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ORIGINAL ARTICLE

Male Infertility: A Retrospective Review of Laboratory Charts at a Tertiary Teaching Hospital in Nairobi City County

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ABSTRACT

Background: Globally, approximately 50 million couples experience one form of infertility, and 10 million cases of subfertility have been reported in sub-Saharan Africa. Infertility is characterized by a lack of clinical conception among couples who live together for more than one year with regular coitus, without the use of contraception. Factors related to fertility vary by sex and geographical region. These factors include age, lifestyle, infectious diseases, and genetic disorders. In African culture, children are considered a simple inheritance and a measure of masculinity, so efforts are needed to address the growing problem of male infertility in this context.

Objective: To determine the prevalence of male infertility among adult men seeking semen analysis services in a tertiary teaching hospital in Nairobi, Kenya.

Methods: This was a cross-sectional study that involved a retrospective review of archived electronic data in the hospital information system. These data were from male patients who visited the laboratory with a request for semen analysis between January 2016 and December 2020. A checklist was used to extract data related to sociodemographic factors and laboratory results (age, seminal volume, and diagnosis).

Results: The average age of the male clients seen during the review period was 36±8 years, with the majority aged 31–40 years n= 996 (46.7%). The youngest was 21 years old, and the oldest was 70 years old. The total prevalence of seminal abnormalities was 1628 (77%) of the 2131 electronic data that was reviewed. Only 502 (23%) of the patients had a normal seminal diagnosis. Most clients exhibited at least one form of seminal abnormalities, such as asthenospermia 913 (43%), oligospermia 441 (21%), and azoospermia 272 (13%). There was a statistically significant association between age and seminal abnormality ($X^2 = 31.393$, $P=.013$). A significant association was also found between seminal volume and abnormalities ($X^2 = 94.538$, $P=.000$).

Conclusion: Our findings showed that there were some seminal abnormalities among Kenyan men in Nairobi County. More effort is required to identify the cause of this increase in seminal abnormalities. Initiation of health interventions to reduce this burden of infertility may be necessary.

BACKGROUND

Infertility is characterised by a lack of clinical conception in couples who have lived together for more than a year with regular coitus and without the use of contraception.[1] It is estimated that 50 million couples experience infertility globally. Sub-Saharan Africa alone accounts for 10 million of these reported cases of subfertility. [2] Subfertility is thought to vary between men and women from one region to another. These variations are associated with factors such as age, lifestyle, infectious diseases, hormonal abnormalities, and genetic complications.[3] Globally, the trend of male infertility is a growing public health concern, subjecting couples and their families to immense pressure.[4-7]

By definition, infertility can be classified into two broad categories: primary and secondary infertility. Primary infertility refers to infertility in married individuals (men and women) who have remained together for several years without evidence of conception.[8] Secondary infertility is characterized by the lack of conception by a couple for one year after a previous conception.[1] Primary and secondary infertility have different aetiologies in which genetic or social factors play an important role.[9] The genetic factors that contribute to infertility among couples are gene mutations and chromosomal abnormalities. These factors are known to interfere with women's oogenesis and men's spermatogenesis.[10,11]

Conversely, social factors include things such as smoking, obesity, sexually transmitted infections, environmental toxins, and work-related risks.[12-14]

Clinically, semen abnormalities are classified into several categories, including azoospermia, oligospermia

, asthenozoospermia and teratozoospermia. Azoospermia is characterised by a lack of sperm cells after ejaculation, and approximately 15% of men who report fertility problems suffer from azoospermia.[15] To cause conception, male gametes travel through the reproductive canal and encounter the female gamete. However, this is usually not achieved when sperm motility is low, which is a condition called asthenozoospermia. The prevalence of asthenozoospermia is estimated to be around 18.71%.[16] Asthenozoospermia is associated with oligospermia (63.13%) and teratozoospermia (81.84%), which alters sperm movement, thus reducing the chance of fallopian fertilization.

