Factors predictive of abnormal semen parameters in male partners of couples attending the infertility clinic of a tertiary hospital in south-western Nigeria

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Background. Infertility is a common gynaecological problem and male factors contribute significantly to its aetiology. Semen analysis has remained useful for investigation of male factor infertility.
Objective. To assess the pattern of semen parameters, and predictive factors associated with abnormal parameters, in male partners of infertile couples attending a Nigerian tertiary hospital.
Methods. A descriptive study of infertile couples presenting at the clinic between January 2012 and December 2015 at Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria was done. Seminal fluid from the male partners was analysed in the laboratory using the World Health Organization 2010 criteria for human semen characteristics. Data were analysed using SPSS 17 and logistic regression analysis was used to determine the predictive factors associated with abnormal semen parameters.
Results. A total of 443 men participated in the study and 38.2% had abnormal sperm parameters. Oligozoospermia (34.8%) and asthenozoospermia (26.9%) were the leading single-factor abnormalities found, and astheno-oligozoospermia occurred in 14.2% and oligoasthenoteratozoospermia in 3.6% of cases. The prevalence of azoospermia was 3.4%. Smoking habit, past infection with mumps and previous groin surgery significantly predicted abnormal semen parameters (p=0.025, 0.040 and 0.017, respectively). Positive cultures were recorded in 36.2% of cases and *Staphylococcus aureus* was the most common.
Conclusion. Male factor abnormalities remain significant contributors to infertility and men should be encouraged, through advocacy, to participate in investigations into infertility, to reduce stigmatisation and ostracising of women with infertility, especially in sub-Saharan Africa.

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Infertility is a common gynaecological problem and is one of the most common reasons for consultations in gynaecological clinics. Over 80% of laparoscopic investigations are performed for infertility management.[1-3] and infertility remains a sensitive issue in our environment and a source of social stigma.[1,4] The burden of this stigma is felt more by female partners, who are often perceived as responsible for infertility and are faced with the challenges of economic deprivation, social neglect, marital instability, emotional stress and unhappiness.[1,5]

Infertility is a global problem with a variation in prevalent rate between regions. Worldwide, infertility is generally quoted as occurring in 8 - 15% of all couples,[3,6] while in sub-Saharan Africa a prevalent rate of 15 - 45% has been variously reported.[1,3,7] However in Nigeria, reports from earlier studies have given an incidence of 20 - 30%.[7,8]

Infertility is an underlying pathology, with female factors contributing 30 - 40% of causes, male factors about 30 - 40%, and both factors and unexplained infertility accounting for 20 - 40% of causes.[3,6,7,9,10]

The aetiology of male infertility is largely unknown in most cases.[7,11] However, studies have shown upward trends in the prevalence of sexually transmitted and urogenital infections. Seminal tract infections play a major contributory role in male infertility, affecting fertility through a number of different mechanisms, including impairment to spermatogenesis and sperm function, and obstruction of the seminal tract.[6,10-12] Other factors that may lead to male infertility include varicocele, endocrine disturbance, immunological conditions, sexual dysfunction and ejaculatory failure.[7,11]

Semen analysis has remained a useful investigation in the search for male factor infertility and provides insight into the process of sperm production count, and sperm quality-motility and morphology.[3,6,8,9] The semen parameters have been found an important determinant of functional competence of the spermatozoa.[12,13] Therefore, careful evaluation of these parameters may point to the possible causes of abnormal semen parameters and male infertility. This would enable the institution of appropriate treatment targeted at the identified aetiological factors.

Most previous studies on semen pattern have been based on the World Health Organization (WHO) 1999 criteria for human semen characteristics;[1,4-7,9] however, there is a paucity of recent studies using the WHO 2010 criteria.[3,14]

This study was conducted to assess the pattern of semen parameters in male partners of infertile couples attending the

gynaecological clinic of Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria using the recent WHO 2010 criteria for semen characteristics to identify the contribution of male factors to the burden of infertility in our environment.

