Effect of women's Obesity on the outcome of In Vitro Fertilization (Comparative study)

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Abstract

Background: Obesity is a major problem of public health, intervenes at different levels on the reproductive function such as: increase conception time and decreased fecundity.

Aim of the Work: to assess the impact of women's obesity on the outcome of ICSI and embryo transfer by measuring the number of clinical pregnancies in groups of patients with different BMI, also by measuring total FSH dose required for follicular stimulation, The duration required for stimulation, Serum estradiol level on the day of hCG administration, number of oocytes collected, number of normally fertilized oocytes, fertilization rate, positive serum β-hCG rate, ongoing pregnancy rate.

Patients and Methods: Retrospective comparative cohort study, conducted in IVF unit in maternity hospital of Ain Shams university, from January 2016 to December 2021, all the patients underwent ICSI and embryo transfer in the given period their record will be revised and included regardless sample size. With at least 132 patients will be enrolled divided into 3 groups: normal weight patients with BMI from 18.5kg/m2 to 24.9 kg/m2, overweight patients with BMI from 25kg/m2 to 29.9 kg/m2, and obese patients with BMI ≥ 30kg/m^2.

Results: The starting dose of FSH showed no significant differences (p=0.240), and likewise, the total dose exhibited no significant variations (p=0.370). However, certain trends emerged. Group C had a slightly longer duration of stimulation (p=0.091), potentially indicating a more robust approach, notably, the number of oocytes collected significantly differed among the groups (p=0.019*), with Group A having the highest mean count (13.17±8.28), followed by Group B (11.05±6.78), and then Group C (9.48±6.37). This disparity might imply differences in ovarian response or treatment effectiveness. The number of oocytes fertilized did not significantly differ (p=0.630).

Conclusions: The comprehensive analysis of demographic and fertility-related parameters across three distinct groups (Group A, Group B, and Group C) undergoing in vitro fertilization (IVF) treatment reveals that there are statistically significant differences in the ovarian response

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to the stimulation in the form of the duration and the number of oocytes retrieval, while in the in most of the measured variables there is no statistically significant difference. These include age, parity, infertility status, hormone levels, antral follicle counts, type and dosage of follicle-stimulating hormone (FSH), and numerous IVF outcome measures such as the number of good quality embryos, embryos obtained, fresh transferred embryos, biochemical and clinical pregnancy test results, and live birth outcomes. These findings suggest that, on average, the studied groups exhibit comparable demographic characteristics, ovarian function, and IVF treatment outcomes, highlighting the consistency in various aspects of IVF protocols and reproductive outcomes among these groups.

Keywords: Women's Obesity, Vitro Fertilization.

INTRODUCTION

Obesity is a major problem of public health, intervenes at different levels on the reproductive function such as: increase conception time and decreased fecundity. The number of obese women in demand of ART is unknown **(Brunet et al., 2020)**.

According to the National Institute for Health and Care Excellence (NICE) guidance on fertility problems, women should be informed that body mass index (BMI) has to be in the range of 19–30 kg/m2 before starting assisted reproduction. Higher BMI is likely to reduce ART procedures success. A BMI more than 35 kg/m2 is likely to be considered as a contraindication to ART, and many centers around the world are prohibit access to ART program for obese women, in particular IVF **(Brunet et al.,2020)**

Studies on the potential effects of the increased BMI on fertility treatment outcomes have shown conflicting results. Surprisingly, multiple studies and two systematic reviews reported insignificant adverse effects of elevated BMI on IVF outcomes **(Kudesia et al., 2018)**.

Other studies, however, including a systematic-analysis have associated elevated BMI with higher gonadotropin requirement, fewer oocytes collected, higher cancellation rates, reduced pregnancy and live birth rates, as well as higher miscarriage rates **(Sarais et al., 2016)**.

Given the limited access of obese women to IVF, few studies included women with a BMI greater than 35 kg/m2. Most studies considered only fresh embryo transfer (Provost et al., 2016; Kawwass et al., 2016) or only the first stimulation attempt (Ding et al., 2019). Thus, the impact of obesity on IVF outcomes remains unclear, especially the grade of obesity, and studies taking into account both the entire embryonic cohort (fresh and frozen or vitrified embryos) and all stimulation attempts are lacking **(Brunet et al.,2020)**.

AS it is common for overweight and obese women to seek fertility treatment, such as IVF. Many studies have found that the excess in the maternal adipose tissue is linked to a number of important adverse outcomes in spontaneous pregnancies (Liu et al., 2020).

After ART, pregnant women have a higher risk to experience pregnancy-related complications (i.e., high blood pressure, gestational diabetes, placenta previa, placental abruption, postpartum hemorrhage, hydramnios, small for gestational age (SGA), premature birth, and cesarean) compared with those who conceive naturally **(Luke, 2017 ;Szymusik et al., 2019)**.

In an analysis of nearly 500,000 cycles reported to the Society for Assisted Reproductive Technologies (SART), both obese and underweight women had lower rates of clinical pregnancy and live birth after fresh autologous transfers (adjusted RR 0.97 and 0.95 for underweight, 0.94 and 0.87 for obese women, respectively), as well as higher rates of low birth weight and premature deliveries. Meanwhile, in the study, only obese women had a higher miscarriage rate **(Kawwass et al., 2016)**.

