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EVALUATION OF OLIGOZOOSPERMIA IN MALE INFERTILITY: UNRAVELLING EPIDEMIOLOGICAL PATTERNS AND EXPLORING ASSOCIATED RISK FACTORS

Obstetrics & Gynaecology

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ABSTRACT

Background: Infertility affects 15% of couples, with male factor infertility, particularly oligozoospermia being a significant contributor. This study explores oligozoospermia's prevalence, demographic variations, and associated risk factors. It aims to inform public health strategies and clinical interventions by providing a comprehensive understanding of male infertility, emphasizing the dynamic nature of societal influences on reproductive health. **Methods:** A cross-sectional observational study was conducted at a tertiary care teaching hospital, for a total duration of 1.5 years after obtaining ethical approval. Participants satisfying the inclusion criteria were enrolled in the study. Data collection involved demographic, clinical, lifestyle information, and semen analysis. Appropriate statistical tests were applied to perform the data analysis. **Results:** Among 389 participants with infertility, 55.8% had oligozoospermia. The mean age was 35.2 ± 2.4 years, with the majority falling within the 30-39 years age group. Type 1 infertility was most common and evident in around 96% of the participants. The majority of the participants with oligozoospermia were from the age group of 30-34 years. About 24% of participants exhibited a very low frequency of coitus. Elevated BMI, longer duration of infertility, history of smoking, alcohol consumption, and various comorbidities were associated with increased risk of infertility. **Conclusion:** Oligozoospermia prevalence is substantial, necessitating targeted interventions and public health strategies. Risk factors, especially age, lifestyle choices, and co-morbidities provide valuable insights for personalized male infertility management and preventive measures.

KEYWORDS

Oligozoospermia, Male infertility, Epidemiological patterns, Risk factors, Reproductive outcomes

INTRODUCTION

Infertility, a prevailing concern worldwide, is a multifaceted reproductive health issue that affects approximately 15% of couples attempting to conceive.[1] Among the various factors contributing to infertility, male factor infertility, characterized by abnormalities in sperm quantity, quality, or both, constitutes a significant proportion of cases.[2] Male infertility poses a significant challenge to reproductive health globally. Oligozoospermia, a condition characterized by a lower-than-normal sperm count in semen, plays a significant role in male infertility. Defined by a sperm concentration below 15 million sperm per millilitre, oligozoospermia can hinder the chances of successful conception.[3] It emerges as a prominent contributor to male infertility, necessitating a comprehensive investigation to elucidate its epidemiological patterns and associated risk factors. Understanding and addressing oligozoospermia are vital steps in managing male infertility, facilitating informed decisions on appropriate interventions for couples aspiring to conceive.

The etiology of oligozoospermia is multifactorial, involving a complex interplay of genetic predisposition, environmental exposures, lifestyle factors, and certain medical conditions.[4] Epidemiological studies form the cornerstone for understanding the prevalence and distribution of oligozoospermia, offering valuable insights into the demographic landscape of affected populations. This study aims to thoroughly assess oligozoospermia by examining its occurrence, prevalence, and demographic features using a comprehensive epidemiological approach. The global prevalence of male infertility is underscored by the widespread occurrence of oligozoospermia, with notable disparities observed across regions and populations. The demographic patterns of oligozoospermia remain insufficiently characterized, necessitating a comprehensive evaluation to discern potential geographical, racial, and age-related variations.[5] This study aims to bridge existing knowledge gaps by elucidating the epidemiological nuances of oligozoospermia, unravelling its prevalence in diverse populations and identifying key demographic determinants.

Unravelling the intricate web of risk factors associated with oligozoospermia is crucial for developing targeted interventions and preventive strategies. This study delves into the exploration of risk factors, ranging from genetic predispositions and endocrine disruptors to lifestyle factors such as smoking, obesity, and occupational exposures.[6] By systematically examining these factors, this study aims to provide a detailed understanding of the modifiable and non-modifiable determinants influencing oligozoospermia.

Advancements in reproductive medicine and technology have highlighted the importance of identifying and addressing male factor infertility, emphasizing the need for a comprehensive evaluation of oligozoospermia.[7] This study endeavors to contribute to the existing body of knowledge by elucidating the epidemiological landscape of oligozoospermia and unravelling its associated risk factors. Such insights are essential not only for understanding the burden of male infertility on a global scale but also for informing public health strategies and clinical interventions tailored to the specific needs of affected populations.

