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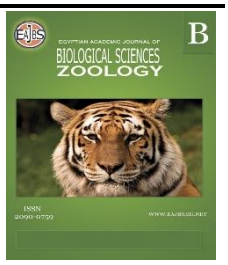

Effect of Varicocele and Diabetes on the Semen Quality and Intracytoplasmic Sperm Injection Outcome in the Obese Men

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ABSTRACT

Background: Obesity is among the most common causes of male infertility. Infertility rates have risen in recent years among men, particularly those with concomitant health issues besides obesity, such as varicocele or diabetes, in couples who underwent in vitro fertilization (IVF) or intracytoplasmic sperm injection (ICSI). **Objective** The goal of this study was to see how varicocele and diabetes affected semen quality, hormonal profile, the rate of fertilization, the quality of the embryo, and the pregnancy rate after intracytoplasmic sperm injection (ICSI) in overweight men. **Patients and methods**: The study involved 150 couples who were recruited from the assisted reproductive unit at Al-Azhar University. International Islamic Center for Population Studies and Research. Control (C), overweight with varicocele (OW & V), and overweight with diabetes (OW & D) were the three groups (each with 50 participants). For each case, the biochemical, antioxidants, and sperm parameters were examined. Then, during and after the ICSI procedure, fertilization, cleavage, embryo quality, and pregnancy rates were all checked and recorded. The percentages of fertilization rate and high-quality embryos in the OW & V and OW & D groups were significantly less than in the control group ($p<0.001$). However, it was noted that abnormal sperm morphology increased and the percentage of positive pregnancy tests was reduced by 50% in OW and V, followed by OW and D (55%). **Conclusion:** The overweight males with varicocele and the overweight with diabetes males had considerably worse semen parameters and hormone profiles, as well as decreased rates of fertilization, pregnancy, and embryo quality.

INTRODUCTION

Obesity is a significant contributing factor to male infertility (Amiri and Tehrani *et al.*, 2020). It lowers sperm quality and changes the morphological and chemical structure of testicular germ cells, reducing male reproductive capacity and leading to the creation of immature sperm cells (Teerds *et al.*, 2011). Oxidative stress and a disturbance of the

hypothalamic-pituitary-gonadal axis are linked to obesity (Stefan *et al.,* 2013). Unbalanced sex hormones can significantly affect spermatogenesis and other aspects of male reproduction (Shukla *et al.,* 2009). Obesity is an increasing public health problem, according to Wolf and Woodworth (2009**).** According to the study, more than 1 billion people worldwide are overweight (BMI 25.0–29.9) and 300 million adults worldwide are obese (BMI > 30.0).

The World Health Organization (WHO) defines obesity as having a body mass index (BMI) ≥30 kg/m^2. Obesity is a medical condition where there is too much body fat, which raises the risk of non-communicable diseases, which has a negative impact on morbidity and mortality (Begg et al., 2008). There have been few studies on the impacts of paternal BMI on foetus health and live birth outcomes (Tola and Oral, 2019), despite the fact that the impact on sperm function has been examined (Bakos *et al.,* 2011). In vitro fertilisation (IVF) following maternal obesity has been associated with oocyte alterations that damage the embryo's growth and decrease the likelihood of a subsequent pregnancy (Pinborg *et al.,* 2011). Male obesity has a deleterious effect on a man's ability to reproduce, specifically modifying the morphological and molecular characteristics of the testicular germ cells, and eventually mature sperm (Palmer *et al.,* 2012).

Reduced sperm concentration, aberrant sperm morphology, reduced chromatin reliability, and irregular motility is all problematic sperm factors linked to obesity (Puri *et al.,* 2020).

Congenital abnormalities (Klinefelter's disease, Y chromosome deletions), germ cell aplasia, anorchia, testicular dysgenesis, cryptorchidism and spermatogenic arrest are all possible causes of spermatogenic failure (Colpi *et al.,* 2005). Obesity, alcohol misuse, excessive smoking, anabolic steroids, elevated scrotal temperature and a variety of medicines that alter spermatogenesis can all have an effect on sperm quality (Jungwirth *et al.,* 2012).

