

Epidemiological Profile of Male Infertility in Two Hospitals of Douala: A Cross-Sectional Study in a Sub-Saharan Africa Setting

Frantz Guy Epoupa Ngalle^{1,2,*}, Kelly Donfack², Edouard Herve Moby Mpah^{2,3}, Sylvain Raoul Simeni Njonou⁴, Charlotte Tchente Nguetack^{2,5}

¹Department of Surgery, Douala General Hospital, Douala, Cameroon

²Department of Surgery, Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon

³Nkongsamba Regional Hospital, Nkongsamba, Cameroon

⁴Department of Internal Medicine and Specialties, Faculty of Medicine and Pharmaceutical Sciences, University of Dschang, Dschang, Cameroon

⁵Department of Gynaecology, Douala General Hospital, Douala, Cameroon

Email address :

frantzepoupa@gmail.com (F. G. E. Ngalle)

*Corresponding author

To cite this article:

Frantz Guy Epoupa Ngalle, Kelly Donfack, Edouard Herve Moby Mpah, Sylvain Raoul Simeni Njonou, Charlotte Tchente Nguetack. Epidemiological Profile of Male Infertility in Two Hospitals of Douala: A Cross-Sectional Study in a Sub-Saharan Africa Setting. *International Journal of Clinical Urology*. Vol. 4, No. 2, 2020, pp. 85-91. doi: 10.11648/j.ijcu.20200402.22

Received: October 17, 2020; **Accepted:** November 2, 2020; **Published:** November 11, 2020

Abstract: *Background:* Male infertility is defined as a lack of pregnancy for a couple after 12 months of regular and normal sexual intercourse without contraception with the cause being clearly from the male origin. Contrary to popular belief, the prevalence of male infertility is similar to that of female infertility and sometimes even higher. However, data on the subject in Cameroon are scarce and nonexistent in the city of Douala. This motivated the realization of this study in two centers in the city of Douala. The objective was to describe the epidemiological profile of male infertility. *Methods:* We conducted a cross-sectional study among patients who consulted for infertility in two hospital centers in Douala from January 2014 to October 2019. A consecutive sample of all eligible cases was considered for this study. Data were analyzed using Statistical Package for Social Sciences (SPSS Inc, Chicago, Illinois, USA) V. 20.0 and EPI-INFO V. 3.5 software. Analyzed variables included sociodemographic data (age, marital status, educational level, profession, region, alcohol, smoking habit and mean infertility duration) and other causes of infertility (obesity, history of testes infection, STI, testes traumatism, varicocele or varicocele surgery, herniorrhaphy, genetic or malformative disease). *Results:* We included 137 patients' records. The frequency of male infertility for patients consulting in urology was 5.6%. Their average age was 35.4±7.4 years. The average number of sexual intercourses per week was 2.7±0.97. Those patients were mainly from an intellectual profession (40.2%), married (71.5%) with a higher education level (67.2%). Almost 60% of the studied population had alcohol consumption. Primary infertility accounted for 65.7% of the study population and the average duration of infertility was 5.9±5.3 years. The main factors for infertility were respectively history of sexually transmitted infections (STI) in 59 (43.1%) and childhood mumps in 42 (32.7%) cases. Furthermore, herniorrhaphy (16.1%) and varicolectomy (10.9%) were the most representative surgical background. *Conclusion:* Male infertility is not uncommon in urological consultation with primary infertility been more frequent. Risk factors of infertility in our setting included a history of STI, mumps, and surgery.

Keywords: Epidemiology, Male Infertility, Sub-Saharan Africa Setting

1. Introduction

The World Health Organization (WHO) defines infertility as the absence of pregnancy after more than twelve months of regular and normal sexual intercourse without contraception [1]. It can be female or male. Infertility is said to be male when the anomaly is due to man. It can be primary or secondary, depending on whether he has already fertilized a woman or not [2]. Nowadays, it represents a real public health problem because of its frequency, the impact on the quality of life, and the difficulties inherent in its diagnosis and its cost burden. Currently, in increasingly industrialized societies, the absence of a desired pregnancy is accompanied by a profound psychological and emotional impact on the couple [3]. The distribution of couples' infertility is variable around the world. Thus, it is 25% in China according to Zhou *et al.* in 2017, 6% in the United States according to Chandra *et al.*, 10-15% in England according to Oakley *et al.* [4–6].