Furthermore, as the societal landscape evolves, with changing patterns of work, lifestyle, and environmental exposures, the impact on male reproductive health becomes increasingly pertinent.[8] This study recognizes the dynamic nature of these influences and seeks to explore contemporary factors that may contribute to the prevalence of oligozoospermia.

The significance of this study lies in its potential to inform public health strategies, clinical interventions, and reproductive health policies. By unravelling the epidemiological patterns of oligozoospermia and elucidating associated risk factors, we aim to contribute valuable knowledge that can guide healthcare professionals, policymakers, and researchers in devising effective measures to address male infertility on a global scale.

The present study aimed to evaluate the epidemiological patterns and explore the associated risk factors of oligozoospermia in male infertility.

Methods

This cross-sectional observational study was conducted at a tertiary care teaching hospital, Ahmedabad for a total duration of 1.5 years from June 2022 to November 2023. Ethical approval was obtained from the Institutional Review Board (IRB) before commencing the study. The study participants were enrolled as per the below-mentioned inclusion criteria.

Inclusion Criteria:

- Males aged 18 to 50 years, visiting the IVF (In vitro fertilization) OPD of the study site and seeking medical assistance for infertility, defined as the inability to achieve conception despite regular

unprotected intercourse for at least 12 months.
- Male participants with diagnosed oligozoospermia on HSA (Human sperm assay)

Exclusion Criteria:
- Individuals with a history of known genetic disorders affecting fertility, previous vasectomy, recent chemotherapy or radiation therapy, and those with anatomical abnormalities of the reproductive tract identified through medical history or initial examinations.
- Individuals with age > 50 years
- Male participants with normal sperm count on HSA

Sample Size Calculation:
The sample size was calculated based on the prevalence of oligozoospermia reported in previous studies, aiming for a confidence level of 95% and a margin of error of 5%.

$n = [z^2 * p(1-p)] / e^2$

Where:
- n is the sample size
- Z is the Z-score corresponding to the desired confidence level (for 95%, Z≈1.96)
- p is the estimated prevalence (proportion) of the condition (in this case, 50% or 0.5)
- E is the margin of error (in this case, 5% or 0.05)

So, n = 384.16 ≈ 385

Data Collection:
Eligible study participants were approached and briefed about the study rationale. Participants were required to provide informed consent for inclusion in the study. Demographic data, medical history, lifestyle factors, and relevant clinical information of the study participants were collected using a structured semi open questionnaire administered through face-to-face interviews. Semen samples were obtained by masturbation following 2–7 days of sexual abstinence and analyzed according to the World Health Organization (WHO) guidelines for semen analysis. Semen parameters, including sperm concentration, motility, morphology, and volume, were assessed. Additional tests such as sperm DNA fragmentation was measured to provide a comprehensive evaluation of semen quality.

Epidemiological Analysis & Exploration of Risk Factors:
Descriptive statistics was employed to analyze demographic characteristics, presenting a comprehensive overview of the study population. The prevalence of oligozoospermia was calculated, and its association with demographic variables was assessed using appropriate statistical tests. A multivariate logistic regression analysis was conducted to identify independent risk factors associated with oligozoospermia. Potential risk factors examined included age, BMI, smoking status, alcohol consumption, occupation, exposure to environmental toxins, comorbidities, and duration of infertility. Adjustments for confounding variables were made to obtain accurate estimates of the association between each risk factor and oligozoospermia.

Statistical Analysis:
Statistical Package for Social Sciences (SPSS), version 20.0 was used to perform statistical evaluation of data. Descriptive statistics was presented as means with standard deviations for continuous variables, and frequencies with percentages for categorical variables. The significance level was set at $p < 0.05$.

Ethical Considerations:
This study adhered to ethical standards, ensuring the confidentiality and privacy of participants. Informed consent was obtained, and participants were provided with the option to withdraw from the study at any point without consequences. All collected data was anonymized and stored securely to protect participant identity.

RESULTS
A total of 389 participants was enrolled in the study, ensuring a diverse representation of age, socio-economic status, and geographical background.

