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ORIGINAL RESEARCH

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Prevalence of abnormal seminal fluid and associated factors among patients attending fertility clinics in Osogbo: a cross-sectional study

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Abstract

Background: Infertility is a global health issue affecting millions of couples worldwide. In Nigeria, the prevalence of infertility is particularly high, underscoring the need for a better understanding of the factors contributing to male infertility, with Seminal Fluid Analysis (SFA) being a critical diagnostic tool. This study aimed to assess the prevalence of abnormal seminal fluid and its associated factors among patients attending fertility clinics in Osogbo, Nigeria. **Methods**: A descriptive cross-sectional study design was used among male patients attending fertility centers in Osogbo, Osun State. Fisher's formula ($n = z^2pq/d^2$) was used to determine the sample size, and 305 respondents were selected using a multistage sampling technique. A pre-tested questionnaire was used to collect data from respondents, and those who consented to participate underwent SFA. Data were analyzed using IBM Statistical Product for Service Solution (SPSS) version 27. Descriptive statistics were performed for all variables, while bivariate and multivariate analyses were conducted at a significance level of $p < 0.05$. **Results**: The majority of the respondents, 257 (84.3%), had at least one abnormality in their seminal fluid. Multiple regression analysis revealed that habitual drunkards were approximately five times more likely to have at least one abnormality in their seminal fluid (Odd's ratio (OR): 4.990, p: 0.004, Confidence Interval (CI): 1.688–14.749), while smokers were three times more likely to have at least one abnormality in their seminal fluid ($p = 0.005$, OR = 3.300 and CI = 1.396–4.273). Additionally, respondents with a history of sexually transmitted infections were 3.5 times more likely to have at least one abnormality in their seminal fluid ($p = 0.039$, OR = 3.595 and CI = 1.072–14.146). **Conclusions**: This study observed a high prevalence of abnormal seminal fluid, which was significantly associated with lifestyle habits such as smoking and alcohol consumption, as well as a history of sexually transmitted infection.

Keywords

Male infertility; Implications; Seminal fluid analysis; Sperm count

1. Introduction

Infertility is a significant global health issue that affects millions of couples worldwide. The inability to conceive a child after one year of regular, unprotected intercourse is a distressing experience for many couples, leading to emotional, psychological and social challenges [1]. In Nigeria, the prevalence of infertility is particularly high, with studies indicating that approximately 20–30% of couples experience fertility challenges [2].

Male infertility is a complex condition influenced by a combination of genetic, environmental, hormonal and lifestyle factors. One of the most important aspects of male infertility is the quality and characteristics of the seminal fluid. Seminal fluid, also known as semen, is a complex mixture of spermatozoa and secretions from the male reproductive glands, including the seminal vesicles, prostate and bulbourethral glands. It plays a crucial role in the fertilization process, providing a supportive environment for sperm transport, nourishment, and protection against the hostile conditions of the female reproductive tract [3]. Alterations in the seminal fluid's composition and function can significantly impact male fertility and contribute to the couple's inability to conceive. Abnormality in sperm production, such as oligospermia (low sperm count), azoospermia (absence of sperm) and teratozoospermia (abnormal sperm shape) can lead to male infertility [4].

Understanding the implications of SFA findings on male infertility can help inform the selection of appropriate therapeutic

interventions for affected couples. Lifestyle modifications such as quitting smoking, losing weight, reducing alcohol and managing stress can help improve fertility. Also, men with oligozoospermia (low sperm count) may benefit from lifestyle modifications, medical treatment or assisted reproductive techniques, depending on the underlying cause and severity of the condition [5]. Similarly, men with asthenozoospermia (poor sperm motility) or teratozoospermia (abnormal sperm morphology) may require targeted interventions to address the specific factors contributing to their impaired semen quality [6].

Male infertility accounts for approximately half of the cases of infertility worldwide [7]. In Southwest Nigeria, particularly, there is a notable gap in research on seminal fluid analysis (SFA) and its implications for male infertility among patients attending fertility clinics [8]. Therefore, this study aims to assess the prevalence of abnormal seminal fluid among male patients attending fertility centers in Osogbo, Osun State, Nigeria.

