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Original Research Article

Evidence-based assessment of male-only infertility: prevalence and associated risk factors in Port Harcourt metropolis, Rivers State, Nigeria

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ABSTRACT

Background: Male infertility is the condition in which a male is unable to establish pregnancy in a fertile woman over 12 months of unprotected sexual intercourse. In this study, the prevalence of male-factor infertility and some associated risk factors in Port Harcourt, Rivers State was carried out.
Methods: The study design was a case-controlled randomized one, in which semen specimens were collected from case and control groups randomly amongst males visiting urology/fertility clinics by masturbation after 3 days of abstinence. A total of 276 males indicated interest to participate in study of which 193 male subjects were recruited.
Results: The result showed that 20.8% were azoospermic, 27.4% were oligospermic, 23.7% were asthenozoospermic, 27.9% oligoasthenozoospermic, 15.1% teratozoospermic, 19.4% asthenoteratozoospermic, and 12.9% oligoasthenoteratospermic. Furthermore, the microbial quality of the semen assessed indicated the prevalence of scanty, moderate, and heavy growth as 12.5%, 9.3%, and 7.3% respectively. Likewise, organisms isolated and identified were *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae*, and mixed growth of staphylococcus *aureus, and Escherichia coli* with a prevalence of 18.2%, 5.6%, 2.0%, 1.04%, and 2.6% respectively. Civil servants had the highest prevalence of 20.8% followed by artisans with 11.9%. The prevalence of primary and secondary infertility was observed to be 30.1% and 18.1% respectively.
Conclusions: Male-only factor infertility is on the increase and occupations that are accompanied by prolonged sitting, sedentary work style, or working in or close to high-temperature sources as seen in civil servants and welders (artisans) were observed to be more prone to male-only factor infertility.

Keywords: Infertility, Male-only infertility, Risk factor, Infectious organisms, Occupation

INTRODUCTION

Male factor infertility in Nigeria accounts for up to 50% of all infertility cases.[1] According to the international committee for monitoring assisted reproductive technology (ICMART) and the world health organization (WHO), infertility is a derangement culminating in the failure to achieve pregnancy after a year of regular unprotected coitus.[2] Infertility has further been more comprehensively defined as the inability of a couple (not above 35 years) to achieve and sustain a pregnancy to delivery after at least 2-3 times weekly unprotected, penetrative, and ejaculatory vaginal intercourse over 12 months with an adult of the opposite sex.[3] Following this definition, implies that infertility among couples is also a function of age. In order words, it will be misleading to classify couples in their mid-forties and above infertile

after 12 months of regular, unprotected, penetrative, and ejaculatory vaginal intercourse.

Infertility is grouped into primary and secondary infertility.[2] Primary infertility is when a male has never established pregnancy in a fertile female while secondary infertility defines a condition where the male has established pregnancy in a fertile female in the past but is unable to do so at the present. Male infertility can either be complete or partial which is termed sub-fertility.[4,5] There are several factors associated with male infertility such as genetic factors (deletion, inversion, mutation, aneuploidy, and translocation), environmental factors (exposure to chemical contaminants such as heavy metals, pesticides, and other polychlorinated hydrocarbons (PCHs).[6] PCHs are known endocrine disruptors, causing increasing cases of male infertility), oxidative stress, lifestyle (age, obesity, smoking, consumption of alcohol, use of recreational drugs.[7-9] Infertility has been a major condition or concern in families associated with psychological, social (e.g. stigmatization), economic, as well as medical insults resulting in trauma, stress, and depression, especially in our Nigerian society with a strong emphasis on childbearing. Emopkae and Brown, reported that even males with normospermia have failed to impregnate their fertile wives.[1] However, due to cultural and socio-economical as well as religious influences, male infertility contributing to couples' inability to reproduce has been undermined and is usually attributed to the female. The focus of this study therefore is on establishing the prevalence of male-only infertility in Port Harcourt and some associated risk factors through semen analysis.

