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TRICHOMONAS VAGINALIS INFECTION AMONG ADOLESCENT GIRLS IN SOME SECONDARY SCHOOLS IN BENIN CITY, EDO STATE, NIGERIA

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RUNNING TITLE: TRICHOMONIASIS AMONG ADOLESCENT GIRLS

ABSTRACT

*Trichomonasvaginalis*is the most common non-viral sexually transmitted disease (STD) and one of the neglected parasitic infections. This study aimed to determine the prevalence of *T. vaginalis*infection among adolescent girls in some secondary schools in Edo State, Nigeria. A total of 272 girls were recruited in this study. The participants' age ranged from 13 to 18 years. Two high vagina swab specimens were collected from each participant. The specimens were analyzed using wet mount examination and culture methods. A prevalence of 9.2% of *T. vaginalis* was observed among adolescent girls in this study. Level of education of parents, occupation of mothers, sexual relationship and clinical manifestation of participants significantly affected the prevalence of *T. vaginalis*infection among adolescent girls attending secondary school. Culture method detected more cases of *T. vaginalis* infection than the wet mount technique. The use of culture method in routine diagnosis of *T. vaginalis*infection is advocated as this will reduce cases of infertility resulting from undetected and untreated infection as well as the risk of HIV transmission and acquisition.

Key words: Adolescent girls,Benin City, *Trichomonasvaginalis*

TRICHOMONAS VAGINALIS INFECTION CHEZ LES ADOLESCENTES DANS CERTAINES ÉCOLES SECONDAIRES À BENIN CITY, EDO STATE, NIGERIA

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TITRE COURANT: LA TRICHOMONASE PARMI LES ADOLESCENTES

Résumé
Trichomonas est le plus souvent non virale maladie transmise sexuellement (MTS) et l'une des infections parasitaires négligées. Cette étude visait à déterminer la prévalence de l'infection à T. vaginalis chez les adolescentes dans certaines écoles secondaires à Edo State, Nigeria. Un total de 272 jeunes filles ont été recrutés dans cette étude. L'âge des participants variait de 13 à 18 ans. Deux spécimens ont été prélevés du vagin-tige de chaque participant. Les spécimens ont été analysées à l'aide de l'état frais et l'examen des méthodes de culture. Une prévalence de 9,2 % de T. vaginalis a été observée chez les adolescentes dans cette étude. Le niveau de scolarité des parents, la profession des mères, des relations sexuelles et de manifestation clinique des participants touchés de manière significative la prévalence de l'infection à T. vaginalis chez les adolescentes fréquentant l'école secondaire.

Méthode de culture détecté plus de cas d'infection à T. vaginalis de la technique de montage humide. L'utilisation de la méthode de culture dans la routine diagnostic de l'infection à T. vaginalis est préconisé comme cela va réduire l'infertilité résultant d'une infection non traitée ainsi que le risque de transmission du VIH et d'acquisition.

Mots clés : adolescentes, Benin City, *Trichomonas vaginalis*

INTRODUCTION

Globally, *Trichomonas vaginalis*is the most common non-viral sexually transmitted disease (STD) and one of the neglected parasitic infections (1). According to WHO, an incidence of 276 million new cases each year and a prevalence of 187 million of infected individuals with ages 15 and 49 years old were reported (2). The global prevalence of trichomoniasis is much higher than other curable STDs such as gonorrhea and syphilis, both counting for 36.4 million cases, and *Chlamydia* infection, with 100.4 million of infected adults (3).

Sexually transmitted infections (STIs) are the most common public health problem in Africa and high rates of STI in adolescents and young adults indicate their vulnerability to HIV infection (4). *T. vaginalis*has a cosmopolitan distribution and has been found in all racial group and socioeconomic strata; with no seasonal variability. Trichomoniasis commonly associated with other sexually transmitted diseases (5, 6). The preferred cells infected by *T. vaginalis*are those of squamous epithelium origin involving the vagina, urethra as well as the endocervix (7, 8). This parasitic infection is frequently asymptomatic in adults. However, symptomatic women may complain of vaginal discharge, vulvovaginal soreness, pruritus, odour and irritation (8, 9). The disease is a recognized cause of urethritis associated with scanty, clear to mucopurulent discharge, dysuria, and burning sensation immediately after sexual intercourse (10). Complications of this disease in both men and women have been reported and they include increased risk of HIV, premature rupture of membranes, premature labour, pelvic inflammatory disease, low birth weight, infection of the adnexa, endometrium and bartholin glands (in women), prostatitis, balanoposthitis, epididymo-orchitis (in men) and possibly infertility (9, 11, 12, 13, 14). It has been reported that *T. vaginalis*infection in adolescent girls is likely to remain undetected and untreated, causing increasing morbidity and reducing their fertility as well as increasing their risk of other reproductive tract infection and human immunodeficiency virus (15). This has not been well studied in our locality therefore, this study aimed to determine the prevalence of *T. vaginalis*infection among adolescent girls in some secondary schools in Edo State, Nigeria.