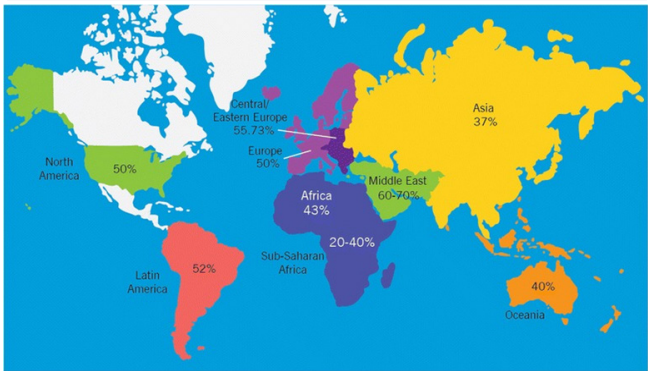
Treatments for male infertility include hormonal therapy where testosterone hormone is used, treatment of sexually transmitted infections, and medication to improve sperm production.[17] Surgical procedures are available to fix a varicocele or eliminate obstacles that could prevent sperm maturation, production, or ejaculation.[18] Technology for assisted reproduction, such as artificial insemination using donor sperm, intracytoplasmic sperm injection (ICSI), and in vitro fertilization (IVF) are other options for men affected with infertility.[19-22] Additionally modifications to one's lifestyle include maintaining a healthy weight, eating more fruits and vegetables, exercising regularly, controlling life stressors, and quitting alcohol, cigarettes, and non-prescription drug use.[23-25] By controlling reproductive hormones and improving blood flow to the uterus and ovaries, acupuncture can improve fertility. [26]

The global prevalence of primary and secondary infertility ranges between 10% and 15%, with many cases related to secondary infertility. [27] This prevalence varies throughout the world, as shown in Figure 1. The highest number of cases is reported in the Middle East, countries with a list of cases seen in sub-Saharan Africa.[28] However, these differences can be attributed to several factors, such as testing capacity, country priorities, and many others. For example, the low prevalence in Africa could be because of a lack of interest from African researchers and/or the negligence of policy makers.

In African cultures, children are considered a symbol of inheritance and a measure of masculinity, and there are a variety of conventional beliefs about what causes infertility. [29] In many Kenyan communities, the absence of pregnancy in the first months after a couple's wedding is a concern for their relatives and close friends.[30,31] Therefore, couples are under excessive pressure to meet this societal expectation to prevent people from asking questions. Without the support of the scientific community, these individuals may face stigma and ridicule from others, including those close to them. The published data estimated the prevalence of secondary and primary infertility at approximately 15%.[32] This is of concern because it has a significant impact on the social well-being of affected individuals.[33-35] Women are the most victimized group and experience domestic violence worldwide because of complications related to infertility.[36] Societal beliefs in African communities dictate that it is the responsibility of a woman to raise children. Stigmatization related to not fulfilling this role affects women's mental well-being, and some may also experience gender-based violence[31,37,38] as infertility plays an important role in cases of increased gender-based violence in Africa and other regions.

The general prevalence of infertility in Kenya among patients who have sought fertility-related services in health facilities is 2 to 30%.[39] Despite the importance of this problem, there is little epidemiological information available on male infertility. Most studies conducted in Africa have focused on women's infertility-related issues rather than men's related issues.[40] Limited data on male infertility affect the allocation of resources for reproductive health-related issues, especially issues related to male infertility.[41]

FIGURE 1: Summary of the Global Prevalence of Male Infertility



Adapted From[45]

The increasing prevalence of infertility among couples is often attributed to untreated sexually transmitted infections (STIs).[39] An estimated 30% of married couples in Kenya experience infertility problems, with male factors accounting for the highest proportion of these cases.[42] Detailed data from previous studies showed a 32% reduction in sperm concentration in the past five decades.[43] This decline is believed to be related to idiopathic abnormalities that alter sperm production.[10,44-50] There are no clear explanations for this impairment, but evidence suggests that poor lifestyle behaviors, chemical exposure, obesity, excessive alcohol consumption, and hormonal dysfunction play an important role.[51] In several studies, a strong association has been documented between excessive alcohol consumption and semen quality, although with contradictory findings.[14,52-55]

The exact cause of male infertility remains unknown, and there are major uncertainties about the causal variables. The literature suggests that male infertility is associated with factors such as cultural beliefs, health-seeking behaviors, infectious diseases, hunger, poverty, and poor lifestyles.[56,57] However, laboratory-based information on various cases of infertility is important in the development of health policies at both the local and national levels to address issues of male reproductive health. This area has been consistently neglected by governments and most health stakeholders in low-middle-income countries (LMIC).[58,59] Few studies have been conducted in Kenya to address issues related to male reproductive health.

