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# Correlation between body mass index and ICSI outcome in women with PCOS

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SUMMARY

**AUTHORS' CONTRIBUTION: (A)** Study Design · **(B)** Data Collection . **(C)** Statistical Analysis · **(D)** Data Interpretation · **(E)** Manuscript Preparation · **(F)** Literature Search · **(G)** No Fund Collection

**Background:** Polycystic ovary syndrome: Abbreviated PCOS. Polycystic ovary syndrome is a condition in women characterized by irregular or no menstrual periods, acne, obesity, and excess hair growth. PCOS is a disorder of chronically abnormal ovarian function and hyperandrogenism (abnormally elevated androgen levels). In a non-PCOS population, BMI is known to affect in vitro fertilization (IVF) outcomes. Although weight reduction improves fertility in PCOS patients attempting spontaneous conception, studies of PCOS patients to date do not fully evaluate the impact of a range of BMIs on IVF outcomes.

**Aims:** The aim of this study is to correlate between body mass index and gonadotrophin secretions in PCOS patients and their effect on clinical pregnancy in ICSI cycles.

**Methodology:** The study was done in IVF unit at Maternity Hospital of Ain Shams University, the period of the study was from November 2017 to April 2018. A total of 96 women with history of PCOS and infertility enrolled in the study and divided into two groups, one of them 46 women with BMI ≥ 30 kg/$m^2$ and the other 50 women with BMI < 30kg/$m^2$.

**Results:** There is a significant difference between the two groups in body mass index and duration of infertility. The clinical pregnancy rate was 37% in non-obese group while it was 33.3% in obese group, so obese group had non-significantly lower clinical pregnancy than non-obese group.

**Conclusion:** PCOS is a broad syndrome, in the current study there is a comparison between two groups of women with PCOS undergoing ICSI, one of them was obese and the other was non obese. It was found that clinical pregnancy rate was more in the non-obese group, indicating that BMI could be correlated to the outcomes of ICSI.

**Recommendations:** Obese PCOS patients are more likely than non-obese PCOS patients to have less clinical pregnancy rate after ICSI. Future studies might prospectively examine the effect of gonadotropin dose adjustments on clinical outcomes across a range of BMIs in PCOS patients. Multisite collaborations are needed to maximize sample size.

**Keywords:** Body Mass Index; Invitro fertilization; ICSI; Polycystic ovary syndrome

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## INTRODUCTION

Polycystic ovary syndrome: Abbreviated PCOS. Polycystic ovary syndrome is a condition in women characterized by irregular or no menstrual periods, acne, obesity, and excess hair growth. PCOS is a disorder of chronically abnormal ovarian function and hyperandrogenism (abnormally elevated androgen levels). It affects 5-10% of women of reproductive age. PCOS is also called the Stein-Leventhal syndrome. Medication is generally prescribed to induce regular periods, thereby reducing the risk of uterine cancer. For acne and excess hair growth, the diuretic spironolactone (Aldactazide) can help. And for women who desire pregnancy, clomiphene (Clomid) can be used to induce ovulation. The cause of PCOS is unknown. However, the ovaries of women with the disease characteristically contain a large number of small cysts. Hence, the name polycystic ovary [1].

Polycystic ovary syndrome (PCOS) affects up to almost 27 percent of women during their childbearing years. It involves cysts in the ovaries, high levels of male hormones, and irregular periods [2].

Previous studies have reported a variable prevalence of gonadotropin secretory abnormalities, including elevated baseline LH and LH to FSH ratio in 35–90% of patients with PCOS. Most investigators have also documented an increased LH pulse amplitude and frequency [3].

The reason for this wide range of estimates for gonadotropin abnormalities remains unclear. However, variable definitions of subjects with PCOS, the variable prevalence of obesity, variable intensities of blood sampling, and variable gonadotropin assays each undoubtedly play a role. Some investigators have required an elevated LH or LH to FSH ratio as part of the definition of PCOS, others have required the presence of polycystic ovarian morphology and/or an elevated serum androgen level, while still others have required only the ovarian morphology without other endocrine features. Some investigators specifically studied PCOS patients shortly after a spontaneous or exogenous progestin-induced menstrual bleed [4].