Materials and methods

Subjects

The study was a descriptive evaluation of seminal fluid of male partners of infertile women presenting at the gynaecological clinic of Ekiti State University Teaching Hospital, Ado-Ekiti between January 2012 and December 2015. The male partners of infertile women who presented at the clinic were invited to the clinic through the women and a total of 443 consecutively consenting male partners of women with infertility were recruited.

Sample collection

A semistructured questionnaire with two sections was used to record information from the participants elicited by house officers and nursing staff of the gynaecological clinic. The first section reported the sociodemographic characteristics of the participants in terms of age, educational status, religion, occupation, marital status, family setting, type of infertility, duration of infertility, history of smoking and alcohol intake, history of childhood mumps infection, past history of chronic medical conditions such as diabetes mellitus, and past history of groin surgery such as herniorrhaphy or hydrocelectomy. In the second section the results of semen analysis in terms of volume, concentration, count, motility, morphology, period of continence and method of collection were recorded. The male partners were adequately counselled and given instructions on how to collect the semen sample. Instructions included abstinence from coitus for 3 - 5 days, washing of their hands before starting masturbation, and sample collection by masturbation only, kept close to the body and delivered to the hospital laboratory within 15 - 20 minutes of semen collection if not collected in the laboratory. Spilled samples were avoided. Samples were collected into sterile screw-capped plastic universal containers.

The semen samples were collected in a dedicated room with bed and other facilities to promote relaxation within the laboratory, while participants living close to the hospital were allowed to collect at home, bringing the samples to the hospital within 15 - 20 minutes of collection.

Laboratory methods

The semen analysis was performed according to the methods and standards outlined by the WHO 2010.[15] The parameters assessed included volume 1.5 mL or more; sperm concentration >15 × 10^6 cells/mL; motility >40% progressive/forward movement; morphology >4% normal form; and white blood cell count 1 ×10^6 cells/mL.

The sample analysis was done by the same laboratory scientist to avoid inter-laboratory variation, within 1 hour of collection. The sample was assessed for volume, appearance, liquefaction, concentration, motility, morphology, viability and presence of pus cells. The semen volume was measured using a graduated disposable pipette and pH checked with pH paper. After liquefaction, the semen specimen was thoroughly mixed using a pipette and a thin drop of specimen was spread on a glass slide by placing a cover slip on it. Sperm motility was assessed using an Olympus binocular microscope, magnification ×100, while the sperm concentration was counted in millions per mL using the Meckler counting chamber

Table 1. Sociodemographic characteristics of male participants involved in the study

Characteristic	*n* (%), *N*=443	
Age group (years)		
≤30	55 (12.4)	
31 - 35	216 (48.8)	
36 - 40	90 (20.3)	
41 - 45	55 (12.4)	
46 - 50	24 (5.4)	
≥50	3 (0.7)	
Family setting		
Monogamous	362 (81.7)	
Polygamous	81 (18.3)	
Educational level		
Primary	48 (10.8)	
Secondary	105 (23.7)	
Tertiary	290 (65.5)	
Occupation		
Clergy	37 (8.4)	
Teaching	68 (15.3)	
Trading	75 (16.9)	
Artisan	84 (19.0)	
Civil servant	179 (40.4)	
Social habits		
Smoking		
Yes	41 (9.3)	
No	402 (90.7)	
Alcohol		
Yes	18 (4.1)	
No	425 (95.9)	
Past infection with mumps		
Yes	19 (4.3)	
No	424 (95.7)	
Chronic medical condition		
Yes	34 (7.2)	
No	409 (92.3)	
Previous groin surgery		
Yes	45 (10.2)	
No	398 (89.8)	
Type of infertility		
Primary	72 (16.3)	
Secondary	371 (83.7)	
Volume of semen (mL)		
<2.0	154 (34.8)	
≥2.0	289 (65.2)	
	Range	**Mean (SD)**
Age of male partner (years)	30 - 60	36.36 (5.07)
Duration of infertility (years)	1 - 11	3.13 (2.40)
Volume of semen (mL)	0.5 - 5.0	2.36 (1.22)
Period of abstinence (days)	3 - 7	4.54 (0.99)
Sperm concentration (10^6/mL)	0 - 170	35.41 (31.60)
Total sperm count (10^6)	0 - 510	90.36 (97.44)

