



The Prevalence of *Trichomonas vaginalis* infection and Associated Risk Factors among Undergraduate Female Students of Babcock University, Ilishan-Remo, Ogun State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors JHS and ESS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors AO and IGE managed the analyses of the study. Authors OGO and OAO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: *Trichomonas vaginalis* infection is the most common curable sexually transmissible disease (STD) among women of reproductive age worldwide.

Aims: To determine the prevalence rate and associated risk factors of *Trichomonas vaginalis* infection among undergraduate female students of Babcock University, Ilishan-Remo, Ogun State, Nigeria.

Study Design: This is a cross-sectional, as well as institutional-based study.

Methodology: Six Halls of residence were selected for screening and a total of two hundred (200) high vaginal swab samples were randomly collected from consenting female students and

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analyzed by wet mount preparation. Demographic and clinical information of the participants were obtained using prepared questionnaires.

Results: Out of the 200 female students that were examined, 25 (12.5%) were positive for *Trichomonas vaginalis* infection. Among the 25 individuals who tested positive for *T. vaginalis* infection, only 2 (8.0%) were without symptoms associated with vaginal trichomoniasis, while the remaining 23 (92.0%) presented symptoms such as vaginal odour (20%), itching and discomfort (32%) and greenish yellow vaginal discharge (92%). Statistical analysis shows that there was no significant difference ($P>0.05$) in the prevalence rate of *Trichomonas vaginalis* infection among the study participants on the basis of: Age, Tribe, Religion and Study Level; except for Hall of residence. The occurrence of *T. vaginalis* infection particularly among the occupants of Hall 6 (45.0%) was significantly higher ($P<0.05$) compared to the occupants of other Halls of residence: Hall 3 (13.0%) and Hall 5 (6.3%). Meanwhile, there was no record of *T. vaginalis* infection in the rest of the Halls (Hall 1, 2 and 4). Risk factors associated with the occurrence of *T. vaginalis* infection among the study participants include: Sexual activities, douching, wearing of wet pant, sharing underwear, sharing sanitary facilities and use of sanitary pads among others.

Conclusion: *Trichomonas vaginalis* infection exists among undergraduate female students of Babcock University. Improvement on the level of personal hygiene and toilet sanitation of Students' Halls of residence is very crucial to the control of non-venereal mode of transmission for *T. vaginalis* infection.

Keywords: *Trichomonas vaginalis*; trichomoniasis; females; itching; odour; vaginal discharge.

1. INTRODUCTION

Trichomonas vaginalis (*T. vaginalis*) is an anaerobic-flagellated pear-shaped highly predatory obligate protozoan parasite which is extracellular to the genitourinary tract epithelium. It phagocytoses bacteria, vaginal epithelial cells and erythrocytes and is itself ingested by macrophages. It causes a sexually transmitted parasitic infection in females known as trichomoniasis with an enormous public health implications and impacts upon birth outcomes [1]. Annually, 1.1 million people are newly infected with *T. vaginalis* in the United States [2]. Globally, the parasite is known to be responsible for an estimated 248 million infections per year, making it the most prevalent non-viral sexually transmitted pathogen worldwide [3-6].

Ninety per cent (90%) cases of trichomoniasis occurred among people living in resource-limited settings. As a matter of fact, *T. vaginalis* is more prevalent than *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and *Treponema pallidum* combined [6]. The global prevalence of *T. vaginalis* has been estimated at 8.1% for women and 1.0% for men [7]. In general, Africans or persons of African descent have higher rates of *T. vaginalis*. In the United States for instance, the highest prevalence of *T. vaginalis* infection in US women is seen among African-Americans with rates ranging from 13–51%. *T. vaginalis* infection has been reported to be ten times higher in African

American women than in white women, constituting a remarkable health disparity [6,7].

Transmission of *T. vaginalis* occurs usually by direct skin to skin contact with an infected individual, most often through vaginal intercourse; Although other means of transmission have been implicated such as toilet seats, contaminated under wears, towels etc [8,9]. Transmission from mothers to neonates during passage through an infected birth canal is also possible [10,11].

Trichomoniasis can occur in females if the normal acidity of the vagina is shifted from a healthy, semi-acidic pH (3.8–4.2) to a more basic one that is conducive to *T. vaginalis* growth. The outcome of infection with *T. vaginalis* may be due to genetic variability of the isolates and the host immune response. The pregnant women infected with this parasite may be at risk of adverse birth outcomes such as premature rupture of membranes, premature labour, low birth weight, and post-abortion or post-hysterectomy infection, as well as infertility and enhanced predisposition to neoplastic transformation in cervical tissues [12].