An infertility examination that includes tests on the man is usually used to diagnose male infertility.[60] Among these examinations, a physical examination includes genitalia, medical history, and indications of penile, scrotal, and endocrine diseases. [61] Semen analysis to examine for abnormalities, antibodies, and sperm count, at least two semen samples are collected on different days. [62] Blood tests to measure hormone levels and rule out other problems. Testicular biopsies A tiny piece of tissue is taken from each testicle if the results of the semen analysis indicate that there are few, no, or very abnormal sperms.[63] Lastly, an ultrasound is used to obtain images of the prostate gland and other reproductive organs. Testicular morphology, patency of the efferent ducts, varicoceles, epididymal abnormalities, secondary changes caused by obstruction of the distal genital duct, and prostatic abnormalities are among the abnormalities in the testes and peri testicular structures that can be identified with the use of these ultrasound images.[64,65]

Therefore, this is a timely study that offers a snapshot of the prevalence of male infertility over the past 5 years. It will also provide an opportunity to discuss health policies geared toward addressing reproductive health issues based on epidemiological evidence on fertility issues among men in Kenya. At the individual and social levels, this study will help to sensitise the public to this rarely discussed topic of male infertility. Finally, we characterize different seminal abnormalities experienced in male infertility, which offers a basis for tailoring health promotion messages along with lifestyle and behavioral interventions in Kenya and elsewhere. In this context, this study aimed to determine the prevalence of male infertility and clinically characterize several types of male infertility based on laboratory diagnosis among adult men who have sought semen analysis services for the past 5 years in a tertiary institution in Nairobi, Kenya.

MATERIALS AND METHODS

Study Site

This study was conducted in a tertiary teaching health facility (Aga Khan University Hospital Nairobi) in Nairobi County. The hospital was established in 1958 as a 254-bed long-term care facility providing general medical services, specialist clinics, and diagnostic services. Nairobi is the capital of the Republic of Kenya and Nairobi County is one of the most populous Kenyan counties. The Kenyan census for 2019 indicated that the population of Nairobi County was 4,397,073 people, of which 2,192,452 were men and 2,204,376 were women. The population includes people of various backgrounds; most people are casual laborers who work in the informal sector. The county has several public and private health facilities that offer fertility services to clients.

Target Population

The target population for this study was all adult men who sought fertility services at Aga Khan University Hospital Nairobi (AKUHN) between January 2016 and December 2020. The data for this review were drawn from patient laboratory data from patients captured in the hospital information system.

Inclusion Criteria

We include completed electronic medical laboratory data in the hospital information system for all adult men who sought fertility services at the study site from January 2016 to December 2020.

Exclusion Criteria

We excluded all electronic charts with missing data of interest for this study and other charts from patients who visited the laboratory for other services.

Study Design

This was a cross-sectional study design that retrospectively reviewed secondary data from a hospital information system. This was a baseline study survey to provide a point prevalence of seminal abnormalities among male patients. The researchers reviewed all electronically stored data for adult men who submitted their semen for analysis in the hospital laboratory. The study variables included age, seminal volume, and the final laboratory report.

Sample Size Calculation

We used the census method to achieve the required sample size for this study i.e., we reviewed all laboratory electronic reports archived on the hospital information system between January 2016 and December 2020. On average, the laboratory analyzes 500 seminal samples drawn from patients in Nairobi County annually.

Data Collection

We developed a data collection checklist to collect variables specific to the research objectives. The checklist captured sociodemographic variables documented in the hospital information system, including age, seminal volume, and final laboratory diagnosis.

Data Management

The data collected during the study was cross-checked for missing variables before entering them into a Microsoft Excel spreadsheet. This was followed by the calculation of descriptive statistics (that is, mean, standard deviation, and range) for age and seminal volume. Pie charts, frequency tables, and histograms were used to summarize the data for categorical variables. Chi-square tests were used to assess associations between independent and dependent variables. All analyzes were performed with SPSS version 20.0 (IBM, Chicago, USA).

Ethical Considerations

Ethics clearance for this study was obtained from the Aga Khan University Institutional Ethics Review Committee (AKU-IERC) Ref: 2021/IERC-98 (v1) before starting data collection. We used codes to anonymously collect information to protect patient identities and followed strict institutional patient data protection policies for data access, use, and dissemination. The data collected were securely stored by the principal investigator in a lockable place accessible only to researchers.

Risks and Benefits

This was a low-risk study, and no intrusive procedures were used. We handled data obtained from patient records in privacy and confidentially, and only authorized individuals could access the data.

RESULTS

Sociodemographic Characteristics of the Clients

In total, 2031 electronic records from the hospital information system (HIS-Care 2000 system) were reviewed. This comprised data for clients who had submitted their semen for analysis between January 2016 and December 2020. As shown in Figure 2, the mean age of the sample was 36±8 years, with the youngest aged 21 years and the oldest 70 years. Most of the clients were between 31 and 40 years of age n = 996 (47%) and the smallest group consisted of those over 60 years of age n= 21 (1%).