and categorised in accordance with WHO normal and pathological ranges. Bacteriological tests were also carried out on the semen samples by culture on appropriate culture media at 37°C for 24 - 48 hours to detect bacterial pathogens, and positive samples were subcultured to determine the appropriate antibiotic sensitivity pattern.

Operational definitions

The operational definitions used were as follows:

- Normospermia: sperm count of ≥15 million/mL
- Oligospermia: sperm count of ≤15 million/mL
- Azoospermia: absence of spermatozoa in the ejaculate
- Asthenospermia: reduced sperm motility <40%
- Teratozoospermia: reduced sperm morphology <4%
- Oligoasthenoteratozoospermia (OAT): all variables abnormal

Data analysis

Data were analysed using SPSS software version 17 (SPSS Inc, USA) for frequency, mean and χ^2 with the level of significance set at $p<0.05$. Logistic regression analysis was performed to determine the risk factors significantly associated with abnormal sperm concentration.

Ethical considerations

Ethical approval was obtained from the Ethics and Research Committee of Ekiti State University Teaching Hospital and verbal consent was obtained from each couple participating in the study, following explanation of the study objectives. Questionnaires were made anonymous and couples were at liberty to withdraw or refrain from the study without any consequence.

Results

A total of 443 men participated in the study. The analysis revealed that 274 (61.8%) had normal and 169 (38.2%) abnormal semen parameters.

The age range of participants was between 30 - 60 years, with a mean (standard deviation (SD)) of 36.36 (5.07) years and the majority (69.1%) aged between 31 - 45 years. The duration of infertility was between 1 - 11 years, with a mean of 3.13 (2.40) years. A total of 72 (16.3%) participants were investigated for a case of primary infertility while 371 (83.7%) were investigated for secondary infertility. The period of abstinence ranged between 3 - 7 days, with a mean of 4.54 (0.99) days. The sociodemographic characteristics of the male partners are shown in Table 1.

Various risk factors were associated with abnormal semen parameters. These included occupation and smoking habit of participants, past infections with mumps and previous groin surgery (p=0.001, 0.04, 0.022 and 0.004, respectively). Alcohol habits and chronic medical conditions were not significantly associated (p=0.121 and 0.469, respectively) (Table 2).

Multivariate logistic regression showed that smoking habit, past infection with mumps (mumps orchitis) and previous groin surgery in the male participants were significantly associated with abnormal semen parameters (p=0.025, 0.040 and 0.017, respectively) when controlled for multiple risk factors.

Table 2. Risk factors associated with abnormal sperm parameters

	Sperm concentration, *n* (%)			
Variable	**Low**	**Normal**	**Total**	***p*-value**
Occupation				
Clergy	3 (8.1)	34 (91.9)	37 (8.4)	0.001*
Teaching	26 (38.2)	42 (61.8)	68 (15.3)	
Trading	15 (20.0)	60 (80.0)	5 (16.9)	
Artisan	57 (67.9)	27 (37.1)	84 (19.0)	
Civil servant	68 (38.0)	111 (62.0)	179 (40.4)	
Smoking				
Yes	26 (57.8)	19 (42.2)	45 (10.2)	0.04*
No	143 (35.9)	255 (64.1)	398 (89.8)	
Alcohol				
Yes	10 (55.6)	8 (44.4)	18 (4.1)	0.121
No	159 (37.4)	266 (62.6)	425 (95.9)	
Past infection with mumps				
Yes	12 (63.2)	7 (36.8)	19 (4.3)	0.022*
No	157 (37.0)	267 (63.0)	424 (95.7)	
Chronic medical illnesses				
Yes	11 (32.4)	23 (67.6)	34 (7.7)	0.469
No	158 (38.6)	251 (61.4)	409 (92.3)	
Previous groin surgery				
Yes	26 (57.8)	19 (42.2)	45 (10.2)	0.004*
No	143 (35.9)	255 (64.1)	398 (89.8)	

*Indicates statistical significance.

