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Pattern of Semen Analysis Abnormalities Among Male Partners of Infertile Couples Attending a Tertiary Care Hospital in Rajasthan: A Cross-Sectional Study

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ABSTRACT

Background: Male factor infertility contributes significantly to the global burden of infertility and is commonly evaluated using semen analysis. Abnormal semen parameters such as oligozoospermia, asthenozoospermia, teratozoospermia, and azoospermia may adversely affect fertility outcomes. Limited regional data are available regarding semen abnormalities among infertile males in Rajasthan.
Aim and Objectives: To evaluate the pattern of semen analysis abnormalities among male partners of infertile couples attending a tertiary care hospital in Rajasthan and to determine the frequency of different abnormal semen parameters.
Materials and Methods: This hospital-based cross-sectional observational study was conducted in the Department of Pathology of a tertiary care hospital in Rajasthan from January 2026 to April 2026. A total of 160 male partners of infertile couples were included using consecutive sampling. Semen samples were collected after 2–7 days of abstinence and analyzed according to WHO laboratory guidelines. Semen parameters including sperm concentration, motility, morphology, semen volume, and liquefaction time were assessed. Statistical analysis was performed using SPSS version 25.0.
Results: The majority of participants belonged to the 31–35 years age group, and primary infertility was more common than secondary infertility. Abnormal semen parameters were observed in 66.2% of participants. Reduced sperm motility (44.4%) and reduced sperm concentration (40.0%) were the most common abnormalities. Oligozoospermia was the most frequent semen abnormality, followed by asthenozoospermia and oligoasthenozoospermia. A statistically significant association was found between longer duration of infertility and abnormal semen parameters (p=0.02).
Conclusion: Abnormal semen parameters are highly prevalent among male partners of infertile couples in the studied population. Semen analysis remains a valuable and cost-effective diagnostic tool for evaluation of male infertility. Early identification of semen abnormalities may facilitate timely management and improve reproductive outcomes.

Keywords: *Male Infertility, Semen Analysis, Oligozoospermia, Asthenozoospermia, Infertile Couples.*

INTRODUCTION

Infertility is recognized as a major public health issue affecting couples worldwide and has significant psychological, social, and economic consequences. The World Health Organization defines infertility as the inability to achieve pregnancy after 12 months or more of regular unprotected sexual intercourse.[1] Globally, infertility affects nearly 15% of reproductive-age couples, with male factors contributing either independently or in combination in approximately 40–50% of cases.[2] Traditionally, infertility has often been perceived predominantly as a female health problem, particularly in developing

countries; however, increasing evidence suggests that male reproductive abnormalities play an equally important role in unsuccessful conception.[3]

Semen analysis remains the cornerstone investigation for the evaluation of male infertility because it provides objective assessment of spermatogenesis, sperm function, and patency of the male reproductive tract.[4] Parameters commonly evaluated include semen volume, sperm concentration, motility, morphology, vitality, liquefaction time, and viscosity. The World Health Organization has periodically revised laboratory standards for semen examination to improve reliability and comparability of results across institutions.[5] Abnormal semen parameters such as oligozoospermia, asthenozoospermia, teratozoospermia, azoospermia, and oligoasthenoteratozoospermia are associated with reduced fertility potential and may indicate underlying endocrine, infectious, genetic, environmental, or lifestyle-related etiologies.[6]

The burden of male infertility is increasingly becoming evident in South Asian countries, including India, due to changing lifestyle patterns, environmental pollution, occupational exposures, smoking, alcohol consumption, obesity, and delayed parenthood.[7] Several hospital-based studies from India have demonstrated a substantial proportion of abnormal semen profiles among male partners of infertile couples, with varying prevalence of oligozoospermia and asthenozoospermia across regions.[8] Regional differences in dietary habits, socioeconomic conditions, environmental exposures, and healthcare-seeking behavior may contribute to variations in semen characteristics among different populations.[9]

In Rajasthan, infertility clinics in tertiary care hospitals are witnessing a rising number of couples seeking evaluation and assisted reproductive services. Despite this increasing clinical burden, there is limited published literature specifically describing the patterns of semen abnormalities among male partners of infertile couples in this region. Most available Indian studies are either conducted in metropolitan centers or involve smaller sample sizes, thereby limiting the generalizability of findings to the local population.[10] Furthermore, understanding the spectrum of semen abnormalities in a tertiary care setting is important for guiding diagnostic evaluation, counseling, and early management strategies.