Laboratory Characteristics of Male Fertility

Figure 3 shows the laboratory characteristics based on the results of the semen analysis. The total prevalence of male seminal abnormalities was n=1628 (77%) and only n=503 (23%) of the patients had normal semen. The most common abnormality was asthenospermia n=913 (43%), followed by oligospermia n=441 (21%) and azoospermia n=272 (13%).

Seminal Volume

Most of the patients n=792 (37%) submitted 1.1 to 2 ml of seminal fluid (Figure 4). The average seminal volume was 2.3±1.2 mls (range 0.5-8 ml) and a small number n=344 (16%) of patients submitted a seminal volume below the reference range (2 ml) after 3 days of abstinence.

Association between age and male fertility

Table 1 presents the results of the chi-square cross-tabulation of age and seminal volume with seminal abnormalities. There were statistically significant associations between seminal abnormality and age (X^2 =31.393, *P*=.013) and seminal volume (X^2=94.548, *P*=.001) at 95 CI. More cases of azoospermia (38.1%) were observed in patients over 60 years of age. Azoospermia was evenly distributed among the remaining age groups (51–60 years: 13.0%; 41–45 years: 12.6%; 31–40 years: 12.0%; and 20–30 years: 13.6%).

FIGURE 2: Age Distribution of Patients

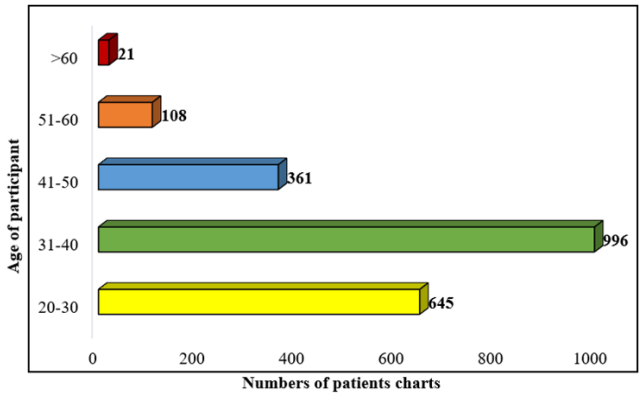


FIGURE 3: Laboratory Classification of Seminal Abnormalities

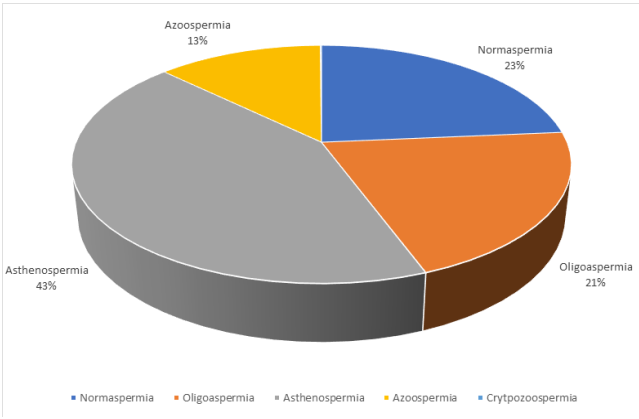


FIGURE 4: Distribution of the Volume of the Seminal Fluid

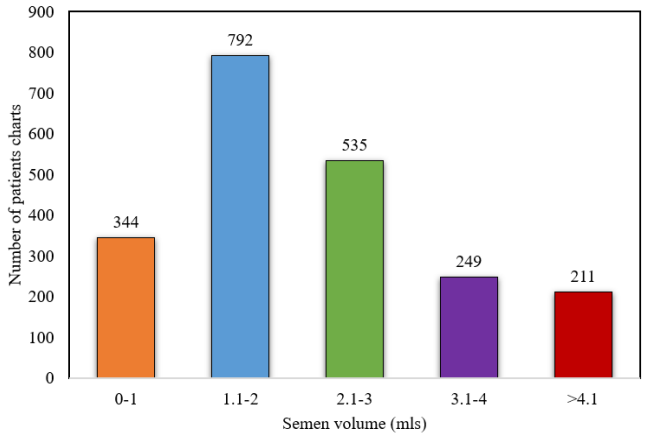


TABLE 1: Associations Between Seminal Abnormalities and Age/Volume

	Diagnosis (95 confidence interval)											
	Normospermia		Oligospermia		Asthenospermia		Azoospermia		Cryptozoospermia		Chi-square	*P Value*
	n	%	n	%	n	%	n	%	n	%		
Age, years												
20–30	156	24.2	125	19.4	283	43.9	81	12.6	0	0.0	31.398	.013
31–40	251	25.2	217	21.8	406	40.8	120	12.0	2	0.2		
41–50	82	22.7	66	18.3	164	45.4	49	13.6	0	0.0		
51–60	13	12.0	30	27.8	51	47.2	14	13.0	0	0.0		
>61	1	4.8	3	14.3	9	42.9	8	38.1	0	0.0		
Volume, ml												
0–1	56	16.3	113	32.8	105	30.5	70	20.3	0	0.0	94.538	.000
1.1–2	193	24.4	140	17.7	344	43.4	115	14.5	0	0.0		
2.1–3	137	25.6	103	19.3	250	46.7	45	8.4	0	0.0		
3.1–4	66	26.5	45	18.1	110	44.2	27	10.8	1	0.4		
>4.1	51	24.2	40	19.0	104	49.3	15	7.1	1	0.5		

DISCUSSION

Prevalence of Male Infertility

Infertility among men increases each year, raising concerns about reproductive health and the general well-being of society. [28] Worldwide, around 50 million men and women are struggling with some form of infertility. The greatest burden is seen in the Middle East and European countries. Our findings showed that asthenospermia was the most common seminal abnormality among men in Nairobi, followed by oligospermia and azoospermia. Our findings were higher than those reported in local studies. A study by Khushboo et al.[66] found that 32.7% of men had normozoospermia, 20.6% had asthenozoospermia, 11.5% had oligospermia, and 6.06% had azoospermia. This prevalence is higher than a pooled prevalence of 31% for oligospermia and 19.39% for asthenozoospermia, as reported in a systematic review and meta-analysis publication by Abebe et al.[67] Other articles in the literature also note that most of these abnormalities are associated with idiopathic and genetic factors.[68-71] The general prevalence of seminal abnormalities in our sample was high, with only a small proportion of clients having a normal seminal evaluation. Furthermore, the rate of azoospermia in our study was higher than that reported by the American Society of Reproductive Medicine.[72]