2. Methods

2.1 Study design and population

A descriptive cross-sectional study design was used in the study. The study population comprised male patients attending fertility centers in Osogbo, Osun State. Fisher's formula ($n = z^2pq/d^2$) was used to determine the sample size, and 305 respondents were selected using a multistage sampling technique. Male patients within the age range of 18 to 50 years who were seeking medical assistance for fertility-related issues in the selected study centres were included in the study. Male patients who have undergone a vasectomy surgery and individuals who have been diagnosed with genital abnormalities that are either congenital or acquired were excluded from the study. Out of 10 major fertility centers in Osogbo, Osun State, 5 centers were randomly selected. Proportional allocation was used to determine the number of respondents from each center. Male patients aged 18–50 were randomly selected in each center.

2.2 Data collection

A pre-tested questionnaire was used to collect demographic and clinical information from the respondents. Patients who consented to the study also underwent seminal fluid analysis. Sample recruitment was done over a period of 9 months from September 2023 to May 2024.

2.3 Seminal fluid collection and handling

Semen samples were collected aseptically after an abstinence period of 2–7 days using sterile universal bottles. The collection was done in a private room near the laboratory to minimize temperature fluctuations and control the time between collection and analysis.

2.4 Seminal fluid analysis

The ejaculate volume was assessed to calculate the total number of spermatozoa and non-sperm cells in the samples.

Liquefaction was facilitated by gently swirling the sample container at 37 °C. After liquefaction, the viscosity of the liquefied ejaculate was estimated by gently aspirating it into a wide-bore (approximately 1.5 mm diameter) sterile plastic disposable pipette (verified as non-toxic to sperm), allowing the semen to drop by gravity and observing the length of any thread. A normal liquefied ejaculate falls as small discrete drops. If viscosity is abnormal, the drop will form a thread more than 2 cm long. The pH of the semen was measured by applying a drop of well-mixed semen onto a pH strip. The impregnated zone's uniform color was observed within 30 seconds and compared against the calibration strip, using test strips in the range of 6.0–10.0. The semen was then analyzed in the laboratory for sperm count, motility and morphology following World Health Organization (WHO) guidelines for the normal range (Table 1).

2.5 Data analysis

Data from the questionnaires and seminal fluid analysis were entered and analyzed using IBM Statistical Product and Service Solutions (SPSS) version 27 (IBM, Armonk, NY, USA). Descriptive statistics were used to summarize variables. Bivariate and multivariate analyses were performed to assess associations, with statistical significance set at $p < 0.05$.

3. Results

TABLE 1. WHO 2021 value for normal semen analysis.

Semen parameter	Lower fifth percentile (95% confidence interval)
Semen volume (mL)	1.4 (1.3–1.5)
Total sperm number (10^6 per ejaculate)	39 (35–40)
Total motility (%)	42 (40–43)
Progressive motility (%)	30 (29–31)
Non progressive motility (%)	1 (1–1)
Immotile sperm (%)	20 (19–20)
Vitality (%)	54 (50–56)
Normal forms (%)	4 (3.9–4)

3.1 Sociodemographic characteristics of respondents

All the respondents were married males attending the infertility clinic in Osogbo. More than half, 164 (53.8%) of the respondents were between the ages of 31–40 years, while the majority, 267 (87.5%) were Yoruba. 164 (53.8%) had a tertiary level of education, followed by 83 (27.2%) with secondary education. About half, 140 (45.9%) were skilled workers, while 110 (36.1%) were unskilled.

3.2 Prevalence of abnormal seminal fluid

The significant majority of the respondents, 257 (84.3%) had at least one abnormality in their seminal fluid while 48 (15.7%) had normal seminal fluid. About two-thirds 217 (71.1%), had total sperm count within 35–40 million sperm cells while 88 (28.9%) had less than 35 million sperm cells. They were further categorised in to Mild Oligospermia (15.4%), moderate Oligospermia (5.2%), Azoospermia (3%) Severe Oligospermia (3%), Cryptospermia (2.3%). Only 97 (31.8%) exhibited progressive motility of 40–43%, while 208 (68.2%) had less than 40% progressive motility (Asthenozoospermia). Additionally, 178 (58.4%) were found to have abnormal morphology (*i.e.*, less than 3.9% of the sperm cells had normal shape in the head and tail; Teratospermia) (Fig. 1).

3.3 Association between lifestyle behaviors and prevalence of seminal abnormality

Of the 107 respondents who were smokers, 87 (81.3%) had at least one abnormality in their seminal fluid, which was statistically significant ($p = 0.046$). Among the 145 respondents who were habitual drinkers, 139 (95.9%) exhibited at least one abnormality, which was also statistically significant ($p = 0.006$). Regarding diet, 190 respondents regularly consumed carbohydrates or starchy foods, of whom 165 (86.8%) had at least one abnormality. Among the 105 respondents who regularly consumed protein, 85 (81.0%) had at least one abnormality. Only 10 respondents regularly consumed vegetables and 7 (70.0%) of them had at least one abnormality. However, the type of food consumed was not statistically associated with seminal abnormality, $p > 0.05$ (Table 2).