Available epidemiological data suggests that more women than men are often infected and in both sexes, most infections are asymptomatic, with symptomatic and severe infections more common in women than men [13]. The most common symptom among women diagnosed with *T. vaginalis* infection is vaginal discharge

seen in more than 50% of cases, which can be copious, malodorous, and frothy. Other symptoms include: moderate inflammation of the cervix, vagina, and urethra, Pruritus and pain with urination or sexual intercourse may also be presenting complaints. Punctate hemorrhagic lesions in the genital epithelium can result in colpitis macularis or strawberry cervix, which is a specific sign for trichomoniasis. And without appropriate treatment, *T. vaginalis* infection may persist for months to years [14]. In fact, trichomoniasis can increase the risk of transmission and also coexists with other Sexually Transmitted Diseases (STDs) such as Candidiasis, Gonorrhoea, Syphilis and Human Immunodeficiency Virus (HIV) infection [15,16].

In Nigeria, prevalence of sexually transmitted diseases like trichomoniasis has been blamed on increase in poverty and hard economic situation in the country which expose young women to see sex as a business and means of using what they have to get what they lack; getting money and obtaining what they desire from wealthy men and men in authority. This is more especially among students of higher institutions where sex is exchanged for better academic performance and also among junior workers in both public and private sectors for promotion and other favors [17]. Other risk factors of trichomoniasis include: sexual violence among woman and children, sexual recklessness, ignorance of the public health implications, poor sanitation and poor personal hygiene [18].

According to Ugwu [19], the level of awareness of some sexually transmitted diseases like trichomoniasis among student population is low. Besides, to the best of our knowledge, no data on the prevalence of *Trichomonas vaginalis* infection among undergraduate female students of Babcock University exist, hence this study. The aim of this work is therefore to determine the prevalence of *T. vaginalis* infection among undergraduate female students in selected halls of residence (hostels) of Babcock University, as well as to identify possible risk factors associated with *T. vaginalis* infection.

2. METHODOLOGY

2.1 Study Area

The study was carried out among undergraduate female students of Babcock University Ilishan-Remo, located in Ikenne Local Government Area, Ogun state, South-Western region of Nigeria, coordinates: 6° 52' N3° 43' E. The study

was carried out between the periods of April to May, 2016.

2.2 Sample Size Calculation

The minimum sample size (n) required was estimated using the single population proportion formula:

$$n = 4pq/d^2,$$

Where:

n = required sample size
P = 11.4% prevalence of *T. vaginalis* infection from previous study [20],
q = 1-p and
d = 0.05, the degree of precision

2.3 Sample Size

A total of 200 (two hundred) high vaginal swab (HVS) specimens were collected randomly from interested female students in selected hostels within Babcock University.

2.4 Eligibility of Subjects

2.4.1 Inclusion criteria

Consenting Students in the selected hostels of Babcock University were recruited for the study.

2.4.2 Exclusion criteria

Those with history of antibiotics and anthelmintic drugs use in the preceding two weeks of the study were also excluded from the study.

2.5 Data Collection

Prior to specimen collection, demographic and clinical information of the participants were obtained using prepared questionnaires which were administered to the female participants. Each questionnaire had a unique participant identification number (PIDN). Data and specimen collection was done simultaneously. The pre-test questionnaires were administered to the participants directly. The first part of the questionnaires contained the biodata of the participants e.g. age, study level, religion, hostel, and tribe. Second part includes clinical data relating to personal hygiene and health care-seeking behavior. The study population was stratified by age, study level, religion, hostel, and

tribe. All filled questionnaires were examined for completeness daily and stored securely in a locker. Data entry was done on the following day. For reasons of privacy, only the PIDN was recorded on the laboratory forms (no names) and all data were kept confidential in accordance with World Medical Association declaration of Helsinki [21]. All filled questionnaires were destroyed after data entry has been completed.

2.6 Sample Collection

Self-collected high vaginal swabs were requested from each participant. Briefly, they were instructed to assume a lithotomy position, use one hand to separate the labia majora/minora of their vagina apart and used the other hand to insert the sterile vaginal swab stick 1–2 inches into the vagina to swab the vagina walls and keep in the vagina for 20 seconds before removing in an aseptic manner and corked immediately. These samples were collected during the day.