Varicocele is a very common ailment. It results in unilateral testicular growth and development failure, as well as pain, discomfort, and diminished fertility (Evers and Collins, 2003). If the male partner is overweight or obese, this effect appears to be connected to decreased blastocyst size, sperm binding, and fertilisation rates during in vitro fertilisation (IVF). (Hwang *et al.,* 2011).

Oxidative stress affects how quickly male infertility develops. Reactive oxygen species (ROS) can impair spermatozoa motility by inducing lipid peroxidation, which damages spermatozoa and fragments of DNA. (Tremellen *et al.,* 2007). According to several studies, a larger accumulation of bioactive lipids and a pro-oxidant/antioxidant balance may be the cause of metabolic disorders associated with obesity (Choromanska *et al.,* 2020).

Type 2 diabetes and cardiovascular disease are both risks that are increased by the long-term condition of obesity (CVD). The disorder known as metabolic syndrome, which is characterised by hypertension, insulin resistance, and dyslipidemia, is more common in overweight or obese people than in those of normal weight (Powell-Wiley *et al.,* 2021).

Aim of the Work:

This study aimed to investigate the effect of varicocele and diabetes on semen quality, fertilization, embryo quality, and their impact on pregnancy after intracytoplasmic sperm injection (ICSI) in overweight men.

MATERIALS AND METHODS

In this prospective trial, 150 patients were included, and they were split into three groups: control (C), overweight with varicocele (OW & V), and overweight with diabetes

(OW & D) (each with 50 participants). From March to September 2019, the study was carried out in the assisted reproductive technology (ART) unit. Al-Azhar University. Cairo, Egypt. International Islamic Center for Population Studies and Research. Inclusion criteria: comprised of Body mass index (BMI) < 30 kg/m^2 and >25 kg/m^2 in the control group to achieve a normal fertility response and > 30 kg/ m^2 in the other groups. The males age less than 45 years old and the female partners were less than 38 years old free of a medical disorder and have normal reproductive functions (no tubal disorders or endometriosis) no reason caused their non-pregnant. Normal quality of sperm in their husbands in the control group. The two other groups include men with diabetes and varicocele. Exclusion criteria: comprised Patients with oligozoospermia, aspermia, a history of cryptorchidism, Klinefelter syndrome, and BMI < 25 kg/m^2 and age more than 45 years old. Patients on oral hormonal therapy and patients on weight loss programs.

1. Study Procedures: The following conditions were applied to the cases in this study:

1 A: Complete history-taking involves a urinogenital examination and a personal history.

1 B: Blood Analysis Entails Determining the Following Factors:

The random glucose level was determined in serum using the approach of Trinder (1969) and glycated haemoglobin (HbA1C) according to Pundir and Chawla (2014**).** Urea and creatinine levels were determined using Tabacco et al. (1979) and Ratels et al. (1971) procedures, respectively. Assay for liver function utilising the Schumann and Klauke (2003) technique aspartate aminotransferase and alanine aminotransferase. Cholesterol was determined according to the method of Richmond (**1973)**, triglycerides according to Bakker and Mücke **(**2007), low-density lipoproteins (LDL) according to the method of Belcher *et al.* **(**1995) high-density lipoproteins (HDL) The LDL/HDL ratio was calculated using the method provided by Seguchi *et al.* (1995).

1 C: Antioxidants and oxidative stress estimation: Using the Ellman method (1959), reduced glutathione (GSH) was colorimetrically detected at 412 nm The activity of catalase (CAT) was measured using the Cohen *et al.* (1970) technique. (Mesbah *et al.,* 2004) method for determining malondialdehyde (MDA) as a lipid peroxidation marker at 534 nm was used, and the (Green *et al.,*1982) protocol for determining nitric oxide level (NO) was used

1 D: Sex hormone estimation: The method described by (Rose et al., 2000) was applied to estimate follicle-stimulating hormone (FSH) levels. Luteinizing and testosterone hormones were determined according to the methods of Knobil (1980) and McCann and Kirkish (1985), respectively.