Concerning male infertility, Agarwal *et al.*, in a systematic review, found higher rates of male infertility in Central and Eastern Europe (8-12%), Australia (8-9%) and Europe (7.5%) than North America (4.5-6%) and Sub-Saharan Africa (2.5-4.8%) [7]. Recent studies in India found a frequency of 20.4% of pure male factor in infertile couple, associated with several factors such as a history of varicocele surgery, STI, alcohol consumption, diabetes, small size testis and tobacco [8, 9]. One-third of these patients had erectile dysfunction while half had azoospermia or oligospermia [8]. In China, Cong *et al.* found an increased risk of infertility in those engaged in occupations with the high-temperature working environment [10]; while tobacco (29%) and history of varicocele surgery (22%) were the main risk factors for male infertility in Iran [11]. Furthermore, azoospermia and oligospermia represented 4% and 23% [10]. In contrast, Aziz *et al.* in the United States of America (USA) found no association between tobacco, alcohol, occupation and the etiologies of male infertility. Genetic predispositions were highlighted as the major factor responsible for male infertility in this study [12].

There are few data on male infertility in Africa. Although lower compared to the other parts of the world, infertility rates vary in Sub-Saharan Africa (SSA) [7]. In Nigeria, Olatunji and Sule-Odu found 14.8% of infertile couples with 30% due to pure male infertility [13]. Gyasi-Sarpong *et al.*, in Ghana, identified respectively 58.2 and 41.8% of primary and secondary infertility in male patients; with varicoceles and small volumes testes among the main risk factors [14]. In Cameroon, two studies were performed on infertility. Nana *et al.* found 11.5% of pure male infertility in our environment, with asthenospermia and varicocele been the main etiologies [15]. Voundi Voundi *et al.* found that the main risk factors associated with semen abnormalities were varicocele, congenital anorchia and mumps history [16].

This cross-sectional study aimed at characterizing the epidemiological profile and the risk factors for male infertility in two main hospital centers in Douala, Sub-Saharan Africa.

2. Methods

Study design and setting: This cross-sectional study was carried out in two therapeutic centers for infertility management in Douala (Douala General Hospital and the Urological Medico-surgical Centre of Douala). Douala General Hospital (DGH) is a tertiary hospital in Douala, the largest of Cameroon (SSA), while the Urological Medico-surgical Centre of Douala (UMSCD) is a private medical institution with a high technology platform.

Study population: We retrospectively reviewed files of male patients seen in outpatient consultation consulting for infertility from January 2014 to October 2019 via clinical records. Patients followed-up, but not seen at outpatient's consultation were contacted by telephone and invited to participate in the study.

Variables and Measurements: We included all files of consenting patients that have performed a seminogram. Patient files were reviewed and patients were contacted to provide some specific information. The files of patients who refused to participate and the incomplete files were excluded. Data on sociodemographic characteristics (age in years, gender, profession, alcohol intake, tobacco consumption) and other risk factors for male infertility (obesity, history of testes infection, STI, testes traumatism, varicocele or varicocele surgery, herniorrhaphy, genetic or malformative disease). Excessive alcohol consumption was considered for a consumption > 40 g/day for men or more than 10 local beers per week.

Definition of operational terms:

Infertility was defined as the absence of pregnancy after more than twelve months of regular and normal sexual intercourse without contraception. Primary male infertility characterizes the situation when a man has never fertilized a woman, (regardless of the course of the pregnancy). Secondary male infertility is used when a man has fertilized a woman, regardless of whether she is the current partner, and regardless of the course of the pregnancy [1].

Varicocele is defined by the presence of varicose dilation of the veins in the anterior pampiniform plexus of the testicle [17].