A total of 154 (34.8%) participants produced seminal volume of <2 mL while 289 (66.9%) produced >2 mL (Table 1). The various abnormalities occurring singly or in combinations are shown in Table 4.

Although seminal fluid abnormality was found throughout the age groups, it was higher in those aged 31 - 45 years (Table 5).

A total of 160 (36.2%) samples cultured positive for organisms and *Staphylococcus aureus* was the most common organism isolated, accounting for 24.4% of organisms cultured (Table 6).

Discussion

The study found that 38.2% of investigated couples had abnormal semen parameters. This result is higher than findings at Ile-Ife and Ibadan in south-western Nigeria.[1,3] but similar to that reported from Abakaliki in south-eastern Nigeria.[12] Semen analysis revealed the various sperm abnormalities contributory to male factor infertility. Sperm abnormalities due to distortion in the spermatogenesis process may be pretesticular (hormonal), testicular (chromosomal) and post-testicular (disorder in transportation or ejaculation, or caused by infections etc).[3,6,8,12] These abnormal parameters, occuring singly or in combination, impair fertility even with normal sperm concentration. The outcome of treatment of male factor infertility is dependent on the presence of these factors. It has been reported that prognosis is inversely proportional to the number of abnormal patterns, i.e. that having one factor abnormality is better than having two factors, and two factors better than three factors.[1,6,16]

The single-factor abnormalities of low sperm count oligozoospermia (34.8%) and poor motility-asthenozoospermia (26.9%) were leading factors in sperm parameter abnormality while teratozoospermia contributed 6.9%. This corroborates findings reported by previous studies in this environment.[1,8,12] However, the two-factor abnormality of astheno-oligozoospermia was recorded in 14.2% of cases, which is comparable with findings from Jos and Ile-Ife[3,16] but lower than reported in Ibadan,[1] and the three-factor abnormality OAT occurred in 3.6% of the participants, which is comparable with that reported from Ile-Ife[3] but lower than figures reported from Jos and Ibadan.[1,17] The presence of these factors is associated with poor outcome with the use of conventional methods in the treatment of infertile couples. However, with newer techniques and advancements in assisted reproduction and conception, which are gradually becoming more available in our environment, pregnancy can be achieved.[1,3,8,17] The prevalence of azoospermia of 3.4% in this study compares well with the rate in the general male population but was lower than findings in previous studies.[3,5,6] About 62% of male partners in this study had normal sperm concentration, while the mean sperm density was 35.41 (31.60) × 10^6 cells/mL; this implies that not only is absolute sperm count a male factor infertility determinant, but other components such as motility and morphology are equally important. Hence, infertility is not only associated with low sperm count but rather defective sperm parameters or other factors such as female factors.

The majority of the male partners produced normal semen volume although 33.1% had a low semen volume. Mean semen volume was 2.36 (1.22) mL. These values are comparable with earlier reports from studies by Butt *et al.*, Nwafia *et al.* and Imam *et al.*[6,18,19] The adequate volumes reported in this study may be related to the period of continence observed by the male partners before presenting for seminal analysis, which was between 3 - 7 days with a mean of 4.54 (0.99) days, and this reflects the importance of abstinence before seminal fluid collection for analysis. Studies have shown that prolonged abstinence is associated with increased sperm concentration, but does not necessarily improve morphology and motility.[3,6,20]