Semen analysis happens to be the most relevant investigation, having a sensitivity of 89.6%, thus having the capacity for the diagnosis of 9 out of 10 males with genuine male infertility.[10,11] The assessment of the male factor infertility using semen analysis is inexpensive, objective, and readily available.[3] Therefore, semen analysis plays a vital role in evaluation of male factor infertility and it is usually the initial aspect of investigations in understanding the cause of infertility in males.[6,12] There are several causes of male infertility in the majority of cases but some cases especially those bothering around abnormal semen parameters are not completely known.[6,12] Some of the causes of male-factor infertility include congenital abnormalities such as cryptorchidism and chromosomal disorders, genital tract infections leading to obstructive azoospermia/ oligospermia/ teratospermia, or a combination of these. Tuberculosis, gonococcal and chlamydia infections are also common factors frequently encountered in Port Harcourt as etiologies associated with male infertility.[3,12] More so, bilateral viral orchitis has also been reported to induce infertility through the process of inducing poor sperm parameters like non-progressive motility and teratozoospermic morphologies in males, especially after 12 years of age. Another factor implicated in male infertility is varicocele. Though the role of varicocoele in male infertility is still poorly understood it is believed that varicocele allows the heavy flow of blood into the testicular tissue enhancing the damaging oxidative stress on the testicles and in turn spermatogenesis.[12] The frequent use of tobacco, alcohol, cannabis, drugs, and wearing of tight underwear has also been investigated to have serious risks associated with male infertility.[1]

Therefore, this study aims to evaluate the prevalence of male-factor infertility and some associated risk factors amongst males visiting or attending fertility/urology clinics in Port Harcourt, Rivers State.

METHODS

Subjects recruitment and characterization

The study investigated the semen parameters of infertile males attending urology or fertility clinics of Rivers State university teaching hospital (RSUTH) and the university of Port Harcourt teaching hospital (UPTH), Port Harcourt as well as from those seeking medical help from primary healthcare centre, Ozuoba, Port Harcourt, Rivers State. The collection of semen specimens was done for a period of 18 months (Nov. 2019-April 2021). A total of 276 males indicated interest in the study, of which 193 male subjects were recruited.

Sample size determination

Sample size for this study was determined using formula as described by Claran and Biswas with a precision or absolute error of 5 and 95% confidence interval.[13] Sample size=$Z^2P(1-P)/d^2$, where Z=standard normal variate=1.96, p=expected proportion of diseases in population based on previous study, d=absolute error at 95% CI=0.05. Expected proportion of male-factor infertility (prevalence) in population amongst males attending infertility clinic in Nigerian tertiary health institution was 7.3% as reported by Umar et al.[12] Therefore, sample size=$1.96^2 \times 0.073\ (1-0.073)/0.05^2=93$. Therefore, total of 93 semen and blood samples were collected from infertile males and 100 samples from fertile males (control) summating to 193 semen and blood samples.

Inclusion and exclusion criteria

A well-structured questionnaire was issued to all the participants to obtain demographic information, medical history, and lifestyle after obtaining their verbal and written consent of participants.

Inclusion criteria: Subjects included in this study were those attending urology/fertility clinics, with no history of hypertension, cardiovascular disorders, osteoporosis, diabetes mellitus, or smoking. Omron digital blood pressure kit (Omron healthcare Co., Ltd, Japan) was used to check the blood pressures of the subjects while the glucose oxidase method was used to determine their

fasting glucose state. Also, the control subjects recruited were males who established pregnancies within the period of this study with a total sperm count of ≥20×10^6 cells/mL, normal sperm morphology, and without bacterial infection of semen at time of investigation following WHO criteria.[14] The infertile males (test subjects) those who had failed to establish pregnancies after years and had been clinically diagnosed as such with a total sperm count between 0 and 19×10^6 cells/mL.

Exclusion criteria: Those who did not give their consent were excluded from the study. Those that had semen leukocytes (pus cells)>1×10^6/ml (approximately >8 pus cells per high field) of ejaculate, semen specimens collected without masturbation were also excluded due to the possibility of spilling. In addition, subjects that did not abstain from sexual intercourse for at least 72 hours (3 days) and lifestyles like smoking, and alcohol consumption were also excluded from study. In addition, those with history of hypertension, cardiovascular disorders, osteoporosis, diabetes mellitus, and prostate-specific antigen (PSA) of >10 ng/ml were also excluded. Finally, those with a history of infertility diagnosed with cryptorchidism, varicocoele, obstructive seminal ducts, or immunological disorders were also excluded from study.