Table 1: Socio-demographic Characteristics Of The Study Participants (n=389)

Characteristics	Values
Age (Years) (Mean ± SD)	35.2 ± 2.4
BMI (Kg/m²) (Mean ± SD)	28.6 ± 3.6
Duration of Infertility	
<5 years (n)	132
5-10 years (n)	147
>10 years (n)	110
Smoking Status	
Yes (n)	260
No (n)	129
Alcohol Consumption	
Yes (n)	213
No (n)	176
Occupation	
Manual Labourer (n)	214
Skilled Labour (n)	140
Professonal (n)	35
Environmental Toxins Exposure	
Yes (n)	202
No (n)	187
Co-morbidities	
Obesity (n)	151
Varicocele (n)	140
Erectile Dysfunction (n)	121
Chronic Hypertension (n)	46
Diabetes (n)	36
Tuberculosis (n)	09
Inguinal Hernia (n)	04

Table 1 presents the demographic characteristics of the study participants. The mean age was 35.2 ± 2.4 years, with the majority falling within the 30-39 years age group. The duration of infertility varied, with 132 participants experiencing infertility for less than 5 years, 147 for 5-10 years, and 110 for over 10 years. The majority were smokers (n=260) and alcohol consumers (n=213). Occupational distribution included 214 manual labourers, 140 skilled labourers, and 35 professionals. Co-morbidities included Obesity (n=151), Varicocele (n=140), Erectile dysfunction (n=121), Hypertension (n=46), Diabetes (n=36), Tuberculosis (n=9), and Inguinal hernia (n=4). Exposure to environmental toxins was reported by 202 participants.

Table 2: Prevalence Of Oligozoospermia Among Study Participants (n=389)

Oligozoospermia Status	Number of Participants	Prevalence (%)
Present	217	55.8%
Absent	172	44.2

Among 389 participants, 55.8% had oligozoospermia, while 44.2% did not exhibit this condition, as indicated in Table 2.

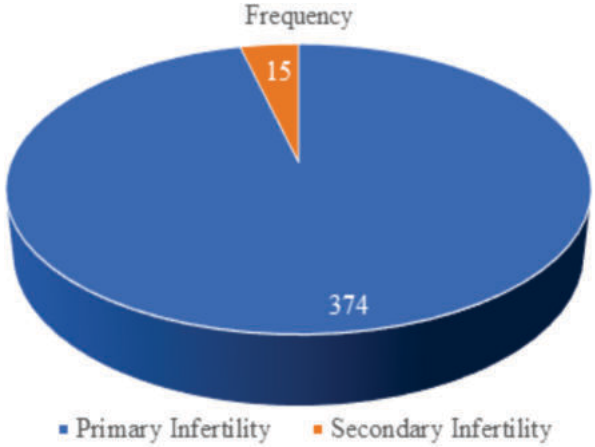

Figure 1: Frequency of Types of Infertility Among Study Participants (n=389)

Figure 1 illustrates the distribution of infertility types among study participants. Type 1 infertility was most common and evident in around 96% of the participants.

Socio-economic Status
Around 65% of participants were part of the BPL category (as per government set up), while 35% were above poverty line.

Frequency Of Coitus
About 24% of participants exhibited a very low frequency of coitus and a diminished desire for sex, while 19% encountered premature ejaculation.

Hair Distribution
About 82% of participants displayed a typical male pattern of hair distribution, while 18% exhibited a feminine pattern.

Testicular Problems
Testicular issues were identified in around 52% of the participants, primarily involving conditions such as undescended testes (10%), testicular trauma (6%), and varicocele (36%).

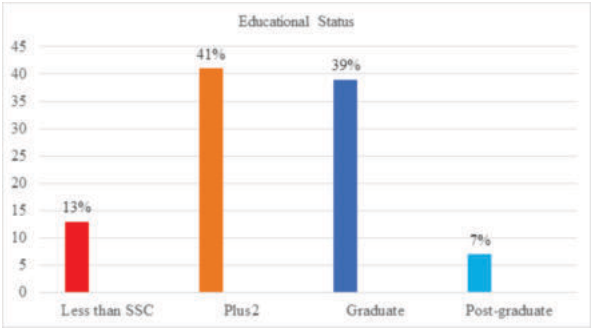

Figure 2: Educational Status Of The Study Participants

Figure 2 demonstrates the educational status of the study participants. It is evident from the figure 2, that majority of the participants were educated.

Figure 3 depicts the frequency of oligozoospermia among different age group participants. It is evident from the figure 3, that the majority of the participants with oligozoospermia were from the age group of 30-34 years, followed by 25-29 years.

