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Symptom-Based Management May Miss the Burden of *Trichomonas vaginalis* Infection: Maternal Care Practices among Healthcare Providers and Epidemiological Assessment of Pregnant Women Attending Antenatal Care at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Awka, Anambra State, Nigeria.

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Abstract

Trichomonas vaginalis infection is a common sexually transmitted infection with significant public health implications, yet it is often underdiagnosed. This cross-sectional study assessed maternal care practices among healthcare providers and undertake an epidemiological assessment of *T. vaginalis* infection among pregnant women attending antenatal care (ANC) at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH), Awka, Anambra State, Nigeria. The study included 14 ANC providers selected through total population sampling and 303 pregnant women systematically selected. In-depth Interview and Focused Group discussion were used to collect data from ANC providers, while Semi-structured questionnaire and microscopy of High vaginal swab specimens were used to collect data from the pregnant women. Texts, Crude Odd Ration (COR), Adjusted Odd Ration (AOR), Pearson 95% confidence

interval (CI), Chi-Square test, and Logistic regression were used in result presentation. All healthcare respondents (100%) reported that pregnant women receive STI education, including trichomoniasis, during ANC visits, while *T. vaginalis* screening was symptom-based. Most (85.71%) rarely encountered *T. vaginalis* among pregnant women, while 14.29% encountered it occasionally. Parasitological investigation revealed 4.95% prevalence of *T. vaginalis* infection, with higher prevalence ($p > 0.05$) among women aged 15–25 years (6.09%), married women (4.97%), housewives (7.69%), and urban residents (5.45%). Prevalence was highest ($p > 0.05$) among primigravidae (7.25%), primiparous women (3.68%), first-trimester pregnancies (5.88%), asymptomatic women (4.97%), those without a history of sexually transmitted infections (5.21%), condom users (11.11%), and women who practiced vaginal douching (20.10%). None of the socio-demographic and obstetric variables included in the multivariable model significantly predicted *T. vaginalis* infection, with adjusted odds ratios ranging from 0.13–21.42 and 0.20–8.48, respectively. In conclusion, absence of routine screening, moderate *T. vaginalis* prevalence, predominance of asymptomatic cases, and lack of significant risk factors or predictors highlight the need for improved diagnostic and management strategies in ANC.

Keywords: *Trichomonas vaginalis*, Pregnant women, Healthcare providers, Prevalence, risk factors, Management practices.

INTRODUCTION

Trichomonas vaginalis is an anaerobic, flagellated protozoan parasite that inhabits the urogenital tract and is responsible for trichomoniasis, the most prevalent curable non-viral sexually transmitted infection (STI) in the world. The World Health Organization (WHO) estimates 156 million new cases annually among individuals aged 15–49 years, highlighting the substantial and persistent global burden of the infection (WHO, 2024). Despite this scale, trichomoniasis consistently receives disproportionately less public health attention and research investment compared with other STIs such as HIV, chlamydia, and gonorrhoea (Van Der Pol, 2007; Elendu *et al*., 2024). This neglect has profound consequences; unlike most viral STIs, trichomoniasis is both curable and preventable, yet its burden endures largely because it remains systematically undiagnosed and underreported.

According to Kissinger *et al*. (2015), global prevalence of *T. vaginalis* infection ranges from 5% to 11% among women of reproductive age, with the highest burden concentrated in sub-Saharan Africa, Southeast Asia, and parts of Latin America. Within sub-Saharan Africa specifically, prevalence rates of 10%–30% have been documented among reproductive-age women, driven by structural health system inequalities, limited STI control programmes, and reliance on syndromic management that inadequately captures asymptomatic infection (Mabaso *et al*., 2019; WHO, 2024). In Nigeria, recent studies report moderate but clinically significant prevalence: Okunade *et al*. (2024) identified infection among ANC attendees in a Lagos multicenter study, while Afolabi *et al*. (2025) reported markedly higher detection rates in Ekiti State using molecular techniques, highlighting how conventional diagnostics substantially underestimate the true burden. Even more conservative estimates are of serious concern, given that *T. vaginalis* infection in some populations exceeds the combined prevalence of chlamydia and gonorrhoea (Van Gerwen *et al*., 2022).

T. vaginalis infects the vagina, urethra, and endocervix in women, and the urethra and

prostate in men. The organism adheres to epithelial cells, secretes cytotoxic proteins, and induces inflammatory responses that destroy host tissue, disrupt the vaginal microbiota, and establish biofilm-mediated colonisation (Sarkar *et al*., 2021). Classic clinical features include frothy yellow-green vaginal discharge, vulvar pruritus, dysuria, and dyspareunia, which occur in a minority of infected women. A substantial proportion, estimated at 70%–85% in some series, remain entirely asymptomatic (Kissinger, 2015; Fortas *et al*., 2024). This asymptomatic predominance is the infection's most epidemiologically consequential characteristic; infected women who are unaware of their status continue to transmit the parasite within their communities and are not captured by symptom-triggered diagnostic pathways.

The pathophysiology extends beyond local genital tract inflammation. *T. vaginalis* disrupts the normal Lactobacillus-dominant vaginal microbiome, reducing mucosal barrier integrity and directly increasing susceptibility to co-infecting pathogens, particularly HIV through enhanced genital shedding and inflammation-mediated HIV acquisition and transmission (Van Der Pol, 2007; Peters *et al*., 2021). Co-infection with bacterial vaginosis is particularly common: Enwuru *et al*. (2024) documented significant co-occurrence of both conditions among pregnant women in Lagos, compounding the adverse clinical profile of each individual infection. The incubation period of 4–28 days further enables asymptomatic carriers to serve as undetected reservoirs of sustained community transmission (Elendu *et al*., 2024).