2 A: Complete semen analysis: was carried out in accordance with WHO (2010) guidelines (Catanzariti *et al.,* 2013). Semen volume, sperm count, and sperm morphology are among the parameters assessed.

2 B: Sperm preparation:

After microscopic examination, sperm samples were prepared for intracytoplasmic sperm injection (ICSI). 1 ml of sperm gradient medium was added to the fresh sample, and it was centrifuged for ten minutes at 1800 rpm. followed by the removal of the supernatant. After this, the addition of 2 mL of the washing solution to the sperm in the resulting pellet was done. Then, it was then centrifuged once more for 10 minutes at 1800 rpm to obtain the required quantity of sperm cells that are mobile and anatomically normal for assisted reproduction, according to the Catanzariti *et al.* (2013) procedure.

2 C: ICSI procedure:

Samples were incubated until the moment of injection after semen analysis and sperm preparation as previously described. A single spermatozoon that was mechanically trapped in polyvinyl pyrrolidone (PVP) and had a grossly normal morphology was inserted into each oocyte. ICSI-subjected individual sperm were analysed and assessed. A holding

pipette and injection needle were used for the injection procedure, which was completed in a sterile dish. The mature oocyte was put in a 10 µl drop of global total w/HEPES Buffer (Life Global, Europe) at 37 ºC in a 6% Co2 in a (90 - 95%) humidity environment equilibrated and covered by mineral oil; sperm was added to 10 µl drop of global total w/HEPES Buffer (Life Global, Europe) after that we select the best sperm for injection & mechanically immobilized in the PVP drop.

Intra cytoplasmic sperm injection was done in accordance with Van-Steirteghem *et al*. (1995). Ax Overt 135 was used for the injection operation, which was outfitted with Hoffman optics, 10x, 20x, and 40x objectives with 10x eyepieces, as well as naurishigea micromanipulators. The holding pipette was used to affix the oocyte with a small negative pressure. One sperm was placed right at the tip of the microinjection needle while the injection needle with the sperm in polvinylpyrrolidone (PVP) was brought into the focal plane. During metaphase 2, the next action was a gradual, constant migration into the oocyte's cytoplasm (MII). The sperm was then placed into the cytoplasm along with 1 to 3 µl of media. The injected oocyte was then cleaned and placed in sterile, warm, equilibrated global oil in a culture dish with global complete media (Life Global, Europe) till fertilisation on a culture dish coated with sterile, warm, equilibrated global oil (Life Global, Europe) at 37 ºC in a 6% Co^2 in (90 - 95%) humidity environment.

2 D: Fertilization and Embryonic Cleavage After ICSI:

The integrity and fertilization of injected oocytes were assessed 16–18 hours following ICSI. Oocytes were judged to be fully fertilized when two pronuclei (2PN) and the ejection of the second polar body were present.

2 E: Embryo Grading, Transfer, And Determination of Pregnancy:

The percentage transformation of microinjected oocytes into two pronuclei was used to calculate the Fertilization rate (FR). About 90% of 2PN oocytes acquired by ICSI enter cleavage after fertilization, resulting in multicellular embryos. Zygotes reached the two - or four-cell stage after 48 hours, 1-2 of the highest quality embryos are then transplanted into the mother's uterus. 15 days after ICSI collection, patients underwent a pregnancy test utilising a serum beta-human chorionic gonadotropin (HCG) titre.

3. Statistical Analysis:

For statistical analysis, SPSS version 20 for Windows was utilized (SPSS Inc, Chicago, IL). The means and standard deviations of the quantitative variables were compared to those of the control group using the Student's T-test. For nominal and frequency data, the Chi-square test was performed, and $P < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Serum random glucose levels and the mean values of glycated haemoglobin (HbA1C) were measured as a biochemical marker of diabetes (Table 1). Serum random glucose levels increased significantly ($p<0.001$) in the obese with varicocele (OW & V) and the obese with diabetes (OW & D). However, mean values of glycated haemoglobin (HbA1C) significantly increased only in OW and D versus control ($p <0.001$). Urea and creatinine indicated no significant changes when compared to the control group. While the results indicated a decrease in the liver functions with the increased activities of serum ALAT and ASAT in OW & V and OW & D ($p <0.001$) compared to the control, which had indirect effects on the fertility parameters. The lipid profile levels showed that triglycerides, total cholesterol, LDL levels, and the LDL/HDL ratio recorded an extremely significant rise ($p <0.001$) in OW & V and OW & D when compared to the control. In contrast, HDL levels, on the other hand, were statistically significant in OW and V but

non-significant in OW and D.