Some studies have tried to identify the mechanisms by which excess weight might affect IVF outcomes by exploring associations with oocyte quality, embryo quality, or uterine function. For example, preliminary data has associated maternal obesity with decreased oocyte size or deformities in meiotic spindle formation **(Kudesia et al., 2018)**.

Given these results and the higher spontaneous miscarriage rates that have been observed in obese women, some researchers have speculated that increased meiotic errors might underlie these pregnancy losses. However, higher miscarriage rates were also observed in one study of women who had pre-implantation screened embryos transferred after IVF **(Tremellen et al., 2016)**.

It has long been hypothesized that environments of excessive adipose tissues may negatively impact implantation. Ovum donation cycles considered as a way to study the possible impact of obesity on implantation in a more well-controlled way **(Kudesia et al., 2018)**.

AIM OF THE WORK

The aim of this study is to assess the impact of women's obesity on the outcome of ICSI and embryo transfer by measuring the number of clinical pregnancies in groups of patients with different BMI.

Also by measuring total FSH dose required for follicular stimulation, The duration required for stimulation, Serum estradiol level on the day of hCG administration, number of oocytes collected, number of normally fertilized oocytes, fertilization rate, positive serum β-hCG rate, ongoing pregnancy rate.

PATIENTS AND METHODS

Study Design: Retrospective comparative cohort study

Study setting: IVF unit in maternity hospital of Ain Shams university

Period of study: From January 2016 to December 2021

Population of the study: All the patients underwent ICSI and embryo transfer in the given period their record will be revised and included regardless sample size. With at least 132 patients will be enrolled divided into 3 groups: normal weight patients with BMI from 18.5kg/m2 to 24.9 kg/m2, overweight patients with BMI from 25kg/m2 to 29.9 kg/m2, and obese patients with BMI ≥ 30kg/m2.

Inclusion Criteria: Patients age between 18 years old to 35 years old, and patients with BMI ≥ 18.5 kg/m^2.

Women will be divided into 3 groups according to the World Health Organization (WHO) classification cut-points: (Brunet et al., 2020) Normal-weight (18.5–24.9 kg/m^2), Overweight (25–29.9 kg/m^2), and obesity (≥ 30 kg/m) and all participants underwent induction of ovulation using long gonadotropin agonist protocol.

Exclusion Criteria: Whose BMI wasn't recorded in their files (Because of the lack of the information), those undergoing IVF for pre-implantation genetic diagnosis, (To minimize the factors that may affect the result), and those for who cycles were cancelled before oocyte pickup, (Because of not completing the IVF process).

Ethical Consideration: the study will be approved by research ethical committee of the faculty of medicine of Ain Shams University. The data will be anonymously analyzed so the confidentiality of the patients will be preserved.

Study procedure: collecting data from records of the patients who underwent induction of ovulation using long gonadotropin agonist protocol:

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, and 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 virilization (irregular cycle- facial hair-deepening of voice), history suggestive of PID (lower abdominal and pelvic pain-heavy vaginal discharge- pain or bleeding during intercourse), and 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), and first day of LMP.

Obstetric history: Data of all previous pregnancies (including miscamiages and terminations), Length of gestation, date and place of delivery, onset of labor (including details of induction of labor), mode of delivery, sex and birth weight, fetal and neonatal lie, and clear details of complications or adverse outcomes (Shoulder dystocia. post-partum hemorrhage, stillbirth)

Contraceptive history: What method-duration- complication.

Sexual history: Frequency- dyspareunia.

Past history: Medical disorders (DM-HTN.), previous operations, allergy, and medications.

Clinical examination including: General exam: include, blood, temperature, height, and weight to calculate BMI body, pressure-pulse-weight (kg) /height (m2), Breast examination: for any discharge, mas, and change in color of skin, Pelvic exemption: Inspection of the vulva, perineum, vaginal examination of bleeding or discharge if any (amount, color, odor), vaginal walls, fornices, and cervical mobility and os direction, MOCK test for assessment of cervical canal by pass catheter through the cervix till internal os to asses for easy embryo transfer if difficult MOCK refer to do hysteroscopy assessment, Bimanual examination for size, mobility, and direction of the uterus- adnexa, Speculum for inspection of the vaginal walls, and fornices and cervix for detection of any adnexal mass 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), and baseline transvaginal ultrasound which include; Uterus (position, size .....X…..X...mm- myometrium-cervix), RT ovary (size ....x....x...mm- site-follicles-any pathology), left ovary (size ....x....x... mm- site-follicles-any pathology), and douglas pouch