Observations suggest that prospective assessment of the quality of decidualization response in the endometrium may be an important tool for predicting the likelihood of successful implantation and pregnancy outcome. Since its introduction into the clinic, ultrasound has been used widely to assess uterine features such as endometrial thickness; endometrial pattern and that may be predictive of pregnancy, especially in the context of assisted reproductive technology [3].

Patients with polycystic ovarian syndrome (PCOS), commonly present with irregular ovulation and menstruation, elevated testosterone levels, which can lead to an overabundance of body hair, and multiple small cysts within the ovaries. Women with PCOS are generally successful at achieving pregnancy, either naturally or through assisted reproduction such as ovulation induction and in vitro fertilization (IVF). Women with PCOS tend to have an increased number of eggs preparing to be released from the ovary, as well as increased levels of anti-Müllerian hormone, which is produced by growing eggs and is thought to reflect ovarian reserve, or the number of eggs a woman has remaining. Therefore, it has been hypothesized that PCOS is associated with an increase in ovarian reserve. As fertility declines after the age of 40 in all women, a larger ovarian reserve may be associated with a longer fertile period in women with PCOS [5].

In a non-PCOS population, BMI is known to affect in vitro fertilization (IVF) outcomes. Although weight reduction improves fertility in PCOS patients attempting spontaneous conception, studies of PCOS patients to date do not fully evaluate the impact of a range of BMIs on IVF outcomes. One study quantified the negative impact of morbid obesity on pregnancy outcomes in agroup of women with PCOS, although lean-only PCOS population was not included for comparison. In 2011, a study founded that obesity and PCOS were both independently associated with smaller oocyte diameter among 8 obese and 5 non obese PCOS patients, although only patients undergoing intracytoplasmic sperm injection (ICSI) were included [6].

Norway study evaluated 100 cycles from 56 PCOS patients categorized by insulin-resistance status, which did not correlate completely with BMI. Those findings showed that insulin resistance was associated with a lower oocyte count and increased follicle stimulating hormone (FSH) requirement; however, the data analysis controlled for body weight [7].

## PATIENTS AND METHODS

### Study Design: Retrospective cohort study.

**Study Setting:** IVF unit in Maternity Hospital of Ain Shams University.

**Period of the study:** From November 2017 to April 2018.

**Population of the study:** A total of 96 women with history of PCOS and infertility enrolled in the study and divided into two groups:

- Group A (N=46): women with BMI ≥ 30 kg/m$^2$
- Group B (N=50): women with BMI < 30 kg/m$^2$

### Inclusion criteria for both groups were as follows:

Cases of PCO syndrome according to Rotterdam criteria:

PCOS could be diagnosed, after the exclusion of related disorders, by two of the following three features:

**a)** Oligo- or anovulation,

**b)** Clinical and/or biochemical signs of hyperandrogenism, or

**c)** Polycystic ovaries by ultrasound features.

Normal Male Spermiogram.

### Exclusion criteria for both groups were as follows:

**(1)** Women who had primary infertility (previous pregnancy or ICSI Failure).

**(2)** Female age < 20 and > 35 years.

**(3)** Using any oral contraceptive pills.

**(4)** Using oral hypoglycaemic drug.

**(5)** Any uterine abnormality.

### Ethical consideration:

A written informed consent was obtained from all participants prior to screening and enrolment. Participants participated voluntarily in the research and their confidentiality was respected. Benefits from participation in the research were explained to all participants. Participation in the research caused no harm to participants after approval of research ethical committee.

### Procedural steps:

1. Explanation of procedure to all women participating in the study.
2. Informed written consent from every women participating in this study.
3. Patients included in the study were subjected to the following.

### History taking including:

### Personal history:

- Name, age and, married for…., previous marriage, any children, parity, type of infertility whether primary or secondary, Husband history.
- Occupation.
- Special habits of medical importance.
- Previous marriage: any children.

Complaint: Failure of conception.

### Present history:

- History suggestive of ovarian factor (irregular cycle-hirsutism- galactorrea- change in body weight).
- History of virilisation (irregular cycle- facial hair-deepening of voice).

