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Low prevalence of *Trichomonas vaginalis* infection among women seeking health care in five communities in Ikot Ekpene Local Government Area of Akwa Ibom State, Nigeria

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Abstract

Trichomoniasis is a common sexually transmitted parasitic infection caused by *Trichomonas vaginalis,* yet it is always neglected and unreported. This study was carried out among women of reproductive age made up of 136(34.2%) pregnant and 262(65.8%) non-pregnant women in a bid to seek possible ways to promote healthy lifestyle among them. They were examined for prevalence, distribution pattern, intensity and risk factors associated with the infection. The study was conducted in communities randomly selected in Ikot Ekpene LGA namely; Nkap, Ikot Obong Edong, Ikot Ekpene and Ikot Abia Idem. Participants were women who registered for antenatal or visited the medical centres for other health needs. Samples were collected and wet mounts and vital staining with Giemsa stain was used to detect *T. vaginalis* trophozoites. Out of 398 samples collected, 17(4.3%) were infected. Only 4(2.9%) women out of 136 pregnant women examined were infected. All infected participants were below 36 years. The highest prevalence was recorded among the 16–25 age group with 9(6%) out of 150 women examined in this group infected. Those infected within 26–35 years were 8(3.8%). The difference in prevalence between the two age groups was not significant (χ^2=2.90, p=0.23). A higher burden of the disease was recorded among sexually active women. Health officials should endeavour to pay attention to curbing the disease, through awareness among vulnerable groups.

Introduction

Prominent infectious diseases of humans are caused by bacteria, viruses and protozoa. Bulks of these infections are spread by direct sexual contact and they have been collectively termed Sexually Transmitted Infections (STIs). About a million STIs are contracted daily due to the indiscriminate sexual lifestyles of victims and may pose chronic health challenges if not promptly treated (World Health Organisation 2011; Korenromp *et al* 2019). Trichomoniasis is one of the commonest non-viral pathogenic protozoan infections of humans with an annual global incidence of 276.4 million cases (Dos Anjos Gatti *et al* 2017). It is primarily transmitted through sexual contact and is one of the common causes of vaginitis globally (Nagesha and Rama 1998; Asmah *et al* 2017). The only non-sexual mode of transmission occurs in infants during birth (Poole and McClelland 2013). It is also a neglected sexually transmitted infection and is often underreported or unreported in some societies. It is however of renowned public health importance since its proliferative efficiency increases as co-infection with other sexually transmitted infections (Miller *et al* 2008). It is sometimes found in conjunction with other sexually transmitted infections caused by *Chlamydia trachomatis, Neisseria gonorrhoea, Treponema pallidum* (syphilis) and *Human alpha herpes virus* 2 (Herpes Simplex Virus type -2, HSV-2) and HIV infections (Kaul *et al* 2007). The spread of the infection changes with respect to the availability of health facilities, diagnostic techniques, age and gender, community types and geographical locations (Swygard *et al* 2004; Tchankoni *et al* 2021; Van Der Pol 2007).

Pregnant women are vulnerable to *T. vaginalis* just as they are to other STIs during this period of pregnancy (Dos Anjos Gatti *et al* 2017). The adversarial effect of trichomoniasis during pregnancy include premature rupture of the placental membrane, preterm delivery, delivery of low birth weight infants, and the transmission of the infection to the baby through the birth canal (Coleman *et al* 2013; Korenromp *et al* 2019). Trichomoniasis in pregnancy is primarily triggered by a previous history of infection of the disease, unprotected sexual intercourse with multiple sexual partners and past exposures to other sexually transmitted infections (Swygard *et al* 2004; Ambrozio *et al* 2016; Oyeyemi *et*

al 2016) among other risk factors. In Akwa Ibom State, the only reported cases of trichomoniasis among women of reproductive age were those of Opara *et al* (2008) and Ekanem *et al* (2012) at Uyo, and Ikot Ekpene respectively. Other two cases were among HIV-seropositive individuals in Uyo (Akpan *et al* 2013) and internally displaced women in Ibaka (Owowo *et al* 2022). There is therefore the need for a current update on the prevalence of trichomoniasis among women of reproductive ages especially at Ikot Ekpene where the most current work was done 11 years ago. This study aimed to determine the prevalence of *T. vaginalis* infection among the reproductive women of different age groups who attended antenatal or visited the medical centres in communities of Ikot Ekpene LGA of Akwa Ibom State, Nigeria and update the available information in the study area. This study also aimed to explore the relationship between intensity, distribution pattern, risk factors and some socio-demographic variables associated with the infection.

Materials and methods

Study area

The study was carried out at Ikot Ekpene Local Government Area, of Akwa Ibom State, Nigeria from August to November 2021. The city lies approximately between latitudes 5° 11' and longitude 7° 43'E (Fig. 1). The temperature varies from 20 to 32ºC. The people in this region are farmers, artisans/craftsmen (raffia and wood carvers) and hunters. The population constitutes of mainly people of the Annang and the Ibibio tribes who co-exist strategically in various regions of the town with a small number of Igbos and Hausas. The town is a notable region for commerce involving exports of palm produce such as palm oil, kernels and also raffia products which earned it the name "Raffia City".