Pregnant women represent a population of particular vulnerability. Hormonal changes during pregnancy, most pronounced in the first trimester, alter vaginal pH and immune regulation in ways that may favour *T. vaginalis* colonisation and growth (Sunmonu *et al*., 2025). The inflammatory cascade triggered by infection, characterised by elevated pro-inflammatory cytokines, uterine prostaglandin synthesis, and cervical matrix metalloproteinase activation mediates a mechanistic pathway to preterm labour and premature rupture of membranes (Tantengco & Menon, 2022; Gibbs & Fairfax, 2022). A systematic review and meta-analysis by Van Gerwen *et al*. (2021) confirmed that trichomoniasis is significantly associated with preterm birth and low birth weight across multiple populations. Additional adverse outcomes include postpartum endometritis, neonatal respiratory infection, and enhanced mother-to-child HIV transmission through increased genital HIV shedding (Peters *et al*., 2021).

Despite this catalogue of adverse pregnancy outcomes, routine antenatal screening for *T. vaginalis* remains absent from ANC protocols in most low- and middle-income countries (LMICs), including Nigeria (Zhang *et al*., 2022). Antenatal care clinics, which offer structured repeated contact with pregnant women, represent a uniquely powerful platform for STI detection and intervention. However, this opportunity is systematically missed for trichomoniasis. Where screening is performed, it is invariably triggered by symptom presentation rather than applied universally, leaving the asymptomatic majority who represent most infected women entirely undetected.

Also, there is limited studies on risk factor predictions for *T. vaginalis* infection; available ones yielded inconsistent findings across literature. For instance, younger age is frequently associated with higher prevalence, attributed to cervical ectopy, hormonal susceptibility, higher sexual activity, and lower STI awareness (Oyeyemi *et al*., 2016; Ndukwu & Ndu, 2024).

However, Okunade *et al*. (2024) found no statistically significant age effect in a multicenter Lagos study, suggesting that the relationship between age and infection risk may be confounded by other behavioural and biological factors. Socio-economic status, occupation, urban residence, and educational attainment have all been investigated, with similarly mixed results. Kissinger, 2015 and Torrone *et al*. (2018) independently concluded that formal education does not reliably protect against infection, as the pathway from knowledge acquisition to sustained behaviour change is complex and often incomplete. Critically, there are growing indications, supported by studies across Nigeria which reported that *T. vaginalis* infection distributes broadly across socio-demographic strata rather than concentrating within any single identifiable high-risk subgroup (Obetta *et al*., 2023; Okoroiwu *et al*., 2025).

Despite the significant burden of *T. vaginalis* infection, most available studies are geographically concentrated in Lagos, Port Harcourt, or Ekiti; and are focused on high-risk rather than general ANC populations, limiting their applicability to the broader pregnant population. There is a particularly acute gap in evidence on whether the infection clusters within identifiable socio-demographic or obstetric risk groups, or whether it distributes uniformly, a distinction with direct consequences for screening policy; targeted risk-based screening is cost-efficient only if meaningful risk differentials exist, whereas uniform distribution across epidemiological subgroups compels universal screening as the only defensible strategy.

Furthermore, the management practices of healthcare providers whose perceptions and clinical protocols are the frontline determinants of whether *T. vaginalis* is detected and treated have received limited systematic investigation in the Southeast Nigerian context.

This study was therefore conducted to assess maternal care practices among healthcare providers and undertake an epidemiological assessment of *Trichomonas vaginalis* infection among pregnant women attending antenatal care at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH), Awka, Anambra State, Nigeria.

Material and Method

Study Area

The study was carried out at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH), a tertiary healthcare institution situated along Km 4, Enugu-Onitsha Expressway, Amaku, Awka, and lies within Awka South Local Government Area Anambra State Nigeria. The geographical coordinates of COOUTH are approximately 6.2100° N latitude and 7.0700° E longitude. COOUTH serves as one of the major referral and teaching hospital in southeastern Nigeria, providing services to a wide catchment area that includes both urban and rural populations across Anambra State and beyond.

Study Design

This study adopted a cross-sectional design to assess maternal care practices by antenatal care (ANC) providers for the management of *T. vaginalis* infection, determined its prevalence, and identified the associated risk factors among the study participants. The study was conducted from September 2025 to January 2026. Data collection, including the administration of questionnaires, In-depth Interviews (IDIs), Focus Group Discussions (FGDs), and the collection of HVS samples, was carried out at COOUTH. The parasitological analysis of the collected HVS specimens was subsequently conducted at the Parasitology and Entomology Laboratory, Nnamdi Azikiwe University, Awka, Nigeria. The IDI,

FGD, questionnaire administration and High vaginal swab (HVS) sample collections were conducted twice a week as approved by the COOUTH antennal care unit head.

Study Population

The study population comprised two groups of participants. The first group consisted of antenatal care providers, including doctors, nurses, midwives, and laboratory scientists involved in the provision of antenatal care services during the study period.

The second group consisted of pregnant women, both married and single, aged 15 years and above, who attended antenatal care (ANC) clinics at COOUTH during the study period.

Sample Size Determination and Selection 0f Participants for the Study.

Considering the low number of the study population for determination of management practices, 14 Healthcare workers were selected using purposive sampling based on their role in ANC service delivery, screening and STI management experience.