Most of the men who sought semen analysis in the tertiary teaching health facility during our 5-year study period were young men in the prime age group who wanted to have children. Poor lifestyles such as obesity, smoking, illicit drugs, and STIs such as gonorrhea can explain the higher number of seminal abnormalities in this group.[23,73-75] Our findings do not support the social assumptions that infertility is related to women. In most African societies, women are blamed when a marriage is childless, despite research that has shown that male factors play a significant role in infertility. [76-81] For example, a study found that 42.4% of infertility cases were attributable to male-related factors compared to 25.8% associated with female factors.[27] Therefore, a comprehensive approach is required to help couples struggling with primary or secondary infertility.

Demographic Characteristics Associated With Male Infertility

Our findings showed that age was a demographic determinant that predicted male infertility. A previous study suggested that increased paternal age was associated with lack or delay in conception. [82] In our study, the average age of the patients was 36±8 years. Similar studies also showed that young men in a comparable age bracket experienced problems related to male infertility.[83] A case series study conducted in Morocco showed that men 35 to 40 years of age (34.8%) were the most common age group who sought help for infertility.[63] The study also showed that just over half of the men (54.8%) had normospermia and 45.2% had seminal abnormalities.[84] This was not comparable to our finding, which showed a higher percentage of seminal abnormalities among Kenyan men. However, ageing independent of genetic and other related confounders was correlated with a decrease in sperm concentration and motility and an increase in sperm necrosis.[85]

On average, men produce 1.25 to 5.00 ml (1/4 to 1 teaspoon) of semen each time they ejaculate, but this amount varies from person to person. Men usually produce the most semen in their early 30s and the amount decreases with age. [86] Genetic factors, diet, smoking, and general health can also affect the volume of semen. In addition, some men ejaculate more if they have not had sex for a few days. Our study showed that the average seminal volume (2.3 ml) was within the normal range. However, there was a significant relationship between seminal abnormalities and seminal volume. [87,88] Our findings were consistent with a previous Japanese study by Iwamoto et al.[89] that reported an average of 3.1 ml. What is also shown in our results is that some patients had a seminal volume of less than 2 ml, contributing to the reported cases of azoospermia.