MATERIALS AND METHODS

Study area

This study was conducted at some secondary schools in Benin City, Edo State, Nigeria. Edo State is situated in the Midwestern part of Nigeria. The state is located within the low rain forest zone of Nigeria and has two seasons, dry and wet. The dry season lasts from mid-October to March or April while the raining season lasts from April to September. Edo State has a population of about 3, 218, 332 (National Population Census, 2006). The secondary schools were: Ezomo College, Iyowa; Ebomisi Secondary School, Ugbogiobo; Oba Erediuawa Secondary School,Utekon; Uwelu Secondary School, Uwelu and Egor Secondary School, Egor, Edo State, Nigeria. These secondary schools are situated in Egor and Ovia Northeast Local Government Areas of Edo State, Nigeria.

Study population

A total of 272 girls were recruited in this study. The participants' age ranged from 13 to 17 years. Serial sampling method was used and participants attending secondary schools whose parents or guardians gave consent were recruited for this study. Adolescent girls that did not return their consent form from their parents or guardians were excluded from the study. Information on demographic characteristics was obtained from participants by administering a well-structured questionnaire bothering on biodata, sexual relationship and personal hygiene. The Ethics and Research Committee of the Ministry of Health, Edo State approved the protocol of this study.

Specimen collection

Two high vagina swab specimens were collected from each participant. The specimens were analyzed using wet mount examination and culture methods were employed. Briefly, a drop of normal saline was added to the exudate collected with the swab and mixed. A drop of the emulsified vagina exudate was placed on a grease free slide, covered with a coverslip and examined microscopically for the presence of *T. vaginalis* (16). The Dorset culture medium was the culture medium used where the exudate on the second swab was inoculated on the medium and kept in the incubator anaerobically at 37^{o}C for 3 days. Detection of growth was checked daily for *T.*

vaginalis.The culture plates were examined for growth of *T. vaginalis* on days 1, 2 and 3 (17).

Statistical analysis

The frequency data were compared using the Chi square (X^2) whereas the odd ratio was calculated for the potential risk factors. The INSTAT software (Graph PAD software Inc, La Jolla, CA) was used in the analyses.

RESULTS

Out of the 272 participants, 15 (5.5%) and 25 (9.2%) were positive for *T. vaginalis*infection using wet mount and culture methods respectively. In addition, diagnostic method did not significantly affect the prevalence of trichomoniasis among the secondary school girls (*P*=0.1385) with the culture method recording more cases of *T. vaginalis*(Table 1).

TABLE 1: DIAGNOSIS OF *T. VAGINALIS* BY WET MOUNT AND CULTURE TECHNIQUES

Method of diagnosis	No. sampled	No. positive (%)	OR	95% CI	P value
Wet mount	**272**	**15(5.5)**	**0.5767**	**0.296, 1.120**	**0.1385**
Culture	**272**	**25(9.2)**	**1.734**	**0.893, 3.368**	