Table 3 presents the results of the multivariate logistic regression analysis, identifying independent risk factors associated with oligozoospermia. Adjusting for confounding variables, the analysis revealed associations with age, BMI, smoking status, alcohol consumption, occupation, exposure to environmental toxins, comorbidities, and duration of infertility.

The semen analysis of 389 study participants revealed mean values (± SD) for sperm parameters: concentration 8.12 (± 2.14) million/mL, total sperm count 29.18 (± 1.18) million, motility 26.12% (± 3.28), morphology 2.98% (± 0.76), semen volume 0.98 (± 0.12) mL, DNA fragmentation 36.22% (± 4.12), and non-sperm cells 2.12 (± 0.14) million/mL (Table 4).

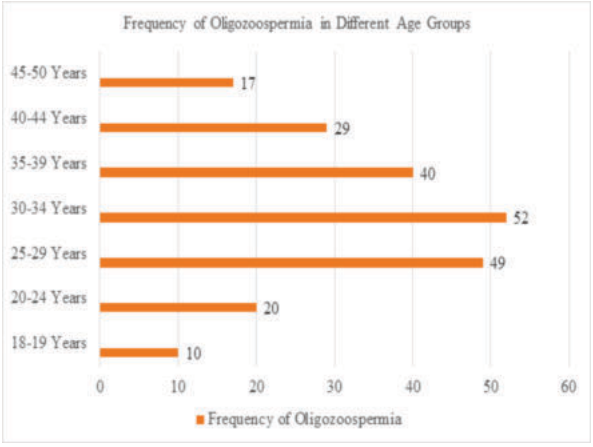

Figure 3: Frequency Distribution Of Oligozoospermia Among Different Age Groups

Table 3: Risk Factors Associated With Oligozoospermia Among Study Participants

Risk Factor	Adjusted Odds Ratio (95% CI)	p-value
Age (Years)		
18-29	1.28 (0.44, 2.78)	0.141
30-39	2.25 (0.82, 4.49)	0.059
40-50	1.80 (0.73, 3.12)	0.022
BMI (Kg/m²)		
<18.5	0.98 (0.32, 1.27)	0.256
18.5-24.9	1.01 (0.52, 2.26)	0.167
25-29.9	2.12 (0.61, 3.12)	0.033
≥30	2.98 (0.68, 3.78)	0.042
Duration of Infertility (Years)		
<5	0.78 (0.26, 1.12)	0.146
5-10	0.82 (0.34, 1.98)	0.163
>10	1.28 (0.76, 2.12)	0.063
History of Smoking	2.34 (0.72, 3.28)	0.051
History of Alcohol Consumption	3.12 (0.86, 4.12)	0.019
Occupation		
Manual Labourer	1.98 (0.76, 3.12)	0.076
Skilled Labour	1.12 (0.66, 2.18)	0.164
Professonal	0.76 (0.54, 1.76)	0.136
History of Environmental Toxins Exposure	2.12 (0.12, 4.18)	0.021
Co-morbidities		
Obesity	2.17 (0.88, 4.32)	0.017
Varicocele	2.18 (0.98, 3.78)	0.076
Erectile Dysfunction	1.12 (0.56, 1.78)	0.175
Chronic Hypertension	1.77 (0.45, 1.98)	0.185
Diabetes	2.89 (0.64, 3.76)	0.027
Tuberculosis	0.98 (0.23, 1.17)	0.187
Inguinal Hernia	0.54 (0.34, 1.98)	0.276

Table 4: Semen Analysis of The Study Participants (n=389)

Semen Parameter	Mean (SD)
Sperm Concentration (million/mL)	8.12 ± 2.14
Total Sperm Count (million)	29.18 ± 1.18
Motility (%)	26.12 ± 3.28
Morphology (%)	2.98 ± 0.76
Semen Volume (mL)	0.98 ± 0.12
DNA Fragmentation (%)	36.22 ± 4.12
Non-Sperm Cells (million/mL)	2.12 ± 0.14