Intermediate work refers to a professional category in which people have an intermediate position between managers and agents of execution [18].

Intellectual work refers to a professional category that includes professors and scientific professions who directly apply very in-depth knowledge in the fields of the exact or human sciences to activities of general interest in research, teaching or health, as well as managers, engineers, professionals in the arts and entertainment [18].

Sample size and Statistical analysis: A consecutive sample of all eligible cases was considered for this study. Data were analyzed using Statistical Package for Social Sciences (SPSS Inc, Chicago, Illinois, USA) V. 20.0 and EPI-INFO V. 3.5 software. We have presented discrete variables as counts and percentages, and continuous variables as mean (standard deviation).

3. Results

Participants: A total of 137 (out of 417 identified cases) cases of male infertility were included during the study period,

while 7.446 consultations were done in both centers within this period. Male infertility represents 5.6% of all urological consultations. Figure 1 presents the patient flow chart.

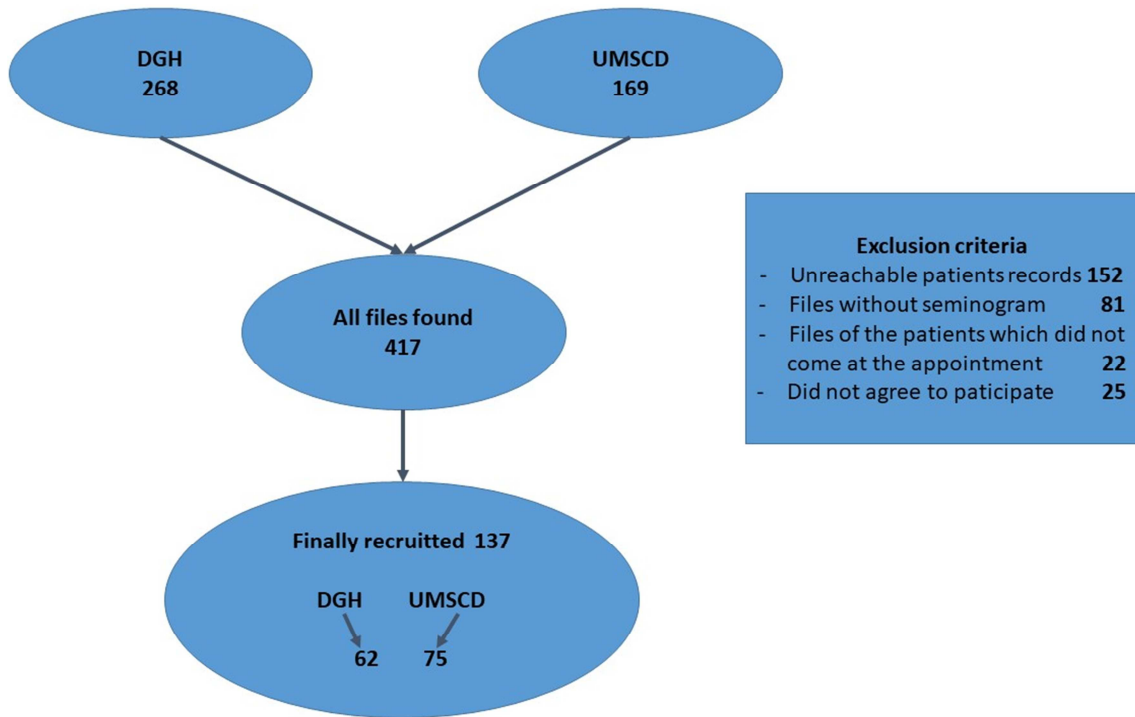


Figure 1. Patient flow chart.

The mean age was 35.4±7.4 years. The 30-34 years age group were the most frequent with 52 (38%) patients (Figure 2). People with an intellectual occupation were the most important professional group with 65 (47.4%) patients. Almost three over four patients were married (71%). Most of

them (67%) had a higher education level. Secondary infertility was the most common (65.7%). Mean infertility duration was 5.9±5.3 years. Most of the patients (55.5%) had an infertility duration between two and five years. Table 1 shows the general characteristics of this population.