***P*<0.05**

TABLE 2: RISK FACTORS ASSOCIATED WITH *T.VAGINALIS* INFECTION AMONG ADOLESCENT GIRLS

Characteristic	No. sampled	No. positive (%)	OR	95% CI	P value
Age					
13-15	129	14(10.8)	1.461	0.637, 3.345	0.4058
16-18	143	11(7.7)	0.684	0.298, 1.568	
Religion					
Muslim	258	23(8.9)	0.587	0.123, 2.787	0.3752
Christian	14	2(14.3)	1.703	0.3588, 8.083	
Educational status of Participants' father					
None	16	0(0)			0.0138
Primary	65	12(18.5)			
Secondary	170	11(6.5)			
Tertiary	21	1(4.8)			
Educational status of Participants' mother					
None	10	0(0)			0.0264
Primary	**51**	10(19.6)			
Secondary	166	13(7.8)			
Tertiary	45	2(4.4)			
Occupation of participants' father					
Farmer	48	5(10.4)			0.1556
Business man	169	18(10.7)			
Civil servant	55	2(3.6)			
Occupation of participants' mother					
Farmer	30	6(20.0)			0.0153
Business man	201	19(9.5)			
Civil servant	48	0(0)			
Location					
Rural	179	21(11.7)			0.0912
Semi-urban	42	3(7.1)			
Civil servant	51	1(1.9)			
Sexual relationship					
Yes	94	21(22.3)	12.514	4.149, 37.740	<0.0001
No	178	4(2.3)	0.079	0.026, 0.241	
Type of toilet					
Bush	26	3(11.5)			0.7328
Pit latrine	71	5(7.0)			
Water cistern	175	17(9.7)			

Age (P=0.4058), religion (*P*=0.3752), occupation of father (*P*=0.2793), location (*P*=0.0913), and type of toilet (*P*=0.7328) did not significantly influence the prevalence of trichomoniaisis among adolescent girls attending secondary schools. Educational level of father and mother of participants significantly

affected the prevalence of *T. vaginalis*infection in this study (*P*=0.0138 and *P*=0.0264 respectively). Occupation of mother affected significantly the prevalence of trichomoniasis among the secondary school girls (*P*=0.0153) with mothers who are farmers having the highest prevalence (20%). Sexual intercourse was a risk factor for acquiring *T. vaginalis*infection among adolescent girls attending secondary school (OR=12.514; 95% CI= 4.149, 37.740; *P*<0.0001). (Table2).

DISCUSSION

*Trichomonas vaginalis*is one of the sexually acquired reproductive tract infections and has been labeled a silent epidemic among females, causing gynaecological morbidity and maternal mortality globally (18). Besides, the main issue concerning trichomoniasis is its relationship with serious health consequences like cancer, adverse pregnancy outcomes, infertility and HIV transmission and acquisition (13, 14, 19, 20, 21, 22). The undetected and untreated *T. vaginalis* infection can result in increasing morbidity and infertility among adolescent girls (15). There is a dearth of information on trichomoniasis among adolescent secondary school girls in Edo State, Nigeria.

T. vaginalis was observed in 25 (9.2%) out of the 272 adolescent girls in this study using the culture methods whereas 15 (5.5%) from the 25 infected participants were positive for *T. vaginalis* using the wet mount preparation. Others reported similar findings (17, 23, 24). Direct microscopic examination of the vaginal specimen remains the most widely used diagnostic test for *T. vaginalis* infection (10). Culture methods have been reported as the current gold standard for the detection of *T. vaginalis* and should be considered for widespread clinical use (17, 25). We suggest the inclusion of culture methods in the screening of *T. vaginalis*.

Generally, an overall prevalence of 9.2% of trichomoniasis was observed among adolescent secondary school girls in this study. The prevalence of *T. vaginalis* observed in this study is similar to the 9.3% reported by Obunge *et al.* (26) in Port-Harcourt, Rivers State. However, the prevalence of 9.2% of *T. vaginalis* infection reported in this study is lower than the 25.9% and 24.6% reported among school girls in Zambia (27, 28). The observed difference in prevalence could be attributed to geographical locations, personal hygiene and diagnostic methods used. There is the need to put in place drastic measures otherwise, the high prevalence of *T. vaginalis*infection observed in adolescent girls is likely to remain undetected and untreated, causing a rising pool of infection in the local population, increasing morbidity and reducing their fertility as well as increasing their risk of other reproductive tract infection and human immunodeficiency virus (15).

It has been observed that the incidence of sexually transmitted diseases including *T. vaginalis* infection is highest among 15 to 30 years age group (29). The 13-15 years age group had the highest prevalence of trichomoniasis (10.8%) when compared with the 16-18 years age group (7.7%). In addition, age was not a risk factor for acquiring *T. vaginalis* infection (P=0.5978) among adolescent girls attending secondary schools.