2.7 Sample Transportation/Handling

The samples were immediately kept in a transport media (Stuarts) at 25°C to prevent dying and loss of the parasite. The samples remained in the transport medium for about 1-2 hours, this is because of the time it took for the samples to be collected and transported to the laboratory where the samples were processed immediately on getting to the laboratory.

2.8 Laboratory Analysis

2.8.1 Wet mount preparation

Briefly, a drop of normal saline was placed on a clean grease-free slide and the swab stick was rolled in the normal saline on the slide to make a smear, it was covered with a cover slip and then viewed under the microscope using x10 and x40 objective lenses.

2.8.2 Microscopic identification of parasite

The trophozoite of *Trichomonas vaginalis* which is about 8-15 µm long, appear ovoid, round, or pear-like in shape. Rapid, jerky motility is

accomplished with the aid of the organism's four flagella, all of which originate from the anterior end. Only one of the flagella extends posteriorly. Ameboid forms of the parasite were also seen under the microscope.

2.9 Management of Positive Patients

Participants that tested positive were advised to visit the hospital for proper treatment and management of the infection.

2.10 Data Analysis

Data obtained were analyzed using one way analysis of variance (ANOVA), using Statistical packages for social Scientists-version 18 (SPSS-18.0) to test for statistical differences between the distributions of *Trichomonas vaginalis* infection by age, tribe, religion, study level and hall of residence. P value <0.05 was considered significant [22].

3. RESULTS AND DISCUSSION

Out of the 200 female students of Babcock University that were examined, 25 (12.5%) were positive for *Trichomonas vaginalis*, while 175 (87.5%) were negative (Table 1). The distribution of *Trichomonas vaginalis* infection by age group is presented in Table 2. 14-18 years old: 8 (14.8%) out of 54 participants were positive, 19-23 years old: 16 (11.9%) out of 134 participants were positive and 29 years and above: 1 (25%) out of 4 participants was infected. Interestingly, *T. vaginalis* infection was not recorded in the age group 24-28 years old. There was no significant difference in the occurrence of *T. vaginalis* infection between and within the age groups examined (P>0.05).

The distribution of *Trichomonas vaginalis* infection by Tribe is presented in Table 3. Out of the 139 Yoruba participants examined, 19 (13.7%) were found positive for *T. vaginalis*. Also, 2 (7.1%) out of the 28 Ibo participants were found to be infected, but none of the 4 Hausa participants were infected. Meanwhile, 4 (13.8%) out of the 29 participants who were neither

Table 1. Prevalence rate of *Trichomonas vaginalis* among study participants

Number examined N	Number positive N	Percentage Positive (%)	Number negative N	Percentage negative (%)
200	25	12.5	175	87.5

Yorubas, Ibos nor Hausas were positive for *T. vaginalis*. Statistical analysis shows that there was no significant difference in the occurrence of *Trichomonas vaginalis* infection between and within the tribes examined ($P>0.05$).

Furthermore, distribution of *Trichomonas vaginalis* infection by Religion is presented in Table 4. Participants were stratified either as Christians or Muslims as no participants indicated traditional religion. Out of the 177 Christian participants examined, 24 (13.6%) were found to be infected. But only 1 (4.4%) of the 23 Muslim participants was positive for *T. vaginalis*. Statistically speaking, there was no significant difference in the occurrence of *Trichomonas vaginalis* infection between Christian and Muslim students ($P>0.05$).

The distribution of *Trichomonas vaginalis* infection by study level is presented in Table 5. Five (41.7%) out of the 27 participants in 100 Level were positive for *T. vaginalis* infection. Eight (16.3%) out of the 49 participants in 200 Level had *T. vaginalis* infection. Six (12.2%) of the 49 participants in 300 Level were positive for *T. vaginalis* infection. There was also occurrence of *T. vaginalis* infection in 4 (6.7%) out of the 60 participants in 400 Level. While only 2 (13.3%)

out of the 15 participants in 500 Level examined were positive for *T. vaginalis* infection. There was no significant difference in the occurrence of *Trichomonas vaginalis* infection between and within the study levels examined ($P>0.05$).

The distribution of *Trichomonas vaginalis* infection by halls of residence is shown in Table 6. Of all the halls of residence for female students examined, the highest occurrence of 18 (45.0%) was seen among those residing in Hall 6, followed by Hall 3 (13.0%) and lastly Hall 5 (6.3%). There was no occurrence of *T. vaginalis* infection in Hall 1, 2 and 4. The occurrence of *T. vaginalis* infection particularly among the occupants of Hall 6 was significant higher ($P<0.05$) compared to the occupants of other halls of residence.