The sample size for determination of prevalence, and risk factors of *T. vaginalis* infection among the pregnant women was calculated using the Taro Yamane formula ($n = N / [1 + N (e)^2]$ for prevalence studies. Where n is the required sample size, e is the margin or error set at 0.05, and N is the total number of pregnant women attending antenatal care at COOUTH within the 3-month prior to this study period, estimated at one thousand two hundred (1,200) participants. With that, a total of 303 the pregnant women were selected from ANC attendance lists using systematic sampling method. Every 4th eligible woman (based on attendance volume) was invited to participate until the required sample size was achieved.

Inclusion criteria

For the maternal care practices assessment, only ANC workers and laboratory scientists directly involved in ANC services who consented to participate in interviews or focus group discussions were included.

For the epidemiological assessment, only pregnant women aged ≥15 years who provided informed consent and were not receiving treatment for *T. vaginalis* or any STI were included.

Exclusion criteria

The study excluded pregnant women who did not provide informed consent or were receiving treatment for *T. vaginalis* or any STI.

Data Collection on Maternal Care Practices for *T. Vaginalis* Infection Among Healthcare Providers

The tools used were Focus Group Discussions (FGDs) and In-Depth Interview (IDI). Following the guide by Kitzinger (1995), the following providers' knowledge, attitudes, and experiences regarding *T. vaginalis* were explored: diagnostic practices for *T. vaginalis* by COOUTH Antenal clinic, treatment protocols towards patients that tested positive, partner notification practices (to ensure proper treatment and avoid reoccurrence) and barriers and challenges to effective management. Also, a checklist used to assess the availability of diagnostic equipment, STI treatment guidelines, and educational materials at the selected ANC clinics.

Data Collection for Epidemiological Assessment of *T. Vaginalis* Infection Among Pregnant Women

A semi-structured, pretested questionnaire was used to collect data for the assessment of prevalence and associated risk factors and for predictive modelling of the infection

among pregnant women. The questionnaire was developed to address specific research gaps identified in the literature and consisted of five sections: Section A, socio-demographic characteristics; Section B, maternal and obstetric characteristics; Section C, genitourinary factors; Section D, history and occurrence of sexually transmitted infections; and Section E, sexual behaviour and access to healthcare among the pregnant women. Each questionnaire was administered face-to-face during antenatal clinic visits. Data collection was conducted four times weekly: on Mondays, Tuesdays, Wednesdays, and Thursdays, which were designated antenatal clinic days, until the required number of participants had been recruited and interviewed.

Collection of High Vaginal Swab (HVS) Specimens from Pregnant Women

In this study, high vaginal swab (HVS) specimens were collected from pregnant women who had completed the questionnaire. Specimen collection was performed with the assistance of hospital laboratory scientists, following standard procedures described by Cheesbrough (2009). Briefly, each participant was positioned comfortably, after which a sterile speculum was inserted to visualize the vaginal walls and cervix. A sterile swab was then gently used to collect the specimen from the vaginal walls and cervix. The swab was subsequently placed in a sterile container and transported to the Parasitology and Entomology Laboratory, Nnamdi Azikiwe University, Awka, Nigeria, for parasitological examination and detection of *Trichomonas vaginalis*.

Laboratory Examination of HVS Specimens for *T. Vaginalis*

Wet-mount microscopy was used for *T. vaginalis* detection. Each collected HVS specimen was immediately emulsified in a test tube containing a few drops of sterile normal saline (0.9% sodium chloride). Following the procedure described by Cheesbrough (2009), a drop of the saline–specimen suspension was placed on a clean glass microscope slide, and a coverslip was gently applied, taking care to avoid the formation of air bubbles. The preparation was examined immediately under a light microscope using the 10× objective, followed by the 40× objective. *Trichomonas vaginalis* was identified by its characteristic pear-shaped morphology and active, jerky or twitching motility. Because motility is an important diagnostic feature and decreases rapidly after specimen collection, microscopic examination was performed within 10–15 minutes of specimen collection. The observation of characteristic motile *T. vaginalis* organisms was recorded as a positive result.

Ethical Considerations and Approval

A letter of introduction was received from the Head of Parasitology and Entomology Department, Nnamdi Azikiwe University AwkaNigeria. This alongside Letter of Attestation from the research Supervisor was presented to the Research Ethics Committee of Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Awka, Anambra State, after explaining the research objectives and aims. Thereafter, an Ethical Approval (Reference number: COOUTH/HREC/Vol.ii/FN:05/040) was received.

Advocacy Visits and Informed Consent

Prior to commencement of the study, advocacy visits were made to the Hospital Management Committee, Chief Medical Director, Matron, Head of the Laboratory Unit, and other relevant healthcare providers at COOUTH to obtain institutional permission and support for the study. On the day of data collection, verbal consent were obtained from each of the 303 pregnant

women and 14 healthcare workers recruited for the study after the research objectives had been clearly explained. The explanation covered the purpose, significance, and potential benefits of the study and was provided before questionnaire administration, interviews, and sample collection, as applicable. Participants were informed that their participation was entirely voluntary and that they had the right to decline participation or withdraw at any time without penalty. They were also assured that their privacy would be respected and that all information and data obtained would be treated with strict confidentiality throughout the study.

Data Summary and Statistical Analysis

Data obtained from the study were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize the prevalence of *Trichomonas vaginalis* infection and the socio-demographic and other study variables. Chi-square test was used to assess associations between potential risk factors and infection status. Multiple Binary logistic regression analysis was performed to assess the predictive value of the epidemiological variables for *T. vaginalis* infection, while controlling for some factors. Crude odds ratios (CORs) versus Adjusted odds ratios (AORs) where applicable, 95% confidence intervals (CIs), and corresponding ***p***-values were reported, as applicable. A p-value ≤ 0.05 was considered statistically significant. The predictive results were interpreted based on the statistical significance and estimated effect of the variables in the logistic regression model.