There was a positive culture in 36.2% of our cases, with *S. aureus* accounting for the greatest proportion, comparable with previous findings.[3,7,21,22] This may reflect penile contamination of the semen during collection even though the participants were instructed to observe aseptic technique. It may also be due to male genital infection, an important aetiological factor in male infertility which may lead to distortion of the process of spermatogenesis, impairment of sperm function and obstruction of the seminal tract. This may be contributory to the abnormal semen parameters recorded in this study, among the other factors elucidated.[1,3,6,12,20]

Environmental factors such as exposure to heat and chemicals, lifestyle factors such as smoking and alcohol consumption, chronic medical conditions such as diabetes mellitus and thyroid disease, previous groin surgery, including herniorrhaphy or varicocelectomy, and past mumps infection have been demonstrated as having adverse effects on sperm parameters.[12,23] Consistent with previous reports,[24-26] this study demonstrated a significant association

Table 3. Multivariate logistic regression analysis with sperm concentration as dependent variable

Variable	AOR (95% CI for AOR)	*p*-value
Smoking		
Yes	1	
No	0.479 (0.252 - 0.911)	0.025*
Previous groin surgery		
No	1	
Yes	0.460 (0.243 - 0.871)	0.017*
Past infection with mumps		
No	1	
Yes	0.396 (0.150 - 1.046)	0.040*
Occupation of male partner		
Professional	1	
Artisan	1.486 (0.989 - 2.231)	0.056

AOR = Adjusted odds ratio; CI = confidence interval.
*Indicates statistical significance.

Table 4. Pattern of abnormal semen parameters results of couples involved in the study (*N*=16)

Seminal fluid analysis	*n* (%)
Oligozoospermia	59 (34.9)
Asthenozoospermia	45 (26.6)
Oligoasthenozoospermia	24 (14.2)
Teratozoospermia	11 (6.5)
Asthenoteratozoospermia	10 (5.9)
Oligoteratozoospermia	7 (4.2)
OAT	7 (4.2)
Azoospermia	6 (3.5)

Table 5. Distribution of abnormal semen parameters by age group

	Age group of husband (years)					
Semen fluid analysis	**≤30**	**31 - 35**	**36 - 40**	**41 - 45**	**46 - 50**	**≥51**
Azoospermia	0	3	1	1	1	0
Oligozoospermia	13	40	1	4	0	1
Teratozoospermia	4	4	1	2	3	1
Asthenozoospermia	4	21	6	9	3	2
Oligoteratozoospermia	1	2	1	1	1	1
Oligoasthenozoospermia	4	8	2	3	4	3
Asthenoteratozoospermia	1	3	1	2	2	1
OAT	1	2	1	2	1	0

Table 6. Cultured organisms (*N*=443)

Organism	***n* (%)**
Staphylococcus aureus	108 (24.2)
Klebsiella spp.	15 (3.4)
Escherichia coli	10 (2.3)
Streptococcus spp.	8 (1.8)
Candida spp.	6 (1.4)
Multiple coliforms	13 (2.9)
No organism isolated	283 (63.8)

between smoking habit, past infection with mumps (mumps orchitis) and past groin surgery and abnormal sperm parameters, although Okonofua *et al.*[26] also reported a significant association with alcohol consumption, among other factors.

A total of 371 (83.7%) couples involved in this study presented with secondary infertility, and 72 (16.3%) had primary infertility. This is higher than figures reported in Ibadan and Ile-Ife[1,3] and reflects a growing pattern in the incidence of secondary infertility in this environment. This may be attributed to the significant contribution of obstruction of the female and male genital tract resulting from a high rate of genital infections in both female (post-abortal sepsis, puerperal sepsis) and male partners in our setting.[1,6]

Conclusion

Male factor abnormalities remain significant contributors to infertility, as demonstrated in this study, and the importance of semen analysis cannot be overemphasised in the detection of sperm abnormalities. On the basis of this, society should particularly view infertility as a couple problem rather than ostracising women, and men should be encouraged to take up the challenge and present themselves for appropriate testing and treatment. Government should ensure the establishment of public centres for assisted reproduction, to bring this closer to the less privileged in the society and contribute to solving the challenges posed by male infertility.

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