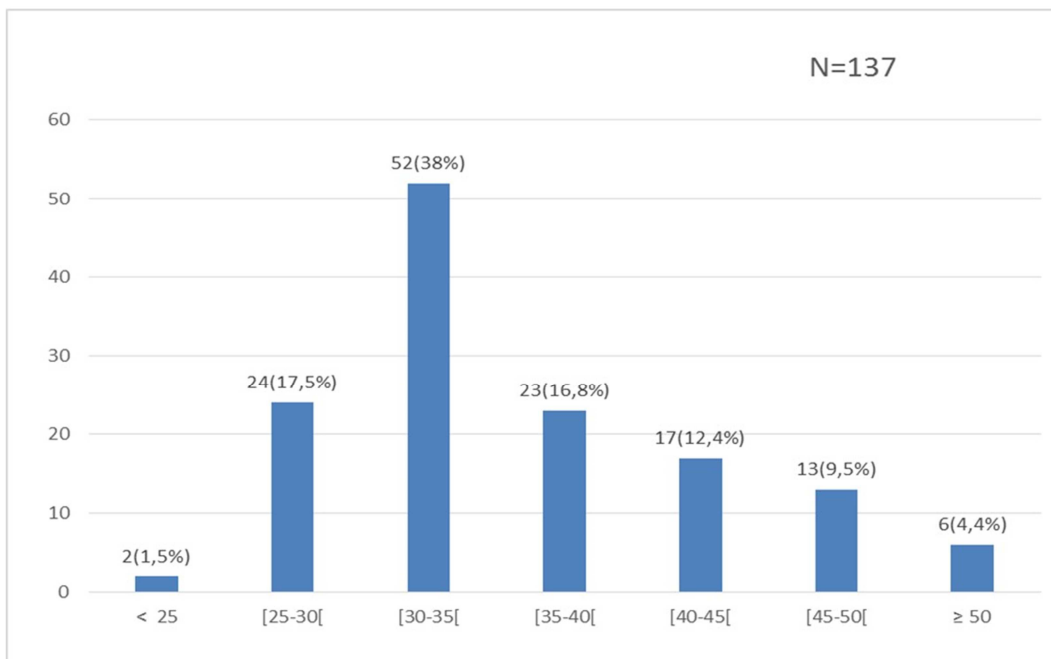


Figure 2. Patient classification by age group.

Table 1. Population characteristics.

Variables	Frequency (%)
Occupation	
Farmers	4 (2.9)
Traders	28 (20.4)
Employees	16 (11.7)
Students	5 (3.6)
Workers	14 (10.2)
Intellectual work	65 (47.4)
Intermediate work	5 (3.6)
Marital status	
Married	98 (71.5)
Single	38 (27.8)
Divorced	1 (0.7)
Educational level	
Primary school	18 (13.1)
Secondary school	27 (19.7)
Higher level	92 (67.2)
Infertility classification	
Primary infertility	90 (65.7)
Secondary infertility	47 (34.3)
Infertility duration	
1 year	27 (19.7)
2-5 years	76 (55.5)
6-10 years	21 (15.3)
11-15 years	8 (5.8)
16-20 years	5 (3.6)

STI (43.1%), mumps history (30.7%) and herniorrhaphy (16.1%) were the main factors in our study population. A varicocele surgery was found in 15 (10.9%) patients while cryptorchidism was found in 11 (8.0%) patients. Alcohol consumption was found in 80 (58.4%) patients and 11 (8.0%) were current smokers. Tables 2 and 3 present medical and surgical risk factors among our study population.

Table 2. Medical factors for male infertility.

Variables	Frequency (%)
STI	59 (43.1)
Mumps history	42 (30.7)
Cryptorchidism	11 (8.0)
Varicocele	7 (5.1)
Testes traumatism	7 (5.1)
Hypertension	7 (5.1)
Hepatitis B or C	5 (3.6)
Orchitis/epididymitis	5 (3.6)
Diabetes	3 (2.2)
Chemotherapy for any cancer	1 (0.7)
Sickle cell disease	1 (0.7)
Genetic disease	2 (1.4)
Klinefelter	1 (0.7)

Table 3. Surgical factors for male infertility.