Qualitative data obtained through in-depth interviews (IDIs) and focus group discussions (FGDs) were transcribed verbatim and analyzed using thematic content analysis**.** NVivo software was used to organize, code, and facilitate the analysis of the interview and focus group transcripts.

Results

Healthcare Provider Characteristics And Maternal Care Practices for *T. Vaginalis* Infection Management

The 14 healthcare providers involved in the study comprised 5 (35.71%) males and 9 (64.29%) females. Regarding age distribution, 1 (7.14%) participant was aged 20–25 years, 2 (14.29%) were aged 26–30 years, 8 (57.14%) were aged 31–35 years, and 3 (21.43%) were aged 40 years and above. By professional category, 5 (35.71%) were doctors, while 9 (64.29%) were nurses/midwives. In terms of experience in antenatal care (ANC), 6 (42.86%) had 1–5 years of experience, while 8 (57.14%) had 6–10 years of experience.

Regarding infection control and management practices, all healthcare providers (100%) reported that, during ANC visits, pregnant women are educated about sexually transmitted infections (STIs). This was reflected in responses such as, *"during ANC visits, the pregnant women are educated about sexually transmitted infections,"* and *"we do mention Trichomonas vaginalis to them as one of the infections they are likely to contact,"* alongside other responses that addressed the research question.

In response to the question, *"How often is screening for T. vaginalis performed for pregnant women in your antenatal care unit?"*, all respondents (100%) reported that screening is performed only for pregnant women who complain of or present with symptoms suggestive of the infection, as exemplified by the response: *"Screening is performed only for patients who complain or present with some symptoms of the disease."*

Regarding the frequency with which healthcare providers encountered *T. vaginalis* infection among pregnant women, 2 (14.29%) reported encountering cases occasionally, whereas 12 (85.71%) reported encountering cases rarely.

Prevalence, Risk Factors and Prediction of *T. Vaginalis* Infection

The overall prevalence of *Trichomonas vaginalis* infection among the 303 pregnant women examined during the period of this research at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH) Awka was 4.95% (n = 15). The response rate varied according to the variables, because some participants did not provide responses to certain questions. Those were removed from prevalence calculation; also the total number of respondent for each question was stated. The univariable binary logistic regression analysis showed that none of the epidemiological variables examined significantly predicted the occurrence of the disease among the study participants. So, multiple logistic regression analysis was performed by inclusion of variables with more meaningful trend in the prevalence result; categories of such variables with no positive cases were excluded from the model.

Prevalence, risk factors and prediction of *Trichomonas vaginalis* infection-based socio-demographic characteristics of the pregnant women.

Table 1 below shows the influence of socio-demographic characteristics of the women examined, on the prevalence of *T. vaginalis* infection. Highest prevalence based on age (6.09 %), was observed among women '15–25' years, followed by those aged '26–35' years (4.83%) and 36–45 years (4.00%). No infection was detected among women above 45 years (0.00%). However, age was not significantly associated with *T. vaginalis* infection in the univariable analysis (p = 0.889). In the multivariable analysis, women aged 15–25 years had 1.63 times higher odds of infection than those aged 36–45 years (AOR = 1.63; 95% CI: 0.19–14.29), while those aged 26–35 years had 1.20 times higher odds (AOR = 1.20; 95% CI: 0.13–10.68), after adjustment for residence and occupation.

For Marital Status, Married women recorded a prevalence of 4.97%, while no infection was observed among single participants (0.00%). There was no statistically significant association between marital status and infection (p = 0.819).

In Educational Level, women with secondary education had the highest prevalence (5.22%), followed by those with primary education (4.08%). No infection was found among women with no formal education or tertiary education (0.00%). Educational level was not significantly associated with infection (p = 0.955). However, Women with secondary education were 1.29 times more likely to be infected than those with primary education (95% CI: 0.28–5.93).

Housewives had the highest prevalence of *T. vaginalis* infection (7.69%), followed by self-employed women (5.30%) and civil servants (4.55%), while no infection was recorded among teachers (0.00%). The association between occupation and infection was not statistically significant by Chi-square test (p = 0.773). In the multivariable analysis, after adjustment for age and residence, housewives had 1.97 times higher odds of infection than civil servants (AOR = 1.97; 95% CI: 0.37–10.61), while self-employed women had 1.43 times higher odds (AOR = 1.43; 95% CI: 0.45–4.59).

Regarding residence, participants living in urban areas had a higher prevalence of *T. vaginalis* infection (5.45%) than those in rural areas (2.17%). The association between residence and infection was not statistically significant by Chi-square test (p = 0.346). Similarly, after adjustment for age and occupation in the multivariable logistic regression analysis, urban residents had 2.68 times higher odds of infection than rural residents; however, this association was not statistically significant (AOR = 2.68; 95% CI: 0.34–21.42).

Religion showed no statistically significant association with infection (p = 0.876). The prevalence among Christians was 5.03%, while no infection was recorded among Islamic or atheist participants (0.00%).

Table 1: Prevalence, risk factors and prediction of *Trichomonas vaginalis* infection based on socio-demographic characteristics of the pregnant women.