Table 1**:** Biochemical analysis (glucose, kidney, liver functions and lipid profile) in the different groups.

Parameters \ Groups			C (N=50)	OW & V (N=50)	OW & D (N=50)
			Mean± S. D	Mean± S.D p-value	Mean± S.D p-value
Biochemical analysis	Random Bl. Glucose (mg/dL)		92.6±7.09	189±14.34**	325.53±49.94**
				<0.00001	<0.00001
	HbA1C (%)		5.34±0.51	5.59±0.55	7.93±0.70**
				0.026576	<0.00001
	Common kidney function tests	Urea (mg/dL)	29.2±2.88	29.84±6.36	28±5.28
				0.274827	0.128206
		Creatinine (mg/dL)	0.84±0.09	0.87±0.1	0.83±0.08
				0.136714	0.430434
	Common liver function tests	ALAT) U/L)	25.12±2.09	56.2±5.63**	52.6±7.25**
				0.0191	<0.00001
		ASAT) U/L)	13.94±0.52	56.92±5.6**	56.6±4.32**
				0.0217	<0.0001
	lipid profile levels	Triglycerides (mg/dL)	143.08±38	325.44±19.51**	333.6±8.00**
				<0.00001	<0.00001
		Total cholesterol (mg/dL)	199.2±16.6	237.44±3.92**	237.6±5.62**
				<0.00001	<0.00001
		LDL (mg/dL)	81.8 ±6.56	151.64±8.97**	149.4±10.83**
				<0.00001	<0.00001
		HDL (mg/dL)	58.82±5.12	65.78±5.08**	60.42±2.99
				0.020465	0.29409
		LDL/HDL Ratio	1.38±0.20	2.48±0.18**	2.5±0.23**
				<0.00001	<0.00001

Data are expressed as mean ± standard deviation **(S.D.)**, P <0.001**: highly significant; C-control, OW – overweight, OW & V – overweight with varicocele, ASAT**,** aspartate aminotransferase, ALAT**,** alanine aminotransferase; HbA1C **–** glycated hemoglobin, HDL **–** high-density lipoproteins and LDL **–** low-density lipoproteins.

Results in Table (2) show the effect of antioxidants and oxidative stress disturbances on fertility parameters in the overweight with varicocele (OW & V) and overweight with diabetes (OW & D) groups, where catalase (CAT) activity and the mean blood reduced glutathione (GSH) level were highly significantly decreased in comparison with the healthy control (C) group which was accompanied by an increase in the MDA and NO levels in OW & V and OW & D when compared to the control (p <0.001).

Table (2): Antioxidant and oxidative stress levels in the various groups.

Groups / Parameters	C (N=50)	OW & V (N=50)	OW & D (N=50)
	Mean± S. D	Mean± S.D p-value	Mean± S.D p-value
GSH (mmol/L)	44.66±2.48	35.72±2.44**	29.64±2.10**
		<0.00001	<0.00001
CAT (U/L)	90.32±3.08	75.45±3.01**	71.26±1.74**
		<0.00001	<0.00001
MDA (nmol/mL)	20.48±1.26	30.48±1.17**	36.93±1.18**
		<0.00001	<0.00001
NO (µmol/L)	50.43±3.04	65.16±3.97**	67.90±3.71**
		<0.00001	<0.00001

Data are presented as mean ± standard deviation (S.D), P <0.001****:** highly significant, C – **c**ontrol, OW & V – overweight with varicocele, OW & D – overweight with diabetes, GSH **–** glutathione, CAT **–** catalase, MDA **–** malondialdhyde, NO **–** nitric oxide.