Furthermore, the prevalence rate of *Trichomonas vaginalis* in relation to risk factors of the study participants is presented in Table 7. Fourteen (13.5) of the 104 respondents who tested positive for *Trichomonas vaginalis*, douched with water only, 7 (8.4%) douched with soap and water, 2 (9.5%) douched with antiseptics and deodorant products; While none (0%) of the 4 respondent who douched with herbal concoctions was positive for *T. vaginalis*.

Table 2. Distribution of *Trichomonas vaginalis* infection by Age

Age range	Number examined N (%)	Number positive N (%)	Number negative N (%)	P-value
14-18	54 (27.0)	8 (14.8)	46 (85.2)	0.592
19-23	134 (67.0)	16 (11.9)	118 (88.1)	0.592
24-28	8 (4.0)	0 (0)	8 (100)	0.241
≥29	4 (2.0)	1 (25.0)	3 (75.0)	0.555
Total	200 (100)	25 (12.5)	175 (87.5)	

P value >0.05 is considered statistically non-significant

Table 3. Distribution of *Trichomonas vaginalis* infection by Tribe

Tribe	Number examined N (%)	Number positive N (%)	Number negative N (%)	P-value
Yoruba	139 (69.5)	19 (13.7)	120 (86.3)	0.682
Ibo	28 (14.0)	2 (7.1)	26 (92.9)	0.803
Hausa	4 (2.0)	0 (0)	0 (0)	0.785
Others	29 (14.5)	4 (13.8)	25 (86.2)	0.490
Total	200 (100)	25 (12.5)	175 (87.5)	

P value >0.05 is considered statistically non-significant

Table 4. Distribution of *Trichomonas vaginalis* infection by religion

Religion	Number examined N (%)	Number positive N (%)	Number negative N (%)	P-value
Christianity	177 (88.5)	24 (13.6)	153 (86.4)	0.211
Islam	23 (11.5)	1 (4.4)	22 (95.6)	0.211
Total	200 (100)	25 (12.5)	175 (87.5)	

P value >0.05 is considered statistically non-significant

Table 5. Distribution of *Trichomonas vaginalis* by study level

Study level	Number examined N (%)	Number positive N (%)	Number negative N (%)	P-value
100L	27 (13.5)	5 (41.7)	22 (58.3)	0.509
200L	49 (24.5)	8 (16.3)	41 (83.7)	0.495
300L	49 (24.5)	6 (12.2)	43 (87.8)	0.371
400L	60 (30.0)	4 (6.7)	56 (93.3)	0.131
500L	15 (7.5)	2 (13.3)	13 (86.7)	0.778
Total	200 (100)	25 (12.5)	175 (87.5)	

P value >0.05 is considered statistically non-significant.

Table 6. Distribution of *Trichomonas vaginalis* by Hall of residence

Hall of residence	Number examined N (%)	Number positive N (%)	Number negative N (%)	P-value
Hall 1	42 (21)	0 (0)	42 (100.0)	0.475
Hall 2	7 (3.5)	0 (0)	7 (100.0)	0.309
Hall 3	46 (23.0)	6 (13.0)	40 (87.0)	0.055
Hall 4	49 (24.5)	0 (0)	49 (100.0)	0.485
Hall 5	16 (8.0)	1 (6.3)	15 (93.7)	0.478
Hall 6	40 (20.0)	18 (45.0)	22 (55.0)	*0.001
Total	200 (100)	25 (12.5)	175 (87.5)	

**P* value <0.05 is considered statistically significant

Three (11.1%) of the 27 infected respondents wear wet pant and under wears; while just only 1 (7.1%) positive respondent shared under wear and sanitary facilities with others. All the 25 (100%) positive participants use sanitary pads. Still, only 2 (4.4%) of the 45 participants who admitted to have had sex before were infected. Whereas 23 (14.8) out of the 155 (77.5%) who claimed celebrity were found positive for *T. vaginalis*. Also, only 1 out of the 2 infected individuals who admitted to have had sex before, indicated that she has changed sex partner recently. Twenty three (15.6%) out of the 147 who indicated that they have no sex partner were positive; while the remaining 2 of the 25 positive cases indicated that they either have 1-2 (2.4%) or 3-5 (33.3%) sex partners and engage in 1-2 sexual intercourse per week (15.4%).