Variable	Category	Number examined	Number positive	Prevalence (%)	*P value*	COR (95% CI)	AOR (95% CI)
Overall	-	303	15	4.95%	-	NA	
Age (years) (n = 291)	15 – 25	115	7	6.09%	*.889*	1.56 (0.18, 13.24)	1.63 (0.19, 14.29)
	26 – 35	145	7	4.83%		1.28 (0.44, 3.75)	1.20 (0.13, 10.68)
	36 – 45	25	1	4.00%		Ref	Ref
	Above 45	6	0	0.00%		-	-
Marital status (n = 303)	Single	1	0	0.00%	*.819*	NA	
	Married	302	15	4.97%			
Educational Level (n = 302)	No formal education	2	0	0.00%	*.955*	-	
	Primary	49	2	4.08%		Ref.	
	Secondary	249	13	5.22%		1.29 (0.28, 5.93)	
	Tertiary	2	0	0.00%		-	
Occupation (n = 302)	Civil servants	132	6	4.55%	*.773*	Ref	Ref
	Teacher	12	0	0.00%		-	-
	Self employed	132	7	5.30%		1.49 (0.29, 7.60)	1.43 (0.45, 4.59)
	House wife	26	2	7.69%		1.75 (0.33, 9.19)	1.97 (0.37, 10.61)
Residence (n = 303)	Urban	257	14	5.45%	*.346*	2.59 (0.33, 20.21)	2.68 (0.34, 21.42)
	Rural	46	1	2.17%		Ref	Ref
Religion (n = 303)	Christianity	298	15	5.03%	*.876*	NA	
	Islamic	2	0	0.00%			
	Aetheist	3	0	0.00%			

COR = Crude Odd Ration, AOR = Adjusted Odd Ratio, NA = Not applicable, CI = Confidence Interval, Ref = reference / base category

Prevalence, Risk Factors, and Prediction of *Trichomonas Vaginalis* Infection Based on Maternal Obstetric Characteristics

Table 2 represents record of the research carried out on the obstetric variables, women with gravidity 1 had the highest prevalence (7.25%), followed by gravidity 2 (3.82%), while no infection was recorded among gravidity 3. Gravidity was not significantly associated with *T. vaginalis* infection in the chi-square analysis (p = 0.170). However, after controlling for

gestational age, primigravid women had 1.91 times higher odds of *T. vaginalis* infection than secungravid women (AOR = 1.91; 95% CI: 0.63–5.81). Parity also showed no statistically significant association with infection (p = 0.577). Women with parity 1 recorded a prevalence of 3.68%, whereas no infection was observed among parity 2 and 3.

For gestational age, the highest prevalence was observed among women in the first trimester (5.88%), followed by third trimester (4.05%) and second trimester (3.57%). Gestational age was not significantly associated with *T. vaginalis* infection in the chi-square analysis (p = 0.719). However, after controlling for gravidity, women in their first trimester had 1.78 times higher odds of infection than those in their second trimester (AOR = 1.78; 95% CI: 0.38–8.44), while women in their third trimester had 1.27 times higher odds of infection than those in their second trimester (AOR = 1.27; 95% CI: 0.20–7.94).

Table 2: Prevalence, risk factors and prediction of *Trichomonas vaginalis* infection based on maternal obstetric characteristics

Variable	Category	Number examined	Number positive	Prevalence (%)	*P value*	COR (95% CI)	AOR (95% CI)
Gravidity (n = 301)	Primigravidae	138	10	7.25%	*.170*	1.97 (0.65, 5.92)	1.91 (0.63, 5.81)
	Secungravidae	131	5	3.82%		Ref	Ref
	Multigravidae (> 2)	32	0	0.00%		-	-
Parity (n = 165)	Primiparous	136	5	3.68%			
	Secundiparous	27	0	0.00%	*.577*	NA	NA
	Multiparous (> 2)	2	0	0.00%			
Gestational age (n = 300)	First trimester	170	10	5.88%		1.69 (0.36, 7.94)	1.78 (0.38, 8.44)
	Second trimester	56	2	3.57%	.719	Ref	Ref
	Third trimester	74	3	4.05%		1.48 (0.40, 5.54)	1.27 (0.20, 7.94)

COR = Crude Odd Ration, AOR = Adjusted Odd Ratio, NA = Not applicable, CI = Confidence Interval, Ref = reference / base category

Prevalence, Risk Factors, and Prediction of *Trichomonas Vaginalis* Infection Based On Genitourinary Factors

In Table 3, Participants who reported recent vaginal discharge had a slightly lower prevalence of 4.92%, lower than those who did not report discharge (4.97%), and this was not statistically significant (p = 0.983), with an odd ratio of 1.01 (95 % CI = 0.35, 2.92). Those who reported watery discharge had the highest prevalence (5.08%), while no infection was observed among those with foul-smelling or frothy discharge (p = 0.852).

None of the participants who reported vaginal itching, dysuria, or dyspareunia tested positive for *Trichomonas vaginalis* infection. Interestingly, infection was detected only among participants who reported no symptoms, indicating that many infections may be asymptomatic. However, these associations were not statistically significant (p > 0.05).

Table 3: Prevalence, risk factors and prediction of *Trichomonas vaginalis* infection based on genitourinary factors

Variable	Category	Number examined	Number positive	Prevalence (%)	P value	COR (95% CI)
Have you noticed any vaginal discharge recently? (n = 281)	Yes	122	6	4.92%	.983	Ref
	No	181	9	4.97%		1.01 (0.35, 2.92)
If yes, what is the nature of the discharge? (n = 65)	Watery	59	3	5.08%	.852	
	Foul smell	3	0	0.00%		NA
	Frothy	3	0	0.00%		
Do you experience vaginal itching or discomfort? (n = 303)	Yes	13	0	0.00%	.400	NA
	No	290	15	5.17%		
Do you experience pain during urination (dysuria)? (n = 303)	Yes	2	0	0.00%	.746	NA
	No	301	15	4.98%		
Do you experience pain during sex (dyspareunia)? (n = 303)	Yes	1	0	0.00%	.819	NA
	No	301	15	4.98%		

Prevalence, Risk Factors and Prediction of *Trichomonas Vaginalis* Infection Based on Occurrence of Sexually Transmitted Infections

In Table 4, no participant reported previous testing or diagnosis of *T. vaginalis* infection, and no significant association was found between prior STI history and current infection. Regarding HIV status, no infection was detected among HIV-positive participants, while HIV-negative participants had a prevalence of 5.07 %; this association was also not statistically significant (p = 0.744).

