

Sociodemographic and Behavioural Correlates of Bacterial Vaginosis and *Trichomonas Vaginalis* Co-Infection at Enrolment among Pregnant Women in Edo State, Nigeria

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Abstract

Bacterial vaginosis (BV) and *Trichomonas vaginalis* (TV) are common vaginal infections during pregnancy and have been associated with adverse maternal and neonatal outcomes. Although several sociodemographic and behavioural factors have been implicated in their occurrence, evidence on factors associated with BV and TV co-infection among pregnant women remains limited in Nigeria. This study assessed the sociodemographic and behavioural correlates of bacterial vaginosis and *Trichomonas vaginalis* co-infection at enrolment among pregnant women attending antenatal care. A cross-sectional study was conducted among 216 pregnant women attending antenatal booking clinics at Irrua Specialist Teaching Hospital. Participants between 14- and 26-weeks' gestation were recruited consecutively. Sociodemographic and behavioural data were collected using a structured interviewer-administered questionnaire. Two high vaginal swabs were obtained from each participant. Bacterial vaginosis was diagnosed using Amsel's criteria, while *Trichomonas vaginalis* infection was identified by saline wet mount microscopy. Data were analysed using SPSS version 26. Associations between participant characteristics and diagnosis were assessed using the chi-square test, independent *t*-test, and one-way ANOVA, with statistical significance set at $p < 0.05$. The mean age of participants was 28.39 ± 4.93 years. Candidiasis was the most common diagnosis, occurring in 99 (45.8%) participants, followed by bacterial vaginosis in 66 (30.6%), candidiasis with *Trichomonas vaginalis* co-infection in 37 (17.1%), no infection in 11 (5.1%), and candidiasis with bacterial vaginosis co-infection in 3 (1.4%). Vaginal douching was reported by 89 (41.2%) participants, inappropriate antibiotic use by 106 (49.1%), and antiseptic vaginal wash use by 70 (32.4%). There were no statistically significant associations between diagnosis and age group ($p = 0.215$), parity ($p = 0.275$), high-risk partner status ($p = 0.495$), previous pelvic inflammatory disease ($p = 0.101$), or

other behavioural characteristics examined. Bacterial vaginosis and *Trichomonas vaginalis*-related infections remain common among pregnant women at antenatal enrolment. These findings suggest that reliance on risk-based screening alone may miss infected women and support consideration of routine microbiological screening during antenatal care.

Keywords: Bacterial Vaginosis, Trichomonas Vaginalis, Pregnancy, Co-Infection, Antenatal Care, Nigeria.

Introduction

Bacterial vaginosis (BV) and *Trichomonas vaginalis* (TV) infection are among the most common causes of vaginal infections in women of reproductive age, particularly during pregnancy (Rezk and Alqabbasi, 2023; Abdul-Aziz et al., 2019). Bacterial vaginosis results from a disruption of the normal vaginal microbiota, characterized by depletion of protective lactobacilli and overgrowth of anaerobic bacteria, while *T. vaginalis* is a sexually transmitted protozoan parasite that causes inflammation of the genital tract (Carlson et al., 2025; Mabaso & Abbai, 2021). Because both conditions alter the vaginal environment and share several risk factors, co-infection is relatively common and may increase susceptibility to adverse reproductive outcomes (Fichorova et al., 2013; Seybold et al., 2025).

Globally, BV affects an estimated 20–50% of women of reproductive age, while *T. vaginalis* remains the most prevalent non-viral sexually transmitted infection, accounting for over 150 million new infections annually (Kenyon et al., 2013; Ndiaye et al., 2023; Van Gerwen et al., 2023). The burden of both infections is disproportionately high in low- and middle-income countries, particularly in sub-Saharan Africa, where limited access to reproductive healthcare, delayed diagnosis, and untreated sexually transmitted infections contribute to their persistence (Shareif, 2017; Torrone et al., 2018).