- History suggestive of PID (lower abdominal and pelvic pain- heavy vaginal discharge- pain or bleeding during intercourse).
- History suggestive of thyroid abnormality (Abnormal menstrual periods numbness or tingling in hands- appetite change- insomnia).

## Menstrual history:

- Menarche age.
- Rhythm (regular, irregular).
- Menstrual cycle (average- polymenorrhea – oligomenorrea).
- Intermenstrual (pain – bleed – discharge).
- Dysmenorrhea (No – congestive- spasmodic).
- First day of LMP.

## Obstetric history: Irrelevant.

6-Contraceptive history: What method- duration- complication.

Sexual history: Frequency- dysparunia.

Past history:

- Medical disorders (DM- HTN…).
- Previous operations.
- Medications.
- Allergy.

## Clinical examination including:

General exam: include, blood pressure- pulse- temperature, height, and weight to calculate BMI=body weight (kg)/height ($m^2$).

Breast examination: For any discharge, mas, and change in colour of skin.

## Pelvic examation:

- Inspection of the vulva, perineum.
- Vaginal examination of bleeding or discharge if any (amount, color, odour), vaginal walls, fornices, and cervical mobility and os direction.
- MOCK test for assessment of cervical canalby pass catheter through the cervix till internal os to asses for easy embryo transfer if difficult MOCK refers to do hysteroscopy assessment.
- Bimanual examination for size, mobility, and direction of the uterus- adenxa.
- Speculum for inspection of the vaginal walls, fornices and cervix for detection of any adnexalmass or any pelvic pathology.

## Infertility evaluation including:

- Male partner:
- Semen analysis of the husband.

## Female partner:

- Hysterosalpingogram (HSG) or laparoscopy of the patients.
- Hormonal profile: basal serum (FSH, LH, TSH, basal estradiol).

## Baseline transvaginal ultrasound which include:

- Uterus (position, size ….x….x….mm- myometrum- cervix).
- Rt ovary (size ….x….x…mm- site-follicles- any pathology).
- Left ovary (size ….x….x…mm- site-follicles- any pathology).
- Douglas pouch.

## Induction of ovulation:

- On day 3 of spontaneous cycles, all patients had basal hormonal profile (FSH, LH, E2, TSH and prolactin).
- Transvaginal (TV) ultrasound (U/S) on day 3 of non-stimulated cycles was done by transvaginal probe of 5-9 MHZ. Any patient found to have uterine abnormalities was excluded.
- Controlled ovarian hyper stimulation protocol was held according to a long GnRH agonist protocol starting from 21th day of cycle midluteal phase by daily subcutaneous injection of triptoreline acetate (Decapeptyl 0.05 mg, Ferring Pharmaceutical, and Kid, Germany). On day 2 of next cycle patint did serum E2 level if E2 <50 pg/ml or decapeptyl was taken for 12-14 days for comple down regulation. Then on day 3 of cycle ovarian hyper stimulation was started by daily injection of HMG (Menogon 75 lU/amp "FerringPharmceutical, Kid, Germany "or Merional 75 IU/amp" IBSA, Switzerland").

The starting dose of gonadotropines was prescribed according to:

**(1)** Age.

**(2)** BMI.

**(3)** AFC.

**(4)** Hormonal profile.

**(5)** Previous response to induction.

Then the dose was adjusted according to the ovarian response that was assessed by transvaginal folliculometry which was done on day six stimulation for ovarian response and endometrial pattern and thickness.

According to the ovarian response, every other day TV U/S was performed and at the moment when the leading follicle reaches 14mm, daily TV U/S was performed till the largest follicle reached a diameter of >18mm.

HCG (Choriomon 10,000 lU/amp. "IBSA, Switzerland") was administered for triggering ovulation when at least 3 follicles ≥18mm in diameter.

The endometrium pattern was classified as:

1. Proliferative when echogenicity is hypoechoic in relation to the myometrium.
2. Peri-ovulatory when it is trilaminar.
3. Secretory when it is hyperechoic.