The occurrence of symptomatic and asymptomatic *Trichomonas vaginalis* infection

among the study participants is presented in Fig. 1. Twenty three (92.0%) out of the 25 participants who were positive for *T. vaginalis* infection showed symptoms of trichomoniasis, while 2 (8.0%) did not.

The clinical indications for *Trichomonas vaginalis* infection as observed in this study are shown in Fig. 2. Out of the 25 respondents who tested positive for *Trichomonas vaginalis* infection, 5 (20%) of them presented with vaginal odour, 8 (32%) had itching and discomfort, while 23 (92%) had vaginal discharge.

Trichomoniasis is the most common curable sexually transmissible disease (STD) among women of reproductive age worldwide [23]. From epidemiological point of view, screening for *T. vaginalis* in a given population is very crucial to control and prevention initiatives for trichomoniasis.

Table 7. Prevalence of *Trichomonas vaginalis* infection in relation to risk factors of the study participants

Characteristics	Responses	Number of participants N (%)	Number of Positive N (%)	Number of Negative N (%)
Douch with water only	Yes	104 (52)	14 (13.5)	90 (86.5)
	No	96 (48)	11 (11.5)	85 (88.5)
Douch with soap and water	Yes	83 (41.5)	7 (8.4)	76 (91.6)
	No	117 (58.5)	18 (15.4)	99 (84.6)
Douch with antiseptics/ deodorant products	Yes	21 (10.5)	2 (9.5)	19 (90.5)
	No	179 (89.5)	23 (12.9)	156 (87.1)
Douch with herbal concoctions	Yes	4 (2.0)	0 (0)	4 (100)
	No	196 (98.0)	25 (12.8)	171 (87.2)
Wear wet pant/underwear	Yes	27 (13.5)	3 (11.1)	24 (88.9)
	No	173 (86.5)	22 (12.7)	151 (87.3)
Share underwear and sanitary facilities with others?	Yes	14 (7.0)	1 (7.1)	13 (92.9)
	No	186 (93.0)	24 (13.0)	162 (87.0)
Use sanitary pads	Yes	114 (57.0)	25 (22.0)	89 (78.0)
	No	86 (43.0)	0 (0)	86 (100)
Have had sex before	Yes	45 (22.5)	2 (4.4)	43 (95.6)
	No	155 (77.5)	23 (14.8)	132 (85.2)
Change sex partner recently	Yes	8 (4.0)	1 (12.5)	7 (87.5)
	No	192 (96.0)	24 (12.5)	168 (87.5)
Number of sex partners	None	147 (73.5)	23 (15.6)	124 (84.4)
	1-2	41 (20.5)	1 (2.4)	40 (97.6)
	3-5	3 (1.5)	1 (33.3)	2 (66.7)
	Undisclosed	9 (4.5)	0 (0)	9 (100)

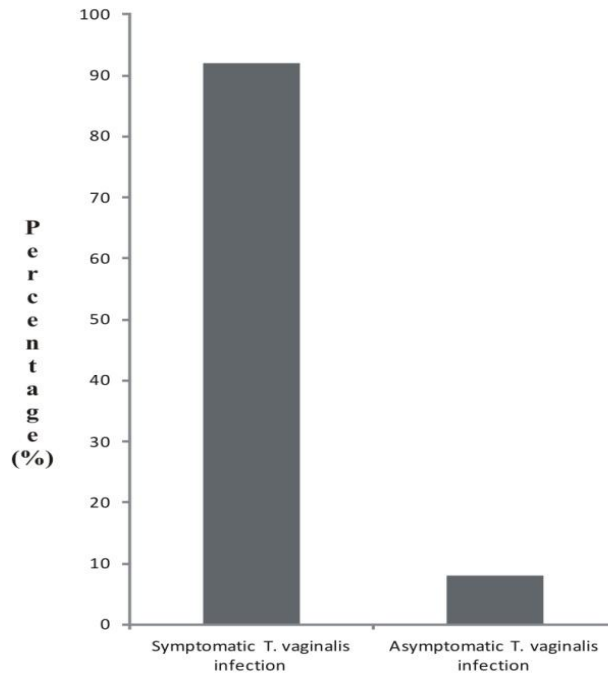


Fig. 1. Percentage occurrence of symptomatic and asymptomatic *Trichomonas vaginalis* infection among study participants