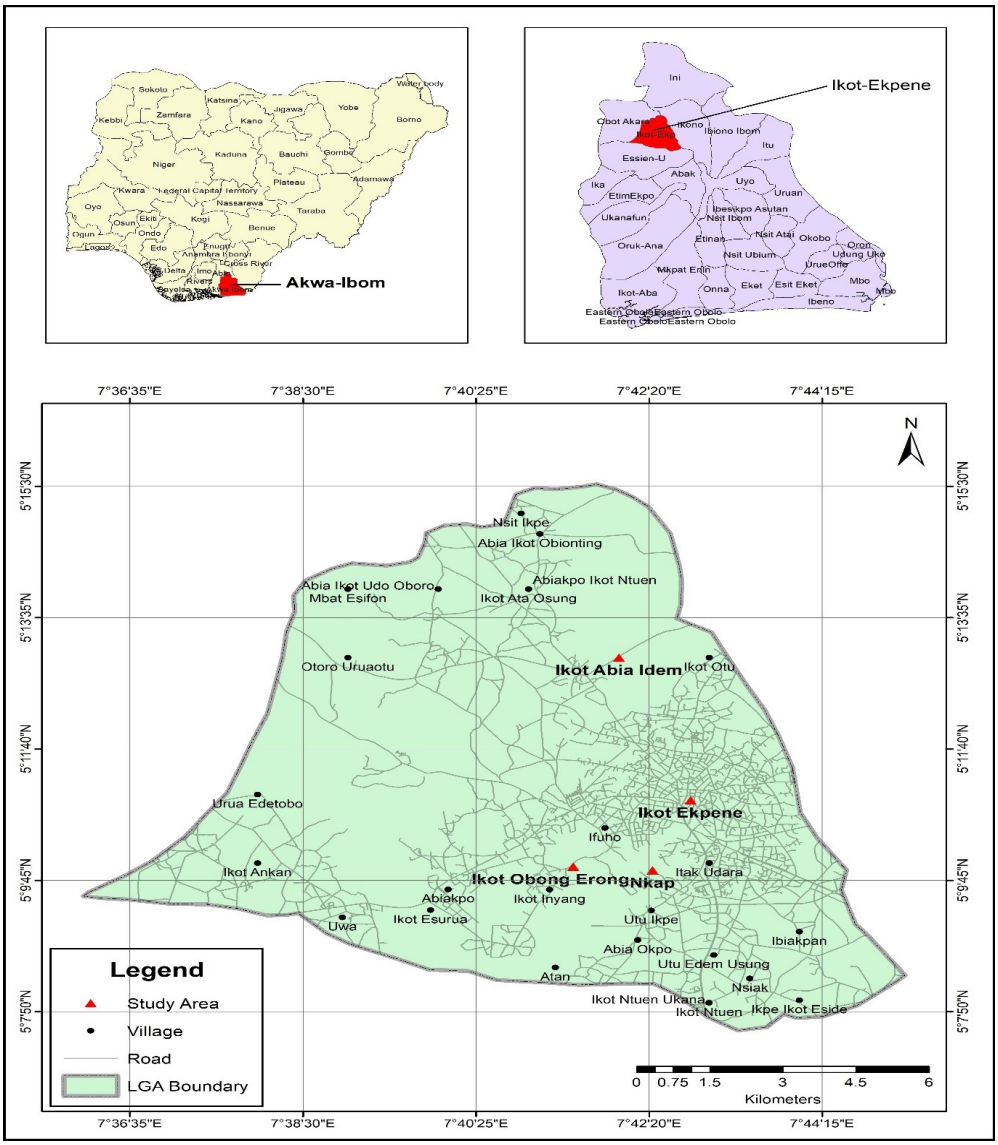

Fig. 1: Map of Ikot-Ekpene Local Government Area showing the study area
Source: Soil Survey Unit, Department of Soil Science, University of Nigeria, Nsukka

Consent and ethical approval

Ethical approval (Number: AKHREC/17/9/044) was obtained from the Akwa Ibom Health Research Ethics Committee at the Ministry of Health, Idongesit Nkanga Secretariat, Uyo, Akwa Ibom State. Consent letters were issued to every participant in the study area to obtain their consent to use the vaginal swab samples and discreet information from questionnaires.