Statement of the Problem

Pregnancy is associated with hormonal and immunological changes that increase vulnerability to vaginal infections (Duarte et al., 2024). Both BV and TV have been linked to adverse maternal and neonatal outcomes, including premature rupture of membranes, preterm labour, low birth weight, postpartum endometritis, and increased susceptibility to human immunodeficiency virus (HIV) infection (Ng et al., 2023). Co-infection may further worsen these outcomes because of enhanced genital tract inflammation and greater disruption of the normal vaginal microbiome (Juliana et al., 2020).

Previous studies have identified several sociodemographic and behavioural factors associated with BV and TV infection, including younger maternal age, lower educational attainment, low socioeconomic status, multiple sexual partners, poor genital hygiene practices, vaginal douching, previous sexually transmitted infections, and inadequate antenatal care attendance (da Silva Pinto et al., 2023; Akubuo et al., 2025). However, most studies have examined these infections independently, with limited evidence on the factors associated with BV and TV co-infection among pregnant women, especially in Nigeria.

Specific Objectives.

This study aimed to assess-

1. The association of sociodemographic characteristics of pregnant women at enrolment for antenatal care with bacterial vaginosis and *Trichomonas vaginalis* co-infection
2. The behavioural correlates of bacterial vaginosis and *Trichomonas vaginalis* co-infection at enrolment among pregnant women.

Hypotheses

The study hypotheses include-

Null hypotheses

H₀: There is no relationship between social demographic characteristics, and bacterial vaginosis and *Trichomonas vaginalis* co-infection at enrolment among pregnant women.

H₀: There is no relationship between behavioural correlates and bacterial vaginosis and *Trichomonas vaginalis* co-infection at enrolment among pregnant women.

Alternate hypotheses

H₁: There is relationship between social demographic characteristics, and bacterial vaginosis and *Trichomonas vaginalis* co-infection at enrolment among pregnant women.

H₁: There is relationship between behavioural correlates and bacterial vaginosis and *Trichomonas vaginalis* co-infection at enrolment among pregnant women.

The identification of pregnant women at increased risk of co-infection will provide evidence to guide targeted screening, early diagnosis, and appropriate management during antenatal care, thereby contributing to improved maternal and perinatal health outcomes.

Methodology

Study Design and Setting

Analytical cross-sectional study was conducted over six months at the antenatal clinic, antenatal ward, and Medical Microbiology and Parasitology Laboratory of Irrua Specialist Teaching Hospital (ISTH), Irrua, Edo State, Nigeria. ISTH is a tertiary referral centre serving Edo State and neighbouring states in the South-South region of Nigeria, with approximately 1,600 deliveries and 100 new antenatal bookings monthly.

Study Population

The study included pregnant women attending the booking and antenatal clinics of ISTH between 14- and 26-weeks' gestation. This gestational age range was selected to minimise the influence of first-trimester pregnancy losses and early reinfection following treatment.

Selection Criteria

Inclusion criteria

Women with singleton pregnancies and gestational ages confirmed by a reliable last menstrual period or ultrasonography performed before 20 weeks were eligible for inclusion.

Exclusion criteria

Women in the first trimester, those with multiple gestations, gross foetal anomalies, polyhydramnios, diabetes mellitus, chronic renal disease, or human immunodeficiency virus (HIV) infection were excluded.

Sample Size Determination

The minimum sample size was calculated using the Cochran formula for descriptive cross-sectional studies (Cochran, 1977)-

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

Where,

n = minimum sample size

z = standard normal deviation usually set at 1.96 for 95% confidence interval

p = proportion of sample with characteristic of interest

d = margin of error set at 5%.

P = 0.15 (prevalence of *Trichomonas vaginalis*) from Vallely et al., 2018

Substituting these values into the formula yielded a minimum sample size of 195.9; approximated to 196 participants. After applying a 10% non-response rate adjustment, the final calculated sample size was 216 participants, all of whom were recruited and enrolled in this study.

