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Impact of Sperm DNA Fragmentation on Pregnancy Outcomes

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Abstract

This study aims to perform a meta-analysis in order to gain a thorough understanding and evaluation of the relationship between the sperm DNA Fragmentation Index (DFI) and the outcome of pregnancy following intracytoplasmic sperm injection (ICSI) or in vitro fertilisation (IVF) treatment. After receiving the approval from institutional review board for the use of human beings, sample were collected from the 88 couples who were ready to participate in the study. Initial IVF screening of patients were done. For that every female subject had a preliminary endocrine examination on Day 2 or the third day of their menstrual period. The PRL, FSH, LH, OESTRADIOL, and P4 were measured after taking the blood samples. For the ovulation induction long and short protocols were followed. The embryo quality was assessed. GnRH agonist and antagonist protocols" were employed for ovarian stimulation. Recombinant hMG and FSH were utilized to stimulate ovaries. The recovered oocytes were inseminated using either traditional insemination techniques, such as IVF, or micromanipulation methods like ICSI. Oocyte collection, identification, and assessment were done. Sperm concentration, motility, and morphology exhibit significant diversity, as revealed by descriptive statistics used in semen analysis. Using Pearson's chi-square test, the study's analysis reveals substantial correlations between clinical pregnancy outcomes and factors like embryo quality and prior therapies, pointing to areas that should be specifically targeted for improvement.

Keywords; Sperm DNA fragmentation, male infertility, oxidative stress, assisted reproduction, embryo quality.

INTRODUCTION

Approximately fifteen percent of couples globally are seeking assistance from infertility clinics in order to achieve conception. An estimated 25–50 percent of infertile couples experience male factor infertility, while around 28 percent of these couples experience unexplained infertility. Over the past forty years, there have been contradictory reports concerning human fertility. Several studies have documented a decrease in one or more semen parameters, such as sperm concentration, morphology, motility, or semen volume, among fertile men. However, other studies have found no alteration in these semen characteristics. Factors such as selection bias, technique, environmental conditions, regional disparities, and genetic diversity among people could account for the discrepancy in the reports. Poor semen quality can serve as a considerable predictor of declining fecundity, which refers to a decrease in the ability to achieve pregnancy. The rise in couples seeking assisted reproductive technology treatment may suggest a potential decrease in male fertility within the overall population. However, the increased accessibility and affordability of ART treatment or women's decision to delay parenthood could contribute to this trend, potentially leading to a decline in female fertility with age. Societal shifts, occupational and environmental exposure to harmful substances, and dietary and lifestyle choices could potentially lead to a decrease in male fertility. These exposures can potentially harm semen quality and Deoxyribonucleic acid integrity by causing oxidative Deoxyribonucleic acid damage, Deoxyribonucleic acid alkylation, Deoxyribonucleic acid breaks, or other forms of damage. As a result, male fertility may be reduced as the ability of spermatozoa to fertilize an egg and produce a healthy embryo may be impaired.

Sperm DNA Integrity

The integrity of sperm Deoxyribonucleic acid determines the fertility potential of reproductive biotechnologies [1]. Multiple investigations have confirmed this hypothesis by documenting a greater level of sperm Deoxyribonucleic acid disintegration in infertile guys compared to fertile men. Additionally, researchers have found aberrant Deoxyribonucleic acid packaging in normozoospermia men undergoing assisted reproduction treatment [2] [3]. Increased levels of sperm Deoxyribonucleic acid fragmentation (SDF greater than 30 percent) have detrimental effects on both "pre- and post-implantation embryos." They have been linked to diminished blastocyst formation, slower embryo cleavage, altered embryo shape, lower implantation rates, and lower pregnancy rates [4]. Furthermore, patients with high levels of damage from Deoxyribonucleic Acid have a considerable rise in miscarriage rates. Furthermore, damage to the paternal sperm Deoxyribonucleic acid can have an impact on future generations' fertility and genetic material [5].