Ethical approval and consent

Before start of experimental study, ethical approval was obtained from the ethical review boards of the Rivers State government, through the Rivers State ministry of health covering Rivers State university teaching hospital and primary healthcare centres (via management board) in State with approval no of MH/PRS/391/VOL.2/726 and MH/PRS/391/VOL.2/727 respectively. In addition, written informed consent was obtained from all subjects before being recruited for study.

Specimens sampling and preparation

Semen sampling: Following ethical approval, blood and semen samples were collected from eligible subjects (subjects and control). All semen specimens were collected into universal sterile plastic containers by masturbation after an abstinence period of 72 hours at the various urology/fertility clinics in the hospitals.

Sample preparation: Semen samples were collected into sterile plastic containers by masturbation. The samples were placed on the bench at room temperature of 25^{0}C and allowed for 40 minutes for liquefaction before analyses (culture, macroscopic, and microscopic) were performed within 1 hour of collection.

Semen analysis and classification of case and control subjects

Semen analysis: Sperm concentration, pH, percentage of progressively motile, sluggish, and inactive sperm cells, and normal sperm morphology were determined.[14]

Classification of case and control subjects: The classification was based on WHO criteria for the classification of sperm cells.[14] Those classified as control subjects had sperm concentration ≥15×10^6/ml of ejaculate (normozoospermic), progressively motile sperms ≥50%, and normal sperm morphology ≥50%. Males (infertile) with sperm concentration ≤15×10^6/ml of ejaculate (oligozoospermia), while those with "zero or absence" sperm cells were grouped as azoospermia. Those with progressively (active) motile sperms ≤50% and normal sperm morphology of >30% ≤50% were classified as asthenozoospermic while those with progressively (active) motile sperms ≤50%, normal sperm morphology >30% ≤50%, and total sperm count ≤15×10^6/ml of ejaculate sperm cells were grouped as oligoasthenozoospermic. In addition, subjects with normal sperm morphology of ≤30% with progressively (active) motile sperms of ≥50% were grouped as teratozoospermic while those subjects with normal sperm morphology of ≤30% with progressively (active) motile sperms of ≤50% were grouped as asthenoteratozoospermic. Finally, those subjects with a total sperm count of ≤15×10^6 cells/ml, and normal sperm morphology of <30% with progressively (active) motile sperms of <50% were grouped as oligoasthenoteratozoospermic. All semen leukocyte concentration was considered at <1×10^6/ml of ejaculate.

Experimental design

The study is a case-control randomized experimental study. Therefore, the study had subjects that were grouped based on the classification of sperm cells.[14]

Control group: Had sperm concentration (count)≥20×10^6/ml of ejaculate (normozoospermia), progressively motile sperms ≥50%, and normal sperm morphology ≥30%. Also, their semen leukocyte concentration was <1×10^6/ml of ejaculate.

Test group: Consists of males with abnormal sperm morphology, absence, or low sperm count. More so, their semen leukocyte concentration was <1×10^6/ml of ejaculate. In addition, the presence or absence as well as the degree (scanty, moderate, or heavy) of bacterial infections of the semen were also considered.

Laboratory analysis of sperm parameters in seminal plasma and serum

Determination of sperm volume, pH, viscosity, sperm viability, and count: The semen ejaculatory volume was determined using a graduated glass Pasteur pipette while the pH of the semen was determined using a combi-9 strip, dipped into the semen, and matched against the combi-9 colour chart while the viscosity was then determined as described by Vasan.[15] Sperm viability was determined as described by WHO and Moratti et al with the use of 10 µL of a properly mixed semen sample to 10

µL of 0.5% eosin Y in 0.9% aqueous sodium chloride solution.[14,16]

The sperm concentration (count) was manually determined using a Neubauer cell counter diluted 1:20 using semen-diluting fluid consisting of sodium bicarbonate, formalin, and distilled water as described by Ochei, Kalhartkar and WHO.[14,17]

Microscopic evaluation of the sperm cells: A wet preparation was made by placing a drop of semen with a Pasteur pipette from a well-mixed sample on a clean grease-free slide and covering it with a cover slip. The wet preparation microscopic fields were examined under high-powered objectives using ×40 objective to estimate and quantitate the presence of pus cells, and epithelial cells and also to determine the motility, morphology, and viability of the sperm cells.[14] At least a hundred cells were examined at a magnification of ×1000, to determine the percentage of sperm cell motility.[14] In addition, the morphology of the sperm cells was determined using the methylene blue-eosin staining technique after incubation at 25^{0}C with trypsin for 10 minutes.

