Bacterial Vaginosis in Women of Reproductive Age: Burden and predictors in Western Kenya

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Abstract

Background: Bacterial vaginosis (BV) is one of the most common Lower genital tract infections among women of reproductive age, resulting from the imbalanced microbiota of the vaginal ecosystem. BV is a common vaginal infection caused by disruption of the normal vaginal microbiota. Despite its high burden in sub-Saharan Africa, bacterial vaginosis (BV) remains underdiagnosed, yet it is associated with adverse pregnancy outcomes and an increased risk of acquiring sexually transmitted infections, including HIV. Therefore, this study was undertaken to determine the burden and predictors of BV among women of reproductive age in Western Kenya.

Methods: This cross-sectional study, conducted between January and December 2024, enrolled 227 consenting non-pregnant women of reproductive age (18-49 years) at Kakamega County General Teaching and Referral Hospital (KCGTRH), Western Kenya. Vaginal swabs were collected, and an associated demographic questionnaire was administered. BV was diagnosed using Nugent's scoring system. Descriptive statistics were used to characterise the population, while logistic regression analysis was used to determine factors associated with BV infection using STATA v 13 (StataCorp LP, Texas, USA). The significance level was established at $p \leq 0.05$.

Results: A total of 129/227 (64.5%) women exhibited abnormal vaginal flora with a Nugent score (NS) of 4–10, while 78 (39%) were diagnosed with BV (NS 7–10). Four (2%) women had Trichomonas vaginalis, and 19 (9.5%) had a yeast infection. Women whose partners used condoms during sexual intercourse (adjusted odds ratio - aOR 0.6; 95% confidence interval - CI 0.4 – 0.8) were less likely to be infected with BV. Women aged 26 to 30 years (aOR 2.0; 95% CI 1.0 – 4.2), experiencing lower abdominal pain (aOR 1.7; 95% CI 1.1 – 2.9), with milky vaginal discharge (aOR 1.5; 95% CI 1.0 – 2.6), and those with yeast infection (aOR 2.0; 95% CI 1.03 – 4.1) were associated with BV infection.

Conclusions: This study highlights a high burden of BV among women of reproductive age in Western Kenya. Risk factors include age, lower abdominal pain, vaginal discharge, and co-infection with yeast, while condom use was protective. These findings underscore the need for improved screening, health education, and targeted interventions to reduce the impact of BV and associated reproductive health risks.

Keywords: *Burden, Predictors of Bacterial Vaginosis, women, Western Kenya*

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Introduction

Reproductive tract infections continue to pose a significant health concern for women, particularly in developing countries (1, 2). Bacterial vaginosis (BV) is one of the most common conditions associated with lower genital tract infections among women of reproductive age (3). BV arises from dysbiosis of the vaginal

ecosystem, but its aetiology remains unclear (3). BV worsen the risk of health complications among childbearing women, their children, and sexual partners. It is linked to abortion, newborn morbidity, premature birth, low birth weight infants, neonatal infections, and cervical lesions (4-8). BV is also associated with sexually transmitted diseases, including an over twofold increase in the risk of contracting HIV among women and a fourfold heightened risk of female-to-male HIV transmission (9). Beyond its clinical implications, BV has been linked to reduced quality of life and psychosocial distress, including increased anxiety and depression (10, 11).

Current global estimates suggest that the burden of bacterial vaginosis (BV) is 30% among women of reproductive age (12). Reports indicate varying prevalence rates among different races and ethnicities, with sub-Saharan Africa and other resource-limited countries showing rates exceeding 50%(13). In South Africa, BV prevalence rates as high as 50% have been reported, albeit lower in East Africa (14). Interestingly, a multicountry study conducted in Kenya, Rwanda, and South Africa reported an average BV prevalence of 38% (15). Conversely, studies in Kenya have shown low prevalence of BV among adolescents in addition to temporal variability of infection around pregnancy (16, 17). Several behavioural and biological factors have been associated with BV infections, including same-sex activities among women, inadequate condom use, early sexual debut, the number of sexual partners, vaginal douching, and other vaginal infections such as human papillomavirus and HIV (18, 19).

In Kenya, the burden of bacterial vaginosis (BV) has been steadily rising. However, data on BV among women in Kenya remains scanty (17). This study was, therefore, undertaken to determine the burden and predictors of BV among women of reproductive age in Western Kenya.