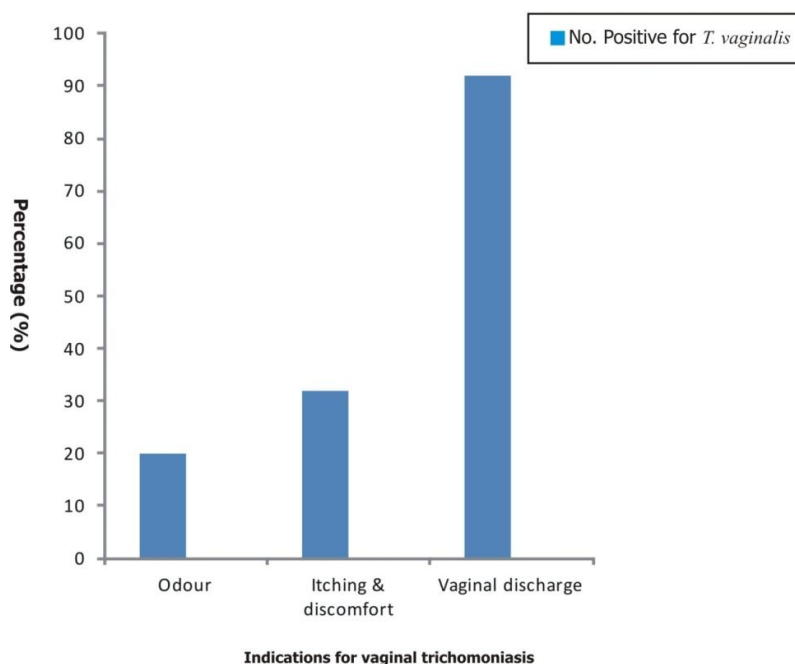


Fig. 2. Percentage occurrence of clinical indications of *T. vaginalis* infection among infected study participants

To the best of our knowledge, no previous work has documented the prevalence of *T. vaginalis* infection among undergraduate female students of Babcock University, Ilishan-Remo, Ogun State. This present study examined 200 vaginal swabs by wet preparation for the detection of *T. vaginalis*. The outcome of the study shows that trichomoniasis is present in Babcock University with a prevalence rate of 12.5% among the study participants. The result is comparable with that of [20] who reported a prevalence rate of 11.4% among female students, but is lower when compared to the works of Amadi and Nwagbo [24] who reported a prevalence rate of 20.6%.

Trichomoniasis has been found to be prevalent among populations with high levels of sexual activity and larger number of different sexual partners [25]. The low prevalence rate reported in this current study against previous studies may be due to the fact most of the study participants examined were virgins, as 73.5% of them indicated that they have no sex partners, while 77.5% of them claimed that they have never had sex before. Whereas only 2 out of the 25 students who tested positive for *T. vaginalis*, have sex partners and have had sex before. On the assumption that the information provided by the participants regarding their sexual life and activities were sincerely correct and authentic, it

is suggestive that non-veral means of transmission be considered in addition to veral means.

Out of the 25 positive cases recorded, 3 (11.1%) indicated that they wear wet pants; while 1 (7.1%) indicated to share underwear and sanitary facilities with others. This agrees with works of Smyth [8] and Njoku et al. [9] who both obliged that other means of transmission of *T. vaginalis* exist apart from sexual intercourse. According to them, *T. vaginalis* have been implicated in contaminated under-wears and towels. Evidence of non-sexual transmission via fomites and possibly water has also been described by Adu-Sarkodie [26] and Crucitti et al. [27].

Another risk factor associated with trichomoniasis is vaginal douching. Globally, women engage in this common practice mainly for the purpose of personal hygiene or other religious reasons [28,29]. The prevalence rate of *Trichomonas vaginalis* infection in this current study appears to be related to the nature of douching practiced by the participants: 13.5% infected participants douched with water only, 9.5% douched with antiseptics and deodorant products, while 8.4% douched with soap and water; howbeit, none of the 4 students who douched with herbal concoctions was positive for

T. vaginalis (0%). The normal vaginal has a pH of 3.8–4.2, but with *T. vaginalis* infection this increases markedly. The parasite has been reported to thrive well in a vaginal environment with a pH >5 [30]. Water has a neutral pH and in no way should it alter the pH of the vaginal environment thereby favoring the survival of the parasite. It is therefore surprising that the highest incidence of *Trichomonas vaginalis* positivity in this study was recorded among those who douched with water only, despite the increased advocacy on the use of water only for the purpose of douching. Lack of *T. vaginalis* positivity among those who douched with herbal concoctions is thought to be due to the ability of the herbal concoctions to maintain the acidic pH of the vaginal environment against infection. While the use of antiseptics and deodorant products on the other hand is thought to alter the pH and normal microbiota of the vaginal, this may favor the survival of *T. vaginalis* in the infected individuals. Hence the 9.5% *T. vaginalis* positivity recorded among this category of participants.