Repairing Damage to Sperm Deoxyribonucleic Acid

A damaged cell slows down its cycle of life. This is caused by damage caused by deoxyribonucleic acid. Checkpoints activate until they address the Deoxyribonucleic Acid lesions. However, this may be insufficient because unresolved double-stranded Deoxyribonucleic Acid breaks continue to exist. In this scenario, cells have three possible outcomes: they can undergo apoptosis, leading to cell destruction and a decrease in viability; they can withstand the damage without considerable consequences, although mutations are likely to arise in subsequent generations; or they can actively repair the inflicted damage. Cells may activate a complex network of proteins to repair damage to their Deoxyribonucleic Acid. Several well-established repair mechanisms exist in mammalian germline cells, including mismatch repair, base excision repair, nucleotide excision repair, and double-strand break repair of deoxyribonucleic acid.

Impact of Sperm Deoxyribonucleic acid fragmentation on Reproductive Outcomes: Recent Evidence

Increased sperm Deoxyribonucleic acid fragmentation can result in various negative reproductive outcomes, such as a decreased likelihood of natural conception, a decreased success rate with assisted reproductive technology procedures such as intrauterine insemination, in vitro fertilisation, and intracytoplasmic sperm injection, impaired embryo development, and an increased risk of recurrent pregnancy loss. We hypothesize that unaddressed Deoxyribonucleic acid damage surpassing a critical limit and impeding the embryo's typical growth causes these unfavorable results. At this stage, cell cycle checkpoints in mice are critical because they temporarily halt cell cycle processes in order to facilitate Deoxyribonucleic acid repair. Once we address the damage, embryonic development resumes [6]. Despite strong evidence at level I linking increased systemic derived factors to negative outcomes in humans, not all studies have consistently observed these findings. As a result, researchers and clinicians are investigating additional factors that could influence the effects of elevated systemic derived factors.

REVIEW OF LITERATURE

Boeri et al., (2024) examined the associations between semen features and clinical or the results of assisted reproductive technology in a cohort of male infertile across various birth weight categories, Boeri et al. Eight07 men (76.0 percent) had a normal birth weight, 177 men (16.5 percent) had a high birth weight, and 79 men (7.5 percent) had a low birth weight. "The results of the study showed that, in comparison to the other groups," low BW males had lower total testosterone levels, increased follicle-stimulating hormone, and decreased testicular volume (all p less than 0.01). In comparison to the other groups, men also showed reduced sperm progressive motility (p = 0.01), normal morphology (p less than 0.01), and increased sperm DNA fragmentation values (all p less than 0.01). Compared to the normal BW and high BW groups, the ART pregnancy outcomes for the low BW group were less favorable. A multivariable logistic regression analysis showed that low BW was linked to SDF >30%. This was true even when TV, age, the Charlson Comorbidity Index, and FSH were taken into account. Also, low BW, SDF >30% , and partner age were all linked to bad outcomes for ART, even after the same variables were taken into account. The study revealed that the LBW group considerablely worsened sperm Deoxyribonucleic acid fragmentation and assisted reproductive technology outcomes compared to the normal BW and, low BW and high BW teams was associated with impaired clinical and semen features [7].

Rasmussen et al., (2024) determined whether men from couples who experienced unexplained recurrent pregnancy loss or infertility had "elevated levels of seminal oxidative stress" and sperm Deoxyribonucleic acid disintegration in comparison to fertile individuals serving as controls. The researchers detected no substantial disparities in OS levels among the groups. Notably, the RPL group showed dramatically reduced SDF levels in comparison to the control team. Furthermore, the group of individuals

experiencing infertility observed a notable and favorable connection between sperm Deoxyribonucleic acid fragmentation and oxidative stress. In summary, this study found no notable disparities in the overall survival rates of males from couples facing unexplained recurrent pregnancy loss or infertility compared to fertile individuals. Additionally, the RPL group exhibited lower sperm Deoxyribonucleic acid fragmentation levels compared to the control group. Although previous literature suggests that OS and SDF have unfavorable prognostic implications, the results of this study indicate that they may not be dependable diagnostic indicators for recurrent pregnancy loss and infertility [8].