Methodology

Study design and site

This cross-sectional study was undertaken from January to December 2024. The study was conducted in Kakamega County General Teaching and Referral Hospital (KCGTRH), which is a level 5 facility in Kakamega County. The facility serves a catchment population of 58,308 people, including 15,627 women of reproductive age (6.8%). The study population were women aged between 18 and 49 years who sought medical services at the outpatient department at KCGTRH.

Study population

Women aged 18 years and above, attending the KCGTRH outpatient department, who were not pregnant, provided written informed consent and agreed to provide vaginal swab samples. Pregnant and menstruating women, as well as those on medication, were excluded from the study.

Sampling

The required sample size was calculated using Lemeshow *et al*. (20), assuming a BV prevalence of 17.5% in Kenya (15) (Z=1.96, p=0.175, m=0.06).

The calculated minimum sample size was 154. To account for a 30% non-response rate, the total sample size was adjusted to 200 women attending KCRH who met the eligibility criteria. A consecutive sampling method was used to recruit all accessible and consenting women.

Data collection

Baseline characteristics. Factors associated with BV infection among this population were collected through face-to-face interviews by trained research personnel using structured, validated questionnaires. The content was validated from literature and expert review to ensure it captured key variables.

Vaginal swabs. Two high vaginal swabs were collected aseptically. The first swab was prepared for wet mount examination of yeast, *T. vaginalis*, and BV diagnosis using Amsel's criteria. In the

laboratory, the swab was smeared on a clean microscope slide, air-dried before being stained and viewed under high-power microscope lenses (21). The second swab was smeared on a glass slide and Gram-stained for Nugent scoring (22).

Gram Stain. The smear was placed on anclean rack and flooded with crystal violet solution for 1 minute, later washed in a gentle stream of water for 2 seconds, the smear was later flooded with iodine solution which is a mordant and left for 1 minute which was later washed in a stream of water for a few seconds and flooded with acetone which is a decolorizer for 10-15 seconds and washed in a gentle stream of water for 15 seconds. The smear was finally flooded with the counterstain neutral red for 30 seconds and washed in a gentle and direct stream of tap water until no colour appeared in the effluent, and then it was blotted dry with absorbent paper, followed by an examination under an oil immersion objective (1000x magnification)

Nugent scoring criteria. Nugent's scoring system was used to examine Gram-stained vaginal smears for the presence of bacteria and cells (22). Each smear was examined for three bacterial morphotypes: large Gram-positive rods resembling *Lactobacillus*, small Gram-negative to Gram-variable rods resembling *G. vaginalis*, and *Bacteroides* and curved rods resembling *Mobiluncus spp*. Each morphotype was scored individually, and the scores were summed up. If the total score was three or less, the smear was reported as usual. However, a score between four and six inclusive was considered intermediate, while a score between seven and ten was regarded as BV.

Scores between 0 and 3 denoted normal vaginal flora, those between 4 and 6 indicated intermediate vaginal flora, and scores between 7 and 10 indicated BV. Determination of Nugent score through laboratory examination of vaginal smear: the sum of the score for every bacterium morphotype is listed Table 1. Taking x to be the Nugent score, it was interpreted thus;

$0 \leq x \leq 3$ = BV Negative

$4 \leq x \leq 6$ = Intermediate

$7 \leq x \leq 10$ = BV positive

Trichomonas vaginalis. After smearing the swabs on the slides, they were inoculated in the In Pouch TV culture kit (Biomed Diagnostic, White City, OR, USA) to detect *T. vaginalis* according to manufacturer instructions. The inoculated pouches were incubated at 37°C vertically for 24 hours, and then examined microscopically at 10x and 40x magnification at 24 hours. This examination was repeated daily for five days. For quality control, the samples were incubated along with positive and negative inocula. The positive control was a known T. Vaginalis strain, which was incubated for 24-48 hours and observed under the microscope for motile, jerky or flagellated trichomonads. The negative control had no inoculum, and it was incubated under similar conditions; motile organisms were not observed after five days.