Collection and examination of samples

Sterile swab sticks were used to obtain high vaginal swab (HVS) samples from 398 women who participated in the study. This study was carried out from August to November 2021. Questionnaires were also administered to participants to obtain data for demographic knowledge and application, hygienic practices and sexual behaviour variables. Each collected sample was soaked in 8 drops of physiological saline from where a wet preparation was made by transferring a homogenized drop to a clean, grease-free, microscope glass slide. The dropped sample was covered with a glass slide coverslip and viewed with x10 and x40 objective lenses. Also, direct smears were made on clean slides, after which they were fixed with methanol for a minute and later stained with Giemsa stain diluted with phosphate buffer in a ratio of 1:19 for ten minutes. The stained slides were viewed with a microscope using x100 objective lens (Khatoon *et al* 2014).

Data analyses

Data were analysed using Statistical Package for Social Sciences (SPSS), version 23.0. Prevalence of *T. vaginalis* infection among individuals in relation to descriptive variables of interest (socio-demographic variables, knowledge and application variables, healthy and hygienic practices variables and sexual behaviour variables) were computed using Chi-square tests. Univariate and multivariate logistic regression analyses were used to estimate the risk factors for infections with *T. vaginalis*. The level of significance was set at $p < 0.05$.

Results

Among the 398 participants examined for *T. vaginalis* infection, only 17(4.3%) were infected. Prevalence of infection was highest in the age group 16–25 years with 9(6%) of the 150 women examined infected, followed by those in the age group 26–35 years in which 8 (3.8%) were infected. The difference in the prevalence of the infection between these age groups was not significant (χ^2=2.90, p=0.23). Those infected were all below 36 years (Table 1). Out of 205 (51.5%) single female participants, 9(4.4%) were infected while 8(4.3%) of the 186(46.7%) married women were infected. All 17(4.3%) infected participants were Christians. Of the 17 infected persons, 13(7.4%) had tertiary education while 4 (3.0%) had Senior School Certificates (SSCE). The difference in the prevalence of *T. vaginalis* infection by the level of education was significant (χ^2=8.80, p=0.03). Ethnicity did not impact significantly among participants (Table 1).

Table 1: Prevalence of *Trichomonas vaginalis* in relation to demographic variables of participants in Ikot Ekpene LGA

Variable	Number examined (%)	Number infected (%)
Community		
Ikot Obong Edong	109 (27.4)	11(10.09)
Nkap	80 (20.1)	2(2.5)
Ikot Ekpene	136 (34.2)	4(2.94)
Ikot Abia Idem	73 (18.3)	0(0)
Age group (year)		
16 – 25	150 (37.7)	9 (6)
26 – 35	210 (52.8)	8 (3.8)
36 – 45	38 (9.5)	0 (0)
		χ^2= 2.90, p =0.24
Total	**398**	**17 (4.3)**
Marital status		
Single	205 (51.5)	9 (4.4)
Married	186 (46.7)	8 (4.3)
Divorced	5 (1.3)	0 (0)
Widowed	2 (0.5)	0 (0)
		χ^2= 0.32, p =0.96
Religion		
Christianity	395 (99.2)	17 (4.3)
Islam	2 (0.5)	0 (0)
Traditional	1 (0.3)	0 (0)
		χ^2= 0.14, p =0.94
Education		
Informal	8 (2.0)	0 (0)
Secondary (SSCE)	133 (33.4)	4 (3.0)
Tertiary	175 (44.0)	13 (7.4)
Postgraduate	82 (20.6)	0 (0)
		χ^2=8.81, p = 0.02
Ethnic group		
Annang	218 (54.8)	10 (4.6)
Ibibio	114 (28.6)	7 (6.1)
Other tribes	66 (16.6)	0 (0)
		χ^2= 3.97, p =0.14

The number of infected non-pregnant women was 13(5.0%) while that of infected pregnant women was 4(2.9%) of the sampled population. The Overall mean intensity of the infected women was 16.39±13.37 (range: 1-54) (Table 2). The intensity of infection among age groups revealed that milder cases of infection occurred in the 16-25 age group (p=0.03, χ^2= 6.83) (Table 3). However, the p-value and χ^2statistic indicated that the severity of the infection and pregnancy status was not significant, p=0.13, χ^2= 4.03, (Table 4) as pregnant individuals were as likely as their non-pregnant counterparts to have both mild and severe cases. Also, at p=0.01, χ^2=13.46, the intensity of *T.*

vaginalis was significantly associated ($p<0.05$) with the manifestation of symptoms (Table 5).

Virtually all the women who participated in the study (99.0%) had toilet facilities while 1.0% had none. Women who had their toilets had a 4.8% prevalence of the infection, as opposed to 3.5% in women whose toilets were conjointly used. There was no significant difference ($p> 0.05$) about conjoined or individual usage of the toilet. Those who used private toilets had the same level of infection as those who did not ($\chi^2=0.30$, $p=0.38$) (Table 6). Approximately 74% of the women knew about STIs, but only 32.70% knew *T. vaginalis*. Those who knew about *T. vaginalis* had less infection than those who did not, though the disparity was not significant (3.10% vs. 4.9%; $\chi^2=0.67$, $p=0.30$). The prevalence of infection in those with one sexual partner was 4.70%. The differences in the prevalence of infection relative to the number of sexual partners were not significant ($\chi^2=3.34$, $p=0.34$). Those who did not use condoms (4.9%) and irregular users (7.9%) had a higher prevalence of infection compared to regular condom users (2.0%). The difference was also not significant ($\chi^2=4.27$, $p=0.12$) (Table 7). Contraceptive use was similarly not associated with *T. vaginalis* infection. Among the three symptoms investigated, 126(31.7%) had itching, 58(14.6%) had vaginal discharges and 34(8.5%) had abdominal pains, though only the presence of vaginal discharge had a close association (Table 7).

