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# Bacterial Vaginosis is a Common Vaginal Infection among First-Time Antenatal Clinic Attendees: Evidence from a Tertiary Health Facility in North-West Nigeria

Victor D Ajayi<sup>1,2</sup>, Habib M Sadauki<sup>3</sup>, Abdullahi Randawa<sup>1</sup>, Bamgboye M Afolabi<sup>4</sup><sup>1</sup>Department of Obstetrics and Gynecology, Ahmadu Bello University Teaching Hospital Shika-Zaria, Nigeria<sup>2</sup>Nordica Fertility Centre, Lagos, Nigeria<sup>3</sup>Pathfinder International, Nigeria<sup>4</sup>Health, Environment and Development Foundation, 34, Montgomery Road, Yaba, Lagos, Nigeria**Corresponding author:** Bamgboye M Afolabi, Health, Environment and Development Foundation, 34, Montgomery Road, Yaba, Lagos, Nigeria, Tel: +234(0) 803 049 0729; Email: bmafolabi@gmail.com**Received date:** October 18, 2016; **Accepted date:** November 25, 2016; **Published date:** December 02, 2016**Citation:** Ajayi VD, Sadauki HM, Randawa A, et al. Bacterial Vaginosis is a Common Vaginal Infection among First-Time Antenatal Clinic Attendees: Evidence from a Tertiary Health Facility in North-West Nigeria. J Prev Inf Cntrl. 2016, 2:2.**Copyright:** © 2016 Ajayi VD, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

## Abstract

**Context:** Bacterial vaginosis has been prospectively linked to various adverse reproductive and pregnancy related events.**Objective:** To determine the prevalence of bacteria vaginosis among first time antenatal clinic attendees in Northwest Nigeria.**Study design, setting and subjects:** A Cross sectional study conducted at the Antenatal clinic of the Ahmadu Bello University Teaching Hospital, Zaria, north-west Nigeria. A total of 228 consecutive booking clients were enrolled from April to June, 2008.**Main outcome measures:** Presence of at least three of the following: (i) thin, white homogenous discharge, (ii) clue cells on microscopy, (iii) pH of vaginal fluid >4.5 (iv) release of fishy odor on adding alkali (10% potassium hydroxide) or positive whiff test (Amsel's criteria) and (v) relative proportion of bacteria morphotypes on gram staining (The Nugent score).**Results:** In all 220 (96.5%) clients concluded the study and were analyzed. Prevalence of bacteria vaginosis (BV) was 14.6% using the Nugent score. Prevalence of asymptomatic BV was 9.6%. Eleven (34.4%) of the clients with BV were symptomatic while 21 (65.6%) were asymptomatic. There was no significant difference in the prevalence of BV between symptomatic and asymptomatic women. Presence of clue cells on microscopy ( $\chi^2=10.5$ ,  $p=0.001$ ), absence of yeast cells ( $\chi^2=4.120$ ,  $p=0.042$ ) and isolation of *Gardnerella vaginalis* ( $\chi^2=36.480$ ,  $p=0.000$ ) were significantly associated with BV. BV was more prevalent in the second trimester (81.3%) among parous women with low education, low economic status, in polygamous marriages, who had not used hormonal contraceptives or who were HIV positive. Amsel criteria method had a low sensitivity of 37.5% and a specificity of 70.7%, a positive predictive value of 17.9% and negative predictive value of 86.9%.**Conclusion:** It is necessary to screen for BV in high risk women with previous untoward events like low birth weight and preterm delivery especially in the second trimester.**Keywords:** Bacterial vaginosis; Nugent score; Clue cells; Amsel criteria; Whiff's test; Northwest-Nigeria