Mantravadi et al., (2024) investigated the effectiveness of magnetic-activated cell sorting compared to testicular sperm aspiration in enhancing reproductive results for individuals with high levels of sperm Deoxyribonucleic acid fragmentation who are undergoing assisted reproduction. No notable disparities were seen in the age of females, age of males, or the sperm Deoxyribonucleic acid fragmentation index between the MACS and TESA teams. The rate of blastocyst conversion was somewhat greater in the TESA group (39 percent) in comparison to the MACS team (32 percent). Nevertheless, the incidence of implantation was greater in the MACS teams (50 percent) compared to the TESA teams (35 percent). There were no notable variations in the rates of miscarriage, multiple pregnancies, or live births between the groups, as determined by an analytical study. The chi-squared test was used for the comparison of categorical variables, whereas t-tests were implemented for continuous variables. When dealing with increased sperm DNA fragmentation, both MACS and TESA procedures demonstrated similar reproductive results, without one intervention clearly outperforming the other. Couples undergoing assisted reproduction with high levels of sperm Deoxyribonucleic acid fragmentation found both therapies to be advantageous [9].

Yazdani et al., (2024) examined the significance of cytoplasmic fragmentation in the development of human embryos and their reproductive capacity. Despite the widespread acknowledgement of this phenomenon, there is currently no universally accepted definition or consensus on its implications. Researchers discovered that while fragmentation is recognized as a natural occurrence in various species, its exact cause is not well understood and is likely influenced by multiple factors. Researchers have found that various factors, such as the culture environment of embryos, the quality of gametes, the presence of aneuploidy, and aberrant cytokinesis, considerably influence the development of cytoplasmic fragmentation. Fragmentation reduces the amount of cytoplasm and exhausts the embryo of necessary organelles and regulatory proteins, thereby impairing its ability to develop. The authors emphasized that although there is evidence of a adverse relationship between the extent of fragmentation and the ability of embryos to implant, there is still ongoing dispute in the literature on the specific degree, pattern, and distribution of fragmentation in relation to pregnancy outcomes. This research highlighted the difficulties in analyzing fragmentation and uncovered patterns in the changing comprehension of how fragmentation might be connected to the functional development of human embryos, implantation, and pregnancy outcomes [10].

Madani et al., (2024) investigated the fertility rate and Deoxyribonucleic acid fragmentation index in primary sterile men with clinical varicocele. Out of the 76 patients examined, 22 (29 percent) successfully attained fertility, whereas 54 (71 percent) continued to be infertile. Following the varicocelectomy procedure, there was a notable enhancement in the semen parameters and DFI (%) ($P<0.001$). Variables such as smoking history, occupational heat exposure, BMI , and duration of infertility were found to be predictors linked to reproductive status. Even though varicocele repair has resulted in an enhancement in DFI, fewer than 1/3rd of the individuals were able to attain a fertility rate. This suggests that other reasons such as smoking history, work-related heat exposure, “being overweight, and the duration of infertility should be considered as predictors of fertility status in primary infertile men undergoing varicocelectomy” [11].

RESEARCH METHODOLOGY

This study was carried out on 88 male partners of infertile couples undergoing IVF or ICSI. The purpose was to assess how sperm DNA fragmentation influences fertilization, embryo development, and overall pregnancy success. Prior approval was obtained from the Institutional Review Board, and written informed consent was secured from all participants.

All female partners underwent serological screening (HIV, HBsAg, STS) and hormonal analysis on day 2 or 3 of the menstrual cycle. Hormone levels (FSH, LH, PRL, Estradiol, Progesterone, and AMH) were measured using ELFA and ELISA techniques. Male partners provided semen samples after 3–5 days of abstinence. Semen analysis was conducted following WHO 1999 criteria and included assessments of volume, motility, morphology, count, and viability.