DISCUSSION
Our study found that 55.8% of the participants had oligozoospermia, while 44.2% did not exhibit this condition. Similarly, around 45% of the infertile participants were found to have oligozoospermia in a study by Karim et al.[9] It shows a significant prevalence of oligozoospermia among infertile patients. Multivariate logistic regression analysis identified several independent risk factors associated with oligozoospermia. Notably, age exhibited an increasing trend in association with oligozoospermia. The prevalence of oligozoospermia was highest in the age group of 30-34 years, followed by 25-29 years. Similar findings were also observed in a study by Mohan et al, where majority of the participants (>40%) were from the age group of 30-40 years.[10] The study's findings suggest that age is a significant risk factor for oligozoospermia. This finding is also consistent with previous study that have reported a decline in semen quality with increasing age.[11] The study also found that BMI is a significant risk factor for oligozoospermia, with higher BMI values associated with an increased risk of the condition. Average BMI in the current study was 28.6 ± 3.6 Kg/m². This finding is consistent with previous research that has identified obesity as a risk factor for oligozoospermia and male infertility.[12] Majority of the participants (66%) had infertility diagnosed for more than 5 years in the current study, while in a similar study, average duration of infertility was found to be 5.8 years.[13]

The study's results highlight the impact of lifestyle factors such as smoking and alcohol consumption on male infertility. The study found that the majority of participants were smokers (66.8%) and alcohol consumers (54.8%), with a significant association observed between these factors and oligozoospermia. Male infertility is significantly influenced by smoking, as evidenced by its presence in 51.2% of the patients examined in a study by Kandari et al.[11] Smoking leads to the release of cadmium (Cd), inducing an imbalance in the levels of reactive oxygen species in seminal plasma, subsequently resulting in

DNA damage.[14] Numerous studies in both humans and animals have reported a link between chronic alcohol consumption and reduced semen quality. This correlation is primarily attributed to the increased generation of reactive oxygen species (ROS) during the metabolism of ethanol (EtOH).[15]

The study's results suggest that occupational factors may contribute to the development of oligozoospermia. The study found that manual labourers had a higher risk of oligozoospermia compared to skilled labourers and professionals, necessitating workplace-specific interventions for preserving male fertility. Additionally, exposure to environmental toxins was reported by a significant proportion of participants, with a significant association observed between exposure to these toxins and oligozoospermia, emphasizing the need for environmental health initiatives. This finding is consistent with previous research that has identified occupational and environmental factors as risk factors for male infertility.[12]

The study's results also highlight the impact of co-morbidities on male fertility. The study found that obesity, varicocele, and diabetes were significant risk factors for oligozoospermia. This finding aligns with prior studies that have recognized these conditions as contributors to the risk of oligozoospermia in male infertility.[16,17] Obesity is associated with male infertility through various mechanisms. It can disrupt hormonal balance, leading to reduced testosterone and elevated oestrogen levels. Additionally, obesity may cause insulin resistance, inflammation, and oxidative stress, adversely impacting sperm production and quality.[18]

Type 1 infertility predominated at 96%, emphasizing primary infertility's prevalence compared to secondary cases. This underscores the need for targeted interventions to address primary infertility causes. Approximately 65% of participants were classified below the poverty line, reflecting a potential link between socio-economic status and infertility. Factors such as low coital frequency (24%), premature ejaculation (19%), and testicular issues (52%), including varicocele (36%), highlight the relevance of psychosocial and physical aspects in male fertility. Testicular problems, notably varicocele, emerged as prevalent issues warranting further investigation and intervention.

Semen analysis results suggest that the study population had suboptimal semen parameters, which could impact their fertility. In a study by Jain et al. almost similar finding were observed in semen analysis leading to infertility.[19]The study's findings are consistent with existing research on the impact of antioxidants in improving semen parameters, such as sperm count, motility, and DNA fragmentation in sub-fertile males.[20]

The study's results have important implications for the management of male infertility. The study's findings suggest that a comprehensive work-up is necessary to identify the underlying cause of oligozoospermia. The study's results also highlight the importance of lifestyle modifications, such as smoking cessation and reducing alcohol consumption, in improving male fertility. Additionally, the study's results suggest that interventions to address occupational and environmental factors may be necessary to improve male fertility.

CONCLUSION

The present study provides valuable insights into the epidemiological patterns and risk factors associated with oligozoospermia in male infertility. Oligozoospermia prevalence is substantial, necessitating targeted interventions and public health strategies. The identified risk factors, especially age, lifestyle choices, and co-morbidities, provide valuable insights for personalized male infertility management and preventive measures. The study's results have important implications for the management of male infertility and highlight the need for a comprehensive work-up to identify the underlying cause of oligozoospermia. Further research is necessary to develop effective interventions to improve male infertility and address the risk factors associated with oligozoospermia.

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Conflict Of Interest: *None declared*

Ethical Approval: *The study was approved by the Institutional Review Board*

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