Adolescent girls that are Muslims presented with the highest prevalence (14.3%) of *T. vaginalis* infection when compared with their Christian counterparts (8.9%). However, religion was not a risk factor for acquiring *T. vaginalis* infection among the adolescent girls attending secondary schools (P=0.3752).

Individuals with poor personal hygiene and low socio-economic status have been reported to have an increased risk of *T. vaginalis* infection (30). Adolescents that are from home with poor educational background are likely to have poor personal hygiene standards. Level of education of parents of the school girls significantly affected the prevalence of *T. vaginalis* infection (P<0.05) with the girls from father and mother that had primary school education having the highest prevalence of 13.3% and 19.6% respectively. Low level of education has been reported to play a major role in epidemiology of parasitic diseases (2).

Occupation of participants' father did not significantly affect the prevalence of *T. vaginalis* infection among the adolescent girls (P=0.2793). However, the occupation of participants' mother greatly affected the prevalence of trichomoniasis among the adolescent girls attending secondary school (P=0.0153) with the girls whose mothers are farmers having the highest prevalence (20.0%). Most farmers are believed to be of poor educational background which is likely to impart on their level of personal hygiene as well as that of their girl child. This may explain the reason for this finding.

Improvement in personal hygiene is more likely to be observed in the urban settings due to access to sexual and reproductive health education from several media as well as the availability of reproductive health services which include treatment and counseling services (15). Girls from the rural settings had the highest prevalence (11.7%) of trichomoniasis when compared with other locations. However, location of adolescent girls did not affect significantly the prevalence of trichomoniasis in this study (P=0.0912). This finding is inconsistent with the report of Nazari*et al.* (17) that had higher prevalence of *T.*

vaginalis infection from the urban dwellers than their rural counterparts. The reason for this difference is unclear.

The relationship between bacterial vaginosis, *Neisseria gonorrhoeae, Chlamydia trachomatis*, genital ulcer disease, and the increase in the risk of HIV transmission make early detection and diagnosis of reproductive tract infection particularly *T. vaginalis*, a major public health imperative (31, 32, 33, 34, 35, 36). *T. vaginalis* primarily infects the squamous epithelium of the genital tract where it replicates by binary fission. It is transmitted among human host mainly by sexual intercourse (37). In this study, the prevalence of trichomoniasis was strongly associated with sexual intercourse. In addition, sexual intercourse appears to have 4-37-fold increased risk of acquiring *T. vaginalis* infection among adolescent girls (P<0.0001). Adolescent girls that have had sexual intercourse presented with the highest prevalence (22.3%) when compared with those that did not have sexual (2.3%). The incidence of *T. vaginalis* infection has been reported to depend mainly on sexual activity (3). This observation may explain our finding.

Participants that used bush as a type of toilet had the highest prevalence (11.5%) of trichomoniasis when compared with other types of toilet (pit latrine 7.0%; water cistern 9.7%). In addition, type of toilet did not significantly affect the prevalence of trichomonias is among adolescent girls attending secondary school (*P*=0.7328). This finding is consistent with the report of Crucitti*et al.* (28). The reason for this finding is unclear.

CONCLUSION

An overall prevalence of 9.2% of *T. vaginalis* was observed among adolescent girls in this study. Level of education of parents, occupation of mothers and sexual relationship of participants significantly affected the prevalence of *T. vaginalis*infection among adolescent girls attending secondary school. Culture method detected more cases of *T. vaginalis* infection than the wet mount technique. The introduction of culture methods to routine diagnosis of *T. vaginalis*infection is advocated as this will reduce cases of infertility resulting from undetected and untreated infection as well as the risk of HIV transmission and acquisition.

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REFERENCES

1. Secor W. E., Meites E., Starr M. C., Workowski K. A. Neglected parasitic infections in the United States: trichomoniasis. Am. J. Trop. Med.Hyg. 2014;90(5): 800-804.

2. World Health Organization. Global incidence and prevalence of selected curable sexually transmitted infections – 2008. World Health Organization, Geneva. 2012.

3. Menezes C. B., Frasson A. P., Tasca T. Trichomoniasis – are we giving the deserved attention to the most common non-viral sexually transmitted disease worldwide? Microbial Cell. 2016; 3(9): 404-418.