Surgical history	Frequency (%)
Herniorrhaphy	22 (16.1)
Other surgery (non-urolological)	16 (11.7)
Varicocele surgery	15 (10.9)
Orchidopexy	3 (2.2)
Hydrocele surgery	2 (1.5)
Testicular torsion	1 (0.7)

4. Discussion

This cross-sectional study aimed to describe the epidemiology of patients consulting for male infertility in two hospital centers in Douala. Epidemiology of male infertility is still poorly known in the Sub-Saharan parts of Africa [13, 14, 19–26]. Few studies, especially on the prevalence and risk factors have been carried out in Cameroon [15, 16]. Our results show that the patients with male infertility are young, have an intellectual profession and high educational level, suffer mostly from primary infertility. The main medical factors for infertility were STI, childhood mumps in 42 (32.7%) cases. Furthermore, herniorrhaphy (16.1%) and varicocelelectomy (10.9%) were the most representative surgical background.

Male infertility prevalence in urological consult was 5.6% in Douala. This frequency was higher than the one found in Burkina Faso by Kirakoya *et al.* (3.6%) but lower than the 8.2% found by Bah *et al.* [25, 26]. However, this does not seem to reflect the real level of this pathology in both hospitals and society. Increased urbanization with a sedentary lifestyle, STI, obesity, heavy alcohol consumption in Sub-Saharan Africa should have increased the prevalence of this disease.

The mean age in our study was 35.4±7.4 years. This was similar to Sari-Minodier *et al.* in Marseille (35.8±7.3 years) and Kirakoya *et al.* in Burkina Faso (36.9±6.8) [25, 27]. In contrast, Punab *et al.* found a mean age of 33 in Estonia [28]. This age difference could be due to cultural influence with early or late wedding and/or to the health facilities access. But, globally, the male age upper 30 years seems to reflect the need of a child in the couple.

Intellectual workers represent 47.4% of the study population, followed by traders (20.4%). This was similar to Kirakoya *et al.* findings [25]. In contrast, Niang *et al.* in Senegal found 13.6% of intellectual workers; Bah *et al.* in Guinea, found that workers were the main professional group and Sari-Minodier *et al.* in Marseille found traders as the main professional group [26, 27, 29]. Those results possibly reflect the financial status of those groups in their countries.

Married patients account for 71% of the study population. This value varies from each country to another one, higher values in Nigeria (90.7%) and Ghana (98.2%) [14, 22]. In Mali, 57.2% of the study population had only one wife, the others were polygamous. This finding sustains the hypothesis men would seek the solution of their infertility in the marriage of a new wife, sometimes supported by their family [30].

A higher educational level was found in 67% of our patients. This value varies according to geographic area, with 54.7% in Nigeria and 35% in Iran [11, 22]. This result could reflect either a good understanding of the disease or access to health facilities.

Similar to our findings, primary infertility (65.7%) was the main in most studies. Moussa *et al.*, in Mali, found 57.8% of primary infertility [20]. Kirakoya *et al.*, so too, found 68.4% of

primary infertility in Burkina Faso while Benbella *et al.* and Aziz *et al.*, respectively in Morocco and USA found almost 80% of male infertility [12, 25, 31]. However, few studies in Nigeria, such as Nwajiaku *et al.* and Olatunji *et al.*, reported secondary infertility predominance [13, 32]. This can be a clue of STI's high rate in this setting. The mean infertility duration was 5.9±5.3 years. This was similar to Benbella *et al.*, Niang *et al.* and Kirakoya *et al.* findings [25, 29, 31].

