



The Prevalence of *Candida albicans* and *Trichomonas vaginalis* among First Year Female Students of a Tertiary Institution in Southeastern Nigeria

Usanga Victor Udoh¹, Kalu Michael Erem^{1*}, Ibiam Gideon Ama¹, Eze Ibe Kiran², Azi Simon Onyema¹ and Ukwah Boniface Nwofoke¹

¹*Department of Medical Laboratory Science, Faculty of Health Science and Technology, Ebonyi State University, Abakaliki, Nigeria.*

²*Department of Laboratory Services, Alex Ekwueme Federal University Teaching Hospital Abakaliki, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. Author UVU designed the study and wrote the first draft of the manuscript. Author UBN wrote reviewed the manuscript. Authors KME and IGA performed statistical analysis and managed the analyses of the study. Authors EIK and ASO managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2020/v18i530201

Editor(s):

(1) Dr. Mohamed Salem Nasr Allah , Weill Cornell Medical College, Qatar.

Reviewers:

(1) R. Umamaheswari , DR. M. G. R. Medical University. India.

(2) Lafta Inam Jasim , University of Baghdad, Iraq.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/57627>

Original Research Article

Received 24 March 2020

Accepted 31 May 2020

Published 10 June 2020

ABSTRACT

Aim: To determining the prevalence of *Candida albicans* and *Trichomonas vaginalis* infections among first year female students of Ebonyi State University, Abakaliki, a tertiary institution in Southeastern Nigeria.

Study Design: A cross sectional exposed case study.

Place and Duration of Study: Ultramodern Diagnostic Laboratory and Research Center, Department of Medical Laboratory Science, between June and November, 2019.

Methodology: The study involved 350 randomly selected students who consented to the study. Urine and high vagina swab (HVS) samples were carefully and aseptically collected using sterile

*Corresponding author: E-mail: kalu.irem@ebsu.edu.ng;

universal containers and sterile cotton swabs respectively and analysed within 30 minutes of collection. Analytical methods including plate culturing, Gram staining, wet mount preparation and germ tube tests were used to diagnose these infections.

Results: The overall results showed a *Candida albicans* and *Trichomonas vaginalis* prevalence of 11.1% and 6.0% respectively, while 2.0% were co-infected. The subjects within the age group 21-25 years had the highest prevalence of *C.albicans* and *T. vaginalis*, 14.5% and 8.5% respectively, while subjects between the ages of 26-30 years had the least prevalence; 5.5% and 0% respectively. However, a weak association was observed between *C. albicans* infection and age difference of the subjects ($P = .11$), while a strong association was observed between age difference of subjects and *T. vaginalis* infection ($P = .04$).

Conclusion: The study confirms the prevalence of these infections among the students of Ebonyi State University. There is need for provision of proper counseling on sexual behavior and genital hygiene as well as public health education for creation of awareness and sensitization for students through regular seminars is recommended.

Keywords: *Candida albicans*; *Trichomonas vaginalis*; students; Ebonyi State University; prevalence.

1. INTRODUCTION

Among the most typical communicable diseases related to women of reproductive age are vaginal infections caused by parasitic *Trichomonas vaginalis* and *Candida spp.* These organisms are responsible for the most prevalent curable sexually transmitted infections (STIs) amongst infections caused by etiologic agents including *Neisseria gonorrhoeae* and *Chlamydia trachomatis* [1]. About 180 million people globally are *T. vaginalis* infected with about 1 million infections yearly [2]. The high prevalence of trichomoniasis and vulvovaginal candidiasis (VVC), likewise their progression in acute and chronic phase with sequelae as a result of inaccurate diagnosis and treatment, perinatal morbidity and infertility has rendered these STIs as an issue of public health concern [3,4].

