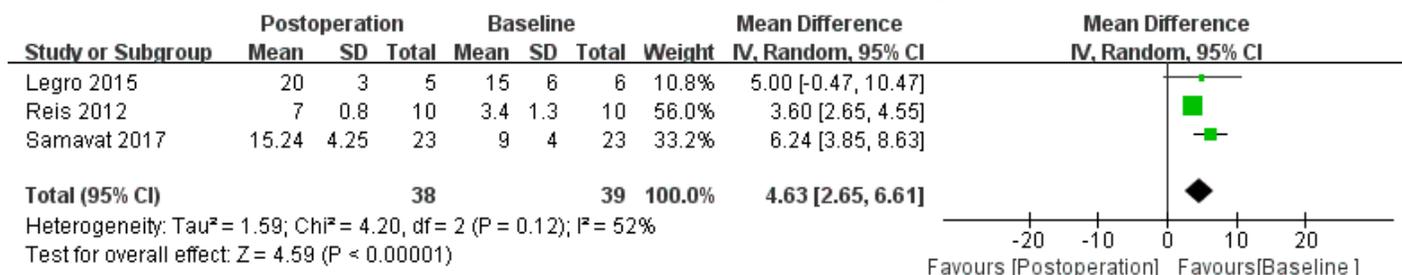


Figure 6

Forest plot for the testosterone concentration between the postoperative and baseline group

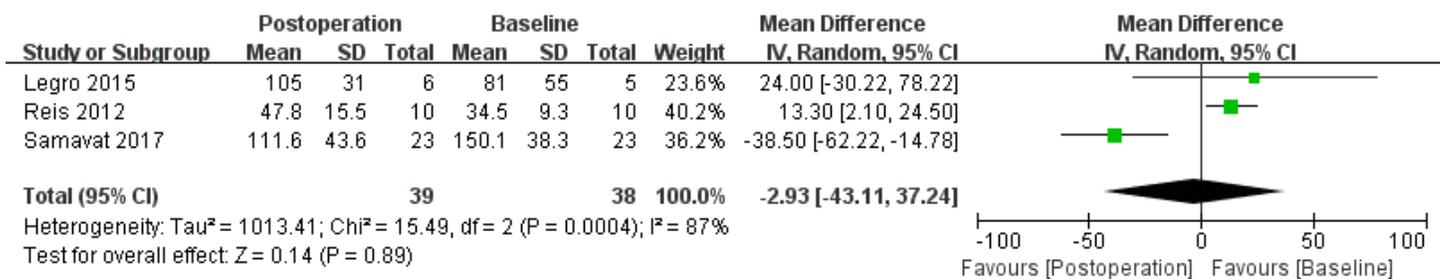


Figure 7

Forest plot for the estradiol concentration between the postoperative and baseline group

Supplementary Files

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- [S1PRISMA2009checklist.doc](#)