Sampling Technique

Eligible women who provided written informed consent were recruited consecutively and stratified into groups based on the presence or absence of vaginal discharge until the target sample size was achieved.

Data Collection

Data were collected using a structured interviewer-administered questionnaire covering sociodemographic characteristics, behavioural risk factors, pregnancy history, and vaginal discharge characteristics. Information obtained included age, parity, body mass index, marital status, educational level, occupation, last menstrual period, and features of vaginal discharge. Data were verified using antenatal records where necessary.

Clinical Sample Collection and Laboratory Diagnosis

Two high vaginal swabs were collected aseptically from each participant using a sterile Cusco's speculum and processed within one hour. One swab was used for culture and potassium hydroxide testing, while the other was used for Gram staining and saline wet mount microscopy.

Bacterial vaginosis was diagnosed using Amsel's criteria, requiring at least three of four diagnostic features, while *Trichomonas vaginalis* infection was diagnosed by identifying motile flagellated protozoa on saline wet mount microscopy.

Outcome Measures

The primary outcome was the presence of bacterial vaginosis, *Trichomonas vaginalis* infection, or co-infection at enrolment. The mean parity score was assessed which refers to the actual number of pregnancies that got to term (at least 36 weeks of gestation).

Data Analysis

Data were analysed using SPSS version 26. Continuous variables were summarized using means and standard deviations, while categorical variables were presented as frequencies and percentages. Associations were assessed using the chi-square test, independent *t*-test, or one-way ANOVA as appropriate. Variables with significant association were entered into multivariable logistic regression to identify independent correlates of co-infection. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of Irrua Specialist Teaching Hospital with reference number ISTH/HREC/20201112/149. Written informed consent was obtained from all participants, and confidentiality was maintained throughout the study. Participation was voluntary, and participants could withdraw at any time without affecting their care.

Results

Sociodemographic Characteristics of Participants (Table 1)

A total of 216 pregnant women were enrolled between 14 and 26 weeks of gestation. The mean age was 28.39 ± 4.93 years. Over one-third, 80 (37.0%), were aged 25–29 years, while 53 (24.5%) each were aged 20–24 and 30–34 years. Participants aged 35 years and above accounted for 30 (13.9%). Most participants were married, 170 (78.7%), and almost half, 97 (44.9%), had attained tertiary education. Secondary education was reported by 67 (31.0%), primary education by 35 (16.2%), and no formal education by 17 (7.9%).

Tribal Distribution of Participants (Figure 1)

The predominant ethnic group was Esan, comprising 116 (53.7%) participants. This was followed by Etsako, 40 (18.5%), Bini, 27 (12.5%), Yoruba and other ethnic groups, 12 (5.6%) each, while Igbo participants accounted for 9 (4.2%).

Distribution of Diagnoses at Enrolment (Figure 2)

Candidiasis was the most frequently diagnosed vaginal infection, affecting 99 (45.8%) participants. Bacterial vaginosis was diagnosed in 66 (30.6%), while candidiasis with *Trichomonas vaginalis* co-infection occurred in 37 (17.1%). Eleven (5.1%) participants had no identifiable infection, whereas candidiasis with bacterial vaginosis co-infection was the least common diagnosis, occurring in 3 (1.4%).

Association Between Age Group and Diagnosis at Enrolment (Table 2)

There was no statistically significant association between age group and diagnosis at enrolment ($\chi^2 = 15.504$, $p = 0.215$). Bacterial vaginosis was most common among participants aged 20–24 years, 22 (41.5%), while candidiasis predominated among those aged 25–29 years, 43 (53.8%), 30–34 years, 22 (41.5%), and those aged 35 years and above, 14 (46.7%).

Association Between Parity and Diagnosis at Enrolment (Table 3)

Parity was not significantly associated with diagnosis at enrolment ($\chi^2 = 14.42$, $p = 0.275$). Candidiasis was the most common diagnosis across all parity groups, occurring in 34 (50.7%) nulliparous, 31 (41.3%) primiparous, 30 (46.2%) multiparous, and 4 (44.4%) grand multiparous women.