Candidiasis is a fungal or yeast infection of female lower genital tract, the vulva, caused by dimorphic fungus of the genus *Candida* [5]. *Candida albicans* lives and survives in different areas of the body such as the alimentary canal, oral fissure as well as the vagina where they live as commensal microorganisms or normal flora [6], although, in debilitated or immune compromised individuals, *C. albicans* may cause disseminated and mucosal candidiasis [7]. *Candida albicans* may not be completely regarded as a STI as they are seen in children and celibate women [8]. *Candida* infections usually occur in warm and moist body parts. Clothing that are too tight or made of nylon can trap heat and moisture and consequently, may lead to *Candida* over growth [9]. Three out of every four women experience at least one bout of vulvovaginal candidiasis (VVC),

during their lifetime [10]. *Candida species* are the fourth most commonly isolated pathogens from blood cultures [11]. *Candida albicans* accounts for about 80% to 90% of isolated fungal species [12]. In the diagnosis of candidiasis, cultural isolation and identification of *Candida spp* is crucial together with patient's history and genital examination.

Trichomonas vaginalis is an anaerobic, flagellated protozoan parasite and the causative agent of trichomoniasis [13]. It is a multicultural parasite of male and female genital tract whose main route of transmission is by sexual contact [1], likewise sharing of underwear with an infected person [14]. Nearly half of infected females and about 90% of infected men remain asymptomatic [15]. One third of asymptomatic carrier women become symptomatic within 6 months [16,17].

Trichomonas vaginalis is also called "trich" [18]. Women who engage in high risk sexual activities are at a greater risk of *T. vaginalis* infection [18]. The range of clinical related *T. vaginalis* infections among women extends from asymptomatic carrier stage to overt vaginal infection. According to the severity of the infection, trichomoniasis may be classified as acute, chronic or asymptomatic [19]. Despite its high annual prevalence of 174 million worldwide, *T. vaginalis* forms a major proportion of all curable sexual transmitted infections [4].

Other predisposing factors to candidiasis and trichomoniasis include: poor personal hygiene, immunosuppressive drugs, immunological deficiencies and systemic conditions and low social economic status [11,18].

Studies carried out in Nigeria have revealed a high prevalence of trichomoniasis and candidiasis in different parts of the country [20-24], with dearth of data on their prevalence in Ebonyi State. Therefore, this study was conducted to determine the prevalence of candidiasis and trichomoniasis among female students of Ebonyi State University, Abakaliki.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out at Ultramodern Diagnostic Laboratory and Research Center, Ebonyi State University Abakaliki. The University is made up of four campuses, all within the state capital with an estimated population of 20,000 students of which over 80% are indigenes of the state.

2.2 Study Design and Population

The study was a cross sectional prevalence study among female students of the University who came for laboratory screening which is usually done to document their health status. The study population consisted of newly admitted female students in the 2018/2019 academic session. The annual student's intake of the university is between 4000-5000. Three hundred and fifty (350) students who participated in this study were randomly selected from those who consented to the study between June and November, 2019.

2.3 Determination of Sample Size

The sample size for the study was calculated using the formula below described by Araoyo [25].

$$n = \frac{Z^2 pq}{d^2}$$

Where n is the desired sample size when the population is more than 10,000, z is the standard variation, usually set at 1.96 (which corresponds to 95% confidence interval), p is the proportion in the target population estimated to have a particular characteristic (Prevalence of 15% (0.15) for *T. vaginalis* and 76.8% (0.768) *C. albicans* both recorded in Anambra State [21,23], q is 1.0 – p, d is the degree of accuracy desired; set at 0.05.

Using the formula, the minimum sample size was 196 and 274 for *T. vaginalis* and *C. albicans* respectively. However, with uncertainty about the

true prevalence, a 10% attrition rate was anticipated, therefore adjusting the minimum sample size to 216 and 301 respectively.

2.4 Sample Collection

The students were given sterile universal containers to produce urine and a sterile cotton swabs were used to collect high vagina swab (HVS). These were done aseptically with optimum carefulness. The samples were analyzed within 30 minutes after collection to avoid loss of organism motility at the Ultramodern Diagnostic Laboratory and Research Center in the Department of Medical Laboratory Science.

2.5 Sample Analysis

The swabs and urine were inoculated on blood and Sabouraud dextrose agars prepared according to manufacturer's instruction with autoclaving at a temperature of 121°C for 15 minutes. The inoculated plates were then incubated at 37°C for 48 hrs. Wet preparations were made from the swabs and urine sediments spun for 5 minutes at 3,500r pm and examined microscopically with low power 10x and high power 40x objectives for motile flagellates and *Candida*. *Trichomonas vaginalis* was confirmed through its characteristic jerking movement, pseudohyphae and/or budding yeast cells were suggestive of *Candida*. Gram staining was performed by collecting a discrete colony of growth from the culture plates and emulsified on a clean grease free slide with a drop of normal saline and stained according to the procedure described by Cheesbrough [26] and examined using 100x objective with oil immersion for identification of *Candida*.