Table 3 shows the estimated parameters for the hormonal profiles and sperm. When comparing the OW & V and OW & D groups to the control, the level of testosterone in the OW & V and OW & D groups was considerably lower (p<0.001). The pituitary gland, on the other hand, did not respond to biochemical and physiological changes in blood content, as the mean levels of FSH and LH did not alter significantly. The mean values of the fertility parameters (volume of the sperm, sperm count, and percentage of sperm motility) were significantly reduced in OW and V and OW and D versus the control group (p<0.001). However, when compared to the control, the prevalence of abnormal sperm morphology increased significantly (p<0.001) in OW & V and OW & D.

Table (3): Hormonal profiles and sperm parameters in the control and other different groups.

Groups / Parameters		C (N=50)	OW & V (N=50)	OW & D (N=50)
		Mean± S. D	Mean± S.D p-value	Mean± S.D p-value
Hormonal profiles	FSH (mIU/mL)	7.87±2.26	8.56±2.72	8.4±1.05
			0.125994	0.194314
	LH (mIU/mL)	5.02±0.69	5.19±1.15	5.36±1.56
			0.216882	0.115762
	Testosterone (ng/dL)	7.24±1.75	2.68±0.75**	2.2±0.41**
			<0.00001	<0.00001
Parameter assessments for	Volume (mL)	3.85±0.92	1.96±0.56**	1.78±0.26**
			<0.00001	<0.00001
	Sperm count (10^6/suspension)	54.98±16.27	14.6±4.73**	13.33±4.88**
			<0.00001	<0.00001
	Sperm motility (%)	80±6.47	23±6.46**	23±6.21**
			<0.00001	<0.00001
	Abnormal sperm morphology (%)	23.5±8.16	98.84±0.8**	98.6±0.51**
			<0.00001	<0.00001

All data are presented as mean ± S.D, **P < 0.001 highly significant, C – control; OW&V – overweight with Varicocele group, OW&D – overweight with diabetes group, N – number, LH – luteinizing hormone; FSH – follicle stimulating hormone.

The percentage of fertilization rate was considerably lower in the OW & V and OW & D groups ($p<0.001$) in comparison with the control group and**,** all the zygotes were successfully cleaved after fertilization in all groups (100%) (Fig.1). At the same time, the percentage of low-quality embryos was noticeably higher while high-quality embryos were considerably lower in the OW & V and OW & D versus the control ($p<0.001$) (Fig.2). Also, the positive pregnancy test was recorded at the lowest percentage in the OW & V group (50%), followed by OW & D (55%) (Fig. 3).

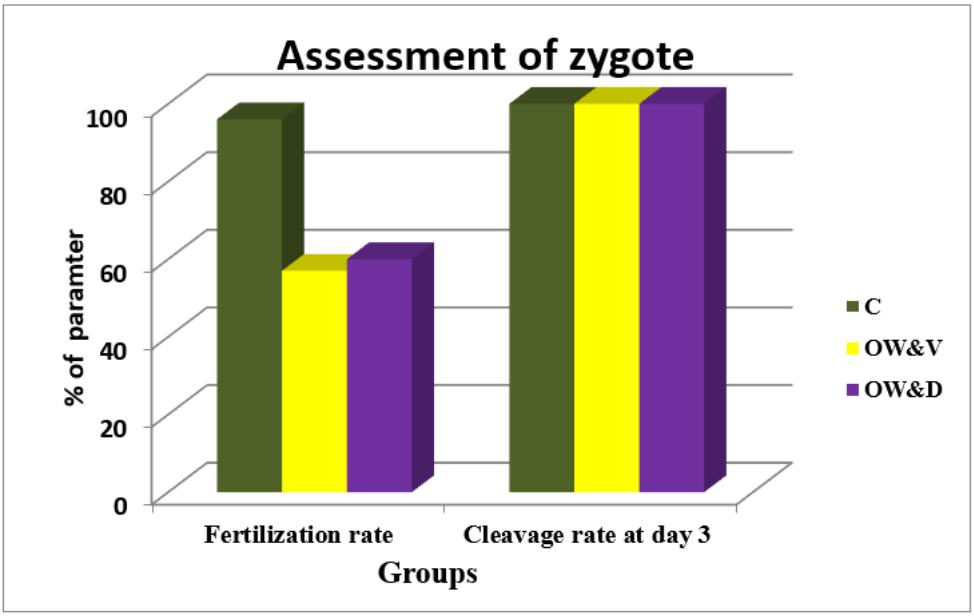

Fig. 1. Comparison between the fertilization rates and cleavage rate in the control (C), overweight with varicocele (OW & V), and overweight with diabetes (OW & D) groups.