Table 2:
Nuget Scoring System

Lactobacillus	Score	G vaginalis Bacteroides	Score	Curved Gram variables	Score	Nugent Score
30 or more	0	0	0	0	0	0
5-30	1	Less than 1	1	Less than 1	1	3
1-2	2	1-4	2	1-4	1	5
Less than 1	3	5-30	3	5-30	2	8
0	4	30 or more	4	30 or more	2	10

Note: (the quantity of organism/100x objective)

Additionally, every 10th Gram stain slide was packed in wooden slide boxes and transported to the Centre of Microbiology at the Kenya Medical Research Institute (KEMRI), Nairobi, for quality control by experts. To reduce bias, the laboratory personnel were blinded to the patient's history.

Data analysis

Descriptive statistics were utilised to characterise the population. Bivariate and multivariate analyses were conducted to identify factors associated with BV infection. Significance was established at $p \leq 0.05$. Analyses were executed using STATA v 13.

Ethical considerations

The KEMRI ERC approved the protocol under approval number KEMRI/SERU/2545. Participation in the study was voluntary, and privacy was safeguarded by interviewing in a secure private space. Confidentiality of all study materials ensured.

Results

Participants baseline characteristics

The study achieved a 100% response rate. The participants mean age was 35 years (Range = 18-49 years), with 78% (n=156) reporting their age of sexual debut as below 18 years. Additionally, 93.5% (n=187) of the participant' sexual partners were circumcised, and 57% (n=114) used condoms during their last sexual encounter. Table 2.

Vaginal irritation, lower abdominal pain, and douching were reported by 12% (n=24), 21% (n=42), and 6% (n=12) of the women, respectively. Using a Nugent score (NS) of 4–10, 64.5% (n=129; 95% CI 57.7 – 70.8) of women had abnormal vaginal flora, while 78 (39%) were diagnosed with BV (NS 7–10). *T. Vaginalis* and yeast infections were found in 4 (2%) and 19 (9.5%) women, respectively, as shown in Table 3.

Factors associated with BV infection

Table 4 summarises factors associated with BV infection among study participants. Women whose partners used condoms during their last sexual encounter were less likely to be infected with BV (P= 0.037aOR 70.6; 95% CI 0.4-0.8). Those who experienced lower abdominal pain (P= 0.046, aOR 1.7; 95% CI 1.1 – 2.9), milky vaginal discharge (P= 0.035, aOR 1.5; 95% CI 1.0 – 2.6), and those with a yeast infection (P= 0.044, aOR 2.0; 95% CI 1.03 – 4.1) were more likely to be positive for bacterial vaginosis.

Table 2:
Demographic Characteristics of the Study Participants

Variables	Category	Frequency n (%)
Age group	< 20	3 (1.5)
	21-25	25 (12.5)
	26-30	45 (22.5)
	31-40	76 (38)
	>41	51 (25.5)
Education Level	None	3 (1.5)
	Primary	80 (40)
	Secondary	84 (42)
	College/university	33 (16.5)
Marital status	Single	15 (7.5)
	Married	157 (78.5)
	Separated/Divorced/Widowed	28 (14)
Occupation	Employed	26 (13)
	Business	68 (34)
	Unemployed	106 (53)
Parity	None	5 (2.5)
	1	30 (15)
	>1	165 (82.5)

Women aged 26 to 30 years (P =0.05, aOR 2.0; 95% CI 1.0 – 4.2) were also more likely to have bacterial vaginosis, although this was marginally significant.

Discussion

Bacterial vaginosis was an important infection in this study population, with 39% testing positive for Bacterial vaginosis (BV); moreover, BV is the most common vaginal infection, detected in up to 70% of women of childbearing age (10). Worldwide, the burden of BV varies significantly across countries, regions, races, and ethnic groups (2). Although antibiotics are recommended as the first-line therapy, 20–30% of women experience a recurrence of symptoms after completing the initial treatment (23). Furthermore, the association of BV with adverse outcomes, such as abortion, newborn morbidity, neonatal infections, cervical lesions, sexually transmitted diseases (STDs), and HIV infection, indicates a crucial need for ongoing monitoring to implement control and management strategies, especially in developing nations where the burden is severe but often overlooked (4-8).