## Introduction

The impact of many infectious diseases is complicated by pregnancy [1]. These infections are usually of considerable concern to clinicians because of the potential threats to the lives of the pregnant woman and that of her fetus [2]. Feto-maternal wellbeing in pregnancy and pregnancy outcome are certainly of great worry to the obstetrician and gynecologist. Bacterial vaginosis has the potential of causing late miscarriages, preterm births, preterm premature rupture of membranes, pelvic inflammatory disease, increased risk of human immunodeficiency virus infection, post-partum, post-abortion and post-operative endometritis. Detection, treatment and prevention of bacterial vaginosis may help improve perinatal and maternal morbidity and mortality. Bacteria vaginosis (BV) is the commonest cause of abnormal vaginal discharge in women of childbearing age and the most common infectious condition in women [3-5]. BV is particularly common in black women, especially in sub-Saharan Africa [6-9]. It is usually detected in 10-40% of women worldwide and is most prevalent among women who have multiple sexual partners; those of low income status and lower levels of education; among women who smoke cigarettes; in African-American women; and in women who do not use hormonal contraception [10]. Certain intra-vaginal practices have been linked with risk of acquiring Bacterial vaginosis. Intra-vaginal practices are common among sexually active women and have been described in several sub-Saharan African countries and parts of Asia and the United States of America [8]. These practices include vaginal wiping, vaginal washing (the most studied risk factor for BV) and inserting

substances into the vagina. Vaginal washing may be by douching with a stream or jet of water or by using fingers to insert water, soap or variety of other substances into the vagina [8]. Women report using intra-vaginal practices for the purpose of genital hygiene, treatment of sexually transmitted diseases and to enhance sexual pleasure for male partners (dry sex). Although most women engage in these practices for perceived benefits, a number of studies have demonstrated potential harmful association with Human Immunodeficiency Virus 1 (HIV-1) infections, Sexually Transmitted Diseases (STDs), BV and other obstetric and gynecologic conditions such as Pelvic Inflammatory Disease (PIDs), decreased fertility and ectopic pregnancy [8]. Bacterial vaginosis has the potential of causing late miscarriages, preterm births, preterm premature rupture of membranes, pelvic inflammatory disease, increased risk of HIV infection, post-partum, post-abortal and post-operative endometritis [9]. Detection, treatment and prevention of bacterial vaginosis may help improve perinatal and maternal morbidity and mortality.

## Materials and Method

The study was conducted between April and June 2008 at the Antenatal Clinic of Ahmadu Bello University Teaching Hospital, Shika, Zaria in Kaduna, one of the states in Northwest Nigeria. It was a cross sectional study combining the use of administered questionnaires with clinical examination and laboratory results. The interviewers completed the standardized baseline questionnaires containing information about patient demographics, reproductive profile, gynecologic history, previous adverse events during pregnancy and risk factors for BV. Laboratory analysis of samples taken from the study population was also carried out.

Kaduna State in Northwest Nigeria has a population of approximately 1.5 million (National Population Commission. Nigeria National Population Census 2005) and Zaria, one of the major cities in the State, has some prominent Federal institutions of higher learning and research. The Ahmadu Bello University Teaching Hospital (ABUTH) serves as a tertiary/referral health facility for Zaria and its environs. Zaria occupies a portion of the high plains of Northern Nigeria, 652.6 m above sea level and some 950 km from the coast. It is located at 11°31' N, 7°42' E.

The Hausa-Fulani ethnic group constitutes more than 70% the population, and are mainly peasant farmers, predominantly of the Islamic faith. Other ethnic groups that live and work in Zaria include the Yorubas from the Southwest and the Igbos from the Southeast of the country. The study population were consenting pregnant women seeking antenatal care (first time attendees) at the ABUTH.

All consenting pregnant women encountered at the antenatal booking clinic of the health facility who met the inclusion criteria

were recruited. The inclusion criteria were absence of systemic diseases such as diabetes mellitus, hypertension, renal disease; no prior history of placental abruption, uterine anomaly, incompetent cervix, twin pregnancy or prior antibiotic use in preceding two weeks before the study.

The antenatal booking clinic at the facility was held once a week with an average of forty women seen per week. The women were initially counselled to secure their consent for collection of various biological samples. All consecutive consenting pregnant women attending the antenatal clinic for the first time were recruited for the study until the desired sample size was attained.

Questionnaires were structured and pre-tested. Doctor and nurse interviewers specifically trained for the study screened each woman for study eligibility, explained the purpose and practice of the study and obtained informed consent. The same interviewers completed the standardized baseline questionnaires which contained information about patient demographics, reproductive profile, gynaecologic history, previous adverse effect in pregnancy and risk factors for BV.