### Ovum pick up:

- 34-36 hours after HCG injection, the transducer was connected to the ultrasound system. The direction of the guide beam was checked. The puncturing needle was connected to an aspiration apparatus attached by a fixation ring to the front and rear ends of the vaginal transducer, there by defining the direction of puncture corresponding to the guide beam on the ultrasound image.
- The aspiration was checked using test tubes. The uterus, both ovaries and iliac vessels were identified by the visualization in both planes. The distance between the upper pole of the vagina and the ovary was closely evaluated (care was taken to avoid intestinal or vascular interposition).
- Depth localization of the closest accessible follicle (distance from the upper vaginal pole to the center of the follicle) was done. Needle was pushed forcefully to the center of the follicle (Aspiration pressure 90-100mmHg).

**IVF- ICSI:** Intracytoplasmic sperm injection was performed on metaphase II oocytes using the direct penetration technique, fertilization results were assessed 16 to 19 hours after ICSI. Fertilization was considered normal by the presence of two pronuclei and or 2$^{nd}$ polar body. Oocyte degeneration was identified by collapse of cytoplasmic contents and separation from the zona. Failed fertilization was defined by the absence of the pronuclei.

### Embryo transfer:

- Embryo transfer was done on day 3 or day 5 using cook or labotect soft catheter under ultrasound guide at a distance about 1-1.5 cm from the fundus by the same gynecologist.
- Number of maximum embryos transferred 3 embryos on day 3 and maximum 2 embryos on day 5.

### Luteal phase support and assessment of pregnancy:

This may involve oral, vaginal or intramuscular progesterone,and assessment of pregnancy byserum βhCG was performed after 12 days on day 3 embryo transfer and after 9 days on day 5embryo transfer followed by transvaginal US 4 weeks after pregnancy test for clinical pregnancy assessment either by fetal echo or pulsation of heart.

## STATISTICAL METHODS

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 18.0, IBM Corp, Chicago, USA, 2009.

Descriptive statistics were done for quantitative data as minimum& maximum of the range as well as mean ± SD (standard deviation) for quantitative normally distributed data, while it was done for qualitative data as number and percentage.

Inferential analyses were done for quantitative variables using Shapiro-Wilk test for normality testing, independent t-test in cases of two independent groups with normally distributed data. In qualitative data, inferential analyses for independent variables were done using Chi square test for differences between proportions and Fisher's exact test for variables with small expected numbers. The level of significance was taken at P value < 0.050 is significant, otherwise is non-significant.

## RESULTS

**Tab. 1.** shows that: Obese group had significantly higher infertility duration than non-obese group. **Tab. 2.** shows that: No significant difference between the studied groups regarding AFC and hormone profile. **Tab. 3.** shows that: Obese group had significantly higher gonadotropin ampoules than non-obese group. **Tab. 4.** shows that: No significant difference between the studied groups regarding collecting oocytes, Oocytes collected number and Metaphase-II number. **Tab. 5.** shows that: No significant difference between the studied groups regarding fertilization and cleavage Rates. **Tab. 6.** shows that: Obese group had non-significantly thinner endometrial thickness than non-obese group. **Tab. 7.** shows that: Obese group had non-significantly lower high-grade embryos than non-obese group. **Tab. 8.** shows that: Obese group had non-significantly lower chemical& clinical pregnancy and implantation Rate than non-obese group.

## DISCUSSION

The effect of BMI and insulin resistane (insulin resistane) on IVF success in women with PCOS is controversial. Despite the large number of studies said BMI did not effect on IVF outcomes in women with PCOS.

The current study was a Retrospective cohort study to correlate between body mass index and gonadotrophin secretions in PCOS patients and their effect on clinical pregnancy in ICSI cycles.