Table 2: Prevalence of *T. vaginalis* infection in relation to pregnancy status of women in Ikot Ekpene LGA

Pregnancy status	Number examined	Number infected (%)
Not pregnant	262	13 (5.0)
Pregnant	136	4 (2.9)
		$\chi^2 = 0.89$, $p = 0.25$

Table 3: Association between intensity of *T. vaginalis* infection and the different age groups of participants

			Age		
			16-25	26-35	All
	Mild	Count	6	0	6
		Expected Count	3.5	2.5	6.0
	Acute	Count	1	3	4
		Expected Count	2.4	1.6	4.0
	Severe	Count	3	4	7
		Expected Count	4.1	2.9	7.0
All		Count	10	7	17
		Expected Count	10.0	7.0	17.0
		Chi-Square		**DF**	**p-Value**
Pearson Chi-Square		6.83		2	0.03
Likelihood Ratio		8.98		2	0.01

Table 4: Association between intensity of *T. vaginalis* infection and pregnancy status of participants.

			Pregnancy status		
			Pregnant	Not pregnant	All
Infection	Mild	Count	2	4	6
		Expected Count	1.4	4.6	6.0
	Acute	Count	2	2	4
		Expected Count	0.9	3.1	4.0
	Severe	Count	0	7	7
		Expected Count	1.6	5.4	7.0
	All	Count	4	13	17
		Expected Count	4.0	13.0	17.0
		Chi-Square		**DF**	**p-Value**
Pearson Chi-Square		4.03		2	0.13
Likelihood Ratio		5.37		2	0.07

Discussion

The overall prevalence of *T. vaginalis* infection among women of reproductive age in this study was 4.3%. There have been several previous reports of the infection at various degrees of prevalence among pregnant and non-pregnant women in Nigeria (Kanu *et al* 2015; Akinbo *et al* 2017; Avidime *et al* 2017; Oyeyemi *et al* 2016; Adeoye and Akande 2007). In Akwa Ibom State, two previous reports of *T. vaginalis* infections among antenatal attendees showed higher prevalence rates of 5.2% and 17.7% at Ikot Ekpene and Uyo, respectively (Ekanem *et al* 2012 and Opara *et al*

2009). Also, reports of prevalence rates of 7.1% among both pregnant and non-pregnant women of internally displaced persons (Owowo *et al* 2022), and 16.2% among HIV-seropositive people (Akpan 2013), were all higher than the outcome of our study. Reports from other parts of the globe were also either lower or higher than the current report (Nourian *et al* 2013; Tchankoni *et al* 2021; Tine *et al* 2019). Generally, the prevalence and incidence of *T. vaginalis* infections reported in previous studies were influenced by several factors including the age of participants along with their sexual habits, attitude towards treatment after infection, availability and use of sanitary facilities, knowledge of the disease, study settings, geographical location, and diagnostic methods employed in the study (Gregson *et al* 2001; Miller *et al* 2008; Geelen *et al* 2013; Menezes *et al* 2016; Owowo *et al* 2022).

Table 5: Association between Intensity of *T. vaginalis* Infection and Manifestation of Symptoms in Participants.

			Symptoms		
			Present	Absent	All
Infection	Mild	Count	0	6	6
		Expected Count	3.5	2.5	6.0
	Acute	Count	4	0	4
		Expected Count	2.4	1.6	4.0
	Severe	Count	6	1	7
		Expected Count	4.1	2.9	7.0
	All	Count	10	7	17
		Expected Count	10.0	7.0	17.0

	Chi-Square	**DF**	**p-Value**
Pearson Chi-Square	13.46	2	0.001
Likelihood Ratio	17.29	2	0.000

Table 6: Odd ratios of infection with *Trichomonas vaginalis* infection in relation to symptoms among women in Ikot Ekpene

	Odd ratio (95% confidence interval)	P-value
Knowledge of STIs		
No	Ref.	
Yes	0.379 (0.14–1.01)	0.05
Possess toilet facility		
No	Ref.	
Yes	0.127(0.01–1.29)	0.08
Vaginal discharge		
No	Ref.	
Yes	9.911 (3.60–27.210)	**< 0.01**
Itching		
No	Ref.	
Yes	1.186 (0.43–3.28)	0.74
Abdominal pain		
No	Ref.	
Yes	0.659 (0.09–5.13)	0.69