The questionnaire was administered in a confidential location within the antenatal clinic by mostly female interviewers. Vaginal swabs for BV assessment were collected from clients using swab sticks which were immediately transported to the laboratory. At first, a clean, unlubricated speculum was introduced into the vagina and vaginal pH measured using pH strips. A sterile cotton swab was used to obtain material from the posterior vaginal fornix for vaginal smear. Wet smear of vaginal secretion from posterior fornix was diluted with normal saline, examined microscopically (x400) for identification of clue cells and bacteria morphocytes. These vaginal secretions (on wet smears) were also subjected to studies using Amsel and Nugent criteria. Each sample was also cultured for the offending organisms. The remainder of the prenatal care and BV screening was under the direction of the principal investigator.

The protocol and consent was approved by the ethical committee of ABUTH Zaria. Diagnoses were by Amsel criteria and Nugent score. By Amsel's criteria, at least three of the four criteria should be present for diagnosis of Bacterial vaginosis to be confirmed. The criteria included (i) thin, white homogenous discharge, (ii) clue cells on microscopy, (iii) pH of vaginal fluid greater than 4.5, and (iv) release of fishy odor on adding alkali (10% potassium hydroxide) or positive Whiff's test. The Nugent score estimated relative proportion of bacteria morphotypes to give a score between 0 and 10. Less than 4 was regarded as normal, 4-6 as intermediate, greater than 6 as indicative of the presence of Bacterial vaginosis. The Nugent score was the main diagnostic test.

**Table 1** Socio-demographic characteristics of respondents,\*Fisher's exact test.

Variable	Item	Bacteria vaginosis		$\chi^2$ (P-value)	OR (95% CI)	Total (%)
		Positive	Negative			
		Freq (%)	Freq (%)			
Age (years)	20-24	8 (25.0)	48 (25.5)	0.04 (0.95)	0.97 (0.41, 2.31)	57 (25.9)
	25-29	16 (50.0)	58 (30.9)	4.49 (0.03)	2.24 (1.05, 4.79)	74 (33.6)
	30-34	4 (12.5)	26 (13.8)	0.006 (0.94)*	0.89 (0.29, 2.75)	30 (13.6)
	35-39	4 (12.5)	24 (12.8)	0.06 (0.81)*	0.98 (0.31, 3.03)	27 (12.3)
	≥ 40	0 (0.0)	32 (17.0)	5.08 (0.02)*	Undefined	32 (14.6)
Educational status	None	1 (3.1)	1 (0.5)	0.18 (0.67)*	6.03 (0.37, 98.98)	2 (1.0)
	Koranic	10 (31.3)	58 (30.9)	0.002 (0.96)	1.02 (0.45, 2.29)	68 (30.9)
	Primary	9 (28.1)	39 (20.7)	0.87 (0.35)	1.50 (0.64, 3.49)	48 (21.8)
	Secondary	9 (28.1)	63 (33.5)	0.36 (0.55)	0.78 (0.34, 1.78)	72 (32.7)
	Tertiary	3 (9.4)	27 (14.4)	0.23 (0.63)*	0.62 (0.18, 2.17)	30 (13.6)
Occupational status	Housewife	12 (37.5)	75 (39.9)	0.07 (0.80)	0.90 (0.42, 1.96)	87 (39.5)
	Business/trading	7 (21.9)	34 (18.1)	0.26 (0.61)	1.27 (0.51, 3.17)	41 (18.6)
	Civil servant	1 (3.1)	16 (8.5)	0.49 (0.49)*	0.35 (0.04, 2.71)	17 (7.7)
	Artisan	7 (21.9)	52 (27.7)	0.47 (0.49)	0.73 (0.30, 1.80)	59 (26.8)
	Student	5 (15.6)	11 (5.9)	3.87 (0.04)	2.30 (0.96, 9.24)	16 (7.3)
Occupation of partner	Civil servant	12 (37.5)	69 (36.7)	0.01 (0.93)	1.03 (0.48, 2.24)	81 (36.8)
	Farmer	1 (3.1)	12 (6.4)	0.10 (0.75)*	0.47 (0.06, 3.77)	13 (5.9)
	Business man	3 (9.4)	42 (22.3)	2.08 (0.15)*	0.36 (0.10, 1.24)	45 (20.5)
	Petty trader	9 (28.1)	14 (7.4)	12.49 (0.0004)	4.86 (1.89, 12.49)	23 (10.4)
	Artisan	2 (6.3)	25 (13.3)	0.69 (0.41)*	0.43 (0.10, 1.93)	27 (12.3)
Parity	0	3 (9.4)	39 (20.7)	1.61 (0.20)*	0.40 (0.11, 1.37)	42 (19.1)
	1	6 (18.8)	30 (16.0)	0.16 (0.69)	1.22 (0.46, 3.21)	36 (16.4)
	2-4	13 (40.6)	71 (37.8)	0.09 (0.76)	1.13 (0.52, 2.42)	84 (38.2)
	5 and more	10 (31.3)	48 (25.5)	0.46 (0.50)	1.33 (0.59, 3.00)	58 (26.4)
Type of marriage	Monogamous	16 (50.0)	125 (66.5)	3.23 (0.07)	0.5 (0.24, 1.07)	141 (64.1)
	Polygamous	16 (50.0)	63 (33.5)			79 (35.9)
Total		32 (14.5)	188 (85.5)	-	-	220 (100.0)