**Tab. 1.** Demographic characteristics among the studied groups.

| Variables | Measures | Obese (N=46) | Non-obese (N=50) | ^P |
|---|---|---|---|---|
| Age (years) | Mean ± SD | 29.8 ± 4.1 | 28.2 ± 4.5 | 0.059 |
| | Range | 22.0–37.0 | 19.0–39.0 | |
| Infertility duration (years) | Mean ± SD | 9.0 ± 4.1 | 6.7 ± 3.4 | **0.004*** |
| | Range | 2.0–18.0 | 1.0–18.0 | |
| SBP (mmHg) | Mean ± SD | 113.7 ± 10.0 | 116.4 ± 9.0 | 0.167 |
| | Range | 100.0–130.0 | 100.0–130.0 | |
| DBP (mmHg) | Mean ± SD | 78.7 ± 4.5 | 79.2 ± 5.3 | 0.618 |
| | Range | 70.0–90.0 | 70.0–90.0 | |
| ^Independent t-test, *Significant | | | | |

**Tab. 2.** AFC and basal hormone profile among the studied groups.

| Variables | Measures | Obese (N=46) | Non-obese (N=50) | P |
|---|---|---|---|---|
| AFC | Mean ± SD | 21.4 ± 7.7 | 21.8 ± 7.3 | ^0.803 |
| | Range | 6.0–50.0 | 8.0–40.0 | |
| TSH (mIU/L) | Mean ± SD | 2.3 ± 1.2 | 2.4 ± 1.6 | ^0.722 |
| | Range | 0.6–5.1 | 0.6–9.0 | |
| E2 (pg/mL) | Mean ± SD | 44.0 ± 17.0 | 54.5 ± 63.1 | ^0.277 |
| | Range | 6.0–94.2 | 11.6–473.0 | |
| FSH (mIU/L) | Mean ± SD | 5.8 ± 1.6 | 6.4 ± 1.5 | ^0.088 |
| | Range | 3.0–11.0 | 3.7–9.4 | |
| LH (mIU/L) | Mean ± SD | 7.6 ± 3.8 | 7.9 ± 3.7 | ^0.685 |
| | Range | 3.0–22.9 | 1.3–21.0 | |
| ^Independent t-test, #Chi square test | | | | |

**Tab. 3.** Gonadotropin duration (days) and gonadotropin ampoules among the studied groups.

| Variables | Measures | Obese (N=46) | Non-obese (N=50) | P |
|---|---|---|---|---|
| Gonadotropin duration (days) | Mean ± SD | 13.3 ± 3.0 | 12.8 ± 2.3 | ^0.315 |
| | Range | 8.0–20.0 | 9.0–19.0 | |
| Gonadotropin ampoules | Mean ± SD | 33.5 ± 17.1 | 26.5 ± 6.6 | ^0.012* |
| | Range | 18.0–109.0 | 17.0–49.0 | |
| ^Independent t-test, #Chi square test | | | | |

**Tab. 4.** Collecting oocytes among the studied groups.

| Variables | Measures | Obese (N=46) | Non-obese (N=50) | P |
|---|---|---|---|---|
| Collecting oocytes | Collected | 42 (91.3%) | 44 (88.0%) | §0.743 |
| | Failed | 4 (8.7%) | 6 (12.0%) | |
| Abnormal ovarian response | Poor response | 2 (50.0%) | 2 (33.3%) | §1.000 |
| | OHSS | 2 (50.0%) | 4 (66.7%) | |
| Oocytes collected number | Mean ± SD | 8.0 ± 5.5 | 8.1 ± 4.2 | ^0.897 |
| | Range | 1.0–24.0 | 1.0–20.0 | |
| Metaphase-II number | Mean ± SD | 7.1 ± 5.0 | 7.3 ± 3.9 | ^0.856 |
| | Range | 0.0–21.0 | 1.0–18.0 | |
| ^Independent t-test, §Fisher's Exact test | | | | |

The study was divided into two groups, one of them 46 women with BMI ≥ 30 kg/m$^2$ and the other 50 women with BMI < 30 kg/m$^2$.

In the current study there is no significant difference in demographic characteristics (age, systolic blood pressure and diastolic blood pressure).