Mean Parity Score by Parity Group (Figure 3)

The mean parity score did not differ significantly across parity groups ($F = 2.35$, $p = 0.073$). The highest mean score was observed among primiparous women (3.13 ± 0.30), while the lowest was recorded among grand multiparous women (2.80 ± 0.44).

Association Between High-Risk Partner Status and Diagnosis (Figure 4)

Forty-six (21.3%) participants reported having a high-risk sexual partner, while 170 (78.7%) did not. There was no significant association between high-risk partner status and diagnosis at enrolment ($\chi^2 = 3.389$, $p = 0.495$).

Association Between Previous Pelvic Inflammatory Disease and Diagnosis (Figure 5)

A previous history of pelvic inflammatory disease was reported by 58 (26.9%) participants, whereas 158 (73.1%) had no such history. No statistically significant association was observed between previous pelvic inflammatory disease and diagnosis at enrolment ($\chi^2 = 7.761$, $p = 0.101$).

Behavioural and Clinical Characteristics of Participants (Table 4)

Vaginal itching was reported by 44 (20.4%) participants, while burning sensation was uncommon, occurring in 4 (1.9%). Abnormal vaginal odour during or after intercourse was reported by 29 (13.4%). A history of vaginal douching was present in 89 (41.2%) participants, improper antibiotic use in 106 (49.1%), and use of antiseptic vaginal wash in 70 (32.4%). Copious vaginal discharge during the index pregnancy was reported by 96 (44.4%) participants.

Summary of Associations Tested (Table 5)

None of the sociodemographic or behavioural variables examined showed a statistically significant association with diagnosis at enrolment ($p > 0.05$ for all comparisons). Age group, parity, mean parity score, high-risk partner status, and previous pelvic inflammatory

disease were not significantly associated with the pattern of vaginal infections among the study participants.

Table 1. Sociodemographic characteristics of the enrolment cohort (n = 216)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
20–24	53	24.5
25–29	80	37.0
30–34	53	24.5
≥35	30	13.9
Marital status		
Married	170	78.7
Single	34	15.7
Separated	5	2.3
Divorced	3	1.4
Steady partner (unmarried)	4	1.9
Educational status		
No formal education	17	7.9
Primary	35	16.2
Secondary	67	31.0
Tertiary	97	44.9
Mean age ± SD (years)	28.39 ± 4.93	–

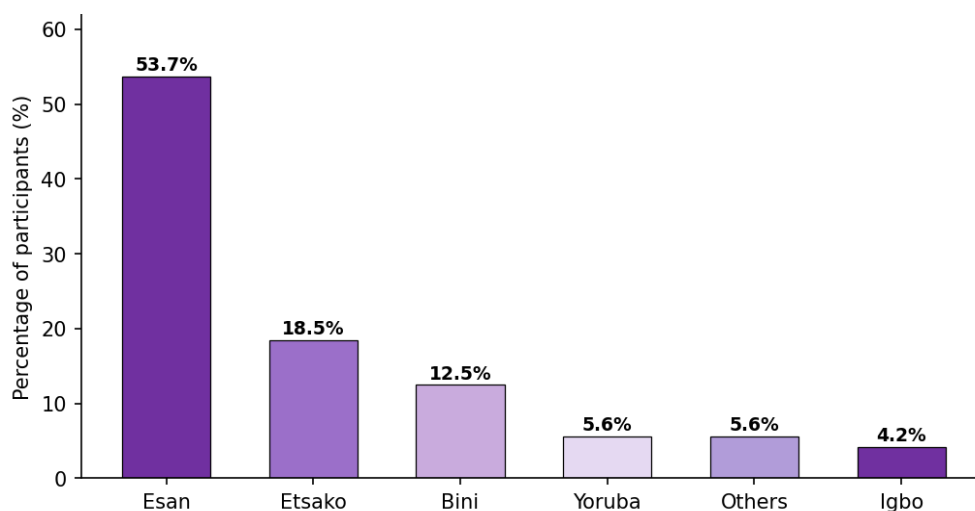


Figure 1: Tribal distribution of participants (n = 216). Esan was the predominant tribal group (53.7%), followed by Etsako (18.5%) and Bini (12.5%).