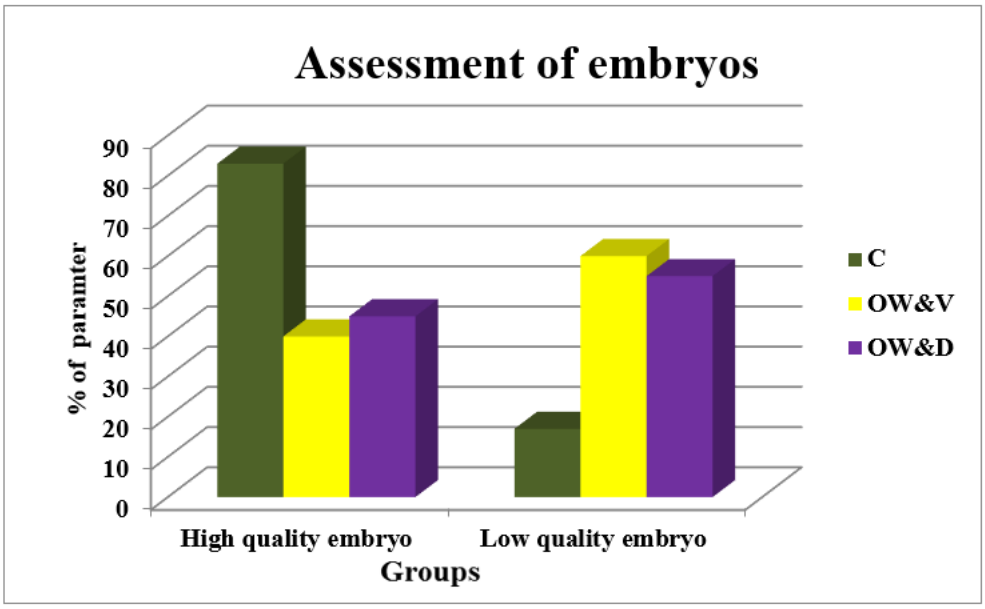

Fig. 2. Comparison between the qualities of embryos in the control (C), overweight with varicocele (OW & V), and overweight with diabetes (OW & D) groups.

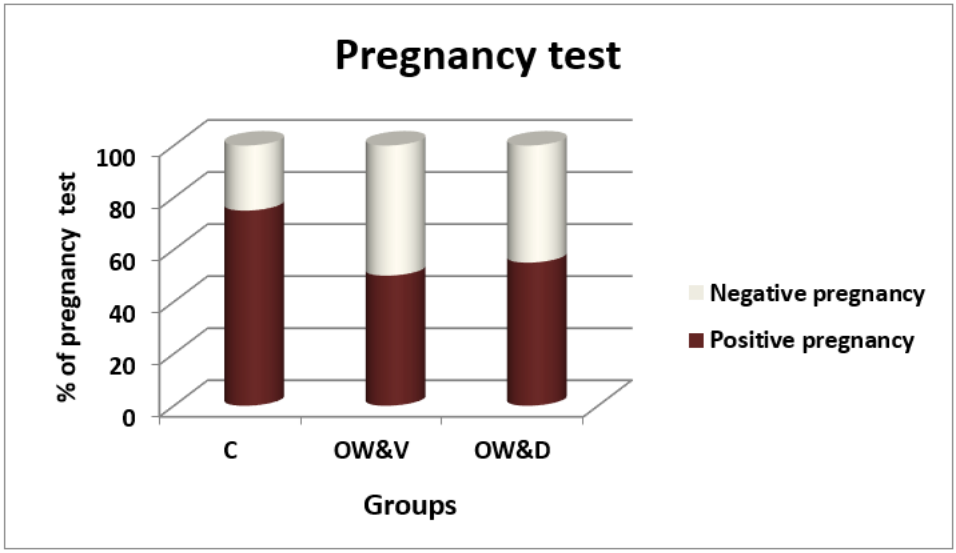

Fig. 3. Comparison between the pregnancy tests in the control (C), overweight with varicocele (OW & V), and overweight with diabetes (OW & D) groups