Table 4: Prevalence, risk factors and prediction of *Trichomonas vaginalis* infection based on occurrence of sexually transmitted infections

Variable	Category	Number examined	Number positive	Prevalence (%)	P value	COR (95% CI)
Have you been tested for T. vaginalis during this pregnancy? (n = 11)	Yes	0	0	NA	-	NA
	No	11	0	0.00		
Have you ever been diagnosed with STI? (n = 288)	Yes	0	0	0.00	-	NA
	No	288	15	5.21		
Were you diagnosed with T. vaginalis or another STI before this pregnancy? (n = 288)	Yes	0	0	NA	-	NA
	No	288	15	5.21		
What is your HIV status? (n = 98)	Positive	2	0	0.00	.744	NA
	Negative	296	15	5.07		

Prevalence, Risk Factors and Prediction of *Trichomonas Vaginalis* Infection Based on Sexual Behaviour and Health Care Access

Participants who were not receiving treatment for any sexually transmitted infection had a prevalence of 5.21%, while no infection was recorded among those receiving treatment. Access to healthcare services showed similar prevalence between those with very good access (5.00%) and good access (4.93%), with no statistically significant association (p = 0.981). Participants who reported financial difficulty accessing healthcare had a slightly higher prevalence (6.78%) compared to those without financial challenges (4.51%), although this was not statistically significant (p = 0.470). Notably, women who practiced vaginal douching recorded a much higher prevalence (20.00%) compared to those who did not (4.58%), though the association was not statistically significant (p = 0.111), likely due to the small sample size. Similarly, participants who reported condom use had a higher prevalence (11.11%) compared to non-users (4.76%), but this difference was not statistically significant (p = 0.387). All participants reported having only one sexual partner, with an overall prevalence of 4.95%. Overall, although some variations were observed, none of the health care access factors showed a statistically significant association with *Trichomonas vaginalis* infection (p > 0.05).

Table 5: Prevalence, risk factors and prediction of *Trichomonas vaginalis* infection based on sexual behaviour and health care access

Variable	Category	Number examined	Number positive	Prevalence (%)	P VALUE
Are you currently receiving treatment for any sexually transmitted infections (e.g., Chlamydia, Gonorrhea)? (n = 288)	Yes	0	0	Not applicable	-
	No	288	15	5.21	
How would you describe your access to health care services? (n = 303)	Very good	80	4	5.00	.981
	Good	223	11	4.93	
Do you face financial difficulties in accessing healthcare or medication? (n = 303)	Yes	59	4	6.78	.470
	No	244	11	4.51	
Do you practice vaginal douching (washing inside the vagina) (n = 289)	Yes	5	1	20.00	.111
	No	284	13	4.58	
How often do you or your partner(s) use condoms during sexual intercourse? (n = 303)	Yes	9	1	11.11	.387
	No	294	14	4.76	
How many sexual partners have you had in the past 12 month? (n = 303)	One partner	303	15	4.95%	-

Discussion

From this study, the characteristics and maternal care practices of healthcare providers regarding *T. vaginalis* infection revealed that nurses and midwives constituted the majority of respondents, whereas doctors accounted for a smaller proportion. Most of the healthcare providers were within the age range of 30–35 years and had between 6–10 years of antenatal care experience, indicating a relatively experienced workforce in maternal healthcare delivery. This is comparable to

findings from a study conducted by Adekanle *et al.,* (2010) in Southwestern Nigeria, where nurses and midwives formed the largest proportion of healthcare personnel involved in antenatal care services due to their direct and continuous contact with pregnant women. The predominance of female healthcare workers observed in this present study is also consistent with reports from Nigerian maternal health facilities, where nursing and midwifery services are female-dominated professions (Fagbamigbe and Idemudia, 2015). All healthcare providers reported educating pregnant women on sexually transmitted infections, including *Trichomonas vaginalis*, during antenatal visits. Similar findings were reported by Ojong *et al.,* (2015), who observed that health education on sexually transmitted infections formed a routine component of antenatal care services in Nigerian health facilities. However, diagnosis and treatment were usually carried out only when pregnant women reported symptoms. Such practice has also been documented in Nigerian studies where STI screening during antenatal care is often symptom-driven due to limited laboratory resources and absence of routine screening policies (Uneke *et al.,* 2007). The majority of healthcare providers reported that they rarely encounter *T. vaginalis* infection in pregnant women, while only a few encountered it occasionally, this perception may be due to inadequate routine testing. Similar observations were made by Oyeyemi *et al*., (2016), who noted that asymptomatic trichomoniasis is frequently overlooked in antenatal settings where routine laboratory screening is not practiced.

The overall prevalence of 4.95% observed in this study indicates a moderate burden of infection among the study population. This level of prevalence recorded is of very serious public health concern, as *T. vaginalis* infection is often overlooked in discussions of sexually transmitted infections (STIs), leading to the misconception that it is a rare infection. This finding is consistent with a multicenter study conducted by (Okunade *et al*., 2024) among pregnant women in Lagos state Nigeria. Interestingly, the prevalence of *T. vaginalis* infection in this current research showed no statistically significant association with the socio-demographic variables studied, suggesting that *T. vaginalis* infection is evenly distributed across different demographic groups and that individuals from all social classes are equally susceptible to the infection.