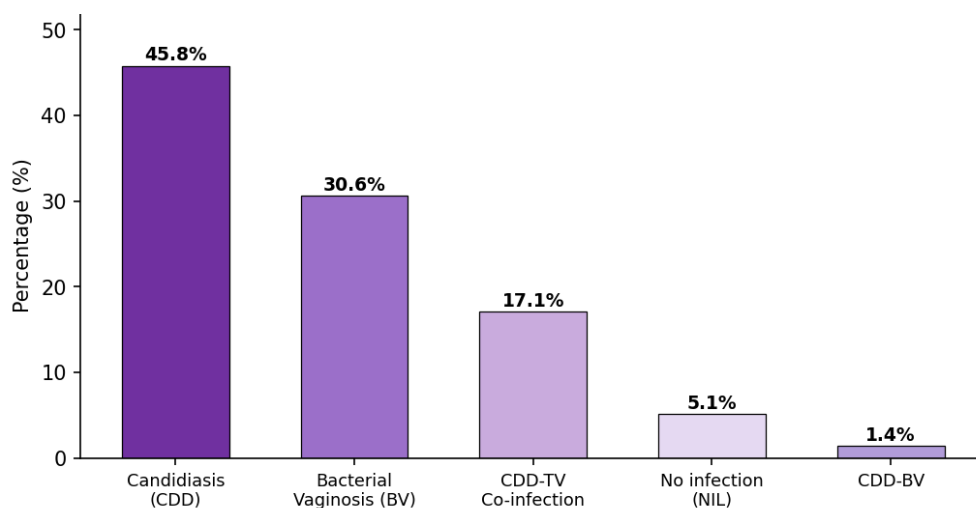


Figure 2: Distribution of diagnoses at enrolment (n = 216). CDD was the most prevalent diagnosis (45.8%), followed by BV (30.6%) and CDD-TV (17.1%).

Table 2. Diagnosis at enrolment by age group (n = 216)

Age group	BV (%)	CDD (%)	CDD-TV (%)	NIL (%)	CDD-BV (%)	Total
20–24 yrs	22 (41.5)	20 (37.7)	10 (18.9)	1 (1.9)	0 (0.0)	53
25–29 yrs	22 (27.5)	43 (53.8)	11 (13.8)	3 (3.8)	1 (1.3)	80
30–34 yrs	12 (22.6)	22 (41.5)	13 (24.5)	4 (7.5)	2 (3.8)	53
≥35 yrs	10 (33.3)	14 (46.7)	3 (10.0)	3 (10.0)	0 (0.0)	30
Total	66 (30.6)	99 (45.8)	37 (17.1)	11 (5.1)	3 (1.4)	216

Note. $\chi^2 = 15.504$, $p = 0.215$. BV = bacterial vaginosis; CDD = candidiasis; CDD-TV = candidiasis with *Trichomonas vaginalis*; NIL = no infection; CDD-BV = candidiasis with bacterial vaginosis.

Table 3. Diagnosis at enrolment by parity group (n = 216)

Parity	BV (%)	CDD (%)	CDD-TV (%)	NIL (%)	CDD-BV (%)	Total
Nullipara	23 (34.3)	34 (50.7)	9 (13.4)	1 (1.5)	0 (0.0)	67
Primipara	26 (34.7)	31 (41.3)	12 (16.0)	5 (6.7)	1 (1.3)	75
Multipara	16 (24.6)	30 (46.2)	14 (21.5)	3 (4.6)	2 (3.1)	65
Grand multipara	1 (11.1)	4 (44.4)	2 (22.2)	2 (22.2)	0 (0.0)	9
Total	66 (30.6)	99 (45.8)	37 (17.1)	11 (5.1)	3 (1.4)	216

Note. $\chi^2 = 14.42$, $p = 0.275$.