Furthermore, although there is no significant differences in the prevalence rate of *T. vaginalis* infection among the various age groups studied, the prevalence rate of *T. vaginalis* particularly among the age groups: 14-18 years (14.8%) and 19-23 years (11.9%) as observed in this current studies, agrees with the findings of previous works by Ulogu et al. [18], as well as Amadi and Nwagbo [24] who both reported that trichomoniasis is more prevalent among young people within reproductive age. It also agrees with the work of Iwueze et al. [20] who reported a prevalence of 14.3% and 47.2% among age group <20 years and 21-30 years, respectively.

This age range is the period of greatest sexual activity and those in this group tend to be promiscuous and are therefore prone to sexually transmitted diseases [25]. Regarding the distribution of *T. vaginalis* infection by tribe, religion and study level, statistical analyses of the data obtained in this study shows that there was no significant differences ($P>0.05$) between and within the various strata. Hence, it can be concluded that the prevalence of *T. vaginalis* infection in Babcock University is not associated with the tribe, religion or study level of the participants.

On the other hand, the current data shows that the prevalence of *T. vaginalis* infection among the student population was hall-dependent.

Distribution of *T. vaginalis* infection by halls of residence shows that the parasite is predominantly concentrated among occupants of Hall 6 (45.0%), followed by Hall 3 (13.0%) and Hall 5 (6.3%). However, no occurrence of *T. vaginalis* infection was observed in the rest of the halls (Hall 1, 2 and 4). These results warranted environmental inspection of Hall 6 in particular. The physical conditions of some of the toilet facilities in the hostel as at the time of visit calls for serious health concerns as some students are in the habits of not flushing the toilets after use. Further findings revealed that the Hall 6 is one of the oldest Halls of residence on the campus with high level of occupancy and a toilet-students ratio of 1:12, which we considered to be inadequate.

According to Smyth [8], Njoku et al. [9] and Maufi et al. [31], *T. vaginalis* have been implicated in contaminated shared toilet seats. Ukoli [32], specifically stated that other means of vaginal contamination apart from sexual intercourse may be as a result of the non-venereal mode of transmission of the parasite which may remain viable in urine on lavatory seats for 30-45 minutes. He emphasized that such agents undoubtedly occurs especially in areas with poor environmental and personal hygiene and females with their open biological nature could easily be infected. This explains why trichomoniasis has been recently considered a neglected disease associated with poverty [2,5,33].

Furthermore, according to Wilkinson et al. [34] and Sorvoillo et al. [35], most patients with *T. vaginalis* infection are asymptomatic or mildly symptomatic and hence they are likely to continue to remain sexually active in spite of infection. However, in this current study, among the 25 individuals who tested positive for *T. vaginalis* infection, only 2 (8%) were without symptoms associated with trichomoniasis (*i.e.*, asymptomatic), while the remaining 23 (92%) presented symptoms such as vaginal odour (20%), itching and discomfort (32%) and greenish yellow vaginal discharge (92%). This is in disagreement with the work of Sutton et al. [36] who reported that 85% of women infected with *T. vaginalis* are asymptomatic.

It is worth knowing that the diagnosis of trichomoniasis cannot be readily made solely on the basis of clinical presentation for two main reasons: (i) the clinical symptoms may be identical to those seen with other STDS [37,38] and (ii) the characteristic frothy discharge is seen

in only 10% of women with *T. vaginalis* [39]. If these classic features alone are used for the diagnosis of trichomoniasis, 88% of infected women will not be diagnosed and 29% of uninfected women will be mistakenly diagnosed as having *T. vaginalis* infection. Therefore, the laboratory plays a key role in the diagnosis of this infection. Accurate diagnosis is essential, since it will lead to appropriate treatment and will facilitate the control of the spread of *T. vaginalis* infection.