3.4 Association between medical history and abnormal seminal fluid

Among the respondents, 65 (91.5%) who were diabetic, 29 (96.7%) who were hypertensive and 49 (90.7%) who were overweight had at least one abnormality in their seminal fluid. However, these factors were not statistically significantly associated with abnormal seminal fluid. Conversely, 84 (96.6%) respondents with a history of sexually transmitted infection had at least one abnormality in seminal fluid and this was statistically significant ($p = 0.001$) (Table 3).

3.5 Association between sociodemographic characteristics and prevalence of abnormal seminal fluid

More than half of the respondents, 139 (51.0%) who had at least one abnormality were aged within 41–50 years. More than half of those who had at least one abnormality had tertiary

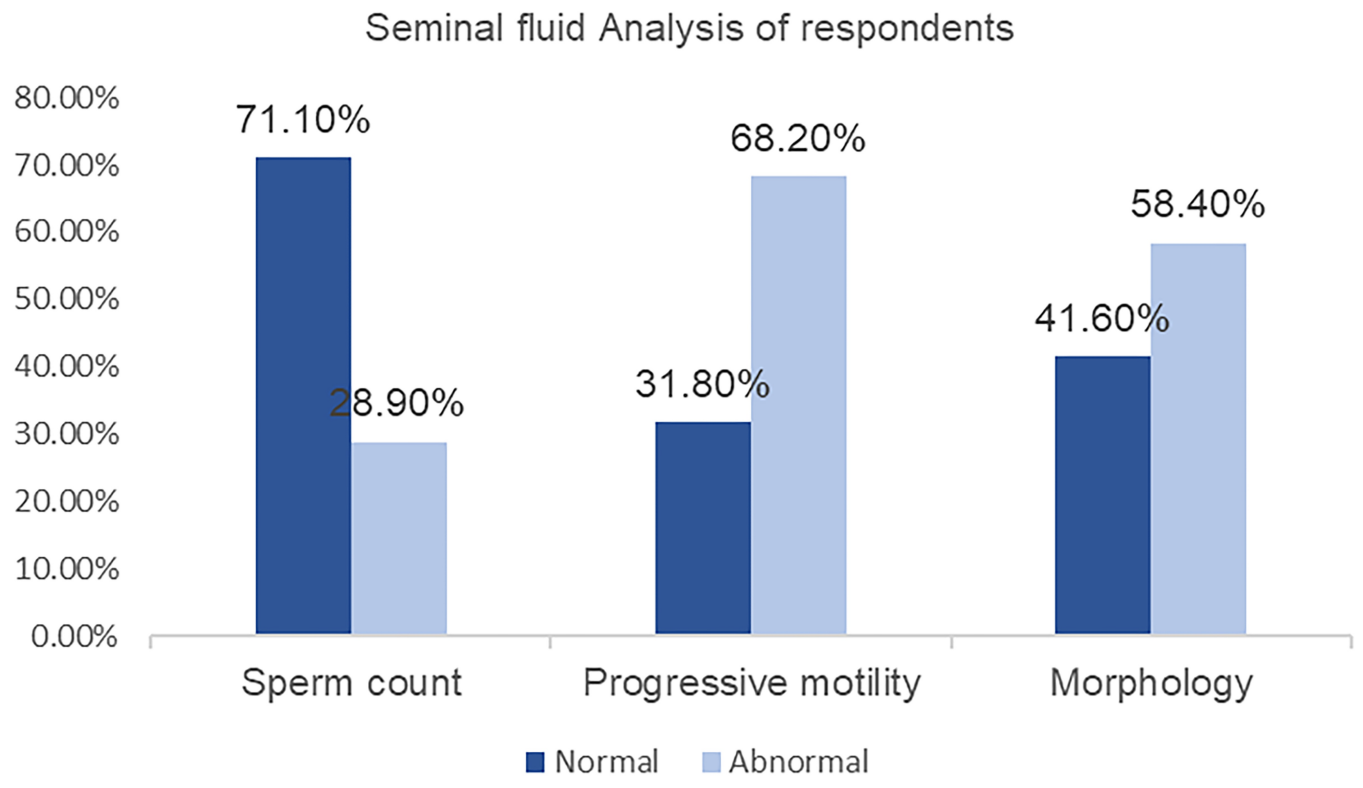

FIGURE 1. Seminal fluid analysis of respondents. Distribution of seminal fluid abnormalities among respondents, highlighting the proportions of normal and abnormal sperm count, progressive motility and morphology.