Reference group in each case referred to pregnant women who were confirmed to have Bacterial vaginosis. Data was analyzed using SPSS computer software version 15.0. Significance was considered at a p-value of <0.05. Data was presented in tables and figures.

## Results

A total of 228 clients were initially recruited for the study but 220 (96.5%) of them completed it. Of these 220 clients, 32 (14.5%) were confirmed to have Bacterial vaginosis (BV) based on Nugent score (**Table 1**).

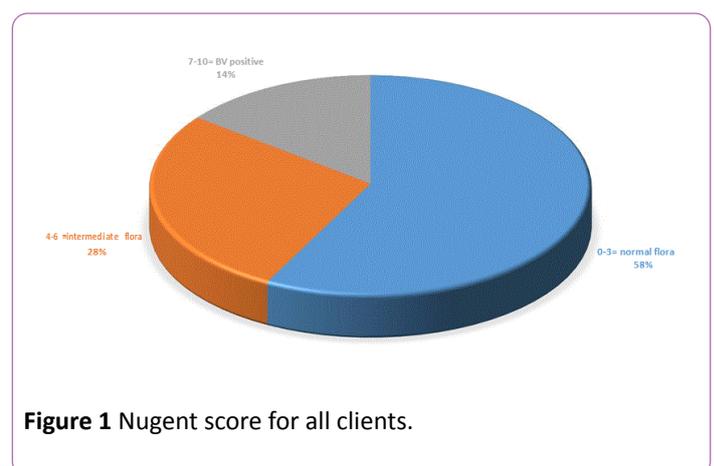
There was no significant statistical difference ( $t=-0.85$ ,  $df=49.9$ ,  $P\text{-value}=0.20$ ) in the mean ( $\pm$  SD) age (in years) of clients with ( $25.5 \pm 4.7$ ) and without ( $26.3 \pm 6.0$ ) BV. The infection was more prevalent (16, 50.0%) among those aged 25-29 years who were 2.2 times more likely to present with BV than any other age group ( $\chi^2=4.49$ ,  $P\text{-value}=0.03$ ,  $OR=2.24$ ,  $CI: 1.05, 4.79$ ). Bacterial vaginosis was more prevalent among women who had only Koranic education (10, 31.3%), among occupational housewives (12, 37.5%) and among those with a parity of 2-4 (13, 40.6%).

**Table 2** Prevalence of bacteria vaginosis by gestational age of index pregnancy, history of vaginal discharge and risk factors, \*Fisher's exact test.