The most frequent etiological factors found in this study were alcohol consumption, STI, mumps history, herniorrhaphy, and varicocele presence. However, some studies, in contrast to proven knowledge, denied the alcohol consumption impact on male infertility [33]. Okonofua *et al.*, so, did not find any correlation between alcohol consumption and infertility, in contrast to most of the studies [22]. STI and varicocele are among the most common risk factors identified. Chlamydia trachomatis remains by far the most common pathogen [34]. Bah *et al.*, however, found a history of gonorrhea in 17.9% [26]. Almost all studies reported either varicocele or varicocele surgery. It has been implicated in primary and secondary male infertility.

Although the present study is among the first multicenter report on epidemiology and risk factors of male infertility in the Sub-Saharan setting, some limitations should be noted. First, the lack of response from some patients led to the limitation of the sample size. Second, the fact that this study is not analytical reduces our ability to identify risk factors.

5. Conclusion

Male infertility accounts for 5.6% of all urological consultations in Douala, Cameroon. Intellectuals around 35 years old, married (probably reflecting the need of a child in the couple), with a higher level of education make up the bulk of the patients followed in urology for infertility. Factors associated with male infertility in our setting include alcohol consumption, STI, mumps history, herniorrhaphy, and varicocele presence. Further studies (analytics, with larger sample size) are thus needed for a detailed description in the Sub-Saharan setting.

Abbreviations

DGH: Douala General Hospital
 SPSS: Statistical Package for Social Sciences
 SSA: Sub-Saharan Africa
 STI: Sexually transmitted infection
 UMSCD: Urological Medico-surgical Centre of Douala
 USA: United States of America
 WHO: World Health Organization?

Declarations

Ethics Approval and Consent to Participate

The institutional review board of the Faculty of Medicine and Pharmaceutical Sciences of the University of Douala

approved this work (registration number N°1688 CEI-Udo/02/2019/T). Administrative authorizations were obtained from the hospital administrations. We carried out this work in accordance with the declarations of Helsinki [35]. We report this work following the Standard for Reporting Observational Studies in Epidemiology (STROBE) checklist.

Consent to Publish

Not applicable

Availability of Data and Materials

The dataset analyzed during this study is not publicly available due to individual privacy issues. It could be available from the corresponding author on a reasonable request.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contribution

Conception and Design: CTN, KD, EHMM, FGEN and SRSN. Data collection: KD. Administrative support: CTN, EHMM, FGEN. Data analysis and Interpretation: KD and FGEN

Drafting of the Manuscript

FGEN, SRSN, KD. Reviewing Manuscript: CTN, KD, EHMM, FGEN and SRSN. All the authors read and approved the final draft for publication.

Acknowledgements

We thank all the staff of DGH surgical and gynecological departments and all the staff of the Urological Medico-surgical Centre of Douala.

References

- [1] Zegers-Hochschild F, Adamson GD, de Mouzon J, Ishihara O, Mansour R, Nygren K, et al. International Committee for Monitoring Assisted Reproductive Technology (ICMART) and the World Health Organization (WHO) revised glossary of ART terminology, 2009. *Fertil Steril.* 2009; 92 (5): 1520-4.
- [2] Jungwirth A, Diemer T, Kopa Z, Krausz C, Minhas S, Tournaye H. European Association of Urology guidelines on male infertility. Arnhem, The Netherlands: European Association of Urology; 2018 p. 1-47.
- [3] Brzakowski M, Lourdel E, Cabry R, Oliéric M-F, Claeys C, Devaux A, et al. Épidémiologie du couple infertile. *J Gynécologie Obstétrique Biol Reprod.* 2009; 38: F3-7.
- [4] Oakley L, Doyle P, Maconochie N. Lifetime prevalence of infertility and infertility treatment in the UK: results from a population-based survey of reproduction. *Hum Reprod Oxf Engl.* 2008; 23 (2): 447-50.