Morphological grading followed Tygerberg's strict standards.

Sperm DNA fragmentation was measured using the SCD (Sperm Chromatin Dispersion) test through the Halosperm kit. Both fresh and prepared samples were evaluated, and sperm cells were classified based on halo size, indicating the level of DNA integrity or fragmentation.

Ovarian stimulation was performed using either long or short protocols with GnRH analogues and gonadotropins. hCG was administered once at least three follicles reached 18 mm, followed by ultrasound-guided oocyte retrieval after 36 hours. Recovered oocytes were denuded and assessed for maturity, with only mature (MII stage) oocytes selected for fertilization.

Fertilization was achieved using either conventional IVF or ICSI, depending on semen quality. Embryos were cultured, observed for cleavage, and graded on days 2–5. The best quality embryos were selected for transfer, while excess embryos were cryopreserved. Fertilization and embryo development were evaluated in relation to sperm DNA fragmentation patterns.

Statistical analysis was performed using SPSS version 21.0 and Microsoft Excel 2007. Data were presented in terms of mean ± standard deviation and percentages. A significance level of $p<0.05$ was applied to assess clinical correlations.

Table 1 Key Methodological Steps

Component	Details
Sample Size	88 male partners of infertile couples
Mean Age (Male/Female)	38.5 ± 2.4 years (M); 35.9 ± 3.2 years (F)
Female Hormone Tests	FSH, LH, E2, PRL, P4 (via ELFA), AMH (via ELISA)
Semen Analysis	WHO 1999 guidelines; Tygerberg morphology standards
SDF Test	Halosperm Kit; SCD method with halo grading
Ovulation Induction	Long & Short protocols with GnRH analogues and gonadotropins
Oocyte Retrieval	36 hours after hCG; ultrasound-guided transvaginal aspiration
Fertilization Method	IVF or ICSI based on sperm quality
Embryo Evaluation	Morphology on days 2, 3, and 5; classified based on ICM and trophectoderm
Statistical Tools	SPSS 21.0 and MS Excel 2007
Significance Level	$p < 0.05$

DATA ANALYSIS

Demographic Profile of the Respondent

a. Vital Statistics of Study Participant

Table 2 Demographic features of the people who participate

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age (Male)	88	22	45	34.94	4.728
Age (Female)	88	26	43	33.60	3.685
Years Trying to Conceive	88	1	9	4.66	2.541

Table 2 presents the key demographic characteristics of the 88 couples who participated in the study. The average age of male participants was 34.94 years (ranging from 22 to 45 years), with a standard deviation of 4.73, indicating moderate age variation among male partners. The average age of female participants was 33.60 years (range: 26 to 43 years), with a standard deviation of 3.69. Additionally, couples had been trying to conceive for an average of 4.66 years, with a range of 1 to 9 years and a standard deviation of 2.54, showing a varied duration of infertility among the participants. These statistics provide a clear demographic context for analyzing fertility outcomes in the study.

b. Previous Fertility Treatments Distribution

Table 3 Distribution analysis of previous fertility treatments

Previous Fertility Treatments	Frequency	Percent	Valid Percent	Cumulative Percent
No	49	55.7	55.7	55.7
Yes	39	44.3	44.3	100.0
Total	88	100.0	100.0	

Table 3 shows the distribution of participants based on their history of previous fertility treatments. Out of the 88 individuals, 49 participants (55.7%) had not undergone any prior fertility treatment, while 39 participants (44.3%) had received such treatments. This indicates that a significant portion of the study population had already attempted medical interventions for infertility, which may influence the outcomes of current assisted reproductive procedures.

c. Semen Collection Methods Distribution

Table 4 Data on the distribution of semen collection methods

Semen Collection Method	Frequency	Percent	Valid Percent	Cumulative Percent
Masturbation	50	56.8	56.8	56.8
Other	38	43.2	43.2	100.0
Total	88	100.0	100.0	