Nevertheless, the highest prevalence was observed among women aged 15–25 years, which aligns with findings from Ndukwu and Ndu, (2024) who reported higher infection rates among younger women due to increased sexual activity and biological susceptibility. Focusing on age as a potential predictive of risk factor for *Trichomonas vaginalis* infection among women attending antenatal care, this study found that women aged 15–25 years were 1.56 times more likely to be infected, while those aged 26–35 years were 1.28 times more likely compared to women aged 36–45 years. Although the association between age and *T. vaginalis* infection was not statistically significant, the observed trend persisted after adjusting for residence and occupation, suggesting that younger women aged 15–25 years had 1.63 times higher odds of infection than those aged 26–35 years (AOR = 1.63; 95% CI: 0.19–14.29). This pattern is consistent with findings from previous studies in Nigeria and other sub-Saharan African settings, where younger reproductive-aged women have been reported to exhibit higher prevalence of trichomoniasis (Oyeyemi *et al*., 2015). Similar to this study, Okunade *et al*., (2024) report on the Lagos multicenter study found that age was not a statistically

significant predictor. The increased likelihood of infection in younger women has been attributed to factors such as higher sexual activity, cervical ectopy, hormonal influences, and lower levels of awareness regarding sexually transmitted infections. These factors collectively increase exposure risk and biological susceptibility, making younger age groups an important population in the epidemiology of *T. vaginalis*. This suggests that while younger women may show higher prevalence, age alone may not independently determine infection risk.

Marital status showed a higher prevalence of 4.7% among married women, although not statistically significant. This finding agrees with recent evidence by (Kamalu *et al*., 2025) indicating that marital status is not a strong independent predictor of infection, even though married women may have increased exposure through regular sexual activity.

Women with secondary education were 1.29 times more likely to be infected with *Trichomonas vaginalis* compared to those with primary education. This suggests that a higher level of formal education did not necessarily confer protection against infection in this study population. Kissinger (2015) noted in her work that socio-demographic factors such as education often show inconsistent relationships with trichomoniasis, as infection risk is more strongly influenced by behavioral and biological factors than by formal schooling alone. Likewise, a study by Torrone *et al.* (2018) reported that *Trichomonas vaginalis* infection occurs across different educational groups, suggesting that higher levels of formal education, do not consistently confer protection against the infection. The lack of a significant association in this study reinforces the idea that education alone is not a reliable predictor of infection, highlighting the need for comprehensive sexual health education and routine screening for all pregnant women regardless of their educational background.

With respect to occupation, housewives recorded the highest prevalence of *T. vaginalis* infection. In the crude analysis, housewives had 1.75 times higher odds of infection than civil servants, while self-employed women had 1.49 times higher odds; however, neither association was statistically significant. After adjusting for age and residence, the odds ratio increased slightly to 1.97 for housewives but decreased to 1.43 for self-employed women, suggesting that the observed differences were not entirely explained by age and residence. Nevertheless, the wide confidence intervals indicate considerable uncertainty around these estimates, and the apparent differences by occupation should therefore be interpreted cautiously. Occupation may indirectly influence infection risk through differences in social interaction, sexual behaviour, or access to health information and services; however, these pathways were not directly assessed in the present study and therefore cannot be confirmed. This finding is consistent with Enwuru *et al.* (2024), who reported that occupation was not a strong predictor of *T. vaginalis* infection. Larger studies incorporating detailed assessment of sexual behaviour, healthcare access, and occupational characteristics may help clarify whether occupation independently influences the risk of *T. vaginalis* infection.

In terms of residence, participants residing in urban areas had a higher prevalence of *T. vaginalis* infection (5.45%) than those residing in rural areas (2.17%) and had 2.59 times higher odds of infection. After adjusting for age and occupation, the odds ratio increased slightly to 2.68, suggesting that these factors did not substantially

account for the observed difference between urban and rural residents. However, the wide confidence interval (0.34–21.42) indicates considerable uncertainty around the estimate, and the absence of statistical significance limits the inference that urban residence independently increases the risk of infection. The higher prevalence observed in urban residents contrasts with reports of greater STI burden in rural settings, where limited access to healthcare and sexual health services may increase vulnerability. Conversely, the present pattern is consistent with evidence that urban environments may facilitate STI transmission through higher population density, greater social interaction, and more interconnected sexual networks (WHO, 2021; Centers for Disease Control and Prevention, 2022). Similarly, Ndukwu and Ndu (2024) suggested that increased population density and social interaction in urban settings may contribute to greater exposure to sexually transmitted infections. Thus, while the higher prevalence and odds observed among urban residents may indicate a possible contextual influence of residence on *T. vaginalis* transmission, the non-significant adjusted association and wide confidence interval warrant cautious interpretation. Religion, on the other hand, showed no apparent association with *T. vaginalis* infection, suggesting that religious affiliation did not meaningfully differentiate infection occurrence in this study.