- [5] Zhou Z, Zheng D, Wu H, Li R, Xu S, Kang Y, et al. Epidemiology of infertility in China: a population-based study. *BJOG Int J Obstet Gynaecol.* 2018; 125 (4): 432-41.
- [6] Chandra A, Copen CE, Stephen EH. Infertility and impaired fecundity in the United States, 1982-2010: data from the National Survey of Family Growth. *Natl Health Stat Rep.* 2013; (67): 1-18, 1 p following 19.
- [7] Agarwal A, Mulgund A, Hamada A, Chyatte MR. A unique view on male infertility around the globe. *Reprod Biol Endocrinol.* 2015; 13 (1): 37.
- [8] Velu A, Prasad G. Epidemiologic aspects of male infertility. *Int J Reprod Contracept Obstet Gynecol.* 2017; 6 (8): 3362.
- [9] Alam J, Choudhary P, Aslam M. Prospective study to evaluate the risk factors associated with male infertility at tertiary care centre. *Int Surg J.* 2018; 5 (8): 2862.
- [10] Cong J, Li P, Zheng L, Tan J. Prevalence and Risk Factors of Infertility at a Rural Site of Northern China. *Handelsman DJ, éditeur. PLOS ONE.* 2016; 11 (5): e0155563.
- [11] Sohrabvand F, Jafari M, Shariat M, Haghollahi F, Lotfi M. Frequency and epidemiologic aspects of male infertility. *Acta Med Iran.* 2015; 53 (4): 231-5.
- [12] Aziz N, Agarwal A, Nallella KP, Thomas Jr AJ. Relationship between epidemiological features and aetiology of male infertility as diagnosed by a comprehensive infertility service provider. *Reprod Biomed Online.* 2006; 12 (2): 209-14.
- [13] Olatunji AO, Sule-Odu AO. The pattern of infertility cases at a University Hospital. *West Afr J Med.* 1 janv 2003; 22 (3): 205-207.
- [14] Gyasi-Sarpong C, Manu Maison P, Koranteng A. The pattern of male infertility in Kumasi, Ghana. *Afr J Infertil Assist Concept.* 2017; 2 (1): 3.
- [15] Nana PN, Wandji JC, Fomulu JN, Mbu RE, Leko RJ, Woubinwou MJ. Aspects Psycho-Sociaux chez Patients Infertiles à la Maternité Principale de l'Hôpital Central de Yaoundé, Cameroun. *Clin Mother Child Health.* 2011; 8: 1-5.
- [16] Voundi Voundi E, Cyrille Noa Ndoua C, Belinga E, Ndoumba AM, Emmanuel Voundi Voundi J, Toukam M, et al. Factors Associated with Spermatic Abnormalities in Men Consulting for Couple Infertility at the Hospital Center for Research and Application in Endoscopic Surgery and Human Reproduction, Cameroon. *Int Ann Med.* 2018; 2 (11):. Disponible sur: <https://iamresearcher.online/ojs/index.php/iam/article/view/661>
- [17] Benazzouz MH, Essatara Y, Sayegh HE, Iken A, Benslimane L, Nouini Y. Impact de la varicocèle sur le volume testiculaire et les paramètres spermatiques. *Pan Afr Med J.* 2014; 19: 1-8. Disponible sur: <http://www.panafrican-med-journal.com/content/article/19/334/full/>.
- [18] Institut National de la Statistique et des Etudes Economiques (INSEE). NOMENCLATURE DES PROFESSIONS ET CATEGORIES SOCIOPROFESSIONNELLES. Paris; 2016 p. 666. Report No.: 3è édition, 2003. Available at: <https://www.insee.fr/fr/metadonnees/pcs2003/categorieSocioprofessionnelleAgreguee/4?champRecherche=false>.
- [19] Diallo AB, Bah I, Barry M, Diallo TMO, Bah MD, Kanté D, et al. La varicocèle de l'adulte: aspects anatomo-cliniques et résultats thérapeutiques au service d'urologie-andrologie du CHU de Conakry, Guinée. *Afr J Urol.* 2015; 21 (2): 137-141.