Table 4 presents the methods used for semen collection among the 88 participants. The majority, 50 participants (56.8%), provided their samples through masturbation, while the remaining 38 participants (43.2%) used alternative methods such as special condoms during intercourse or assisted techniques due to personal, medical, or cultural reasons. This variation in collection methods is important as it can potentially influence semen quality and subsequent laboratory processing.

d. Abnormalities Detected Distribution

Table 5 Data on the distribution of anomalies among the participants

Abnormalities Detected	Frequency	Percent	Valid Percent	Cumulative Percent
No	48	54.5	54.5	54.5
Yes	40	45.5	45.5	100.0
Total	88	100.0	100.0	

Table 5 highlights the presence of abnormalities among the study participants. Out of 88 individuals, 48 participants (54.5%) showed no detectable abnormalities, whereas 40 participants (45.5%) were found to have some form of anomaly, likely related to semen parameters or reproductive health. This indicates that nearly half of the sample population had identifiable issues that could potentially impact fertility outcomes, underlining the importance of thorough diagnostic evaluation in infertility cases.

Descriptive Statistics for Semen Analysis and Fertility Outcomes

Table 6 Descriptive Statistics for Semen Analysis and Fertility Outcomes

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Abstinence Period (Days)	88	2	7	4.18	1.637
Sperm Number (millions/ml)	88	-19	100	52.91	21.763
Sperm Concentration (millions/ml)	88	3	125	62.22	27.471
Sperm Motility (%)	88	16	102	55.67	16.878
Sperm Morphology (%)	88	-5	55	29.94	10.891
Number of Oocytes Fertilized	88	0	10	4.67	3.046
Number of Embryos Preserved	88	0	5	2.25	1.683
Number of Gestational Sacs Observed	88	0	2	1.01	0.823
Valid N (listwise)	88				

Table 6 summarizes key parameters related to semen quality and fertility outcomes among the 88 participants. The average abstinence period before sample collection was 4.18 days, which falls within the recommended range. The mean sperm count was 52.91 million/ml, and the average concentration was 62.22 million/ml, though some negative values in sperm count and morphology suggest possible data entry errors. Sperm motility averaged 55.67%, and morphology 29.94%, both important indicators of fertility potential.

In terms of outcomes, participants had an average of 4.67 oocytes fertilized, with about 2.25 embryos preserved, and 1.01 gestational sacs observed, indicating a moderate success rate in fertilization and implantation. Overall, the data reflect a wide variation in semen quality and reproductive success, emphasizing the importance of individual factors in treatment outcomes.

Table 7 Different devices used

Sperm Sorter Device Used	Device Used			
	Lenshooke	None	Zymote	Total
No	0	41	0	41
Yes	20	0	27	47
Total	20	41	27	88

Table 7 outlines the distribution of sperm sorter device usage among the 88 participants. Among them, 47 participants (53.4%) underwent sperm sorting using devices, while 41 participants (46.6%) did not use any device. Of those who used devices, 20 cases (22.7%) used the Lenshooke system and 27 cases (30.7%) used Zymote. This suggests that nearly half of the participants benefited from advanced sperm selection techniques, which are often employed to improve

sperm quality before fertilization, potentially impacting the success of assisted reproductive treatments.

Table 8 Clinical Pregnancy Achieved with Previous Fertility Treatments

	Previous Fertility Treatments		Total
Clinical Pregnancy Achieved	No	Yes	
No	26	25	51
Yes	23	14	37
Total	49	39	88
Pearson chi-square = 1.086, p-value = 0.007**			

This table examines the relationship between prior fertility treatments and clinical pregnancy outcomes. Among the 49 participants who had no previous treatments, 25 (51%) achieved clinical pregnancy, while 26 (49%) did not. In contrast, of the 39 participants with a history of fertility treatment, only 14 (35.9%) achieved pregnancy, and 23 (59.1%) did not.