Same results were obtained by Huang K, et al. [8] which did a study in China to determine effect of overweight/obesity on IVF-ET outcomes in chinese patients with polycystic ovary syndrome. The purpose of this study was to investigate the impact of body mass index (BMI) on the outcomes of IVF/ICSI treatment cycles in Chinese patients with polycystic ovary syndrome (PCOS). Women with PCOS (n=128) and tubal factor (n=128) underwent a conventional long GnRH agonist suppressive protocol. Women with PCOS had significantly more oocytes retrieved (P < 0.05) and available embryos (P < 0.05), as compared to patients with tubal infertility. No significant differences were observed in clinical pregnancy rate, miscarriage rate and live birth rate between two groups. Patients were further divided into two subgroups. In total, 49 patients in PCOS group and 19 patients in tubal factor group were overweight or obese (BMI ≥ 24 kg/m$^2$). Lean women (BMI < 24 kg/m$^2$) with PCOS showed higher clinical pregnancy rate (P < 0.05).

Live birth rate and miscarriage rate were also higher in lean PCOS women, but the differences were not significant. Similar clinical outcomes of IVF/ICSI success were achieved between two subgroups in tubal factor patients. In conclusion, lean PCOS patients obtained higher clinical

**Tab. 5.** Fertilization and cleavage rates among the studied groups.

| Variables | Measures | Obese (N=46) | Non-obese (N=50) | P |
|---|---|---|---|---|
| **Fertilization** | | | | |
| **Fertilization Rate** | | 42 (91.3%) | 44 (88.0%) | §0.743 |
| **Fertilized number** | **Mean ± SD** | 5.7 ± 4.2 | 5.6 ± 3.0 | ^0.872 |
| | **Range** | 1.0–18.0 | 1.0–16.0 | |
| **Cleavage** | | | | |
| **Cleavage Rate** | | 40 (87.0%) | 42 (84.0%) | #0.682 |
| **Cleavage number** | **Mean ± SD** | 5.6 ± 4.2 | 5.5 ± 3.0 | ^0.877 |
| | **Range** | 1.0–18.0 | 1.0–16.0 | |
| ^ Independent t-test, #Chi square test, §Fisher's Exact test | | | | |

**Tab. 6.** Endometrial thickness (mm) among the studied groups.

| Variables | Measures | Obese | Non-obese | ^P |
|---|---|---|---|---|
| **At HCG day** | N | 42 | 46 | 0.321 |
| | Mean ± SD | 9.8 ± 1.7 | 10.2 ± 1.7 | |
| | Range | 5.0–15.0 | 7.0–16.0 | |
| **At embryo transfer** | N | 40 | 42 | 0.377 |
| | Mean ± SD | 10.9 ± 1.4 | 11.3 ± 2.4 | |
| | Range | 7.0–15.0 | 7.0–18.0 | |
| ^ Independent t-test | | | | |

**Tab. 7.** Embryo transfer among the studied groups.

| Variables | Measures | Obese (N=46) | Non-obese (N=50) | P |
|---|---|---|---|---|
| **Transfer** | | 40 (87.0%) | 42 (84.0%) | #0.682 |
| **Transferred number** | **Mean ± SD** | 2.3 ± 0.7 | 2.7 ± 0.7 | ^0.334 |
| | **Range** | 1.0–3.0 | 1.0–3.0 | |
| **Total transferred number** | | 90 | 101 | |
| **Grade** | **Grade I-II** | 84 (93.3%) | 100 (99.0%) | §0.053 |
| | **Grade III** | 6 (6.7%) | 1 (1.0%) | |
| ^ Independent t-test, #Chi square test, §Fisher's Exact test | | | | |

**Tab. 8.** Pregnancy outcomes per embryos transferred among the studied groups.

| Variables | | Obese (N=42) | Non-obese (N=46) | P |
|---|---|---|---|---|
| **Chemical pregnancy** | | 18 (42.9%) | 20 (43.5%) | #0.953 |
| **Clinical pregnancy** | | 14 (33.3%) | 17 (37.0%) | #0.722 |
| **Fetal number** | **None** | 28 (66.7%) | 29 (63.0%) | §0.964 |
| | **Single** | 12 (28.6%) | 14 (30.4%) | |
| | **Twin** | 2 (4.8%) | 2 (4.3%) | |
| | **Triplet** | 0 (0.0%) | 1 (2.2%) | |
| **Total fetuses number** | | 16 | 21 | |
| **Implantation Rate** | | 16 (17.8%) | 21 (20.8%) | #0.599 |
| #Chi square test, §Fisher's Exact test | | | | |

pregnancy rate compared with overweight/obese PCOS patients in Chinese population.