Assessment of semen patterns in infertile men can also help identify preventable risk factors and facilitate timely referral for specialized reproductive care. Early identification of abnormal semen parameters may improve treatment outcomes and reduce the emotional and financial burden experienced by affected couples. In addition, data generated from institutional studies contribute to regional epidemiological evidence and may support planning of reproductive health services.

Therefore, the present study was undertaken to evaluate the patterns of semen analysis among male partners of infertile couples attending a tertiary care hospital in Rajasthan. The objectives of the study were to determine the distribution of normal and abnormal semen parameters and to assess the frequency of different semen abnormalities among the study participants.

METHODOLOGY

Study Design: The present study was a hospital-based cross-sectional observational study conducted to assess the patterns of semen analysis among male partners of infertile couples attending a tertiary care hospital.

Study Setting: The study was conducted in the Department of Pathology at a tertiary care hospital in Rajasthan. Semen samples were processed and analyzed in the central clinical laboratory following standard laboratory protocols and World Health Organization guidelines for semen examination.

Study Duration: The study was conducted over a period of four months from January 2026 to April 2026.

Study Population: The study population comprised male partners of infertile couples attending the infertility clinic or referred for semen analysis to the Department of Pathology during the study period.

Inclusion Criteria

- Male partners of infertile couples presenting to the tertiary care hospital during the study period
- Age ≥18 years
- Individuals willing to participate and provide written informed consent
- Subjects providing semen samples after recommended abstinence period of 2–7 days

Exclusion Criteria

- Individuals with history of vasectomy or known obstructive azoospermia
- Men receiving chemotherapy or radiotherapy
- Patients with acute febrile illness at the time of semen collection
- Improperly collected or inadequate semen samples
- Repeat samples from the same individual during the study period

Sample Size: The sample size was calculated using the formula for single population proportion,

$$n = \frac{Z^2 \times p \times q}{d^2}$$

Where:

- (n) = required sample size
- (Z) = standard normal variate at 95% confidence interval = 1.96
- (p) = prevalence of abnormal semen parameters among infertile males from previous literature = 68% (0.68)[8]
- (q = 1-p = 0.32)
- (d) = allowable error = 7.5% (0.075)

Substituting the values:

$$n = \frac{(1.96)^2 \times 0.68 \times 0.32}{(0.075)^2}$$

$$n = \frac{3.84 \times 0.2176}{0.005625}$$

$$n = \frac{0.835}{0.005625}$$

$$n \approx 148$$

Considering possible incomplete records and non-response, the final sample size was rounded to 160 participants.

Sampling Technique: A consecutive sampling technique was used. All eligible male partners of infertile couples attending the hospital during the study period and fulfilling the inclusion criteria were included consecutively until the required sample size of 160 was achieved.

Data Collection Tools and Procedure: After obtaining informed written consent, demographic and clinical details including age, duration of infertility, type of infertility, and relevant medical history were recorded using a predesigned semi-structured proforma. Participants were instructed regarding proper semen sample collection according to WHO recommendations. Semen samples were collected by masturbation in sterile wide-mouthed containers after 2–7 days of sexual abstinence. Samples were allowed to liquefy at room temperature and analyzed within one hour of collection. Macroscopic examination included assessment of semen volume, color, viscosity, liquefaction time, and pH. Microscopic examination included sperm concentration, total sperm count, motility, morphology, and presence of pus cells or debris. Semen analysis was performed according to the World Health Organization laboratory manual for examination and processing of human semen (6th edition).[5] Semen abnormalities such as oligozoospermia, asthenozoospermia, teratozoospermia, azoospermia, and oligoasthenoteratozoospermia were categorized based on WHO reference values.

Study Variables: The independent variables included age, duration of infertility, type of infertility, abstinence period, and relevant clinical history. The dependent variables were semen analysis parameters including semen volume, sperm concentration, sperm motility, sperm morphology, sperm count, liquefaction time, and categorized semen abnormalities. The prevalence and distribution of abnormal semen patterns among study participants were assessed.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Descriptive statistics were expressed as mean with standard deviation for continuous variables and frequency with percentages for categorical variables. Chi-square test or Fisher's exact test was used for comparison of categorical variables wherever appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants prior to enrollment. Confidentiality and anonymity of participant information were strictly maintained throughout the study. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for biomedical research involving human participants.