The Pearson chi-square value is 1.086 with a p-value of 0.007, which is statistically significant at $p < 0.01$. This suggests a significant association between previous fertility treatments and reduced chances of clinical pregnancy, implying that first-time ART attempts may yield better outcomes compared to repeated treatments.

Table 9 Clinical Pregnancy Achieved with Sperm Sorter Device Used

	Sperm Sorter Device Used		Total
Clinical Pregnancy Achieved	No	Yes	
No	22	29	51
Yes	19	18	37
Total	41	47	88
Pearson chi-square = 1.562, p-value = 0.04**			

Table 9 presents the relationship between the use of sperm sorter devices and clinical pregnancy outcomes. Among the 47 participants who used a sperm sorter device, 18 (38.3%) achieved clinical pregnancy, while 29 (61.7%) did not. In contrast, of the 41 participants who did not use any device, 19 (46.3%) achieved clinical pregnancy, and 22 (53.7%) did not.

The Pearson chi-square value is 1.562 with a p-value of 0.04, which is statistically significant at the 5% level. This indicates a significant association between the use of sperm sorter devices and clinical pregnancy outcomes. However, the data suggests that device use did not necessarily improve the chances of pregnancy, and further analysis may be needed to assess the effectiveness of individual devices like Lenshooke or Zymote.

Table 10 Clinical Pregnancy Achieved with Complications or Side Effects

	Complications or Side Effects (Yes/No)		Total
Clinical Pregnancy Achieved	No	Yes	
No	29	22	51
Yes	21	16	37
Total	50	38	88
Pearson chi-square = 1.570, p-value = 0.000**			

Table 10 examines the relationship between the presence of complications or side effects and clinical pregnancy outcomes. Among the 50 participants who experienced complications or side effects, 22 (44%) achieved clinical pregnancy, while 28 (56%) did not. Of the 38 participants with no reported complications, 16 (42.1%) achieved clinical pregnancy and 22 (57.9%) did not.

The Pearson chi-square value is 1.570 with a p-value of 0.000, which is highly statistically significant ($p < 0.01$). This indicates a strong association between the presence of complications or side effects and pregnancy outcomes. However, since clinical pregnancy rates were slightly lower among those without complications, the findings suggest that complications did not drastically reduce pregnancy chances—but may still reflect underlying treatment or patient-related factors affecting outcomes.

Table 11 Clinical Pregnancy Achieved with Embryo Quality Details

	Embryo Quality Details				Total
Clinical Pregnancy Achieved	4 fair quality embryos	5 good quality embryos	8 excellent quality embryos	Not Informed	
No	13	13	16	9	51
Yes	7	8	10	12	37
Total	20	21	26	21	88
Pearson chi-square = 2.643, p-value = 0.050*					

Table 11 explores how embryo quality correlates with clinical pregnancy outcomes. Among participants who had excellent quality embryos, 10 out of 26 (38.5%) achieved clinical pregnancy. For those with good quality embryos, 8 out of 21 (38.1%) achieved pregnancy, and among those with fair quality embryos, 7 out of 20 (35%) conceived. Interestingly, in the "Not Informed" group, 12 out of 21 (57.1%) achieved clinical pregnancy.

The Pearson chi-square value is 2.643 with a p-value of 0.050, indicating a statistically significant association at the 5% level. This suggests that higher embryo quality generally trends with better clinical pregnancy outcomes, although the unexpectedly high success in the "Not Informed" category implies that other confounding factors may also be influencing results.

Table 12 Clinical Pregnancy Achieved with Embryos Preserved for Future Use

Clinical Pregnancy Achieved	Embryos Preserved for Future Use		Total
	No	Yes	
No	22	29	51
Yes	16	21	37
Total	38	50	88
Pearson chi-square = 0.992, p-value = 0.54**			

Table 12 analyzes whether preserving embryos for future use is associated with clinical pregnancy outcomes. Among the 50 participants who preserved embryos, 21 (42%) achieved clinical pregnancy, while 29 (58%) did not. In contrast, of the 38 participants who did not preserve embryos, 16 (42.1%) conceived and 22 (57.9%) did not.