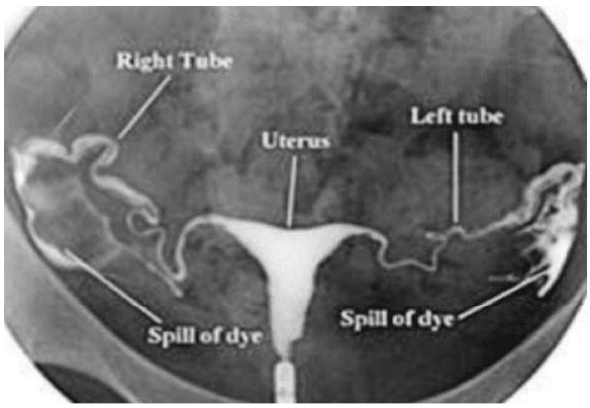

Figure 1: Normal Hysterosalpingogram **(Ain shams maternity hospital)**

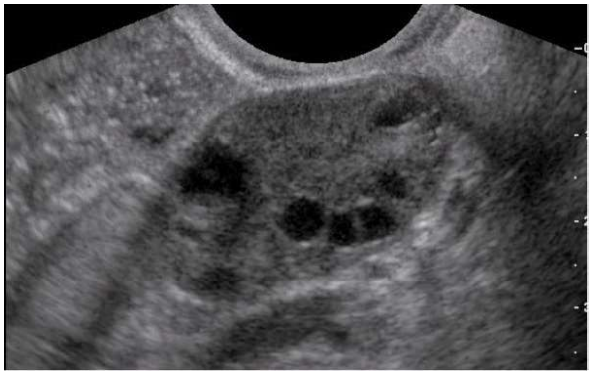

Figure 2: Normal ovarian size with multiple follicles **(Ain shams maternity hospital)**

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, and controlled ovarian hyper stimulation protocol was held according to a long GnRH agonist protocol starting from 21" day of cycle midluteal phase by daily subcutaneous injection of triptoreline acetate (Decapeptyl 0.05 mg.Ferring Pharmaceutical, Kid, Germany). On day 2 of next Cycle Patient did serum E2 level if E2≤ 50pg/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 IU/ amp "FerringPharmceutical. Kid,Germany" Merional 75 IU/ amp IBSA, Switzerland") or rFSH (Gonapure 75 IU/amp MINAPHARM, Egypt) or Urofollitropin (fostimon 75IU/ amp IBSA, Switzerland)

The Starting dose of gonadotropins was prescribed **According to:** Age, BMI, AFC, hormonal profile, and previous response to induction.

Then the dose was adjusted according the ovarian Response that was assessed 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 reaches14mm, Daily TV U/S was Performed till the largest follicle reached a Diameter Of>18mm.

HCG (Choriomon 10,000 du/n1 "IBSA, Switzerland") was administered for triggering ovulation when at least 3 Follicles >18mm diameter.

The endometrium pattern was classified as: Proliferative when echogenicity is hypo echoic in relation to the myometrium, peri-ovulatory when it is trilaminar, and secretory when it is hyper echoic.

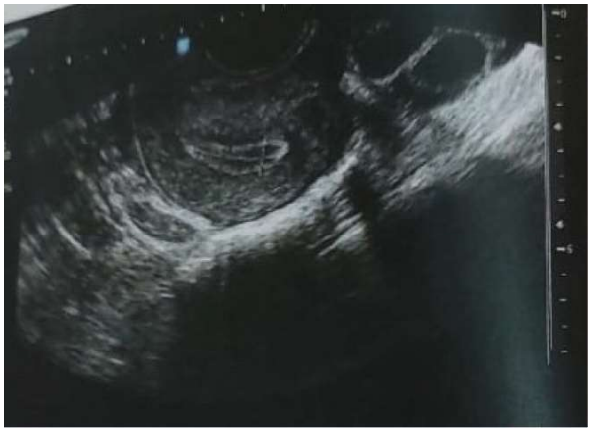

Figure 3: Monitoring of endometrial development during ovulation induction preovulatory **(Ain shams maternity hospital)**

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 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 16-19 Hours after ICSI. Fertilization was considered normal by the presence of two pronuclear and or 2nd polar body. Oocyte degeneration was identified by collapse of cytoplasmic contents and separation from the zona. Failed fertilization was defined the absence pronuclei.

Embryo transfer: Embryo transfer was done on day 3 or 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 maximum embryos transferred 3 embryos on day 3 and maximum 2 embryos on day 5.

Luteal phase support and assessment of: This may involve oral, vaginal or intramuscular progesterone, and assessment of pregnancy by serum βhCG was performed after 12 days on day 3 embryo transfer and after 9 days on day 5 embryo transfer followed

Transvaginal US 4 weeks after pregnancy test for clinical pregnancy assessment either fetal echo or pulsation of heart.

Statistical analysis: Recorded data were analyzed using the statistical package for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA). The quantitative data were presented as mean± standard deviation and ranges when their distribution was parametric (normal) while non-normally distributed variables (non-parametric data) were presented as median with inter-quartile range (IQR). Also qualitative variables were presented as number and percentages. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk Test.

The following tests were done: One way ANOVA test of significance was used when comparing between more than two means, the Comparison between groups with qualitative data was done by using Chi-square test and the confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:

Probability (P-value): P-value <0.05 was considered significant, P-value <0.01 was considered as highly significant, and P-value >0.05 was considered insignificant.