Germ tube test was also performed as a rapid tool for identification of *C. albicans*. Using a sterile wire loop, a small portion of a pure colony of *Candida* was inoculated into sterile test tubes containing 0.5ml of human serum. The resulting suspension was incubated at 37°C for 3 hours. The appearance of small, sprouting tube like outgrowths or filaments projecting from the cell surface confirmed the production of germ tubes.

2.6 Statistical Analysis

Data were analyzed using Statistical Package for Social Science (SPSS) version 20.0 (IBM SPSS Statistics 22, Chicago, IL, USA). Results were presented as frequency and percentages. The

relationship between prevalence of trichomoniasis and candidiasis and age distribution was compared using chi-square at 95% confidence level. *P*-values greater than 0.05 were considered as statistically significant.

3. RESULTS

Out of the 350 samples analyzed, 11.1% (39/350) were positive for *C. albicans*, while 6.0% (21/350) were positive for *T. vaginalis* (Table 1).

Age-related prevalence showed that subjects within the ages of 21 and 25 years (n = 165) had the highest prevalence of *C. albicans* (14.5%, 24/165) as well as the highest prevalence of

T. vaginalis (8.5%, 14/165). The subjects in the age group 16-20 (n = 112) years and 26-30 years (n = 73) had *T. vaginalis* prevalence of 6.3% (7/112) and 0.0% (0/73) and *C. albicans* prevalence of 9.8% (11/112) and 5.5% (4/73) respectively. A weak association was observed between *C. albicans* infection and age difference of the subjects (*P* = .11), while a strong association was observed between age difference of subjects and *T. vaginalis* infection (*P* = .04) (Tables 2 & 3).

Seven (7) subjects within the age group 21-25 years were positive for *T. vaginalis* and *C. albicans* co-infection, making a prevalence of 2% (7/350) (Table 4).

Table 1. Overall prevalence of *C. albicans* and *T. vaginalis* detected among the studied population

Microorganism	Total no. examined	No. infected (%)	No. uninfected (%)
<i>Candida albicans</i>	350	39 (11.1)	311 (88.9)
<i>Trichomonas vaginalis</i>	350	21 (6.0)	329 (94)

Table 2 Age - specific distribution of *C. albicans* among the studied population

Age group (Years)	Total no. examined		<i>C. albicans</i>				X ² -value	P-value
	No.	%	Infected		Uninfected			
			No.	%	No.	%		
16-20	112	32.0	11	9.8	101	90.2	4.492	0.106
21-25	165	47.1	24	14.5	141	85.5		
26-30	73	20.9	4	5.5	69	94.5		
Total	350	100	39	11.1	311	88.9		

Table 3. Age specific distribution of *T. vaginalis* among the studied population

Age group (Years)	Total no. examined		<i>T. vaginalis</i>				X ² -value	P-value
	No.	%	Infected		Uninfected			
			No.	%	No.	%		
16-20	112	32.0	7	6.3	105	93.7	6.478	0.039
21-25	165	47.1	14	8.5	151	91.5		
26-30	73	20.9	0	0.0	73	100		
Total	350	100	21	6	329	94		

Table 4. Age specific distribution of *C. albicans* and *T. vaginalis* co-infection among the studied population

Age group (Years)	Total no. examined		<i>Candida albicans</i> and <i>Trichomonas vaginalis</i>			
	No.	%	Infected		Uninfected	
			No.	%	No.	%
16-20	112	32.0	0	0.0	112	100.0
21-25	165	47.1	7	4.2	158	95.8
26-30	73	20.9	0	0.0	73	100.0
Total	350	100	7	2.0	343	98.0

4. DISCUSSION

Candida albicans have been implicated in about 95% of VVC or *Candida* vaginitis, and *Candida glabrata* or *Candida tropicalis* responsible for the remaining 5% [9]. Meanwhile, over 50% cases of trichomoniasis have been reported to be asymptomatic [27].