In the present study, the sexually active groups, 16–25 and 26–35, showed 6.0% and 3.8% infections, respectively while no infection was recorded for the age group 36-45. There are previous reports of high prevalence of *T. vaginalis* infection among the age groups above 36 (Sutton *et al* 2007; Leon *et al* 2009; Sam-wobo *et al* 2012; Owowo *et al* 2022) while some reports follow the trend of our current finding of higher infection among the sexually more active group (Swygard *et al* 2004; Weinstock *et al* 2004; Okojokwu *et al* 2015). Some other reports, however, show inconsistencies regarding the age and prevalence of *T. vaginalis* infection (Menezes *et al* 2016; Hussein and Shaker 2017; Tompkins *et al* 2020).

Table 7: Prevalence of *Trichomonas vaginalis* infection in relation to sexual practices among women in Ikot Ekpene

Parameter	**Number examined (%)**	**Number infected (%)**
Number of partners		
None	50 (12.6)	0 (0)
1	257 (64.6)	12 (4.7)
2	59 (14.8)	4 (6.8)
> 2	32 (8.0)	1 (3.1)
		χ^2=3.34, p=0.34
Number of sexual acts		
None	26 (6.5)	0 (0)
1 – 10	2 (0.5)	0 (0)
11 – 20	136 (34.2)	9 (6.6)
21 – 30	229 (57.5)	8 (3.5)
> 30	5 (1.3)	0 (0)
		χ^2=3.64, p=0.46
Use of condom		
No	182 (45.7)	9 (4.9)
Yes	153 (38.4)	3 (2.0)
Sometimes	63 (15.8)	5 (7.9)
		χ^2=4.27, p=0.12
Contraceptive use		
No	266 (66.8)	14 (5.3)
Yes	42 (10.6)	0 (0)
Previously	90 (22.6)	3 (3.3)
		χ^2=2.71, p=0.26

The absence of infection in the older group could be attributed to the priority given to younger women during screening exercises, which is an important tool in the diagnosis of *T. vaginalis* infection (Sutton *et al* 2007; Fernando *et al* 2012).

This study recorded more cases of infection among non-pregnant women as opposed to their pregnant counterparts. A similar result was reported in the past (Oyeyemi *et al* 2016). A factor that could lower the cases of trichomoniasis among pregnant women is the halt of the menstrual cycle, which lowers iron production that enhances the growth and functioning of *T. vaginalis* trophozoites (Hussein and Shaker 2017). Variations in the level of oestrogen production and pH imbalance are also among various factors that have been reported as possible drivers of low or high infections (Lin *et al* 2021; Margarita *et al* 2020). Higher levels of oestrogen and pH support the growth of *T. vaginalis* (Gorodeski *et al* 2005; Nagesha and Rama 1998). Although pregnant women are considered a risk group for the infection, the effects and consequences are more serious in their non-pregnant counterparts because of the intensity triggered by the iron boom associated with the menstrual cycle (Hussein and Shaker 2017)

Hygiene was the determinant factor predisposing individuals to *T. vaginalis* infections (Hussein and Shaker, 2017; Sutton et al., 2007; Olaniran *et al* 2017) rather than the possession and use of private or public toilet facilities in our report. There was however no significant difference between the results obtained from the users of the toilets of the different statuses. Ignorance of what *T. vaginalis* is all about and the infection it causes could have generally influenced the hygienic attitude of the individuals (McClelland 2008). Our result shows that those who did not know about trichomoniasis had more infections than those who knew, though not statistically significant. Such people in their ignorance, perhaps, did not see the need or know how to protect themselves, especially when *T. vaginalis* infection is majorly asymptomatic (Kim *et al* 2017; Menezes *et al* 2016).

The number of sexual partners and whether the individuals were protected with a condom or not during the sexual act, were found to have influenced the level of infection but not significantly. Those who used condoms regularly or occasionally had less infection than those who did not use them at all. The number of sex partners and direct contact with the genitalia of the sex players have been reported as predisposing factors for *T. vaginalis* infection (Fernando *et al* 2012; Owowo *et al* 2022). However, some argue that condom usage and sexual behaviour have not contributed to a decrease in the prevalence of the disease and that more innovative approaches should be sort for the prevention of the disease (Menezes *et al* 2016)

Other factors investigated for their impact on the transmission and prevalence of trichomoniasis were marital status, religion, education and ethnicity. No significant impact was recorded for these parameters except the level of education (see Table 1). This study showed that educational institutional level impacted the degree of infection with those who had tertiary education being more significantly infected ($p<0.05$) than postgraduate and secondary school students. This could be attributed to the sexually active nature and imprudent expression of freedom by adolescents as undergraduates above all others. There are diverse reports on the effect of marital status, religion, education and ethnicity on the prevalence of trichomoniasis (Ekanem *et al* 2012; Byun *et al* 2015; Ambrozio *et al* 2016; Alomair *et al* 2020).