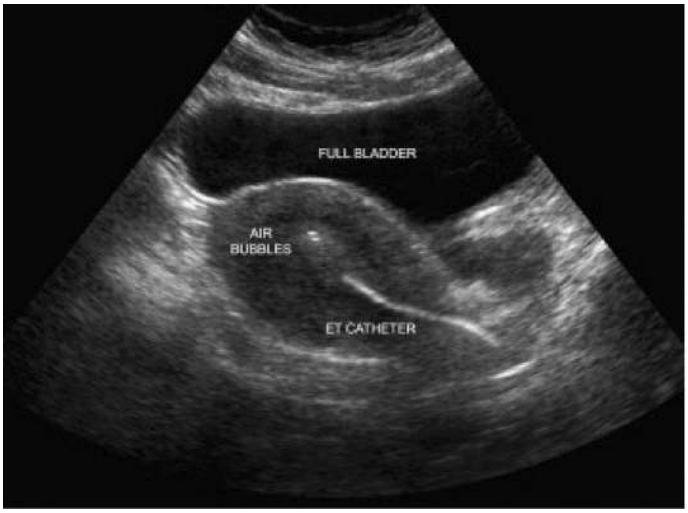

Figure 4: Embryo transfer by soft catheter

RESULTS

The aim of the study was to assess the impact of women's obesity on the outcome of ICSI and embryo transfer by measuring the number of clinical pregnancies in groups of patients with different BMI

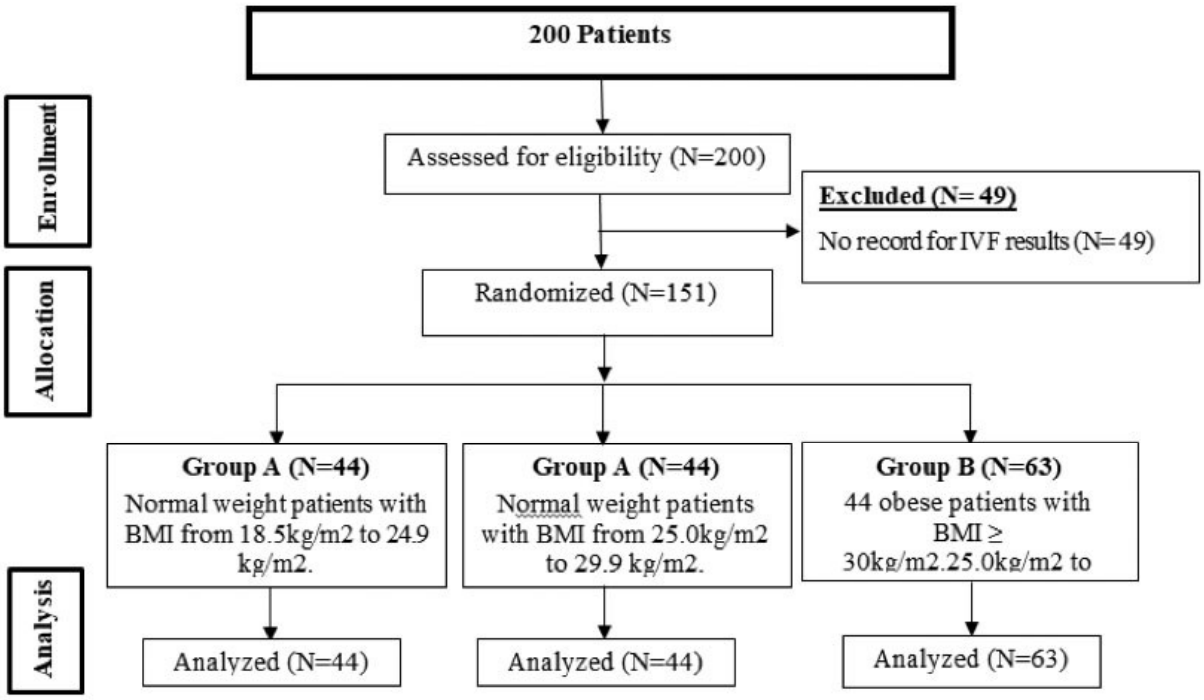

Figure (5): Study consort

Table 1: Comparison of Demographic Data in Groups (A, B, and C).

		Group A (n=44)	Group B (n=44)	Group C (n=63)
Age	**Range**	19 - 35	20 - 35	21 - 35
BMI	**Range**	**18 – 24.9**	**25 – 29.9**	**30 - 35**

Using: One way ANOVA test for Mean±SD (§); p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant.

The study compared three groups (A, B, and C), Group A and B consisting of 44 participants and Group C consisting of 63, based on age and BMI.

Table 2: Distribution of Parity and Infertility Factors among Participant Groups (A, B, and C).

		Group A (n=44)		Group B (n=44)		Group C (n=63)		Test value	P-value
		N	%	N	%	N	%		
Parity	Null Para	32	72.6%	25	56.8%	39	61.9%	0.323	0.729
	Multipara with living offspring	6	13.7%	12	27.3%	17	26.9%		
	Multipara with no living offspring	6	13.7%	7	15.9%	7	11.2%		
Infertility	NR	14	32.0%	17	38.3%	24	38.3%	0.423	0.644
	Male factors	18	40.9%	15	34.3%	21	33.4%		
	PCO	2	4.5%	2	4.5%	9	14.3%		
	Tubal factor	4	9.1%	5	11.2%	6	9.2%		
	Poor ovarian reserve	3	6.8%	2	4.5%	1	1.6%		
	Endometriosis	3	6.8%	1	2.3%	1	1.6%		
	Hypogonadotrophic	0	0%	1	2.3%	1	1.6%		
	Small uterus	0	0%	1	2.3%	0	0%		

-NR: no recorded cause for the infertility -PCO: polycystic ovarian syndrome.