Primigravid women in this study had 1.97 times higher odds of *T. vaginalis* infection than secundigravid women, although the association was not statistically significant. After adjusting for gestational age, the odds ratio was only slightly reduced to 1.91, suggesting that the observed difference by gravidity was not substantially explained by gestational age. Although the lack of statistical significance precludes concluding that primigravidity independently increases the risk of infection, the consistent direction of the association may indicate a possible vulnerability among first-time pregnant women. This pattern could reflect differences in prior exposure to antenatal health education, awareness of sexually transmitted infections, or familiarity with preventive maternal health practices. It may also be influenced by differences in healthcare-seeking behaviour or timing of first antenatal attendance, through which previously acquired asymptomatic infections may be detected among women with limited prior experience of antenatal care. The finding is comparable with that of Okonko *et al.* (2010), who reported a higher prevalence of *T. vaginalis* among primigravidae than multigravidae and attributed the pattern to poor awareness and limited health-seeking behaviour among first-time mothers. Similarly, Uneke *et al.* (2007) reported increased susceptibility to reproductive tract infections among primigravidae, suggesting that limited experience with antenatal care may contribute to higher infection rates. Conversely, Adamu *et al.* (2018) found no significant association between gravidity and *T. vaginalis* infection, although prevalence was also higher among primigravidae. Taken together, the consistency in the direction of the observed association across some Nigerian studies, despite the absence of statistical significance in the present study, suggests that primigravidity may warrant further investigation as a potential marker of vulnerability rather than being considered an established independent risk factor.

Parity analysis showed infection only among women with parity one, which aligns with some recent findings but remains statistically insignificant. Research from Ndukwu and Ndu, (2024) suggests that parity may not independently influence

infection risk, as also observed in contemporary Nigerian studies.

Gestational age showed a pattern of higher *T. vaginalis* prevalence during early pregnancy, with the highest prevalence observed among women in the first trimester. In the crude analysis, women in the first trimester had 1.69 times higher odds of infection than those in the third trimester, while those in the second trimester had 1.48 times higher odds. After controlling for gravidity, these estimates were 1.78 and 1.27, respectively, indicating that the higher odds observed in early pregnancy were not substantially explained by differences in gravidity. Although neither association was statistically significant, the consistent pattern of higher odds during the earlier stages of pregnancy may indicate a possible concentration of infection among women presenting early in gestation. This could reflect pre-existing infections acquired before pregnancy that remain undetected until antenatal care is initiated, particularly where screening is predominantly symptom-based. It may also reflect differences in healthcare-seeking and timing of antenatal care attendance across gestational periods rather than an increased biological susceptibility associated with early pregnancy. The observed pattern is nevertheless consistent with Oyeyemi *et al.* (2016), who reported a significantly higher prevalence of trichomoniasis among women in the first trimester compared with those in later trimesters. Similarly, Okoroiwu *et al.* (2025) reported the highest prevalence of *T. vaginalis* infection among women in the first trimester. Taken together, these findings suggest that early pregnancy may represent an important period for identifying undiagnosed *T. vaginalis* infection, although the lack of statistical significance in the present study warrants cautious interpretation and further investigation in larger studies.

This findings revealed that genitourinary symptoms were not significantly associated with *T. vaginalis* infection. Participants who reported vaginal discharge had a prevalence similar to those without discharge. This finding is consistent with recent studies by Enwuru *et al*., (2024) indicating that vaginal discharge is a non-specific symptom and cannot reliably diagnose *T. vaginalis* infection. Participants who reported recent vaginal discharge had a prevalence, which was slightly lower than the prevalence among those who did not report vaginal discharge. The odds ratio of 1.01:1 indicates equal risk of infection between participants without vaginal discharge and those with discharge. Although frothy discharge is classically associated with trichomoniasis, its absence among positive cases in this study may be due to the small sample size and variability in symptom presentation. It also indicates that symptom-based diagnosis alone is not a reliable yardstick for determining whether an individual is infected.

Conclusion

This study identified gaps in maternal care practices, particularly the reliance on symptom-based screening. The study also revealed that *T. vaginalis* infection remains a significant public health concern among women attending antenatal care at COOUTH, Awka, with an overall prevalence of 4.95%. However, none of the assessed socio-demographic, obstetric, genitourinary, or healthcare access-related factors showed a statistically significant association with *T. vaginalis* infection, and none of the selected epidemiological variables included in the multivariable binary logistic regression model significantly predicted infection. This

suggests that, within the population and conditions of this study, the examined epidemiological variables were insufficient to reliably predict *T. vaginalis* infection or identify women at increased risk. However, this does not establish that these factors are unrelated to infection, as notable trends were observed among younger women, housewives, urban residents, primigravidae, and women in their first trimester.

Importantly, the presence of infection among asymptomatic women highlights the limitation of symptom-based diagnosis and the hidden burden of infection in antenatal populations. The occurrence of infection across different socio-demographic, obstetric, genitourinary, sexual behaviour, and healthcare access groups further suggests that *T. vaginalis* infection can occur among pregnant women irrespective of these characteristics and that reliance on such characteristics alone may be inadequate for identifying infected women. This underscores the need for continued clinical assessment and appropriate diagnostic testing rather than reliance solely on epidemiological characteristics for identifying individuals at risk.

This study therefore underscores the urgent need for routine laboratory screening during antenatal care, improved reproductive health education, and strengthened maternal healthcare services. By promoting early detection, appropriate treatment, and preventive maternal care practices, the burden of trichomoniasis and its associated pregnancy complications can be significantly reduced, ultimately contributing to better maternal and neonatal health outcomes.

Conflict of Interest

The authors declare no competing interest.

Authors Contributions

PO – Conceptualism, Writing original draft, writing final draft, Resources and Field data collection; CO – Writing review, Resources and Final editing; FG - Field data collection and Laboratory investigations; JO - Field data collection and Laboratory investigations; NA – Writing review; BC - Field data collection and Laboratory investigations; BS - Writing review and Resources; EG - Field data collection and Laboratory investigations; CM – Conceptualisation, data analysis, Final editing and Supervision

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