Determination of bacterial quality and identification: The presence and degree of bacterial load in the semen specimens were determined using the culture technique as described by Solomon and Henkel.[18] The culture media used were McConkey and blood agar. After the period of incubation, bacteria were isolated and identified biochemically. Catalase test as described by Ochei and Kolhatkar was used to differentiate catalase-producing bacteria such as *Staphylococci* from non-catalase producing such as *Streptococci*.[17] A citrate utilization test was used to assist in the identification of enterobacteria. The coagulase test as described by Ochei and Kolhatkar was also used to identify *Staphylococcus aureus* which produce the enzyme coagulase (free and bound).[17] The oxidase test (cytochrome oxidase test) was used to assist in the identification of *Pseudomonas*, *Neisseria* spp., *Vibrio* spp., *Brucella* and *Pasteurella* species, all of which produces the enzyme cytochrome oxidase. A urease test using Chistensens's modified urea broth was used in differentiating enterobacteria. Proteus strains are strong urease producers. *Y. enterobacteria* also show weak urease activity at 35^{0}C. *Salmonella* and *Shigellae* do not produce urease. Gram staining technique using Robert grams method was used to differentiate gram-positive and gram-negative bacteria.

Statistical analysis

Data were obtained using well-structured questionnaires. Data were analysed using GraphPad Prism 8.0.2 and IBM SPSS (version 2022). The data analysis were done using descriptive and inferential statistics. The descriptive statistics was done using the contingency platform of fractions (GrpahPad Prism) while the inferential statistics employed the use of chi-square (IBM SPSS). Statistical significance was set at $p<0.05$.

RESULTS

Educational, occupation, and age information of subjects

The educational characteristics of the subjects indicated that those with tertiary education had higher attendance rates followed by secondary education in control and infertile subjects. Normospermic (control) subjects based on occupation had a percentage prevalence of 31.3%, 3.1%, 7.3%, and 10.4% for civil servants, mechanics, transporters, and artisans (welders) respectively while infertile males had 20.8%, 6.3%, 9.4%, and 11.9%. More so, the age groups of 23-33, 34-44, and 45-54 had %prevalence of 9.4%, 17.7%, and 25.5% respectively for fertile normospermic males while the infertile had 17.7%, 18.8%, and 11.9% for same age intervals respectively. The chi-square results indicated a significant difference except in age intervals of infertile males.

Classification of infertility and characteristics of semen of subjects

Results of primary and secondary infertility indicated 30.1% and 18.1% respectively. Of normospermic, azoospermic, and oligospermic subjects indicated 52%, 20.8%, and 27.4% respectively. Asthenozoospermia, oligoasthenozoospermia, teratozoospermia, asthenoteratozoospermia, and oligoasthenoteratospermia had %prevalence of 23.7%, 27.9%, 15.1%, 19.4%, and 12.9% respectively. More so, the ejaculatory volumes of the semen were observed to normovolumic, hypovolumic, and hypervolumic with prevalence of 67.7%, 30.2%, and 2.5% respectively. The appearances of the seminal fluid were gray/grayish white and creamy which had a %prevalence of 71.8 and 28.4 respectively. Finally, the consistency of the semen, that is, watery, viscous, and hyperviscous had 47.9%, 44.7%, and 7.7% as their respective prevalence. The chi-square analyses for all the parameters were significant (Table 2).

Microscopic characteristics of semen of subjects

The microscopic examination also considered the presence of pus and epithelial cells in the semen aside from the quality of sperm cells. The %prevalence of pus cells was 17.7%, 40.9%, 23.9%, and 17.7% for 0-2, 2-4, 3-5, and 4-6 pus cells per high-powered field (HPF) respectively. On the other hand, the prevalence of epithelial cells in seminal fluid amongst the subjects recruited were 56.4%, 22.9%, 9.3%, and 11.4% for no epithelial cells, scanty (+), moderate (++), and numerous (+++) respectively (Table 3).