4. Melo J., Folgosa E., Manjate D., Osman N., Francois I., Temmerman M., Cappuccinelli P., Colombo M.M. Low prevalence of HIV and other sexually transmitted infections in young women attending a youth counselling service in Maputo, Mozambique. Trop. Med. Intern. Health. 2008; 13(1): 17–20.

5. Basaca-Sevilla V., Cross J. H., Alquiza L., Lacap T. Prevalence of *Trichomonasvaginalis*in some Filipino women, Southeast

   Asian J. Trop. Med. Public Health. 1986; 17(2): 194–196.

6. Jamali R., Zareikar R., Kazemi A., Yousefee S. Diagnosis of *Trichomonasvaginalis*infection using PCR method compared to culture and wet mount microscopy. Intern. Med. J.2006; 5.

7. Lehker M. W., Alderete J. F. Biology of trichomonosis. Curr.Opin. Infect. Dis. 2000; 13(1): 37-45.

8. Muzny C. A, Schwebke J. R. The clinical spectrum of Trichomonasvaginalis infection and challenges to management. Sex Transm. Infect. 2013;89(6): 423-425.

9. Uneke C. J., Cletus D. C, Ugwuoru E. A., Mirian A. Trichomonasvaginalis infection among pregnant women in South-Eastern Nigeria: Public health significance. Intern .J. Obst .Gynaecol. 2006; 6 (1): 1528-1540.

10. Petrin D., Delgaty K., Bhatt R., Garber G. Clinical and microbial aspects of *Trichomonasvaginalis*. Clin.Microbiol. Rev. 1998; 11:300–317.

11. Wolner-Hanssen P., Krieger J. N, Stevens C. E, Kiviat N. B, Koutsky L., Critchlow C., DeRouen T, Hillier S, Holmes KK.. Clinical manifestations of vaginal trichomoniasis. JAMA. 1989;261(4):571–576.

12. Cox F. E. G., WakelinD., Gillespie S. H., Despommier D. D. *Topley and Wilsons, Microbiology and Microbial Infections,Parasitology*, Edward Arnold, London, UK, 10th edition. 2005.

13. McClelland R. S., Sangare´ L., Hassan W. M., Lavreys L., Mandaliya K., Kiarie J., Ndinya-Achola J., Jaoko W., Baeten JM.Infection with Trichomonasvaginalis increases the risk of HIV-1 acquisition. J. Infect. Dis. 2007; 195: 698–702.

14. Gimenes F., Souza R. P, Bento J. C, Teixeira J. J, Maria-Engler S. S, Bonini M. G, Consolaro M. E. Male infertility: a public health issue caused by sexually transmitted pathogens. Nat. Rev. Urol.2014; 11(12): 672-687.

15. Kerubo E., Laserson K. F, Otecko N., Odhiambo C., Mason L., Nyothach E., Oruko K. O., Bauman A., Vulule J., Zeh C., Phillips-Howard P. A. Prevalence of reproductive tract infections and the predictive value of girls' symptom-based reporting: findings from a cross-sectional survey in rural western Kenya. Sex Transm. Infect. 2016; 92(4):251-256

16. Cheesbrough M. District Laboratory Practice in Tropical Countries. 2nd Edition, Cambridge University Press, Cambridge. 1999.

17. Nazari N, Zangeneh M, Moradi F, Bozorgomid A. Prevalence of Trichomoniasis Among Women in Kermanshah, Iran. Iran Red Crescent Med. J.2015; 17(3): 1-4.

18. WHO. Report on global sexually transmitted infection surveillance. Geneva, Switzerland: World Health Organization, 2013.

19. Grodstein F., Goldman M. B, Ryan L. Relation of female infertility to consumption of caffeinated beverages. American J. Epidemiol. 1993; 137(12):1353-60.

20. Viikki M., Pukkala E., Nieminen P., Hakama M. Gynaecological infections as risk determinants of subsequent cervical neoplasia. ActaOncol. 2000;39(1):71–75.

21. Sutcliffe S., Neace C., Magnuson N. S, Reeves R., Alderete J. F.Trichomonosis, a common curable STI, and prostate carcinogenesis - a proposed molecular mechanism. PLoSPathol. 2012; 8(8): e1002801

22. Silver B. J, Guy R. J., Kaldor J. M., Jamil M. S., Rumbold A. R. *Trichomonasvaginalis*as a cause of perinatal morbidity: a systematic review and meta-analysis. Sex Transm. Dis. 2014; 41(6):369–376.