Using: X2= Chi- Square test, p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant.

This table analyzed three groups (A, B, and C), with respect to parity and infertility factors. Parity distribution demonstrated no significant differences (p=0.729), where Group A had 72.6%, Group B had 56.8%, and Group C had 61.4% null gravid women. Similarly, infertility factors exhibited no significant distinctions (p=0.644).

Table 3: Comparison of Reproductive Hormone Levels and Antral Follicle Counts among Participant Groups (A, B, and C).

		Group A (n=44)	Group B (n=44)	Group C (n=63)	Test value	P-value
AMH	Mean ±SD	3.0±2.06	2.89±1.71	3.39±2.17	0.547	0.581
	Range	0.85 – 10.0	0.61 – 8.33	0.72 – 8.33		
FSH	Mean ±SD	6.33±1.78	6.74±2.30	6.98±2.49	0.745	0.477
	Range	3.7 – 11.0	0.10 – 13.60	3.70 – 11.0		
LH	Mean ±SD	6.27±2.36	5.63±2.52	5.94±2.63	0.572	0.566
	Range	3.0 – 12.80	0.10 – 13.35	0.65 – 13.70		
Antral follicular count	Mean ±SD	13.23±4.4	12.26±4.19	13.66±6.09	0.873	0.421
	Range	7.0 – 23.0	4.0 – 22.0	2.0 – 24.0		

Using: One way ANOVA test for Mean±SD (§); p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant.

This table analyzed three groups (A, B, and C) in terms of various reproductive parameters. No significant differences were found among the groups for anti-Mullerian hormone (AMH) levels (p=0.581), follicle-stimulating hormone (FSH) levels (p=0.477), luteinizing hormone (LH) levels (p=0.566), and antral follicular count (p=0.421) Despite variations in means, the lack of statistically significant differences suggests that these reproductive parameters are relatively comparable among the three groups.

Table 4: Comparison of Treatment Protocol and Oocyte Outcomes among Participant Groups (A, B, and C).

		Group A (n=44)		Group B (n=44)		Group C (n=63)		Test value	P-value
		N	%	N	%	N	%		
Type of FSH	NR	12	27.3%	14	31.8%	19	30.2%	5.369	0.497
	rFSH	18	40.9%	23	52.3%	30	47.6%		
	Human menopausal gonadotrophin	13	29.5%	5	11.4%	13	20.6%		
	Urofollitropin	1	2.3%	2	4.5%	1	1.6%		
Starting dose (amp)	Mean ±SD	2.93±0.83		3.0±0.73		3.20±0.95		1.082	0.240
	Range	2 - 5		2 - 4		2 - 6			
Total dose (amp)	Mean ±SD	36.13±15.76		41.0±13.73		42.0±16.06		1.002	0.370
	Range	12 - 68		12 - 68		18 - 80			
Duration of stimulation (days)	Mean ±SD	12.56±2.02		12.95±2.33		13.34±2.51		2.444	0.091
	Range	9 - 16		9 - 18		10 - 21			
No. oocytes collected	Mean ±SD	**13.17±8.28**		**11.05±6.78**		**9.48±6.37**		**4.120**	**0.019***
	Range	**2 - 31**		**1 - 31**		**1 - 27**			
No. oocytes fertilized	Mean ±SD	10.73±6.58		8.72±5.59		7.05±4.30		0.463	0.630
	Range	1 - 26		1 - 23		1 - 17			

Using: One way ANOVA test for Mean±SD (§), X2= Chi- Square test; p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant.

This table evaluated three groups (A, B, and C) based on the type and dosage of follicle-stimulating hormone (FSH) used during stimulation for assisted reproduction. No significant differences were observed in the type of FSH used (p=0.497), with each group having varying proportions of participants using different types. The starting dose of FSH showed no significant differences (p=0.240), and likewise, the total dose exhibited no significant variations (p=0.370).

However, certain trends emerged. Group C had a slightly longer duration of stimulation (p=0.091), potentially indicating a more robust approach.
Notably, the number of oocytes collected significantly differed among the groups (p=0.019*), with Group A having the highest mean count (13.17±8.28), followed by Group B (11.05±6.78), and then Group C (9.48±6.37). This disparity might imply differences in ovarian response or treatment effectiveness. The number of oocytes fertilized did not significantly differ (p=0.630).

Table 5: Comparison of Embryo Quality, Transfer Outcomes, and Pregnancy Measures among Participant Groups (A, B, and C).