TABLE 2. Association between lifestyle behaviours and prevalence of seminal abnormality among the respondents.

Variables	Seminal fluid analysis category		Statistics
	At least one abnormality (n = 257) %	No abnormality (n = 48) %	
Known smoker			
Yes	87 (81.3)	20 (18.7)	$\chi^2 = 6.157$ $p = 0.046$*
No	170 (85.9)	28 (15.1)	
Known drunkard			
Yes	139 (95.9)	6 (4.1)	$\chi^2 = 10.353$ $p = 0.006$*
No	118 (73.8)	42 (26.2)	
Type of food consumed regularly			
Carbohydrate/Starch	165 (86.8)	25 (14.2)	$\chi^2 = 4.965$ $p = 0.196$
Protein	85 (81.0)	20 (19.0)	
Vegetables	7 (70.0)	3 (30.0)	

*χ^2: chi-square; p: p-value; *Statistically Significant.*

TABLE 3. Association between medical history of respondents and abnormal seminal fluid among respondents.

Variables	Seminal fluid analysis category		Statistics
	At least one abnormality (n = 257) %	No abnormality (n = 48) %	
Diabetic			
Yes	65 (91.5)	6 (8.5)	$\chi^2 = 3.706$ $p = 0.054$
No	192 (82.1)	42 (17.9)	
Hypertensive			
Yes	29 (96.7)	1 (3.3)	$\chi^2 = 2.893$ $p = 0.089$
No	228 (82.9)	47 (17.1)	
History of overweight			
Yes	49 (90.7)	5 (9.3)	$\chi^2 = 2.077$ $p = 0.150$
No	208 (82.9)	43 (17.1)	
History of STI			
Yes	84 (96.6)	3 (3.4)	$\chi^2 = 13.863$ $p = 0.001$*
No	173 (79.4)	45 (20.6)	

*χ^2: chi-square, p: p-value, *Statistically Significant. STI: Sexually Transmitted Infection.*

education, 121 (47.1%) of those who had at least one abnormality were skilled workers. However, these differences were not statistically significant (*i.e.*, $p > 0.05$). The majority, 220 (85.6%) of those who had at least one abnormality were from Yoruba tribe. This was statistically significant at $p = 0.016$ (Table 4).

3.6 Predictors of abnormal seminal fluid among respondents

Multiple regression analysis revealed that habitual drinkers were approximately five times more likely to have at least one abnormality in their seminal fluid (OR: 4.990, p: 0.004, CI: 1.688–14.749). Furthermore, smokers were three times more likely to have at least one abnormality in their seminal fluid ($p = 0.005$, OR = 3.300 and CI = 1.396–4.273). Respondents with a history of sexually transmitted infection were 3.5 times more likely to have at least one abnormality in their seminal fluid ($p = 0.039$, OR = 3.595 and CI = 1.072–14.146).

4. Discussion

This study assessed the prevalence of abnormal seminal fluid and its associated factors among patients attending fertility clinics in Osogbo, Osun State, Nigeria. More than half of the respondents were between the ages of 31 and 40 years old, while more than two-fifths were aged 21–30 years. The majority of respondents had tertiary education as their highest level of attainment similar to findings from a study conducted among male partners attending an infertility clinic in a Nigerian hospital [9]. In terms of occupation, about half (45.9%) were skilled workers, aligning with another Nigerian study carried out in a fertility clinic, which reported that the majority (62.8%) of the participants were skilled workers [10].

A significant proportion, more than four-fifths, of the re-

TABLE 4. Association between sociodemographic characteristics and abnormal seminal fluid.