Microbial culture characteristics of semen of subjects

Culture results indicated that 52% of normospermic subjects had no semen infection at time of investigation. However, during interview, 39.6% reported never having semen infections, while 12.5% reported that they had

previously had semen infections and treated accordingly. On the other hand, infertile male subjects without semen infections had 19.1%, while infertile males with semen infections were seen to be 29.2%. Likewise, subjects without any microbial infection had prevalence of 70.9% those with scanty growth had 12.5%, moderate had 9.3% and heavy growth had 7.3%. Organisms isolated and identified were *S. aureus, E. coli*, *Klebsiella pneumoniae, P. aeruginosa,* and mixed growth of *Staphylococcus aureus* and *Escherichia coli* with a %prevalence of 18.2, 5.6, 2.0, 1.04, and 2.6 respectively at p<0.05. Chi-square results indicate a significant difference for all (Table 4).

Table 1: Educational, occupation, and age information of subjects.

Subjects characteristics	N	Prevalence	Prevalence (%)	Chi-square	P value
Educational level (control)					
No formal education	0	0.000	0.0	80.420	<0.0001
Primary	3	0.016	1.6		
Secondary	23	0.119	11.9		
Tertiary	74	0.383	38.3		
Educational level (infertile)					
No formal education	0	0.000	0.0	30.387	<0.0001
Primary	6	0.031	3.1		
Secondary	45	0.233	23.3		
Tertiary	42	0.218	21.8		
Occupation (control)					
Civil servants	60	0.313	31.3	69.280	<0.0001
Mechanics	6	0.031	3.1		
Transporter	14	0.073	7.3		
Artisan (Welders)	20	0.104	10.4		
Occupation (infertile)					
Civil servants	40	0.208	20.8	18.699	<0.0001
Mechanics	12	0.063	6.3		
Transporter	18	0.094	9.4		
Artisan (welders)	23	0.119	11.9		
Age interval (years)-control					
23-33	18	0.094	9.4	13.520	0.001
34-44	34	0.177	17.7		
45-54	48	0.250	25.0		
Age interval (years)-infertile					
23-33	34	0.177	17.7	3.161	0.206
34-44	36	0.188	18.8		
45-54	23	0.119	11.9		

Table 2: Types of infertility and semen characteristics.

Subjects/specimen characteristics	N	Prevalence	Prevalence (%)	Chi-square	P value
Type of infertility					
I^0 Infertility	58	0.302	30.1	5.688	0.0170
2^0 Infertility	35	0.181	18.1		
Sperm count					
Normospermic	100	0.520	52.0	30.974	<0.0001
Azoospermic	40	0.208	20.8		
Oligospermic	53	0.274	27.4		
Sperm morphology					
Asthenozoospermic	22	0.237	23.7	7.130	0.1290
Oligoasthenozoospermic	26	0.279	27.9		
Teratozoospermic	14	0.151	15.1		
Asthenoteratozoospermic	18	0.194	19.4		
Oligoasthenoteratospermic	12	0.129	12.9		
Ejaculatory volume (mL)					
Normovolumic	130	0.677	67.7	122.37	<0.0001
Hypovolumic	58	0.302	30.2		
Hypervolumic	5	0.025	2.5		

Continued.

Subjects/specimen characteristics	N	Prevalence	Prevalence (%)	Chi-square	P value
Appearance					
Grayish/grayish white	138	0.718	71.8	35.694	<0.0001
Creamy	55	0.284	28.4		
Consistency					
Watery	92	0.479	47.9	57.027	<0.0001
Viscous	86	0.447	44.7		
Hyper-viscous	15	0.077	7.7		

Table 3: Microscopic characteristics of semen of subjects.

Subjects/specimens characteristics	N	Prevalence	Prevalence (%)	Chi-square	P value
Pus cells (HPF)					
0-2	34	0.177	17.7	8.777	0.012
2-4	79	0.409	40.9		
3-5	46	0.239	23.9		
4-6	34	0.177	17.7		
Epith. cells (HPF)					
Nil	109	0.564	56.4	110.11	0.0001
+	44	0.229	22.9		
++	18	0.093	9.3		
+++	22	0.114	11.4		

Key: + = Scanty, ++= Moderate, +++=Numerous

Table 4: Microbial culture characteristics of semen of subjects.