		Group A (n=44)		Group B (n=44)		Group C (n=63)		Test value	P-value
		N	%	N	%	N	%		
No. of good quality embryo	**Mean ±SD**	3.66 ± 3.31		3.50 ± 3.35		3.25 ± 3.18		0.586	0.532
	Range	1 - 7		2 - 7		1 - 6			
No. of embryo obtained at day 2	**Mean ±SD**	5.83±4.77		5.26±4.71		4.18±3.07		1.517	0.224
	Range	1 - 19		1 - 21		1 - 13			
No. of fresh transferred embryos	**1**	6	13.7%	7	16.2%	11	17.5%	3.055	0.802
	2	18	40.9%	11	25.6%	21	33.3%		
	3	18	40.9%	23	51.2%	29	46.0%		
	4	2	4.5%	3	7.0%	2	3.2%		
Biochemical pregnancy test	**Positive**	21	47.7%	24	54.5%	37	58.7%	1.145	0.564
	Negative	23	52.3%	20	45.5%	26	41.3%		
Clinical pregnancy test	**Mean ±SD**	0.76±0.89		0.59±0.79		0.59±0.87		0.462	0.631
	Range	0 - 3		0 - 2		0 – 3			
live birth	**Mean ±SD**	0.72±0.88		0.51±0.71		0.60±0.88		0.565	0.570
	Range	0 - 3		0 - 2		0 – 3			

Using: One way ANOVA test for Mean±SD (§), X2= Chi- Square test; p-value >0.05 is insignificant; *p-value <0.05 is significant; **p-value <0.01 is highly significant.

This table analysis of three groups (A, B, and C) the outcomes of assisted reproductive procedures were assessed. The number of good quality embryos displayed no significant differences (p=0.532), with Group A having a mean of 3.66, Group B with 3.50, and Group C with 3.25. Likewise, the number of embryos obtained at day 2 showed no significant variation (p=0.224), with Group A having a mean of 5.83, Group B with 5.26, and Group C with 4.18.

When it comes to fresh transferred embryos, the distribution did not significantly differ (p=0.802), with different groups having similar percentages for 1, 2, 3, and 4 embryos transferred. Biochemical pregnancy tests yielded no significant distinctions (p=0.564), with positive results for 47.7%, 54.5%, and 58.7% of Groups A, B, and C respectively.

Clinical pregnancy tests exhibited a non-significant difference (p=0.564), the number of live births did not significantly differ (p=0.630).

DISCUSSION

Obesity is a prevalent global health concern, and its impact on various aspects of reproductive health has garnered significant attention. Among the critical areas of interest is the influence of obesity on the outcomes of in vitro fertilization (IVF). In recent years, obesity has been recognized as a complex factor that can potentially affect the success rates of IVF treatments. This introduction explores the multifaceted relationship between women's obesity and IVF outcomes, shedding light on the challenges and considerations that healthcare providers and researchers must address in the realm of fertility treatments(Tauqeer et al., 2018).

This study is a retrospective cohort study aimed to assess the impact of women's obesity on the outcome of ICSI and embryo transfer by measuring the number of clinical pregnancies in groups of patients with different BMI. All the files of the patients attended to the ART unit in the period of the study were revised with total number 2000.The patients, underwent long agonist gonadotropin ovarian stimulation , divided in to three groups as group (A) of 44 women of normal weight with BMI between 18kg/ m2 to 24.9kg/m2, group (B) with 44women of over-weight with BMI from 25kg/m2 to 29.9kg/m2 and group (C)of 63 women obese patients with BMI ≥ 30kg/m2.

The current study data presents a comparison of demographic information among the three groups labeled as Group A, Group B, and Group C. The data includes information on age and BMI (Body Mass Index) for each group.

The mean age for Group A is 27.97 years, for Group B is 29.42 years, and for Group C it is 29.17 years. Group B has the highest mean age, while Group A has the lowest .The age range for all groups' spans from 19 to 35 years to have a good response during the ovarian stimulation, suggesting that the participants in all three groups are within a similar age range.

Sneed ML et al.,(2008) in their retrospective study to show the impact of both the age and BMI on the IVF revealed that although BMI did not have a major effect on IVF outcome, but there was a significant BMI x Age interaction. Younger ages, a high BMI had a pronounced negative influence on fertility, but this effect decreased as the patient age increased. Clinical pregnancy rates decreased with increasing BMI and increasing Age. So the impacts of BMI on fertility change in relation to the Age of the patient.

In cohert study in china (Xiang Liu et al (2023)) to evaluate the influence of male / female over-weight and obesity combined .They found that combined male/female overweight/obesity groups had much lower numbers of available embryos and high-quality embryos .

In the current study a comparative analysis of demographic information among the three groups. The data includes information on two variables: parity and infertility cause, with the associated test values and p-values. Let's discuss the findings in paragraphs:

The data reveals the distribution of parity among the three groups. It is interesting to note that the majority of participants in all three groups fall into the "NG" category, which typically represents women who have not given birth. Group A has 72.6% in this category, Group B has 56.8%, and Group C has 61.9%. The differences in parity among the groups do not appear to be statistically significant, as indicated by the p-value of 0.729. This suggests that the distribution of parity is relatively similar across the groups.

In the same line Vural et al., (2015) revealed that the mean parity values among three groups.. While there are slight differences in mean parity values, these variations are not statistically significant (p=0.228). This suggests that, on average, the parity levels are relatively similar among the three groups, with no substantial differences observed.