Conclusion

The sexually active women were observed to have had a higher burden of *T. vaginalis* infection. The intensity and pattern of prevalence observed in this study altogether show that demographic variables in conjunction with knowledge of infection, hygienic practices and sexual behaviour variables are important predisposing factors, which work in tandem. An enlightenment campaign with occasional screening exercises, well carried out, as in other sexually transmitted infections will be of immense curative relief to the vulnerable groups. The introduction of improved and effective diagnostic techniques will also aid greatly in estimating and managing the prevalence of this infection.

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References

Adeoye, G.O, Akande A.H. 2007. Epidemiology of *Trichomonas vaginalis* among women in Lagos metropolis, Nigeria. *Pak. J. Biol. Sci. 10*: 2198-2201.

Akinbo, F.O., Mokobia, C.N., Ande, A.B. 2017. Prevalence of trichomoniasis among pregnant women in Benin City. *Sahel Med. J. 20*: 67-71.

Akpan, U.I. 2013. The prevalence of *Trichomonas vaginalis* in Uyo Local Government area of Akwa Ibom State, Nigeria. *Int. J. Mod. Biol. Med. 4*: 134-139

Alomair, N., Alageel, S., Davies, N., and Bailey, J.V. 2020. Sexually transmitted infection knowledge and attitudes among Muslim women worldwide: a systematic review. *Sex. Reprod. Health Matters 28*(*1*). https://doi.org/10.1080/26410397.2020.1731296.

Ambrozio, C.L., Nagel, A.S., Jeske, S., Bragança, G.C.M., Borsuk, S. and Villela, M.M. 2016. *Trichomonas vaginalis* prevalence and risk factors

for women in southern Brazil. *Rev. Inst. Med. Trop. Sao Paulo 58*(*1*): 1–5. https://doi.org/10.1590/S1678-9946201658061.

Asmah, R.H., Blankson, H.N.A., Seanefu, K.A., Obeng-Nkrumah, N., Awuah-Mensah, G., Cham, M. and Ayeh-Kumi, P.F. 2017. Trichomoniasis and associated co-infections of the genital tract among pregnant women presenting at two hospitals in Ghana. *BCM Women's Health 17*(*1*): 1–8. https://doi.org/10.1186/s12905-017-0489-5.

Byun, J.M., Jeong, D.H., Kim, Y.N., Lee, K.B., Sung, M. S. and Kim, K.T. 2015. Experience of successful treatment of patients with metronidazole-resistant Trichomonas vaginalis with zinc sulfate: A case series. *Taiwan J. Obstet. Gynecol. 54*(*5*): 617–620. https://doi.org/10.1016/j.tjog.2015.08.018.

Coleman, J.S., Gaydos, C.A. and Witter, F. 2013. Trichomonas vaginalis vaginitis in obstetrics and gynaecology practice: New concepts and controversies. *Obstet.Gynecol. Surv. 68*(*1*): 43–50. https://doi.org/10.1097/OGX.0b013e318279fb7d.

Dos Anjos Gatti, F.A., Ceolan, E., Salles, F., Greco, R., Santos, P.C., Klafke, G.B., De Oliveira, G.R., Groll, A. Von, De Martinez, A.M.B., GoncËalves, C.V. and Carlos, J.S. 2017. The prevalence of trichomoniasis and associated factors among women treated at a university hospital in southern Brazil. *PLoS ONE 12*(*3*): 1–11. https://doi.org/10.1371/journal.pone.0173604.

Ekanem, E.I., Ekott, M., Udo, A.E., Efiok, E.E. and Inyang-Out, A. 2012. Prevalence of sexually transmitted diseases in pregnant women in Ikot Epene, a rural community in Akwa Ibom State, Nigeria. *Open J. Obstet. Gynecol. 2*: 49-55.

Fernando, S.D., Herath, S., Rodrigo, C. and Rajapakse, L. 2012. Clinical features and sociodemographic factors affecting Trichomonas vaginalis infection in women attending a central sexually transmitted diseases clinic in Sri Lanka. *Indian J. Sex. Transm. Dis. 33*(*1*): 25–31. https://doi.org/10.4103/0253-7184.93813.

Geelen, T.H., Hoebe, C.J.P.A., Dirks, A., Dukers-Muijrers, N.H.T.M., Van Bergen, J.E.A.M. and Wolffs, P.F.G. 2013. Low positivity rate after systematic screening for Trichomonas vaginalis in three patient cohorts from general practitioners, STI clinic and a national population-based chlamydia screening study. *Sex. Transm. Infect. 89*(*6*): 532–534. https://doi.org/10.1136/sextrans-2012-051010.

Gorodeski, G.I., Hopfer, U., Liu, C.C. and Margles, E. 2005 Estrogen acidifies vaginal p^H by up-regulation of proton secretion via the apical membrane of vaginal-ectocervical Epithelial Cells. Endocrinology. *Endocrinology 146*(*2*): 816–824. doi: 10.1210/en.2004-1153.