In this study, a 6.0% of *T. vaginalis* and 11.1% of *C. albicans* were observed among the newly recruited female students of Ebonyi State University. *Trichomonas vaginalis* accounts for almost half of all curable sexually transmitted infections world-wide and it is the most prevalent non-viral STI among sexually active individuals [28]. The prevalence observed in this study is similar to the work of Aboyeji and Nwabuisi [29] who reported a trichomoniasis prevalence of 4.7% in Illorin and Cameron and Padian [30] who reported a 5% to 10% prevalence among healthy women. Although few studies have reported a lower prevalence of *T.vaginalis*, among them is Akinbo et al. [31], Jombo et al. [32], Uneke et al. [20] and Adeoye and Akande [33]. Their studies were carried out on subjects of all ages and different works of life unlike the current study which focused on newly admitted subjects who are at the stage of ambitious exploration of sexual characteristics. However, our study also disagrees with the studies of Obiukwu et al.[34], Ulogu et al. [35] and Ojurongbe et al. [21] where a prevalence of 13.3% in Anambra, 21.5% in Nnewi and 20.0% in Abeokuta, respectively, were reported.

Candida is common in females during their reproductive years and this is in relation with the 11.1% prevalence observed in this study. Similar to our observation is the report of Emeribe et al. [36], who observed a prevalence of 14.0% among non-pregnant women who attended tertiary health care facility in Abuja. Meanwhile, reports of Nandan et al. [37] and Aring et al. [38] with a higher prevalence of 21.31% and 19.0% respectively disagree with our findings. Although, the relative low prevalence of candidiasis in our study may be attributed to adequate knowledge and good personal hygiene of the students.

This study reveals that females within the ages of 21-25 years are more exposed to candidiasis and trichomoniasis when compared to females within the ages of 16-20years and 26-30 years. This does not agree with the findings of Alo et al. [12] where the least prevalence of candidiasis

was observed in participants within the ages of 20 and 25 years while the highest prevalence was observed in those within the ages of 30-36 years. Emeribe et al. [36] had reported a 8.5% prevalence of candidiasis among the age group 20-30 years. Our findings on the prevalence of trichomoniasis were also inconsistent with that of Ijeoma et al. [39] who observed a 23.46% among those within the age range of 18-28 years on one hand, and 0% prevalence among participants aged 20-29 years as reported by Onyibo et al. [23] on the other hand.

However, Lopez-Monteon et al. [40], Alo et al.[12], and Emeribe et al. [36], all reported a higher prevalence of candidiasis and trichomoniasis within the ages of 20-40 years. This is in support of the consensus that sexually transmitted disease including trichomoniasis and candidiasis is higher in sexually active individuals [19,41]. The reduced prevalence in ages beyond 40 have been attributed to the reduced effect of estrogen which reduces sexual activities in addition to the use of contraceptives. However, due to the scope of this study which was limited to first year students of the University within the ages of 16 and 30 years, the relationship or closeness of prevalence of these infections and age group was statistically not significant.

5. CONCLUSION

An overall prevalence of 11.1% candidiasis and 6.0% trichomoniasis were observed among first year students of Ebonyi State University. However low, they constitute a significant public health problem. Early diagnosis and screening of these infections as well as a proper awareness creation on personal hygiene, use of antimicrobial drugs should be encouraged in order to decrease the adverse effects of these infections.