Table 3:
Baseline Characteristics of Study Participants

Variable	Category	Frequency n (%)
Age of sexual debut (Years)	<18	156 (78)
	>18	44 (22)
Ever had an abortion	Yes	5 (2.5)
	No	195 (97.5)
Current sexual partners	None	24 (12)
	1	174 (87)
	>1	2 (1)
Contraceptive use	155	155 (77.5)
	45	45 (22.5)
Contraceptive type used	Condoms	12 (6)
	Regular pill/Injection/ Coil	100 (50)
	Emergency contraceptive	35 (17.5)
	None	53 (26.5)
Partner circumcised	Yes	187 (93.5)
	No	1 (0.5)
Condom use	Yes	114 (57)
	No	86 (43)
Previously infected with an STD	Yes	7 (3.5)
	No	193 (96.5)
HIV sero-statu	Positive	93 (46.5)
	Negative	107 (53.5)
Current vaginal irritation	Yes	24 (12)
	No	176 (88)
Experience lower abdominal pains	Yes	42 (21)
	No	158 (79)
Previous vaginal discharge	Yes	18 (9)
	No	182 (91)
Washed vagina other than during bathing	Yes	194 (97)
	No	6 (3)
Vaginal washing immediately after sex	Yes	160 (80)
	No	40 (20)
Practice douching	Yes	12 (6)
	No	188 (94)
Douching detergent	Water only	5 (2.5)
	Soap/detergent/disinfectant	1 (0.5)
	Not applicable	194 (97)

Using Nugent criteria, this study identified a high proportion (64.5%) of women with abnormal vaginal flora, and a substantial number were diagnosed with BV. As other studies suggest, these results indicate a high burden of BV among the study population, mirroring findings that indicate a higher burden in developing regions compared to developed ones (1, 2, 12). Furthermore, these findings are consistent with other studies conducted in sub-Saharan Africa. A longitudinal multicountry survey in Kenya, Rwanda, and South Africa reported an average BV prevalence of 38% (15), while a separate study among Kenyan women reported a BV prevalence rate of 41% (9). Moreover, studies focusing on high-risk populations observed even higher BV prevalence rates of 48.5%, 63%, and 55% in India, Tanzania, and Kenya, respectively (24, 25).

Table 4:
Logistic Regression Analysis for the Covariates of BV Infection

Variables	Category	% BV positive	Bivariate		Multivariate	
			P - value	cOR (95% CI)	*P* - value	aOR (95% CI)
Age Group	< 20	66.6	0.173	2.8 (0.6 - 12.7)	0.128	3.4 (0.7 – 16.6)
	21-25	44	0.134	1.8 (0.8 - 4.23)	0.198	1.7 (0.7 - 4.4)
	26-30	46.7	*0.*048	1.9 (1.0 - 4.03)	0.05	2.0 (1.0 – 4.2)
	31-40	42.1	0.086	1.7 (0.9 - 3.4)	0.051	1.9 (0.9 - 3.8)
	>41	23.5	Referent	Referent	Referent	Referent
Marital status	Single	20	0.6	0.7 (0.2 - 2.6)	0.448	0.6 (0.2 - 2.3)
	Married	42.7	0.28	1.4 (0.7 - 3.1)	0.395	1.3 (0.6 – 2.9)
	Separated/ Divorced/ Widowed	28.6	Referent	Referent	Referent	Referent
Age of sexual debut	<18	39.7	0.751	1.1(0.6 - 1.8)	0.729	1.1 (0.6 – 1.9)
	>18	36.4	Referent	Referent	Referent	Referent
Current sexual partners	1	39.7	0.439	1.3(0.6 - 2.9)	0.374	1.4 (0.6 – 3.1)
	>1	100	0.124	3.4(0.7 - 16.5)	0.133	3.4 (0.6 – 16.2)
	None	29.2	Referent	Referent	Referent	Referent
Partner circumcised	Yes	40.1	0.422	1.6(0.5 - 5.1)	0.465	1.6 (0.4 – 4.9)
	No	0	ND	ND	ND	ND
	Not applicable	25	Referent	Referent	Referent	Referent
Condom use	Yes	30.7	0.032	0.6(0.39 - 0.95)	0.037	0.6(0.4 – 0.8)
	No	50	Referent	Referent	Referent	Referent
HIV status	Positive	33.6	0.238	0.7(0.48 - 1.19)	0.236	0.7 (0.5 – 1.2)
	Negative	44.1	Referent	Referent	Referent	Referent
Current vaginal irritation	Yes	58.3	0.109	1.6(0.89 - 2.86)	0.484	1.3(0.6 – 2.5)
	No	36.4	Referent	Referent	Referent	Referent
Experience lower abdominal pains	Yes	57.1	0.036	1.6(1.03 - 2.7)	0.046	1.7(1.1 – 2.9)
	No	34.2	Referent	Referent	Referent	Referent
Current vaginal discharge	Milky	47.3	0.035	1.6(1.03 - 2.67)	0.128	1.5(1.0 – 2.6)
	Clear	28.4	Referent	Referent	Referent	Referent
Presence of yeast	Yes	75	0.044	2.1(1.1 - 4.1)	0.041	2.0(1.03 – 4.1)
	No	36.7	Referent	Referent	Referent	Referent
Practice douching	Yes	25	0.427	0.6 (0.9 - 1.98)	0.465	0.6 (0.2 – 2.1)
	No	39.9	Referent	Referent	Referent	Referent