Gregson, S., Mason, P.R., Garnett, G.P., Zhuwau, T., Nyamukapa, C.A., Anderson, R.M. and Chandiwana, S.K. 2001. A rural HIV epidemic in Zimbabwe? Findings from a population-based survey. *Int. J. AIDS 12*(*3*): 189–196. https://doi.org/10.1258/0956462011917009.

Kanu, A.M., Ihekwumere, I., Kalu E.J. 2015. Frequency distribution of trichomoniasis in pregnant women in Aba, south east, Nigeria. *Univers. J. Microbiol. Res. 3*(*4*): 53-55. http//doi: 10.13189/ujmr.2015.030403.

Kaul, R., Nagelkerke, N.J., Kimani, J., Ngugi, E., Bwayo, J.J., MacDonald, K.S., Rebbaprgada, A., Fonck, K., Temmerman, M., Ronald, A.R., Moses, S., Bossen, B., Kamunyo, G., Wanguru, R., Mwakisha, R., Waithira, G., Nganga, D., Nyambogo, C., Ombette, J., … and Kariuki, S. 2007. Prevalent herpes simplex virus type 2 infection is associated with altered vaginal flora and an increased susceptibility to multiple sexually transmitted infections. *J. Infect. Dis. 196*(*11*): 1692–1697. https://doi.org/10.1086/522006.

Khatoon, R., Jahan, N., Khan, H.M., Rabbani, T. and Ahmad, S. 2014. Evaluation of different staining techniques in the diagnosis of trichomonas vaginalis infection in females of reproductive age group. *J. Clin. Diagn. Res.8*(*12*): DC05-DC08. https://doi.org/10.7860/JCDR/2014/9765.5261.

Kim, J.H., Han, I.H., Kim, S.S., Park, S.J., Min, D.Y., Ahn, M.H. and Ryu, J.S. 2017. Interaction between trichomonas vaginalis and the prostate epithelium. *Korean J. Parasitol. 55*(*2*): 213–218. https://doi.org/10.3347/kjp.2017.55.2.213.

Korenromp, E.L., Rowley, J., Alonso, M., Mello, M.B., Wijesooriya, N.S., Mahiané, S.G., Ishikawa, N., Le, L.V., Newman-Owiredu, M., Nagelkerke, N., Newman, L., Kamb, M., Broutet, N. and Taylor, M.M. 2019. Erratum: Global burden of maternal and congenital syphilis and associated adverse birth outcomes-Estimates for 2016 and progress since 2012. *PLoS ONE 14*(*7*): 1–17. https://doi.org/10.1371/journal.pone.0219613.

Leon, S.R., Konda, K.A., Bernstein, K.T., Pajuelo, J.B., Rosasco, A.M., Caceres, C.F., Coates, T.J. and Klausner, J.D. 2009. *Trichomonas vaginalis* infection and associated risk factors in a socially-Marginalized female population in coastal Peru. *Infect. Dis. Obstet. Gynecol*. https://doi.org/10.1155/2009/752437.

Lin, Y.P., Chen, W.C., Cheng, C.M. and Shen, C.J. 2021. Vaginal pH value for clinical diagnosis and treatment of common vaginitis. *Diagnostics 11*(*11*): 1-12 https://doi.org/10.3390/diagnostics11111996.

Margarita, V., Fiori, P.L. and Rappelli, P. 2020. Impact of symbiosis between *Trichomonas vaginalis* and *Mycoplasma hominis* on vaginal dysbiosis: A mini review. *Front. Cell. Infect. Microbiol. 10*:179. https://doi.org/10.3389/fcimb.2020.00179.

McClelland, R.S. 2008. *Trichomonas vaginalis* Infection: Can we afford to do nothing? *J. Infect. Dis. 197*(*4*): 487–489. https://doi.org/10.1086/526498.

Menezes, C.B., Frasson, A.P. and Tasca, T. 2016. Trichomoniasis – are we giving the deserved attention to the most common non-viral sexually transmitted disease worldwide? *Microbial Cell 3*(*9*): 404–419. https://doi.org/10.15698/mic2016.09.526.

Miller, M., Liao, Y., Gomez, A. M., Gaydos, C.A. and D'Mellow, D. 2008. Factors associated with the prevalence and incidence of *Trichomonas vaginalis* infection among African American women in New York City who use drugs. *J. Infect. Dis. 197*(*4*): 503–509. https://doi.org/10.1086/526497.

Nagesha, C.N. and Rama, N.K. 1998. Clinical and microbiological aspects of vaginitis. *Indian J. Med. Sci. 52*(*11*): 526–532.

Nourian, A., Shabani, N., Fazaeli, A. and Mousavinasab, S.N. 2013. Prevalence of *Trichomonas vaginalis* in pregnant women in Zanjan, Northwest of Iran. *Jundishapur J. Microbiol. 6*(*8*): 1–5.