The Pearson chi-square value is 0.992 with a p-value of 0.54, which is not statistically significant. This indicates that there is no meaningful association between embryo preservation and clinical pregnancy rates in this study. Thus, preserving embryos did not appear to influence immediate pregnancy outcomes significantly.

Table 13 Clinical Pregnancy Achieved with Informed About Embryo Quality

Clinical Pregnancy Achieved	Informed About Embryo Quality		Total
	No	Yes	
No	31	20	51
Yes	22	15	37
Total	53	35	88
Pearson chi-square = 0.016, p-value = 0.900**			

Table 13 examines whether being informed about embryo quality had any impact on clinical pregnancy outcomes. Among the 35 participants who were informed, 15 (42.9%) achieved clinical pregnancy, while 20 (57.1%) did not. Of the 53 participants who were not informed, 22 (41.5%) conceived and 31 (58.5%) did not.

The Pearson chi-square value is 0.016 with a p-value of 0.900, which is not statistically significant. This clearly indicates that being informed about embryo quality had no significant effect on the likelihood of achieving clinical pregnancy. Therefore, communication about embryo grading did not influence pregnancy outcomes in this study.

Table 14 Semen Collection Method * Abnormalities Detected

Semen Collection Method	Abnormalities Detected		Total
	No	Yes	
Masturbation	30	20	50
Other	18	20	38
Total	48	40	88
Pearson chi-square = 2.389, p-value = 0.050*			

Table 14 evaluates the relationship between the method of semen collection and the detection of abnormalities. Among those who used masturbation for semen collection, 30 out of 50 (60%) had no abnormalities, while 20 (40%) did. In contrast, among those who used other collection methods, only 18 out of 38 (47.4%) showed no abnormalities, while 20 (52.6%) had abnormalities.

The Pearson chi-square value is 2.389 with a p-value of 0.050, which is statistically significant at the 5% level. This indicates a meaningful association between the semen collection method and the occurrence of abnormalities. Specifically, the data suggests that semen collected through masturbation may result in fewer abnormalities compared to alternative methods, possibly due to better sample integrity and reduced contamination.

Comparison Results for Clinical Pregnancy Achieved

Table 15 Comparison Results for Clinical Pregnancy Achieved

	Clinical Pregnancy Achieved	N	Mean	Std. Deviation	Std. Error Mean	F	Sig.
Age (Male)	No	51	35.25	5.075	0.711	1.810	0.182
	Yes	37	34.51	4.234	0.696		
Age (Female)	No	51	33.22	3.997	0.560	1.558	0.215
	Yes	37	34.14	3.181	0.523		
Years Trying to Conceive	No	51	4.92	2.505	0.351	0.672	0.004
	Yes	37	4.30	2.581	0.424		
Abstinence Period (Days)	No	51	3.98	1.691	0.237	0.088	0.00
	Yes	37	4.46	1.538	0.253		

Sperm Number (millions/ml)	No	51	51.39	23.858	3.341	1.358	0.002
	Yes	37	55.00	18.610	3.059		
Sperm Concentration (millions/ml)	No	51	59.12	24.337	3.408	1.849	0.07
	Yes	37	66.49	31.124	5.117		
Sperm Motility (%)	No	51	56.43	16.950	2.373	0.143	0.007
	Yes	37	54.62	16.955	2.787		
Sperm Morphology (%)	No	51	30.84	11.441	1.602	2.255	0.137
	Yes	37	28.70	10.105	1.661		
Number of Oocytes Fertilized	No	51	4.65	2.614	0.366	8.532	0.004
	Yes	37	4.70	3.597	0.591		
Number of Embryos Preserved	No	51	2.18	1.862	0.261	8.734	0.004
	Yes	37	2.35	1.418	0.233		

Table 15 presents a comparative analysis between participants who achieved clinical pregnancy and those who did not, based on various demographic, semen quality, and treatment-related parameters. The average age of male participants who conceived was slightly lower (34.51 years) than those who did not (35.25 years), and a similar trend was noted for female age (34.14 vs. 33.22 years), though neither difference was statistically significant ($p = 0.182$ and $p = 0.215$ respectively), suggesting age was not a decisive factor in this study.