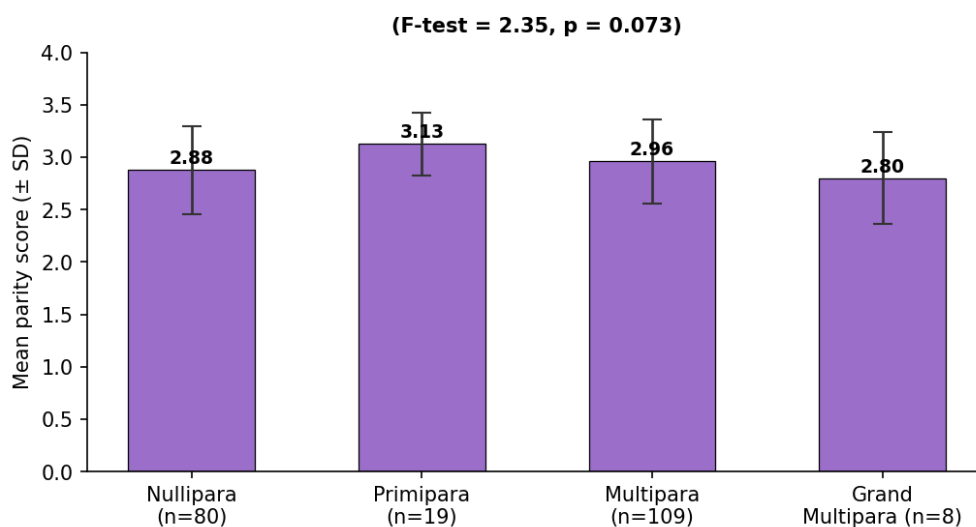


Figure 3: Mean parity score by parity group (n = 216).

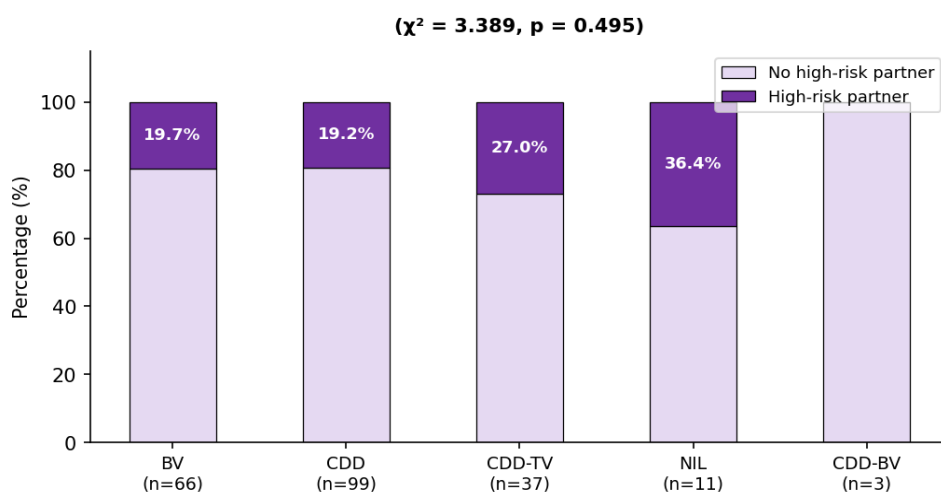


Figure 4: High-risk partner status by diagnosis at enrolment (n = 216).