The infertility status of the participants, categorized into various types of infertility conditions. The most common infertility type in group A appears to be the male factor with 40.9% while in group B and C was "NR" (No Reason Specified), with approximately 38.3% in Group B, and 38.3% in Group C. Other infertility types such as tubal and endometriosis are also present across the groups.

Pandey et al., (2010) revealed that the provided information categorizes infertility factors and suggests diagnostic tests and treatments. Participants' infertility status can be assessed and managed accordingly. Categories include ovulatory dysfunction, tubal occlusion, endometriosis, diminished ovarian reserve, uterine factors, and male factors, each requiring specific evaluation and interventions for improved fertility outcomes.

In the current study the basil hormonal levels AMH (Anti-Müllerian Hormone) levels, FSH (Follicle-Stimulating Hormone) levels, LH (Luteinizing Hormone) levels were measured in the second day of the cycle , and antral follicle counts for both the right and left ovaries, a comparative analysis was done and their associated test values and p-values.

AMH is an important marker for ovarian reserve, reflecting a woman's remaining egg supply. The mean AMH levels are quite similar among the three groups, with Group A having mean of 3.0, Group B with 2.89, and Group C with the highest mean of 3.39. The test value and p-value for AMH levels (0.547 and 0.581, respectively) indicate that there is no statistically significant difference in AMH levels among the three groups. This suggests that the ovarian reserve, as indicated by AMH levels, is comparable across these groups.

FSH is another hormone that plays a role in ovarian function. The mean FSH levels are also quite similar among the three groups, with Group A having a mean of 6.33, Group B with 6.74, and Group C with 6.98. The test value and p-value for FSH levels (0.745 and 0.477, respectively) indicate that there is no statistically significant difference in FSH levels among the groups. Similar to AMH, this suggests that ovarian function, as measured by FSH, is comparable across the groups.

LH is a hormone that, along with FSH, regulates the menstrual cycle and ovulation. The mean LH levels are again quite similar among the three groups, with Group A having a mean of 6.27, Group B with 5.63, and Group C with 5.94. The test value and p-value for LH levels (0.572 and 0.566, respectively) also indicate no statistically significant difference in LH levels among the groups. This suggests that LH levels are comparable across the groups, which is important for normal menstrual and ovulatory function.

Antral follicle counts , indicative of the number of small, growing follicles in the ovaries and can provide insights into ovarian reserve, show similar patterns among the groups. The test values and p-values for these counts also indicate no statistically significant differences among the groups. This suggests that the number of antral follicles in the ovaries, which can influence fertility potential, is comparable across the groups.

The same results was obtained by Vural et al., (2015) who revealed that the provided data compares basal hormonal and ultrasonography characteristics among three groups (Group A, Group B, and Group C). While there are some numerical differences in FSH, LH, E2, AMH, and antral follicle count, most of these variations are not statistically significant ($p>0.05$). The only significant difference is in LH levels ($p=0.015$), where Group C has lower levels compared to the other groups. These findings indicate relatively similar baseline characteristics among the groups, with the exception of LH levels in Group C.

In contrary to Alexis L Oldfield et al.,(2023) who showed that although obese and non-obese women has similar level of gonadotropins, but obese women had a lower AMH .

They also had a fewer antral follicles, fewer follicles progressed to >10 mm. Luteal phase defects were also more common in obese women compared to those with normal weight.

In the current study a comparative analysis of various aspects related to in vitro fertilization (IVF) treatment among the three groups. These aspects include the type of FSH (Follicle-Stimulating Hormone) used, the starting dose of FSH, total dose of FSH, duration of stimulation, number of oocytes collected, and number of oocytes fertilized, along with their associated test values and p-values. Let's discuss the findings in paragraphs:

The data indicates the distribution of the type of FSH used in each group, which includes NR (Not Reported), rFSH (recombinant FSH), Human Menopausal Gonadotrophin, and Urofollitropin. The percentages of each type are provided for each group. The test value and p-value (5.369 and 0.497, respectively) indicate that there is no statistically significant difference in the type of FSH used among the three groups. This suggests that the choice of FSH type is similar across the groups.

The mean starting dose of FSH in ampoules for each group, along with the range of doses. While there are differences in the mean starting doses as the obese women(3.20) need higher dose than the normal weight (2.93)and overweight women (3.0), the test value and p-value (1.082 and 0.240, respectively) suggest that these differences are not statistically significant. This implies that, on average, the starting dose of FSH is comparable among the groups.

Similarly, the data provides information on the mean total dose of FSH in ampoules for each group, along with the range of doses. The test value and p-value (1.002 and 0.370, respectively) indicate that there is no statistically significant difference in the total dose of FSH among the groups. This suggests that, on average, the total amount of FSH administered during IVF treatment is similar across the groups.

The duration of stimulation is presented as the mean number of days of FSH administration, along with the range. It was notable that Group C had a slightly longer duration of stimulation than the other two groups but the test value and p-value (2.444 and 0.091, respectively) suggest that these differences are not statistically significant.

Similar results obtained by Rafique M et al.,(2021)As there was slight increase in gonadotropin requirement in the overweight and obese group, but this had not achieve statistical significance. This is because protocols modify dosage based on the BMI for the IVF cycle.