In addition to high-risk behaviours, the differences in BV prevalence between this study and others may be attributable to variations in environmental factors, socioeconomic status, and stress across geographical areas (26).

Women aged 26 to 30 years had a higher likelihood of BV infection compared to older women. Conversely, previous studies have reported low BV rates among younger women and adolescents (27, 28). Research shows that young women and adolescents under 21 years rarely have BV infections before their first sexual encounter, and the initiation of sexual activity is the strongest risk factor for both prevalent BV and incident BV (17). These studies emphasise that age alone is not a risk factor; rather, as women age, their sexual behaviour may increase the risk.

In the present study, using a condom was protective against BV. It is worth noting that in sub-Saharan Africa, the relationship between BV and male condom use is inconsistent, possibly reflecting the diversity of condom formulation (15, 26, 27). In Burkina Faso, there was no association between condom use and BV (28). Likewise, studies in Zimbabwe and Uganda found no connection between condom use and BV (29). However, another study demonstrated the protective effects of condom use against BV infection, especially among uncircumcised men (30).

Women experiencing abdominal pain and those with milky vaginal discharge were more likely to be infected with BV. Similarly, several studies have highlighted the association between abnormal vaginal discharge, unpleasant odour, and BV. These likely indicate the disruption of normal vaginal flora and biochemical changes, such as a change in PH (27, 31, 32).

While Socioeconomic status was not an important factor in BV infection in the current study, some studies indicate that the prevalence of lower reproductive tract infections is higher among individuals with lower socioeconomic status and educational background (17). An epidemiological study in Brazil suggested that higher income may serve as a protective factor against BV (32), which could be linked to the education and greater access to knowledge about preventing BV and other vaginal infections among women in the higher socioeconomic class.

Yeast infection was associated with an increased risk for BV infection, and studies have shown that shifts in vaginal microbial composition affect the progression of urogenital diseases. Both yeast and BV infections commonly correlate with changes in vaginal microbiota composition (33). Past studies have indicated that BV-related pathogens play a significant pathogenic role in patients with BV and yeast-mixed vaginitis, influencing their treatment outcomes and likelihood of relapse (34); however, the exact mechanism remains unclear.

Limitations

This study has several limitations. First, the results were based on microscopic examination and detection of BV, candidiasis, and trichomoniasis. Culturing, in addition to microscopy, provides more precise results. Secondly, the cross-sectional nature of the study could not establish causal relationships, only associations; however, this study builds on the existing knowledge of BV in Kenya. The study provides baseline data for future longitudinal studies. We acknowledge there was possible recall and selection bias at background data collection; however, the primary findings were confirmed by laboratory testing.

Conclusions and Recommendations

This study demonstrates a high burden of bacterial vaginosis among women of reproductive age in Western Kenya. Significant risk factors included age, lower abdominal pain, abnormal vaginal discharge, and co-infection with yeast, whereas condom use was protective.

These findings highlight the need to strengthen reproductive health programs through routine BV screening, community-based health education on preventive sexual practices, and timely management of genital infections to reduce adverse reproductive health outcomes.

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Author contributions

R. Okuku led the conceptualisation, data collection, formal analysis, methodology development, original drafting, and funding acquisition. C. Bii and E. Makokha contributed to conceptualisation, investigation, supervision, and manuscript writing and review. M. O. Ngayo contributed to conceptualisation, final analysis, methodology, and manuscript preparation. J. Mungiria supported methodology development, writing, and review.

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