23. Radonjic I.V, Dzamic A. M, Mitrovic S. M, ArsicArsenijevic V. S, Popadic D. M, KranjcicZec I. F. Diagnosis of Trichomonasvaginalis infection: The sensitivities and specificities of microscopy, culture and PCR assay. Eur. J. Obstet.Gynaecol.Reprod. Biol.2006; 126(1):116–120.

24. Rezaeian M., Vatanshenassan M., Rezaie S., Mohebal M., Niromand N., Niyyati M., Farnia S., Babaei Z. Prevalence of Trichomonasvaginalis using parasitological methods in Tehran. Iran J.Parasitol. 2009;4(4):43–7.

25. Beverly A. L., Vengtarik L.M., Cotton B., Schwebke J. R. Viability of Trichomonasvaginalis in transport medium. Journal of Clin. Microbiol.1999. 37: 3749-3750.

26. Obunge O.K., Brabin L., Dollimore N., Kemp J., Ikokwu-Wonodi C., Babatunde S., White S., Briggs N. D, Hart C.A. A flowchart for managing sexually transmitted infections among Nigerian adolescent females. Bull.World Health Org. 2001; 79: 301–305.

27. Crucitti T., Jespers V., Mulenga C., Khondowe S., Vandepitte J., Anne B. A. T*ichomonasvaginalis*is Highly Prevalent in Adolescent Girls, Pregnant Women, and Commercial Sex Workers in Ndola, Zambia. Sex.Transm. Dis. 2010;37(4): 223-227.

28. Crucitti T., Jespers V., Mulenga C., Khondowe S., Vandepitte J., Buve A. Non-Sexual Transmission of Trichomonasvaginalis in Adolescent Girls Attending School in Ndola, Zambia. PLoS ONE. 2011; 6(1): 1-5

29. WHO. Sexually transmitted nfection. WHOMediaCenter. (Website:http://www.Mediainq uiries@who.information). 2007.

30. Thomas CQ, King KH. Trichomoniasis: In Tropical and Geographical medicine. Kenneth S. Warren and Adel A.F. Mahmoud (ed). *McGraw Hill Book Company, New York*. 1985. 335-340

31. World Health Organization. Global Prevalence and Incidence of Selected Curable Sexually Transmitted Infections, Overview and Estimates. WHO/CDS/EDC/2001.10.Geneva, Switzerland: WHO, 2001.

32. Cherpes T. L, Meyn L. A, Krohn M. A, Lurie J. G, Hillier S. L. Association between acquisition of herpes simplex virus type 2 in women and bacterial vaginosis. Clin. Infect. Dis.2003; 37: 319–25.

33. Wiesenfeld H. C, Hillier S. L, Krohn M. A, Landers D. V, Sweet R. L. Bacterial vaginosis is a strong predictor of Neisseria gonorrhoeae and Chlamydia trachomatis infection. Clin. Infect. Dis.2003; 36: 663–668.

34. Gillet E., Meys J. F., Verstraelen H., Bosire C., De Sutter P., Temmerman M., Broeck D. V. Bacterial vaginosis is associated with uterine cervical human papillomavirus infection: a meta-analysis. BMC Infect. Dis. 2011;11:10.

35. Cohen C. R., Lingappa J. R., Baeten J. M., Ngayo M. O., Spiegel C. A, Hong T., Donnell D., Celum C., Kapiga S., Delany S., Elizabeth A. Bukusi E. A.Bacterial vaginosis associated with increased risk of female-to-male HIV-1 transmission: a prospective cohort analysis among African couples. PLoS Med. 2012; 9:e1001251.

36. Balkus J. E., Richardson B. A., Rabe L. K., Taha T. E., Mgodi N., Kasaro M. P., Ramjee G., Hoffman I. F.,Karim S. S. A. Bacterial vaginosis and the risk oftrichomonas vaginalisacquisition among HIV-1-negative women.Sex Transm. Dis. 2014;41:123–128.

37. Kissinger P. (2015). Trichomonasvaginalis: a review of epidemiologic, clinical and treatment issues. BMC Infect. Dis. 2015; 15:307-314.