In contrary to Ozekinci M et al ., (2015) who revealed that Higher gonadotropin consumption and longer stimulation durations were observed in the obese females, when compared with the normal weight women.

The current study show the mean number of oocytes collected and the mean number of oocytes fertilized for each group, along with the range. The test values and p-values for these variables that indicate statistically significant differences among the groups. This suggests that the number of oocytes collected were higher in the normal weight group that to the over-weight and obese (p=0.019*), with Group A having the highest mean count (13.17±8.28), which may indicate to the effect of obesity on the ovaries and their respond to the stimulation while fertilized oocytes show no statistically significant during IVF treatment among the groups.

The same results obtained by Yuval Atzmon et al.,(2017) who conduct a prospective cohort study to evaluate the effect of body

mass index (BMI) (kg/m2) on oocyte diameter and treatment. Their result was that more mature oocytes (MII) were retrieved from normal weight than from obese women .Mature oocytes from women in the obese group were significantly smaller than those in the normal weight group were, including diameter (157.9 ± 7.9 vs. 164.3 ± 5.1 μm).

In contrary to Ozekinci M et al.,(2015) who found insignificant differences between the BMI categories in the number of retrieved oocytes, number of MII oocytes, proportion of oocytes fertilized.

The current study show a comparative analysis of various outcomes related to in vitro fertilization (IVF) treatment among the different BMI groups. These outcomes include the number of good quality embryos, the number of embryos obtained at day 2, the number of fresh transferred embryos, biochemical pregnancy test results, clinical pregnancy test results, and live birth outcomes, along with their associated test values and p-values.

The data presents the mean number of good quality embryos for each group, along with the range. The test value and p-value (0.586 and 0.532, respectively) suggest that there is statistically insignificant difference in the number of good quality embryos among the three groups. This implies that, on average, the quality of embryos obtained during IVF treatment is comparable across the groups.

Similarly, the mean number of embryos obtained at day 2, along with the range. The test value and p-value (1.517 and 0.224, respectively) do not indicate statistically significant differences among the groups. Suggesting that, on average, the number of embryos obtained at day 2 during IVF treatment is relatively similar across the groups.

Also the distribution of the number of fresh transferred embryos for each group. The percentages of each category (1, 2, 3, and 4 embryos) are provided. The test value and p-value (3.055 and 0.802, respectively) indicate that there is no statistically significant difference in the distribution of the number of fresh transferred embryos among the groups. This suggests that the choice of the number of embryos for transfer is similar across the groups.

As for the results of both biochemical pregnancy tests and clinical pregnancy tests for each group, along with the associated percentages. The test values and p-values for these variables do not indicate statistically significant differences among the groups. This suggests that the outcomes of biochemical and clinical pregnancy tests are comparable among the groups, with similar percentages of positive and negative results.

The mean number of live births for each group, along with the range. The test value and p-value (0.565 and 0.570, respectively) suggest that there is no statistically significant difference in the number of live births among the three groups. This implies that, on average, the live birth outcomes following IVF treatment are relatively similar across the groups.

In the same line Sathya et al.,(2010) revealed that Increase in body mass index in women does not appear to have an adverse effect on IVF outcome. Also Martinuzzi et al., (2008) revealed that obesity in young women does not adversely affect clinical pregnancy rates in patients treated with in vitro fertilization.

In contrast Vural et al., (2015) revealed that similar counts of recruited mature oocytes, obese POR women had decreased fertilization and clinical pregnancy rates.

In a retrospective cohort study included 11,191 couples undergoing IVF. Per the Chinese BMI standard showed that overweight/obesity does not affect the CPR, LBR or abortion rate after IVF. There was no significant difference in the number of harvested oocytes between the overweight/ obesity group and the normal weight group.(Liu X et al.,(2023))

On contrary to a large meta-analysis on almost 48000 treatment cycles from 33 studies, concluded that overweight or obese women had significantly lower clinical pregnancy and live-birth rates (LBR) and significantly higher miscarriage rates compared with women with a BMI <25 kg/m2 (Rittenberg V et al.,(2011)) .although in the analysis , they did not adjust for the effect of other potentials such as age and polycystic ovary syndrome (PCOS), which both are strongly associated with obesity, as well as other factors, such as smoking. (M Khairy et al.,(2017).

CONCLUSION

In conclusion, the comprehensive analysis of demographic and fertility-related parameters across three distinct groups (Group A, Group B, and Group C) undergoing in vitro fertilization (IVF) treatment reveals that there are statistically significant differences in the ovarian response to the stimulation in the form of the duration and the number of oocytes retrieval, while in the in most of the measured variables there is no statistically significant difference . These include age, parity, infertility status, hormone levels, antral follicle counts, type and dosage of follicle-stimulating hormone (FSH), and numerous IVF outcome measures such as the number of good quality embryos, embryos obtained, fresh transferred embryos, biochemical and clinical pregnancy test results, and live birth outcomes. These findings suggest that, on average, the studied groups exhibit comparable demographic characteristics, ovarian function, and IVF treatment outcomes, highlighting the consistency in various aspects of IVF protocols and reproductive outcomes among these groups.

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