Subjects/specimens characteristics	N	Prevalence	Prevalence (%)	Chi-square	P value
Microbial quality (culture)					
Fertile males, no growth	76}100	0.396}0.521	39.6}5201	32.02	<0.0001
Fertile males, infected before	24	0.125	12.5		
Infertile males, no growth	37	0.191	19.1		
Infertile males, with growth	56	0.292	29.2		
Degree of microbial quality					
No growth	137	0.709	70.9	218.71	<0.0001
Scanty	24	0.125	12.5		
Moderate	18	0.093	9.3		
Heavy	14	0.073	7.3		
Bacteria isolated and identified					
Staphylococcus aureus	35	0.182	18.2	66.32	<0.0001
Escherichia coli	10	0.056	5.6		
Klebsiella pneumoniae	4	0.020	2.0		
Pseudomonas aeruginosa	2	0.0104	1.04		
Mixed *S. aureus* + *E. coli*	5	0.026	2.6		

DISCUSSION

The results indicated that the prevalence of infertile males was 47.9% in the study population of which 20.8% and 27.1% were azoospermic and oligozoospermic males respectively. Our findings are in accordance with the report of Uadia et al. Uadia et al, reported a prevalence of 42.6% as cases of male factor infertility in Southern Nigeria.[19,22] In addition, our findings regarding oligospermic status are similar to the reports of Anaezichukwuolu and Odunvbun et al, who reported a prevalence of the 22.8% and 25% as infertile males with oligozoospermic status in Edo as well as the Delta State respectively.[21,23] However, the reports of the Anaezichukwuolu concerning the prevalence of the oligozoospermic subjects of 11% contradicts our findings of 27.4% as observed in our study.[20] Furthermore, the prevalence of infertile males with asthenozoospermia of 23.7% and oligoathenozoospermia of 27.9% contradicts the results of Anaezichukwuolu but were similar to the findings of Green et al conducted in Port Harcourt.[20,22] Anaezichukwuolu reported a prevalence of 7.3% and 2% for asthenozoospermia and oligoathenozoospermia respectively in a related study in Benin Edo State while Green et al, Nwachuku reported a prevalence at 20.1% as asthenozoospermia in their study done in Port Harcourt.[20,22] However, the prevalence of teratozoospermia at 15.1%, asthenoteratozoospermia of 19.4%, and oligoasthenoteratozoospermia at 12.9% observed in our study relates closely to the findings of

Anaezichukwuolu who also reported 11.5% and 13.8% for teratozoospermia and oligoasthenoteratozoospermia respectively.[20] Likewise, Green et al, also gave a similar report of 18.3% prevalence of teratozoospermia among infertile males in Port Harcourt.[22]

In addition, it was also observed in our study that primary infertility had a higher prevalence of 62.4% while secondary infertility had a prevalence of 37.6%. The trend of our results is similar to the findings of Abarikwu, who reported a higher prevalence of primary infertility at 70.8% and secondary at 29.2% amongst the infertile males in his study.[2] However, our findings contradicted the reports of Odunvbun et al, who observed a higher prevalence of secondary infertility at 58.9% and a lower prevalence of primary infertility at 41.1%.[21] Likewise, Anaezichukwuolu also reported a lower prevalence of primary infertility at 17.7% and 82.3% as secondary infertility among infertile males.[20]

The prevalence values seen in this study suggest a higher rate of male-only infertility in the study population which could be an indication of the decline in male fertility associated with varying degrees of sperm cell abnormalities. The higher prevalence of infertility among males could be attributed to increasing activities of industrial (predominately oil and gas) activities especially illegal bunkering releasing contaminants into our environment and food. These contaminants which are mostly PAH and PCH could have negatively interacted with spermatogenesis and steroidogenesis.

The prevalence of infertility of 17.7%, 18.8%, and 11.9% in the age brackets of 23-33 years, 34-44 years, and 45-54 years respectively are similar to the findings of Odunvbun et al but contrary to the reports of Waheed et al.[24] Odunvbun et al reported 27.2%, 30.5%, 25.3%, and 13.9% for infertile males within the age group interval of 21-25 years, 26-30 years, 36-40 years, and >40 years respectively.[21] Waheed et al reported significantly reduced sperm quality after age 37-44 years.[24] The discrepancy observed between our result and that of Waheed et al could be because younger males (23-33 years or 34-44 years) in our study presented with primary infertility were more in attendance seeking medical interventions compared to older males (45-54 years) with either secondary infertility or other urological issues.[24] However, it is believed that fertility in males declines with age as a result of increasing pathologies associated with aging such as benign prostate hyperplasia, and the anti-oxidants depletion due to the increased oxidative stress.