- [20] Moussa D, Soumana A, Amadou SM, Soli I, Tahirou I, Ali A. Profil hormonal chez l'homme en cas d'infertilité au laboratoire de radio immunologie de l'institut des radioisotopes de Niamey. *Afr J Urol.* 2016; 22 (4): 305-309-309.
- [21] Tijani KH, Oyende BO, Awosanya GO, Ojewola RW, Lawal AO, Yusuf AO. Scrotal abnormalities and infertility in west African men: A comparison of fertile and sub-fertile men using scrotal ultrasonography. *Afr J Urol.* 2014; 20 (4): 180-3.
- [22] Okonofua F, Menakaya U, Onemu SO, Omo-Aghoja LO, Bergstrom S. A case-control study of risk factors for male infertility in Nigeria. *Asian J Androl.* 2005; 7 (4): 351-61.
- [23] Uadia PO, Emokpae AM. Male infertility in Nigeria: A neglected reproductive health issue requiring attention. *J Basic Clin Reprod Sci.* 2015; 4 (2): 45-53-53.
- [24] Martin-Odoom A, Brown CA, Adjei DN. Level of male infertility in the Ghanaian city of Tema. *J Obstet Gynaecol J Inst Obstet Gynaecol.* 2015; 35 (8): 825-8.
- [25] Kirakoya B, Barnabé Z, Karim PA, Aristide KF, Clotaire Y, Amélie N. Epidemiological and Clinical Profile of Male Hypofertility in Consultation at the Urology-Andrology of Yalgado Ouedraogo Teaching Hospital (Burkina Faso). *Adv Sex Med.* 2014; 5 (1): 1-6.
- [26] Bah OR, Diallo AB, Diallo A, Guirassy S, Bah I, Barry M, et al. Infertilité masculine: fréquence et aspects étiologiques au service d'Urologie-Andrologie du CHU de Conakry. *Andrologie.* 2007; 17 (3): 241-5.
- [27] Sari-Minodier I, Loundou A, Ianos O, Ould Hamouda S, De Fleurian G, Lacroix-Paulmyer O, et al. Exposition professionnelle des hommes infertiles aux reprotoxiques: données du CHU de Marseille. *Arch Mal Prof Environ.* 2018; 79 (3): 300-1.
- [28] Punab M, Poolamets O, Paju P, Vihljajev V, Pomm K, Ladva R, et al. Causes of male infertility: a 9-year prospective monocentre study on 1737 patients with reduced total sperm counts. *Hum Reprod.* 17 2016; humrep; dew284v1.
- [29] Niang L, Ndoeye M, Labou I, Jalloh M, Kane R, Diaw JJ, et al. Profil épidémiologique et clinique de l'infertilité masculine à l'hôpital général de Grand-Yoff, Sénégal: à propos de 492 cas. *Basic Clin Androl.* 2009; 19 (2): 103-7.
- [30] Traore M, Toure A, Sissoko S, Samake NF. Profil spermologique des hommes infertiles au Mali. *Andrologie.* 2008; 18 (4): 253-7.
- [31] Benbella A, Aboulmakarim S, Hardizi H, Zaidouni A, Bezad R. Infertility in the Moroccan population: an etiological study in the reproductive health centre in Rabat. *Pan Afr Med J.* 2018; 30: 204.
- [32] Nwajiaku LA, Mbachu IL, Ikealo L. Prevalence, Clinical Pattern and Major Causes of Male Infertility in Nnewi, South East Nigeria: A Five-Year Review. *AFRIMEDIC J.* 2012; 3 (2): 16-9.
- [33] Marinelli D, Gaspari L, Pedotti P, Taioli E. Mini-review of studies on the effect of smoking and drinking habits on semen parameters. *Int J Hyg Environ Health.* 2004; 207 (3): 185-92.

- [34] Zorn B. Le sperme «inflammatoire»: ses relations avec la fertilité. *Andrologie*. 2009; 19 (1): 35-44.
- [35] Association Médicale Mondiale. Déclaration d'Helsinki de l'Association Médicale Mondiale: principes éthiques applicables aux recherches médicales sur des sujets humains. 2013. Disponible sur: <https://www.wma.net/fr/policies-post/declaration-dhelsinki-de-lamm-principes-ethiques-applicables-a-la-recherche-medecale-impliquant-des-etres-humains/>.