DISCUSSION

According to the current study, overweight people with varicocele (OW & V) and overweight people with diabetes (OW & D) experienced more infertility symptoms than the healthy control group. The random glucose level and HbA1C were shown to be much higher than the control values. Also, the liver functions were greatly reduced, which had an indirect effect on reproductive parameters, as the serum ALAT and ASAT activities were significantly enhanced in OW & D and OW & V. This is in line with the discoveries of Gray *et al.* (2013), who revealed that glycosylated haemoglobin (HbA1C) and insulin resistance scores in obese people were all linked to liver function parameters. In addition, they agree with Beiglbock *et al.* (2020), who observed increased levels of ALAT and ASAT in obese males with pre-operative hypogonadism. Furthermore, Maresch *et al.* (2017) [39] concluded that long-term hyperglycemia exposure is linked to progressive testicular disruption in a mouse model, indicating that hyperglycemia disrupts spermatogenesis via the main diabetes pathogenesis pathways.

The researchers found that higher ALAT and ASAT activities indicate higher fat buildup in the liver, which is linked to central obesity, insulin resistance, hypertension, dyslipidemia, and diabetes, among other cardiovascular risk factors (Islam *et al.*, 2020).

The liver is an important organ for metabolism because it helps to maintain glucose homeostasis (Wang *et al.*, 2016). An effective organ for lipid metabolism is the liver because it generates high-density lipoproteins (HDL), and low-density lipoproteins (LDL), and stores fat in itself and in adipose tissues (Heeren and Scheja, 2021).

The current findings revealed highly significant increases in triglycerides, total cholesterol, LDL, and the LDL/HDL ratio in OW & V and OW & D compared to the standard control. This is consistent with Sheriff (2009), who found a large rise in triglycerides and cholesterol in varicocele patients' testes, with the aetiology possibly related to cholesterol not being used for testosterone production. It's possible that varicocele sperm suffer from a dysmetabolic syndrome as a result of inefficient enzymatic activities, resulting in triglyceride accumulation. As a result, during the dysmetabolic syndrome, a substantial connection between testosterone and lipogenesis has been reported at the systemic level (Salam *et al.*, 2012)**.** This study agrees with Hussain *et al.* (2019), who revealed a strong negative association between BMI and HDL-C, but an

insignificant correlation between BMI and LDL-C.

Recent studies have discovered a significant association between oxidative stress biomarkers and BMI (Gusti *et al.,* 2021). Changes in the pro-oxidant/antioxidant balance play a key role in the development of obesity and its consequences (Choromanska *et al.,* 2020). A pro-inflammatory and pro-oxidant state can be brought on by abnormal fat accumulation by a number of biochemical and physiological processes (Colak and Pap, 2021). Increased reactive oxygen species and oxidative stress were found to promote adipocyte proliferation, differentiation, and growth (Higuchi *et al.,* 2013). In the current investigation, antioxidants and oxidative stress levels were found to be imbalanced. Compared to the control, glutathione (GSH) levels were found to be considerably lower in OW & V and OW & D ($p< 0.001$). This result agreed with that of Adeoye et al. (2018), who found that a glutathione shortage causes the midpiece of the spermatozoa to become unstable, resulting in motility problems. Also, compared to the control, catalase (CAT) activity was considerably reduced in OW & V and OW & D ($p< 0.001$). This finding agrees with Gusti *et al.* (2021), who discuss decreased CAT activity in a Saudi obese community.