Furthermore, our results indicated that civil servants (office workers) had the highest prevalence of infertility at 20.8% in the study area followed by artisans (welders) at 11.9%, transporters at 9.4%, and automobile mechanics at 6.3%. The highest prevalence observed in civil servants (office workers) may not necessarily represent the distribution in society but could be an indication of the fact that most civil servants tend to seek or have better behavior towards medical help due to their level of education. As seen in our study, those with tertiary education are the ones mostly attending hospitals for medical help with a prevalence of 21.9%.

When the consistency of seminal plasma was considered, watery specimens accounted for 47.9%, viscous for 44.7%, and hyper-viscous specimens accounted for 7.7%. Though the prevalence was not stated, Mahfouz et al and Siciliano et al documented hyper-viscous semen in their semen analysis of infertile male subjects. Hyper-viscosity of seminal plasma could be an indicator of impaired or poor fertility.[24,26]

Bacterial infections in seminal plasma after culture indicated a prevalence of 29.2% in infertile males of which 12.5%, 9.3%, and 7.3% indicate scanty, moderate, and heavy bacterial growth. The organisms isolated and identified were *Staphylococcus aureus, Klebsiella pneumoniae, Escherichia coli,* and *Pseudomonas aeruginosa.* Of the organisms, *Staphylococcus aureus* had the highest prevalence with 18.2%, followed by *Escherichia coli* with 5.2%, *Klebsiella pneumoniae* with a prevalence of 2.0%, and *Pseudomonas aeruginosa* with 1.1% as well as mixed growth of *Staphylococcus aureus and Escherichia coli* with 2.6%. Our findings are similar to the observations made in Port Harcourt by Oyeyipo et al.[27] They also reported microbial infections (and prevalence) such as *Staphylococcus aureus* (30%), *Klebsiella pneumoniae* (10%), *Escherichia coli* (2%), *Proteus mirabilis* (10%), and *Pseudomonas aeruginosa* (7%) isolated from seminal plasma.

The high prevalence of *Staphylococcus aureus* could be attributed to normal flora contamination of the glans penis or orifice of the urethral opening. However, their heavy presence (*Staphylococcus aureus*) in seminal plasma alongside scanty or moderate growth of *Escherichia coli* observed as mixed growth could suggest actual pathogenic bacterial infection of the seminal plasma with significance. Seminal plasma infection has contributed to male infertility affecting sperm cell viability and motility. Abarikwu and Anaezichukwu reported bacterial infections as one of the major causes of male factor infertility due to their metabolic (toxic) activities culminating in poor spermatogenetic processes.[2,20] In addition, the activities of bacteria lead to the presence of increased pus cells in seminal plasma. Pus cells are a major source of reactive oxygen species (ROS) in the seminal plasma negatively affecting sperm motility, morphology, and viability. In a related work, Aworu et al reported antioxidant levels such as TAC and GPX of subjects with bacterial infections, azoospermia, and oligozoospermia were significantly lowered in seminal plasma linking it to oxidative stress-related mechanisms.[3] This finding also concurs with the findings of Waheed et al, Parrish and Fraczek et al.[24,29] They all reported lower values of GPX and TAC in azoospermic and oligospermic subjects in their studies.

The limitation associated with the study is that most of the males attending fertility clinics are naïve to submit to this investigation. Also, some that indicated interest in participating eventually did not show up for sampling or failed to comply with the 3 days abstinence period after several trials. Overall, it affected the number of participants recruited even though our sample size calculated target was 93.

CONCLUSION

Male-only factor infertility is on the increase and occupational risks associated with prolonged sitting, sedentary work style, or working close to high-temperature sources as seen in civil servants and welders (artisans) was observed to be more prone to male-only factor infertility. *Staphylococcus aureus* infection and in combination with *Escherichia coli* in the urinary or reproductive tract has also been seen to contribute as a major risk for male infertility.

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