Okojokwu, O.J., Akpakpan E.E., Kolawole O.T., Ndubuisi J.C., Okopi, J.A. 2015. Epidemiology of *Trichomonas vaginalis* infection among women in Jos metropolis, Nigeria. *Biomed. Nurs. 1*(*3*): 7-11.

Olaniran, O., Osevwe, A.J., Balogun I.A., Hassan-Olajokun, R.E., Oyetoke, O.O. 2017. The prevalence of *Trichomonas vaginalis* in Wesley Guide Hospital Ilesha, Nigeria. *Int. J. Microbiol. Res. Rev. 6*(*5*): 345-350.

Opara K, Udoidiung N, Atting I, Bassey E, Okon O, Nwabueze. A. 2008. Risk factors for vaginal trichomoniasis among women in Uyo, Nigeria. *Internet J. Health 9*:1-5.

Owowo, E.E., Udofia, L.E., Wisdom, S. and Okon, I.E. 2022. Incidence of *Trichomonas vaginalis* among internally displaced women in Ibaka, Akwa Ibom State, Nigeria. *J. Biosci. Med. 10*: 82-89. https://doi.org/10.4236/jbm.2022.103009.

Oyeyemi, O.T., Fadipe, O. and Oyeyemi, I.T. 2016. *Trichomonas vaginalis* infection in Nigerian pregnant women and risk factors associated with sexually transmitted infections. *Int. J. STD AIDS 27*(*13*): 1187–1193.

Poole, D.N. and McClelland, R.S. 2013. Global epidemiology of *Trichomonas vaginalis*. *Sex. Transm. Infect. 89*(*6*): 418–422. https://doi.org/10.1136/sextrans-2013-051075.

Sam-wobo, S.O., Ajao, O.K., Adeleke, M.A. and Ekpo, U.F. 2012. Trichomoniasis among ante-natal attendees in a tertiary health facility, Abeokuta, Nigeria. *Mun. Ent. Zool. 7*(*1*): 380–384.

Hussein, A.A. and Shaker, M.J. 2017. Infection rate of *Trichomonas vaginalis* among women in Baqubah City. *Int. J. Sci. Res. 6*(*8*): 1954–1957. https://doi.org/10.21275/ART20175717

Sutton, M., Sternberg, M., Koumans, E.H., McQuillan, G., Berman, S. and Markowitz, L. 2007. The prevalence of *Trichomonas vaginalis* infection among reproductive-age women in the United States, 2001-2004. *Clin. Infect. Dis. 45*(*10*): 1319–1326. https://doi.org/10.1086/522532.

Swygard, H., Seña, A.C., Hobbs, M.M. and Cohen, M.S. 2004. Trichomoniasis: Clinical manifestations, diagnosis and management. *Sex. Transm. Infect. 80*(*2*): 91–95. https://doi.org/10.1136/sti.2003.005124

Tchankoni, M.K., Bitty-Anderson, A.M., Sadio, A.J., Gbeasor-Komlanvi, F.A., Ferré, V.M., Zida-Compaore, W.I.C., Dorkenoo, A.M., Saka, B., Dagnra, A.C., Charpentier, C. and Ekouevi, D. K. 2021. Prevalence and factors associated with *Trichomonas vaginalis* infection among female sex workers in Togo, 2017. *BMC Infect. Dis. 21*(*1*): 1–7. https://doi.org/10.1186/s12879-021-06432-w.

Tine, R.C., Sylla, K., Ka, R., Dia, L., Sow, D., Lelo, S., Diallo, K., Faye, B., Dieng, T., Ndour, C.T. and Sow, A.Y. 2019. A Study of *Trichomonas vaginalis* infection and correlates in women with vaginal discharge referred at Fann Teaching Hospital in Senegal. *J. Parasitol. Res.* https://doi.org/10.1155/2019/2069672.

Tompkins, E.L., Beltran, T.A., Gelner, E.J. and Farmer, A.R. 2020. Prevalence and risk factors for *Trichomonas vaginalis* infection among adults in the U.S., 2013–2014. *PLoS ONE 15*(*6*): https://doi.org/10.1371/journal.pone.0234704.

Van Der Pol, B. 2007. *Trichomonas vaginalis* infection: The most prevalent nonviral sexually transmitted infection receives the least public health attention. *Clin. Infect. Dis. 44*(*1*): 23–25. https://doi.org/10.1086/509934.

Weinstock, H., Berman, S. and Willard Cates, J. 2004. Sexually transmitted diseases among American Youth: Incidence and prevalence estimates, 2000. *Perspect. Sex. Reprod. Health 36*(*1*): 6–10.

World Health Organization. 2011. Prevalence and incidence of selected sexually transmitted infections: *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, syphilis and *Trichomonas vaginalis*: Methods and results used by WHO to generate 2005 estimates. *World Health Organisation* 1–38.