Reactive oxygen species (ROS) damage sperm motility and oxidative stress play a crucial role in male infertility because it can cause lipid peroxidation and DNA breakage (Alahmar, 2019). The germinal epithelium's capacity to produce hormones and the Leydig cells' capacity to produce steroids are both compromised by ROS (Hales *et al.,* 2005). Patients with varicoceles in their spermatic veins and seminal plasma have higher nitric oxide levels. NO has been shown to influence sperm function in several studies. Exogenous NO donors at low concentrations have been demonstrated to improve the motility and viability of human sperm, and zona pellucida binding (Agarwal and Dutta, 2020).

When compared to the control group in this study, OW & V and OW & D had significantly higher MDA levels ($p< 0.001$). This is in line with the conclusions made by Yesilli *et al.* (2005), who found that infertile males with varicocele have increased malondialdehyde levels in their sperm. Higher nitric oxide (NO) levels in OW & V and OW & D are consistent with those of Keyhan *et al.* (2012), who found that a rise in NO in the seminal fluid of infertile men reduces sperm motility and results in sperm toxicity.

The pituitary gland did not respond to biochemical and physiological changes in the blood contents in this study, whereas the mean levels of the sexual hormones when compared to the control value, FSH and LH exhibited no significant changes, which is consistent with the prior study's findings (Blache *et al.,* 2003). While, testosterone hormone levels in the OW & V and OW & D groups revealed a highly significant decrease in comparison with the control ($p< 0.001$); which is consistent with previous findings (Caprio *et al.,* 1999) who suggested that in obesity, increased leptin secretion could impede testosterone synthesis by Leydig cells. Increased adipose tissue deposition causes an increase in testosterone to estradiol conversion (Hammoud *et al.,* 2006). In addition, in obese men, hyperinsulinemia, fat accumulation, and low testosterone levels are inversely connected to subcutaneous and intra-abdominal fat percentage, while high oestrogen levels are directly related to both (Du Plessis *et al.,* 2010). Consequently, a higher BMI was associated with diminished quality, concentration, and motility (Be lloc *et al.,* 2014). The study's conclusions are likewise consistent with those of (Puri *et al.,* 2020). According to the researchers, overweight and obese males have been associated with an increased incidence of oligozoospermia, azoospermia, and teratozoospermia.

According to the present findings, obesity's effect on varicocele and diabetic patients has an adverse effect on all sperm parameters (the volume of semen, sperm count, and the percentage of sperm motility). As a result, in comparison with the control group,

the mean aberrant sperm morphology percentage in OW & V and OW & D increased significantly. According to a recent study, the presence of spermatic varicose veins makes spermatogenesis difficult. Increased levels of circulating reactive oxygen species (ROS) cause sperm DNA fragmentation, which reduces sperm quality and quantity and, in exceptional cases, completely eliminates sperm production (Malasevskaia *et al.,* 2021). Most investigations failed to find a connection between obesity and sperm morphology (Chavarro *et al.*, 2010).

According to this study, the percentage of fertilization rate was considerably lower in the OW & V and OW & D groups in comparison with the control group**,** and all the zygotes were successfully cleaved after fertilization in all groups (100%). At the same time, the percentage of low-quality embryos was noticeably higher, while high-quality embryos were considerably lower in OW & V and OW & D versus the control. Also, the positive pregnancy test was recorded at the lowest percentage in the OW & V group (50%), followed by OW & D (55%).

These findings concur with those made by (Xue *et al.*, 2020), who discovered an inverse relationship between body weight and cumulative live birth rate, as well as a reduction in oocyte output rate as BMI increased. In couples who have done IVF or ICSI, male obesity can influence the quality of the embryo, blastocyst development, rates of live birth, and clinical pregnancy (Tola E and Oral, 2019).

Conclusion:

Male obesity, varicocele, and diabetes have a deleterious impact on sperm parameters, hormonal profiles, fertilization, embryo quality, and pregnancy rate.

Ethics Approval: The study protocols and procedures used in this study were approved by the International Islamic Center for Population Studies and Research, ART unit, Al azhar university, Egypt, on 150 adult patients with male infertility that were selected from the study with full counselling and approved in the andrology clinic

Conflict of Interest:

This study has no conflicts of interest.

Acknowledgment:

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