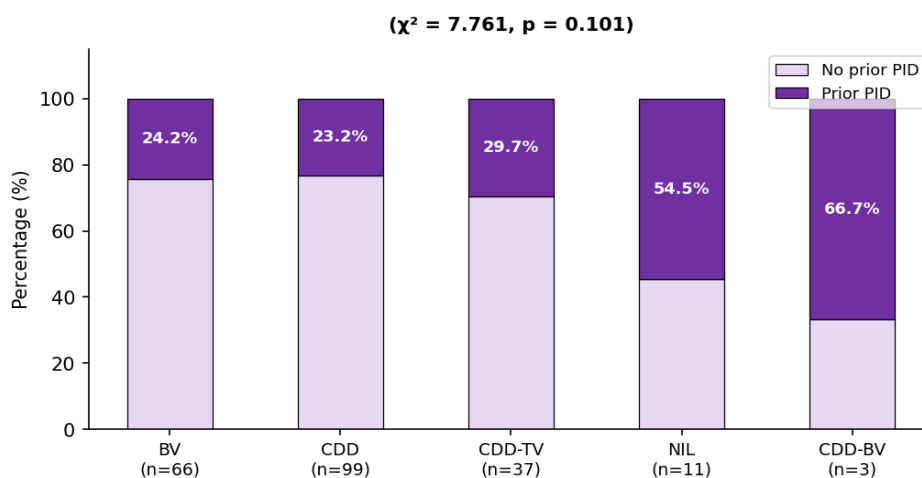


Figure 5: History of pelvic inflammatory disease by diagnosis at enrolment (n = 216).

Table 4. Prevalence of additional behavioural and clinical variables (n = 216)

Variable	Yes, n (%)	No, n (%)	Total
Vaginal itching	44 (20.4)	172 (79.6)	216
Burning sensation	4 (1.9)	212 (98.1)	216
Abnormal odour during/after sex	29 (13.4)	187 (86.6)	216
History of vaginal douching	89 (41.2)	127 (58.8)	216
History of improper antibiotic use	106 (49.1)	110 (50.9)	216
Use of antiseptic vaginal wash	70 (32.4)	146 (67.6)	216
Copious vaginal discharge in index pregnancy	96 (44.4)	120 (55.6)	216

Table 5. Summary of association statistics: variables tested against diagnosis at enrolment (n = 216)

Variable	Test statistic	Value	p-value
Age group × diagnosis	χ^2	15.504	0.215
Parity group × diagnosis	χ^2	14.42	0.275
Mean parity score × parity group	F-test	2.35	0.073
High-risk partner × diagnosis	χ^2	3.389	0.495
Prior PID × diagnosis	χ^2	7.761	0.101

Note. None of the tested associations reached the threshold for statistical significance ($p < 0.05$).

Discussion

This study assessed the sociodemographic and behavioural correlates of bacterial vaginosis (BV) and *Trichomonas vaginalis* (TV) co-infection among pregnant women at enrolment for antenatal care. The findings showed that candidiasis was the most common vaginal infection, followed by bacterial vaginosis, while candidiasis with *T. vaginalis* co-infection accounted for approximately one-sixth of all diagnoses. Although a substantial proportion of participants reported behavioural practices traditionally associated with vaginal infections, including vaginal douching, inappropriate antibiotic use, and antiseptic vaginal wash use, none of the sociodemographic or behavioural variables examined demonstrated a statistically significant association with the pattern of vaginal infections at enrolment.

The predominance of candidiasis observed in this study is consistent with reports by Idowu et al (2022). in Oyo state, Nigeria, and Nnadi and Singh, 2017 in Sokoto, who noted that vulvovaginal candidiasis is among the most frequently diagnosed vaginal infections during pregnancy, as elevated oestrogen levels increase vaginal glycogen content, thereby promoting *Candida* proliferation. However, the substantial burden of bacterial vaginosis observed in this cohort further highlights its continued importance as a reproductive health problem in pregnancy. The coexistence of candidiasis and *T. vaginalis* infection in a considerable proportion of participants also emphasizes the need to consider mixed vaginal infections during antenatal evaluation rather than focusing on single pathogens alone. Early identification and treatment of these infections are important because they have

been associated with adverse pregnancy outcomes, including preterm birth and premature rupture of membranes.