The time-honored approach for the diagnosis of trichomoniasis has been microscopic evaluation by wet mount method, a procedure first described by Donne [40]. The test is inexpensive, less technical and is point of care [41]. But according to Stoner et al. [42] and McMillan [43], this procedure, however, detects only 51-65% and 35-80% of the cases respectively; depending on how soon the samples were examined after collection (usually within 1 hr of collection or less) and the expertise of the Microscopists. But according to Sood et al. [44], the broth culture method is the 'gold standard' for the diagnosis of trichomoniasis, even with its attending limitations. It is time-consuming as a period of 2-7 days is necessary before *T. vaginalis* can be identified in cultures, during which time infected patients may continue to transmit the infection and besides, the culture system (e.g Diamond's medium) is expensive and scarcely available in most resource-limited clinical laboratories and thus used mainly for research purposes [45]. Still, diagnosis by culture requires a return visit for treatment, which can be a barrier to delivery of appropriate therapy. But despite these seemingly limitations, the culture method detects twice as many cases of trichomoniasis as the traditional wet mount method.

Furthermore, the cell culture technique has been reported to be more superior to the broth culture and wet mount examination as it is able to detect the protozoan at a concentration as low as 3 parasites per ml. However, the cell culture technique is not routinely performed as it is expensive and not convenient for rapid diagnosis [46].

According to Workowski and Bolan [47], current diagnostic techniques for the detection of *Trichomonas vaginalis* infection consist mainly of the Wet mount, Culture and molecular techniques. The latter, though moderately priced, it requires instrumentation. However, It is highly sensitive and specific. The first nucleic acid

amplification test (NAAT) for *T. vaginalis* infection in women was cleared by the U.S. Food and Drug Administration in 2011 [48]. The NAAT can be used to test genital secretions or urine specimens. It is fast, as it can provide accurate results within 30 minutes. This is advantageous because therapy can be prescribed or provided at the initial visit, which decreases missed treatment opportunities because of loss to follow-up. Rapid point-of-care tests that detect parasite antigens or multi-copy genetic biomarkers have also been developed [49–51].

There are two point-of-care (POC) tests that have been approved by the U.S FDA for diagnosis of *T. vaginalis* among women, OSOM® Trichomonas Rapid Test (Genzyme Diagnostics; Cambridge, MA), an immunochromatographic capillary flow dipstick technology [52,53] and Affirm VP III (Becton, Dickinson & Co.; Franklin Lakes, NJ), a nucleic acid probe test that evaluates for *Trichomonas vaginalis*, *Gardnerella vaginalis* and *Candida albicans* [54]. Both tests are performed on vaginal secretions and have a sensitivity of more than 83% and a specificity of more than 97%. Results of the OSOM test are available in about 10 min, while results of the Affirm VP III test can be available within 45 min. Xpert® TV by Cepheid (Sunnyvale, CA) has not been FDA approved but holds promise in resource poor countries like Nigeria.

Using just only the wet preparation method may be partly responsible for the low prevalence rate (12.5%) reported in this present study due to its less sensitivity, when compared with other more sensitive methods such as the Giemsa stained microscopic examination and OSOM® Trichomonas Rapid Test used by Gala et al. [45]. who reported a prevalence rate of 40.4% and 57.6%, respectively among women who presented to Assiut Women's Health Hospital Outpatient Clinic in Egypt. It is therefore possible that more cases of trichomoniasis could have been diagnosed in this current study, if more sensitive methods than the wet preparation were employed. Hence, the possibility that the prevalence rate of trichomoniasis among female Babcock students may be higher than reported in this study exist and this would requires further investigations.

4. CONCLUSION

From the data obtained from this current study, it can be concluded that *Trichomonas vaginalis*

infection is present among the undergraduate female students of Babcock University, with a prevalent rate of 12.5% using the wet preparation method. Non-venereal modes of transmission of *Trichomonas vaginalis* infection exist in addition to sexual intercourse and must be considered. Females should therefore improve upon their personal hygiene, particularly in their use of toilet facilities. Advocacy for public health education within the University community and its environs in order to enlighten female students about the occurrence of *T. vaginalis* infection and its public health implication should commenced and be sustained. Participants that tested positive were advised to visit the hospital for proper treatment and management of the infection in order to halt the cycle of infection. Besides these, it is strongly advised that future Researchers should employ more sensitive methods other than the wet preparation method for the detection of trichomoniasis among female students population. We also recommend that future Researchers should screen for other STDs like candidiasis and bacterial vaginosis in the same setting.

CONSENT

All authors declare that 'written informed consent was obtained from the participants in the course of the conduct of this study.

ETHICAL APPROVAL

Ethical approval was obtained from the Babcock University Health Research Ethics Committee (BUHREC).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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