RESULTS

A total of 160 male partners of infertile couples were included in the study. The majority of participants belonged to the 31–35 years age group, followed by 26–30 years (Table 1).

Table 1: Distribution of Study Participants According to Age Group (n=160)

Age Group (years)	Frequency (n)	Percentage (%)

21–25	18	11.3
26–30	52	32.5
31–35	61	38.1
36–40	22	13.8
>40	7	4.3
Total	**160**	**100.0**

Primary infertility was more common than secondary infertility, and most couples had infertility duration between 2 and 5 years (Table 2).

Table 2: Distribution of Participants According to Type and Duration of Infertility (n=160)

Variable	**Frequency (n)**	**Percentage (%)**
Type of infertility		
Primary infertility	108	67.5
Secondary infertility	52	32.5
Duration of infertility (years)		
<2 years	36	22.5
2–5 years	89	55.6
>5 years	35	21.9
Total	**160**	**100.0**

Analysis of semen parameters revealed that reduced sperm motility and reduced sperm concentration were among the most common abnormalities observed. Abnormal sperm morphology was identified in more than one-third of participants, while delayed liquefaction time was comparatively less frequent (Table 3).

Table 3: Distribution of Semen Analysis Findings Among Study Participants (n=160)

Semen Parameter	**Category**	**Frequency (n)**	**Percentage (%)**
Semen volume	Normal	142	88.8
	Reduced	18	11.2
Sperm concentration	Normal	96	60.0
	Reduced	64	40.0
Sperm motility	Normal	89	55.6
	Reduced	71	44.4
Sperm morphology	Normal	101	63.1
	Abnormal	59	36.9
Liquefaction time	Normal	147	91.9
	Delayed	13	8.1

Normozoospermia was observed in approximately one-third of the study participants. Among abnormal semen patterns, oligozoospermia was the most common finding, followed by asthenozoospermia and oligoasthenozoospermia. Azoospermia constituted a smaller proportion of cases (Table 4).

Table 4: Pattern of Semen Abnormalities Among Study Participants (n=160)

Semen Pattern	**Frequency (n)**	**Percentage (%)**
Normozoospermia	54	33.8
Oligozoospermia	29	18.1
Asthenozoospermia	25	15.6
Teratozoospermia	14	8.8
Oligoasthenozoospermia	18	11.3
Oligoasthenoteratozoospermia	12	7.5
Azoospermia	8	5.0
Total	**160**	**100.0**

A statistically significant association was observed between longer duration of infertility and presence of abnormal semen parameters (p=0.02). The proportion of abnormal semen analysis findings increased progressively with increasing duration of infertility (Table 5).

Table 5: Association Between Duration of Infertility and Abnormal Semen Parameters (n=160)

Duration of Infertility	Normal Semen Analysis n (%)	Abnormal Semen Analysis n (%)	Total	p-value
<2 years	18 (50.0)	18 (50.0)	36	**0.02**
2–5 years	29 (32.6)	60 (67.4)	89	
>5 years	7 (20.0)	28 (80.0)	35	
Total	**54 (33.8)**	**106 (66.2)**	**160**	

DISCUSSION

The present hospital-based cross-sectional study evaluated the patterns of semen analysis among male partners of infertile couples attending a tertiary care hospital in Rajasthan. The study demonstrated that abnormal semen parameters were present in nearly two-thirds of the participants, highlighting the substantial contribution of male factors to infertility. Oligozoospermia emerged as the most common abnormality, followed by asthenozoospermia and combined defects such as oligoasthenozoospermia. Additionally, a significant association was observed between increasing duration of infertility and abnormal semen findings.

The majority of participants in the present study belonged to the 26–35 years age group. Similar age distribution has been reported in several Indian studies evaluating infertile males.[8,10] This finding may be attributed to delayed healthcare-seeking behavior and increased awareness regarding infertility treatment during the peak reproductive years. The predominance of primary infertility observed in the current study is also consistent with findings from previous hospital-based studies conducted in India and other developing countries.[3,8]

In the present study, abnormal semen parameters were identified in 66.2% of participants, while normozoospermia was observed in approximately one-third of cases. Comparable observations have been reported by Babu et al., who documented a high prevalence of semen abnormalities among infertile men attending tertiary care facilities.[8] Similarly, Kumar and Singh emphasized that male factor abnormalities contribute substantially to infertility burden globally.[3] The relatively high frequency of abnormal semen profiles in the current study may reflect changing lifestyle patterns, environmental exposures, occupational stress, tobacco use, and nutritional factors increasingly prevalent in urban and semi-urban populations.