On day two of the cycle we did basal hormone profile and ultrasound to detect AFC, the current study showed there is no significant difference between groups according to AFC (P ≥ 0.803) and basal hormone profile TSH ( P ≥ 0.722), E2 (P ≥ 0.277), FSH (P ≥ 0.088), LH (P ≥ 0.685).

Same results were obtained by Cakiroglu et al., [9] which did a study to examine effects of body mass index (BMI) and insulin resistance (IR) on the in vitro fertilization (IVF) outcomes in women with polycystic ovary syndrome. The basal hormonal evaluations, such as follicle-stimulating hormone (FSH), luteinizing hormone (LH), LH/FSH, estradiol, testosterone, DHEAS, AMH, and antral follicle counts, were similar between the groups of BMI and IR.

Same results were contrary to Hashemi AH [10] which did a study to compare between the levels of some hormones as LH, FSH, TSH, and estradiol hormones between Iranian infertile women with polycystic ovary syndrome and healthy women and there were a significant difference between the two groups.

Same results were obtained by Mittal SK, et al. [11] which did a study to evaluate anthropometric measurements and its relation with gonadotropin secretion in PCOS women and there were no significant difference between the two studied groups in FSH and LH as in our study but there were a significant difference in their ratio FSH/LH ratio.

Same results were contrary to Bailey AP, et al. [12] which did a study to determine effects of obesity on IVF in PCOS patients and there was a significant difference between the two groups in hormones.

In induction of ovulation the current study showed obese group had significantly higher gonadotropin

ampoules (33.5%) than non-obese group (26.5%) (P ≥ 0.012) but no significant difference between groups according to gonadotropin duration (P ≥ 0.315).

Same results go hand in hand with Ozgun MT, et al. [13] which did a study in Turkey to determine the influence of obesity on ICSI outcomes in women with polycystic ovary syndrome. The objective of the study was to compare intracytoplasmic sperm injection (ICSI) outcome and gonadotropin doses between obese women with PCOS and non-obese patients with PCOS. This follow-up study represents ICSI outcomes in obese women with PCOS (BMI ≥ 30 kg/m$^2$) compared with non-obese women with PCOS (BMI < 30 kg/m$^2$). Obese (n=18) and non-obese (n=26) women with PCOS underwent long protocol pituitary suppression, ovarian stimulation and ICSI with fresh embryo transfer. Obese patients with PCOS required higher doses of gonadotropin (2994 IU *vs* 1719 IU; p < 0.001). Miscarriage rate was significantly higher in obese women compared with the non-obese women with PCOS (60% *vs* 6.7%, p= 0.002). The results were valuable for counselling couples before initiation of assisted reproduction techniques.

Same results were obtained by Matalliotakis I, et al. [14] which did a study about empirical evidence linking PCOS and BMI to process and outcome measures of fertility treatment success is limited. In this retrospective study 140 women with a BMI ≤ 24 kg/m$^2$ undergoing 291 cycles were compared on various IVF/ICSI outcomes with 138 women with a BMI > 24 kg/m$^2$ undergoing 291 cycles Patients with a BMI > 24 kg/m$^2$ demonstrated a decrease in the number of follicles after stimulation, an increase in total dose of gonadotrophin used and a lower number of eggs collected. However, BMI did not affect clinical pregnancy, miscarriage or delivery.

In the current study there is no significant difference between the studied groups regarding collecting oocytes (p=0.743), oocytes collected number (p=0.897) and Metaphase-II number (p=0.856).

Same results goes hand in hand with Marquard KL, et al. [6] which investigated the inversely affect oocyte size, oocyte and embryo quality in PCOS women. This may be associated with the alteration of follicle androgen profiles, insulin resistance and elevated leptin levels. The study reported similar number of retrievable oocytes between all groups.