Several factors have been associated with azoospermia, including physical obstruction, eg, infection sequelae, or varicose veins. Additionally, approximately 10% of men who have had acute epididymitis develop persistent azoospermia and 30% develop oligozoospermia.[90-92] This, along with post-infectious disturbances of spermatogenesis, can also obstruct excurrent ducts.[90,93] Differential diagnostic evaluation includes the determination of testicular volumes, hormone concentrations, and ejaculate variables.[90] We found an association between seminal abnormalities and both age and seminal volume. A previous report by Larsen[2] in Tanzania showed a significantly higher risk of primary infertility in the coast and Dar es Salaam regions with a significantly higher risk of secondary infertility in the Dar es Salaam, Ruvuma, and Mwanza regions compared to the rest of Tanzania.

Laboratory Characterisation of Seminal Abnormalities

Most of the seminal abnormalities identified in this study were classified as asthenozoospermia and oligospermia. The rates of these conditions in our study were higher than those reported in a previous systematic review of African studies by Abebe et al.[67] (oligospermia: 43% vs 31%; asthenozoospermia: 21% vs 19.39%). In a similar study conducted in Sudan, the main causes of male infertility were sperm disorders such as azoospermia (37%), oligozoospermia (30%), and asthenozoospermia (30%). [94] On the contrary, different findings were reported in a Nigerian study, which found that 70% of the samples had a low sperm count with significantly high morphological seminal defects ($P<.05$); asthenozoospermia and teratozoospermia were the main seminal abnormalities detected and were associated with occupation and age (civil service workers 74% and those aged 31–40 years old at 75%).[95]

These findings suggested that there are variations between different geographical regions. From a global point of view, the rate of male infertility ranges from 20% to 70%, and that of infertile men ranges from 2.5% to 12%, which is much lower compared to our findings. Africa and Asia have the lowest incidence of male infertility from a global point of view. The reported rates of male infertility in other regions, including North America, Australia and Europe, range from 5% to 6%, 9% and 8% to 12%, respectively.[28] This variation can be attributed to differences in geographical regions and the lifestyles of people living in these countries. Lifestyle

tends to influence the quality of sperm cell production, with obesity, smoking, poor diet, lack of exercise, and STIs being risk factors associated with male infertility worldwide. [96]

A previous study by Taleb et al. [97] showed that 10% of the patients had azoospermia, which was clear in its progressive stages. This was similar to the proportion we reported in our study findings. There are several explanations for azoospermia, but one common reason is an abnormality at the chromosomal level. The male sex-determining region (SRY) is located on the short arm of the Y chromosome (Yp11) [98,99], and the proximal part of its long arm (Yq11) contains important genes involved in spermatogenesis. This section of chromosome Y is known as the region of azoospermia factor (AZF), which is subdivided into subregions (AZFa, AZFb, and AZFc). In the AZF region, the most important genes are USP9Y, DBY, UTY, TB4Y (AZFa subregion); EIF1AY, PRY, TTY2, RBMY (AZFb subregion); and DAZ1, DAZ2, BPY2, PRY and CDY (AZFc subregion).[68,100-104]

Microdeletions in the AZFc subregion are the most common and are associated with deletion of the DAZ gene and moderate to severe oligozoospermia, while microdeletions in the AZFa and AZFb subregions have been associated with azoospermia.[105-107] Deletions in the AZF region have been associated with altered sperm parameters and testicular histological characteristics such as Sertoli cell-only syndrome and hypo spermatogenesis.[108-112] The most common defects in spermatogenesis are microdeletions in the AZF region. These can be detected using molecular methods and are found in 5% to 10% of infertile men. [10] Most studies show that deletions in the AZFc region are the most common, followed by deletions in the AZFb and AZFa regions.[113,114]

Although it is the most affordable and easily accessible database, clinical data chart reviews are restricted. The drawback of secondary data is that it is rare that it has the information needed to answer a research inquiry. This was the limitation since several of the risk factors associated with male infertility were not fully addressed using this approach. Furthermore, to properly interpret the semen analysis, we depended on the data recorded in the hospital records, over which we had little to no control over the precision and quality of the information. However, the secondary research approach required less time and money compared to collecting primary data. The data were also easily accessible to researchers to conduct a baseline survey study that will inform future studies.

CONCLUSIONS

Our findings showed that there were seminal abnormalities among Kenyan men in Nairobi County. Age and seminal volume appeared to predict the probability of seminal abnormalities among male patients seeking fertility services in Nairobi County. However, there may be other seminal parameters and contributing factors that were not addressed in this study. We recommend further studies to examine these factors and the quality of life of men facing the challenges of infertility in the Republic of Kenya.

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