Reduced sperm concentration was identified in 40% of study participants. Oligozoospermia was the most common isolated abnormality observed. This finding is in agreement with studies from North India and other South Asian regions, where oligozoospermia constituted a major proportion of semen abnormalities.[10,11] Spermatogenic impairment may result from hormonal imbalance, varicocele, genital tract infections, oxidative stress, and environmental toxins. In Rajasthan, increasing exposure to heat, industrial pollutants, and lifestyle-related risk factors may also influence sperm production and quality.

Reduced sperm motility was another common finding in the present study. Asthenozoospermia and combined motility defects accounted for a significant proportion of abnormal semen patterns. Similar observations have been documented by Mishra et al., who reported associations between sedentary lifestyle, smoking, and decreased sperm motility.[9] Impaired motility adversely affects the fertilizing potential of spermatozoa and may contribute significantly to prolonged infertility duration. The occurrence of combined abnormalities such as oligoasthenoteratozoospermia further indicates multifactorial impairment of spermatogenesis and sperm function.

Abnormal sperm morphology was observed in more than one-third of participants in the current study. Morphological abnormalities are considered important predictors of fertilization potential and reproductive outcomes.[4] Variations in morphology prevalence across studies may be related to differences in laboratory techniques, observer variability, and WHO reference criteria used for interpretation. The use of standardized WHO guidelines in the present study likely improved consistency and reliability of semen analysis reporting.

Azoospermia was identified in 5% of participants, which is comparable with previously published Indian studies.[10,11] Azoospermia may result from obstructive or non-obstructive causes and requires further hormonal, genetic, and radiological evaluation. Early detection is clinically important because timely intervention and assisted reproductive techniques may improve reproductive outcomes in selected patients.

The present study also demonstrated a statistically significant association between longer duration of infertility and abnormal semen parameters. Participants with infertility duration exceeding five years had a higher frequency of abnormal

semen profiles compared to those with shorter duration. Similar associations have been reported in previous studies evaluating infertility duration and semen quality.[11] Delayed evaluation and treatment may worsen psychological distress and reduce the likelihood of spontaneous conception, emphasizing the need for early infertility assessment in couples.

The findings of the present study have important clinical and public health implications. Routine semen analysis remains a simple, cost-effective, and essential investigation for early identification of male factor infertility. Increased awareness regarding modifiable lifestyle factors, occupational hazards, and timely medical consultation may help improve reproductive health outcomes. The study also highlights the need for strengthening andrological evaluation services in tertiary care centers, particularly in resource-limited settings.

The strengths of the present study include the use of standardized WHO semen analysis guidelines and inclusion of a relatively adequate sample size from a tertiary care setting. However, certain limitations should be acknowledged. Being a single-center hospital-based study, the findings may not be generalizable to the broader community population. Detailed evaluation of hormonal profile, genetic factors, lifestyle variables, and female partner factors was not performed. In addition, causal relationships could not be established because of the cross-sectional study design.

CONCLUSION

The present study demonstrated that abnormal semen parameters were highly prevalent among male partners of infertile couples attending a tertiary care hospital in Rajasthan. Oligozoospermia and asthenozoospermia were the most frequently observed abnormalities, while combined defects such as oligoasthenozoospermia and oligoasthenoteratozoospermia were also identified in a considerable proportion of participants. Reduced sperm concentration, impaired motility, and abnormal morphology constituted the major semen abnormalities observed during evaluation. A significant association between longer duration of infertility and abnormal semen findings highlights the importance of early assessment and timely intervention in infertile couples. Routine semen analysis remains a simple, economical, and valuable diagnostic tool for identification of male factor infertility in resource-limited settings. The findings of the study emphasize the need for increased awareness regarding male reproductive health, early infertility evaluation, and counseling regarding modifiable lifestyle risk factors. Further multicentric studies incorporating hormonal, genetic, and environmental assessments are recommended to better understand determinants of male infertility in the regional population.

DECLARATIONS

Funding: No funding was received for this study.
Conflict of Interest: The authors declare no conflict of interest.
Consent: Written informed consent was obtained from all study participants before enrollment.
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