DISCLAIMER

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT AND ETHICAL APPROVAL

This study was approved by the Ethical Research Committee of the Faculty of Health Science and Technology, Ebonyi State University and all subjects gave their written consent before participating in the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Health Organization. Global Strategy for the Prevention and Control of Sexually Transmitted Infections, OMS, Geneva, Switzerland; 2006.
2. World Health Organization. Integrating care for reproductive health, sexually transmitted and other reproductive tract infections; A guide to essential practice, morbidity mortality weekly Recommendation Report. Geneva. 2004; 51:1-118
3. Van Dam CJ. HIV, STD and their current impact on reproductive health: The need for control of sexually transmitted diseases. International Journal of Gynecology and Obstetrics. 1995;50(2): 121–129.
4. World Health Organization. First WHO report on neglected tropical diseases: Working to overcome the global impact of neglected tropical diseases, WHO, Geneva, Switzerland; 2011.
5. Marrazzo J. Vulvovaginal candidiasis. British Medical Journal. 2002;325(7364): 586–587.
6. McClelland RS, Richardson BA, Hassan WM, Graham SM, Kiarie J, Baeten JM, et al. Prospective study of vaginal bacterial flora and other risk factors for vulvovaginal candidiasis. Journal of Infectious Diseases. 2009;199(12):1883–1890.
7. Vecchiarelli A, Pericolini E, Gabrielli E, Pietrella D. New approaches in the development of a vaccine for mucosal candidiasis: progress and challenges. Frontiers in Microbiology. 2012;3(294):1–7.
8. Mardh PA, Rodrigues AG, Genç M, Novikova N, Martinez-de-Oliveira J, Guaschino S. Facts and myths on recurrent vulvovaginal candidiasis – a review on epidemiology, clinical manifestations, diagnosis, pathogenesis and therapy. International Journal of STD and AIDS. 2002;13(8):522–539.
9. Onianwah IF. The incidence and prevalence of *Candida albicans* infection of the urogenital tract of females between the ages of 18 and 45 years old: A case study of patients receiving treatment in Patrice clinic. International Journal of Environmental Science. 2014;3(4):101-110
10. Biggs WS, Williams RM, Cameron S. Common gynecologic infections; Primary Care Journal. 2009;36(1):33-51.
11. Prescott LM, Harley JP, Klein DA. Candidiasis Microbiology. New York Journal. 2005;5:924-926.
12. Alo MN, Anyim C, Onyebuchi AK, Okonkwo EC. Prevalence of asymptomatic co-infection of candidiasis and vaginal trichomoniasis among pregnant women in Abakaliki, South-Eastern Nigeria. Journal of Natural Sciences Research. 2012;2(7): 87–91.
13. Soper D. Trichomoniasis: under control or under controlled? American Journal Obstetrics Gynaecology. 2014;190(1):281-290.
14. Alcamo IE. Fundamentals of Microbiology. Jones and Bartlett Publishers, Boston. 2000;486-487.
15. Centers for Disease Control and Prevention. Guidelines for treatment of sexually transmitted diseases. Morbidity and Mortality weekly report. 2014;47(1):1-111.
16. Boselli F, Chiossi G, Garutti P. Preliminary results of the Italian epidemiological study of vulvovaginitis. Minerva Gynecology Journal. 2004;50(2):149-153.
17. Workowski KA, Berman SM, Hobbs MM. Sexually transmitted diseases treatment guidelines. Morbidity and Mortality Weekly Report. 2006;55:1-94.
18. Crosby R, DiClemente RJ, Wingood GM, Harrington K, Davies SL, Hook EW. Predictors of infection with *Trichomonas vaginalis*: A prospective study of low income African-American adolescent females. Sexually Transmitted Infections. 2002;78:360-364.
19. Usanga V, Abia-Bassey L, Inyang-Etoh P, Udoh S, Ani F, Achibong E. *Trichomonas vaginalis* infection among pregnant women