Variables	Seminal fluid analysis category		Statistics
	At least one abnormality (n = 257) %	No abnormality (n = 48) %	χ^2, p
Age (yr)			
21–30	54 (21.0)	9 (18.8)	$\chi^2 = 0.418$ $p = 0.811$
31–40	64 (24.9)	14 (29.2)	
41–50	139 (54.1)	25 (52.1)	
Tribe			
Yoruba	220 (85.6)	47 (17.6)	$\chi^2 = 8.214^{\#}$ $p = 0.016$**
Igbo	30 (11.7)	1 (3.2)	
Hausa	7 (2.7)	0 (0.0)	
Educational level			
Primary	17 (6.6)	6 (2.3)	$\chi^2 = 2.119^{\#}$ $p = 0.548$
Secondary	69 (26.8)	14 (29.2)	
Tertiary	141 (54.9)	23 (8.9)	
Postgraduate	30 (11.7)	5 (1.9)	
Occupation			
Skilled	121 (47.1)	19 (39.6)	$\chi^2 = 0.939$ $p = 0.625$
Unskilled	91 (35.4)	19 (39.6)	
Professional	45 (17.5)	10 (20.8)	

[#]*Likelihood Ratio;* ***Statistically Significant.*

spondents had at least one abnormality in their seminal fluid. Approximately one-third had abnormal sperm counts, which is below the WHO 2021 reference standards for semen analysis [11]. This proportion is lower compared to the findings of another study, which reported that more than four-fifths of the participants had abnormal sperm counts [12]. Almost 7 out of 10 respondents had abnormal (Asthenozoospermia) progressive motility, which is more than the WHO 2021 reference threshold of <32% [11]. Furthermore, this proportion is higher compared to another study carried out among male partners of infertile couples seeking care at the Lagos University Teaching Hospital where 55.8% had abnormal progressive motility [13]. Also, about three-fifths of the respondents exhibited abnormal morphology (Teratospermia *i.e.*, <4%). This proportion is much higher compared to 60.8% of abnormal morphology reported in the study conducted among male patients in a tertiary Nigerian hospital [9].

Key predictors of abnormal seminal fluid among respondents included smoking, drinking and previous history of sexually transmitted infection. Habitual drinkers were about five times more likely to have at least one abnormality in their seminal fluid (OR: 4.990, *p*: 0.004, CI: 1.688–14.749), while smokers were three times more likely to have at least one abnormality in their seminal fluid ($p = 0.005$, OR = 3.300 and CI = 1.396–4.273). Also, respondents with a history of sexually transmitted infection were 3.5 times more likely to have at least one abnormality in their seminal fluid (OR: 3.595, *p*: 0.039, and CI: 1.072–14.146). These findings align with a previous study [9], which identified age, smoking and alcohol consumption as risk factors for abnormal seminal parameters. This highlights the detrimental impact of substance abuse, smoking and excessive alcohol consumption on reproductive health and fertility. These behaviors have been associated with reduced sperm count, motility and normal morphology as well as increased levels of sperm aneuploidy, reduced seminal plasma antioxidant levels, and increased oxidative damage to sperm deoxyribonucleic acid (DNA) [14]. This finding is also supported by a recent study which revealed that there was statistically significant correlation between smoking and abnormal seminal fluid parameters in patients [15]. Similarly, the findings from the study of revealed that lifestyle factors such as smoking, alcohol consumption as well as feeding habits have implications on medical history of individual which in turn affects the quality of semen. The study further revealed that lifestyle modification significantly improved sperm quality.

5. Conclusions

The findings indicate a high prevalence of abnormal seminal fluid parameters, particularly in motility, followed by morphology and sperm count. Lifestyle factors such as smoking, alcohol consumption and sexually transmitted infections were significantly associated with abnormal seminal fluid. These results underscore the need for targeted interventions to promote healthier lifestyle behaviors and address modifiable risk factors to improve male fertility outcomes.

6. Limitations

Being a descriptive cross-sectional design, causal association cannot be established between exposure and outcome. Also, the scope of the study is limited to the prevalence and associated variables and doesn't cover curative measures.

AVAILABILITY OF DATA AND MATERIALS

The data for this study is available upon reasonable request from the corresponding author. A pre-print version of this manuscript is available on Medrxiv with reference number MEDRXIV/2024/311347.

AUTHOR CONTRIBUTIONS

KA and SCA—designed the research study. KA, ARA, FAO and ADA—collected data. SCA, EDO and FAO—analyzed the data. AOF, LO and ARA—ensured all procedures were done according to ethical standards. KA, SCA, EDO and ADA—wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approvals for this study were obtained from the Ethics and Research Committee of Adeleke University, Ede. The Protocol number UTH/EC/2024/06/957. All ethical principles guiding the conduct of research such as informed consent, beneficence, non-maleficence, confidentiality, justice, autonomy, *etc.* were strictly taken into consideration. All information gathered was confidential and the privacy and confidentiality of the respondents were guaranteed. All respondents were made to sign the informed consent before filling out the questionnaire.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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