The present study found no significant association between maternal age and the pattern of vaginal infections. Although younger women showed a relatively higher proportion of bacterial vaginosis, the overall differences across age groups were not statistically significant. This finding agrees with studies by Danjuma et al (2025), in Plateau state, Nigeria, which similarly reported no independent relationship between maternal age and vaginal infections after adjustment for other risk factors, but disagrees with findings from Fonseca et al (2013), in Brazil, which showed increased levels of pathological vaginal discharge among younger women. The absence of a significant age effect may reflect the relatively narrow reproductive age distribution of the study population, where most participants were young adults with similar sexual and reproductive characteristics. This finding suggests that screening decisions should not rely solely on maternal age, as women across all reproductive age groups remain susceptible to vaginal infections during pregnancy.

Parity also showed no significant association with infection status. Although bacterial vaginosis appeared slightly more common among nulliparous and primiparous women, candidiasis remained the predominant diagnosis across all parity categories. Pregnancy-related hormonal changes occur irrespective of parity and may therefore exert a greater influence on vaginal microbial balance than previous childbirth experience. Consequently, antenatal screening strategies should encompass all pregnant women regardless of parity. Behavioural characteristics traditionally regarded as risk factors for vaginal infections were common within the study population. More than two-fifths of participants reported vaginal douching, almost half acknowledged inappropriate antibiotic use, and nearly one-third used antiseptic vaginal washes. Despite these high prevalences, none of these factors demonstrated a statistically significant association with infection pattern. This finding contrasts with studies by Wireko et al (2024), and Lohova-Matisa et al (2025), who reported strong associations between vaginal douching, disruption of the normal vaginal microbiota, and bacterial vaginosis. The discrepancy may be explained by differences in study populations, local hygienic practices, frequency of douching, or limited statistical power to detect modest associations. It is also possible that these practices were common across both infected and uninfected participants, reducing their discriminatory value within this cohort. Nevertheless, because these behaviours have been consistently associated with adverse reproductive outcomes in previous research, health education discouraging unnecessary vaginal cleansing and indiscriminate antibiotic use should remain an important component of antenatal care.

Similarly, neither a history of a high-risk sexual partner nor previous pelvic inflammatory disease was significantly associated with vaginal infection patterns. Although previous studies have linked sexual behaviour and sexually transmitted infections with both bacterial vaginosis and *T. vaginalis*, these relationships were not evident in the present study (Abou Chacra et al., 2023; Seña et al., 2021). This may reflect underreporting of sensitive sexual

behaviours because of social desirability bias, particularly in a conservative antenatal setting, or the multifactorial nature of vaginal dysbiosis during pregnancy, where hormonal and immunological factors may have greater influence than behavioural characteristics alone.

Conclusion

Bacterial vaginosis and *Trichomonas vaginalis*-related infections constituted a substantial proportion of vaginal infections among pregnant women at antenatal enrolment, with bacterial vaginosis remaining one of the most frequently identified conditions. Although behavioural practices such as vaginal douching, inappropriate antibiotic use, and antiseptic vaginal wash use were common, none of the sociodemographic or behavioural factors evaluated showed a significant association with infection status. These findings indicate that bacterial vaginosis and *Trichomonas vaginalis* co-infection cannot be reliably predicted using routine demographic or behavioural characteristics alone.

Recommendation

Strengthening routine antenatal screening and ensuring prompt diagnosis and treatment may improve maternal and perinatal outcomes in this population.

Limitations

This study was conducted in a single tertiary healthcare facility, which may limit the generalizability of the findings to other populations. The use of saline wet mount microscopy for diagnosing *Trichomonas vaginalis* has lower sensitivity than culture or molecular diagnostic methods and may have underestimated the true prevalence of infection. Behavioural information was self-reported and may have been influenced by recall or social desirability bias. In addition, the relatively modest sample size may have reduced the ability to detect weak associations between sociodemographic or behavioural factors and vaginal infections.

Conflict of Interest

The authors declare no conflict of interest in relation to the design, conduct, analysis, or reporting of this study.

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