- in Calabar, Cross River State, Nigeria. *International Journal of Gynaecology and Obstetrics*. 2009;14:1-7.
20. Uneke CJ, Cletus DC, Ugwuoru EA, Miriam A. *Trichomonas vaginalis* infection among pregnant women in South-Eastern Nigeria: Public health significance. *International Journal of Obstetrics and Gynaecology*. 2006;6:1528-540.
 21. Ojurongbe O, Taiwo BO, Dina BO, Sina-Agbaje OR, Bolaji OS, Adeyeba AO. Prevalence of *Trichomonas vaginalis* infection among pregnant women in Abeokuta, Nigeria. *Sierra Leone Journal Biomedical Research*. 2010;2:82-86.
 22. Dennis OU, Maurice CA, Ucheamaka CN, Uloma A. Epidemiology of *Candida* vaginitis in women of reproductive age in selected hospitals in Onitsha metropolis, Anambra State, Nigeria and its environs. *Journal of Public Health and Epidemiology*. 2013;5(11):459-562.
 23. Onyido AE, Irikannu KC, Umeanaeto PU, Ekwunife CA, Ezeanya LC, Nwangwu UC et al. Prevalence of *Trichomonas vaginalis* among the rural women of Ekwulumili community, Anambra State, Southeastern Nigeria. *Nature and Science*. 2014;12(5):129-134.
 24. Uzoh CV, Iheukwumere IH, Umezurike KC, Onyewenjo SC. Prevalence of *Candida albicans* among women attending Federal Medical Center Asaba, South-South, Nigeria. *Advances in Life Science and Technology*. 2016;41:54-48.
 25. Araoye MO. Sample size determination in research methodology with statistics for health and social sciences. Nathadox publishers, Ilorin. 2004:115-122.
 26. Cheesbrough M. Fungal pathogens. In: *District Laboratory Practice in Tropical Countries*. Cambridge University Press, Cambridge, UK. 2000:235–248.
 27. Plourd DM. Practical guide to diagnosing and treating vaginitis. *Medscape Women's Health*. 1997;2:2.
 28. Schwebke JR. Update of trichomoniasis. *Sexually Transmitted Infections*. 2002;78:378-379.
 29. Aboyeji AP, Nwabuisi C. Prevalence of sexually transmitted diseases among pregnant women in Ilorin, Nigeria. *Journal of Obstetrics and Gynaecology*. 2003;23: 637-639.
 30. Cameron DW, Padian NS. Sexual transmission of HIV and the epidemiology of other sexually transmitted diseases. *AIDS*. 1990;4(1):99-103.
 31. AkinboFO, Mokobia CN, Ande ABA. Prevalence of trichomoniasis among pregnant women in Benin City. *Sahel Medical Journal*. 2017;20(2):67-71.
 32. Jombo GT, Egah DZ, Banwate EB, Opajobi SO. High vaginal and endocervical swabs: A bacteriological study of 8,433 samples in Jos, Nigeria. *Journal of Medical Laboratory Science*. 2006;15:41-46.
 33. Adeoye GO, Akande AH. Epidemiology of *Trichomonas vaginalis* among women in Lagos metropolis, Nigeria. *Pakistan Journal of Biological Sciences*. 2007;10:2198-2201.
 34. Obiukwu MO, Onyido AE, Duru JU, Aleke O. *Trichomonas vaginalis* infection in Anambra State: Demography and behavioural predictors. *Journal of Advances in Medical and Pharmaceutical Sciences*. 2010;4:16-20.
 35. Ulogu IO, Obiajuru IO, Ekejindu IM. Trichomoniasis among women in Nnewi, Nigeria. *Nigerian Journal of Parasitology* 2007;28:7-10.
 36. Emeribe A, Abdullahi NI, Onyia J, Ifunanya AL. Prevalence of vulvovaginal candidiasis among nonpregnant women attending a tertiary health care facility in Abjua, Nigeria. *Research and Report in Tropical Medicine*. 2015;6:37-42.
 37. Nandan D, Gupta YP, Krishnan V, Sharma A, Misra SK. Reproductive tract infection in women of reproductive age group in Sitapur/Shahjahanpur district of Uttar Pradesh. *Indian Journal of Public Health*. 2011;45(1):8–13.
 38. Aring BJ, Mankodi PJ, Jasani, JH. Incidence of vaginal candidiasis in leucorrhoea in women attending in OPD of gynecology and obstetrics department. *International Journal of Biomedical and Advances Research*. 2012;3(12):867–869.
 39. Ijeoma AO, Amara VN, Emmanuel IO. Prevalence of trichomoniasis among Adults in Oru-East L.G.A, Imo State, Nigeria. *Archives of Clinical Microbiology*. 2018;9(2):79.
 40. Lopez-Monteon A, Gomez-Figueroa FS, Ramos-Poceros G, Guzman-Gomex D, Ramos-Ligonis A. Codetection of *Trichomonas vaginalis* and *Candida*

albicans by PCR in Urine Samples in a Low-Risk Population Attended in Clinical First Level in Central Veracruz, Mexico. BioMed Research International. 2013. Available:<http://doi.org/10.1155/2013/281892>

41. World Health Organization. Sexually Transmitted Infection. WHO Media Center; 2007. Available:<http://www.who.int/mediacentre/factsheets/fs110/en>. [Last accessed on 7/10/19]

© 2020 Usanga et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/57627>