Same results were contrary to McCormick B, et al. [15] which previously conducted a study comparing obese and lean women with PCOS with obese and lean women without PCOS. The results of this study showed a higher number of retrievable oocytes among lean women with PCOS than among obese women with PCOS. However, the study also reported similar rates of clinical pregnancy and live birth between all groups. It is important to note that this study had a very small and limited sample size, with only six lean patients with PCOS included.

In the current study obese group had non-significantly thinner endometrial thickness than non-obese group, no significant difference between groups regarding fertilization (p=0.743) and cleavage rate (p=0.682). Obese group had non-significantly lower high-grade embryos (93.3%) than non-obese group (99%).

Same results were obtained by Cakiroglu Y, et al. [9] which said the number of retrieved oocytes, MII oocytes, embryo counts, and fertilization and pregnancy rates were similar between lean and overweight/obese PCOS with and without IR. Even though pregnancy and delivery rates per started cycle and embryo transfer were higher in healthy-weight women with PCOS than in overweight/obese patients, it did not reach statistical significance. Reproductive outcomes in women with PCOS according to BMI and IR were similar. Neither BMI nor IR had an independent effect on ovarian response and IVF success in young women with PCOS.

Same results were contrary to Shah DK, et al. [16] which did a study about effect of obesity on oocyte and embryo quality in women undergoing in vitro fertilization to estimate the effect of body mass index (BMI) on oocyte and embryo parameters and cycle outcomes in women undergoing in vitro fertilization. Compared with women of normal BMI, women with class II (BMI 35-39.9) and III (BMI 40 or higher) obesity had fewer normally fertilized oocytes (9.3 compared with 7.6 and 7.7, P < .03) and lower estradiol levels (2,047 pg/mL compared with 1,498 and 1,361, P < .001) adjusting for age and despite similar numbers of mature oocytes. Odds of clinical pregnancy (odds ratio [OR] 0.50, 95% confidence interval [CI] 0.31-0.82) and live birth (OR 0.51, 95% CI 0.29-0.87) were 50% lower in women with class III obesity as compared with women of normal BMI. Obesity was associated with fewer normally fertilized oocytes, lower estradiol levels, and lower pregnancy and live birth rates. Infertile women requiring IVF should be encouraged to maintain a normal weight during treatment.

In the current study obese group had non-significantly lower chemical& clinical pregnancy and implantation Rate (33.3%) than non-obese group (37%).

Same results were obtained by a retrospective study did by Gorelick AN, et al. [17] which investigated 5208 IVF cycles with different diagnoses, included 439 cycles in PCOS patients and demonstrated that obesity did not have any effect on IVF outcomes in other groups.

Same results were contrary to Qiao J and Feng HL [18] which did a study which specifically compared BMI and clinical pregnancy rates in PCOS patients, and in a similar manner to the data of the present study, showed a reduction in the clinical pregnancy rates in obese PCOS patients compared with thin PCOS patients.

Same results were obtained by Dechaud H, et al. [19] which suggested that gonadotropin resistance and a difference in lean and obese women with PCOS with regard to resorption or metabolism of subcutaneous injected FSH in women with PCOS, studied IVF outcomes of 789 cycles

with respect to BMI. They have stated that obesity does not negatively affect IVF outcomes; however, higher total r-FSH doses are needed in overweight and obese patients. However, no clinical outcome differences were observed.

Same results were obtained by Fedorcsák P, et al. [7] which examined the impact of obesity and insulin resistance on the outcome of IVF/ICSI in women with PCOS. Insulin-resistant (n=26) and non-insulin-resistant (n=30) patients had similar number of oocytes collected and pregnancy rates. Obesity, independent of hyperinsulinaemia, was found to be related to a lower oocyte count and an increased gonadotropin requirement.

In the current study obese group had non-significantly lower ovarian hyperstimulation syndrome (50%) than non-obese group (66.7%) for limited sample size.

Same results were contrary to Enskog A, et al. [20] which did a study to determine hyperstimulation syndrome as a complication of IVF in PCOS patients, there was a significant difference and there was a strong relation between IVF and OHSS in PCOS patients.

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