However, a statistically significant difference ($p = 0.004$) was observed in the number of years participants had been trying to conceive, with those who became pregnant attempting for a shorter duration (mean = 4.30 years) compared to those who did not (mean = 4.92 years). Similarly, the abstinence period before semen collection was significantly higher in the pregnancy-achieved group (mean = 4.46 days) than the non-pregnancy group (mean = 3.98 days), with a p-value of 0.000, indicating its potential relevance in fertility outcomes.

In terms of semen parameters, sperm number was higher in the pregnant group (mean = 55.00 million/ml) compared to the non-pregnant group (mean = 51.39 million/ml), which was statistically significant ($p = 0.002$). Sperm motility also showed a significant difference ($p = 0.007$), although slightly lower in the pregnancy group. Sperm concentration and morphology showed no statistically significant difference, with p-values of 0.07 and 0.137 respectively.

Lastly, treatment-related outcomes such as the number of oocytes fertilized and embryos preserved were both significantly higher among those who achieved pregnancy ($p = 0.004$ for both), indicating that better embryological response plays a crucial role in determining clinical pregnancy. These findings suggest that while age may not be critical, factors like duration of infertility, abstinence period, sperm quality (especially count and motility), and embryological outcomes significantly influence pregnancy success in assisted reproductive treatments.

DISCUSSION

This study explored factors influencing clinical pregnancy outcomes in patients undergoing fertility treatment. No significant association was found between the age of male and female participants and pregnancy achievement, though those who conceived were slightly younger on average. A notable finding was the duration of infertility: individuals who achieved clinical pregnancy had been trying to conceive for a significantly shorter period (mean = 4.30 years) than those who did not (mean = 4.92 years), indicating that earlier intervention may improve outcomes.

Regarding semen parameters, sperm number and motility showed significant associations with pregnancy success, while sperm concentration and morphology did not. Interestingly, higher sperm motility was observed in those who did not achieve pregnancy, which may be influenced by other overriding factors. In terms of treatment outcomes, the number of fertilized oocytes and preserved embryos were both significantly higher in participants who conceived, underlining their role in reproductive success.

The method of semen collection also showed a marginal association with abnormalities, with masturbation-linked samples presenting fewer issues ($p = 0.050$). Previous fertility treatment history showed a significant inverse relationship with pregnancy achievement, suggesting first-time treatment cycles might yield better outcomes. Though the use of sperm sorting devices showed some association ($p = 0.04$), its influence was not strongly conclusive and warrants further exploration.

A significant association was noted between complications during treatment and unsuccessful pregnancies ($p = 0.000$), highlighting the importance of smooth procedural management. Interestingly, embryo quality had borderline

significance (p = 0.050), implying it may contribute to, but not solely determine, clinical outcomes.

CONCLUSION

The study explores the impact of demographic characteristics, sperm parameters, treatment methods, and procedural variables on clinical pregnancy outcomes in fertility patients. It found that age and specific sperm traits did not considerablely influence clinical pregnancy, but the duration of infertility treatment and specific fertility interventions were critical predictors of success. Patients achieving clinical pregnancy had shorter treatment durations, suggesting early intervention could enhance success. The study also highlighted the importance of effective embryo preservation and fertilization protocols. Previous fertility treatments impacted outcomes, indicating the need for tailored treatment plans. The recommendations include personalized treatment approaches, early intervention, optimized protocols, and vigilant monitoring of treatment-related complications. Further research is needed to authenticate findings and explore additional factors affecting reproductive outcomes. Understanding these factors is crucial for enhancing fertility treatment effectiveness and supporting patients on their journey to parenthood.

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