Variable	Item	Bacteria vaginalis		Total (%)	$\chi^2$ (P-value)	OR (95% CI)	
		Positive	Negative				
		Freq. (%)	Freq. (%)				
Gestational Age (weeks)	1-13	1 (3.1)	10 (5.3)	11 (5.0)	0.01 (0.93)*	0.57 (0.07, 4.65)	
	14-26	26 (81.3)	146 (77.7)	172 (78.2)	0.21 (0.65)	1.25 (0.48, 3.23)	
	27-39	5 (15.6)	32 (17.0)	37 (16.8)	0.04 (0.85)	0.90 (0.32, 2.52)	
	40 and over	-	-	-	-	-	
History of Vaginal Discharge	Yes	11 (34.4)	74 (39.4)	85	0.29 (0.59)	0.81 (0.37, 1.77)	
	-Whitish discharge	11 (100.0)	45 (60.8)	56	-	-	
	-Thick	6 (54.5)	51 (68.9)	57	-	-	
	-Itching	4 (36.4)	21 (28.4)	25	-	-	
	-Rashes	3 (27.3)	17 (23.0)	20	-	-	
Risk factors	Douching	-Remarkable Odor	2 (18.2)	10 (13.5)	12	-	-
		Yes	26 (81.3)	162 (86.2)	188	-	-
	Hormonal contraceptive use	No	6 (18.8)	26 (13.8)	32	0.53 (0.47)	0.70 (0.26, 1.85)
		Yes	3 (9.4)	35 (18.6)	40	-	-
	HIV status	No	29 (90.6)	153 (81.4)	182	1.05 (0.31)*	0.42 (0.13, 1.57)
		Positive	3 (9.4)	7 (3.7)	10	-	-
		Negative	29 (90.6)	178 (94.7)	207	0.88 (0.35)	2.63 (0.64, 10.76)
		Unknown	-	3(1.6)	3	-	-
Total		32 (14.5)	188 (85.5)	220 (100.0)	-	-	

Only 1 (3.1%) of the 32 BV positive clients presented for ANC in the first trimester (1-13 weeks) compared to 26 (81.3%) who presented in the second trimester (14-26 weeks) and 5 (15.6%) in the third trimester of pregnancy (**Table 2**). Though 11 (34.4%) of the BV positive and 74 (39.4%) of BV negative clients respectively complained of vaginal discharge, the overall prevalence of asymptomatic Bacterial vaginosis was 9.6% (21/220). Bacterial vaginosis was observed more among pregnant women who practiced douching (26, 81.3%) but not among those who used hormonal contraceptives (3, 9.4%) or those who were HIV positive (3, 9.4%). Of the 32 BV positive clients, 11 (34.4%) gave a history of vaginal discharge. All (11, 100.0%) had whitish discharge which was thick in 6 (54.5%) women. The discharge was associated with itching in 4 (36.4%) women, with rashes in 3 (27.3%) women and with remarkable odour only in 2 (18.2%) women (**Figure 1**).

Whiff's test was positive for 14 (43.8%) BV positive and 99 (52.7%) BV negative clients with no significant statistical difference between these two groups (**Table 3**).

**Figure 1** Nugent score for all clients.

Pregnant women who were BV positive were about 1½ times more likely to present with thin, non-offensive homogenous discharge than those who were BV negative ( $\chi^2=0.78$ , P-value=0.38, OR=1.44, 95% CI: 0.64, 3.28). In addition, BV positive clients were about twice more likely to present with typical thin, non-offensive homogenous vaginal discharge than BV negative clients ( $\chi^2=1.63$ , P-value=0.20, OR=2.06, 95% CI: 0.68, 6.23). Using Amsel's clinical criteria, 25% had BV with a combination of

i) positive Whiff's test with 10% KOH, (ii) presence of clue cells on microscopy, (iii) vaginal pH>4.5 and (iv) thin, homogenous non-offensive discharge, thereby confirming the diagnosis of bacterial vaginosis. The mean ( $\pm$  SD) pH of clients with bacterial vaginosis was 4.7 (0.5) while that of clients without BV was 4.8 (0.5) without any notable difference among the two. However, BV positive clients were 3.3 times more likely to have pH<4.5 than BV negative patients ( $\chi^2=4.57$ , P-value=0.03, OR=3.30, 95%

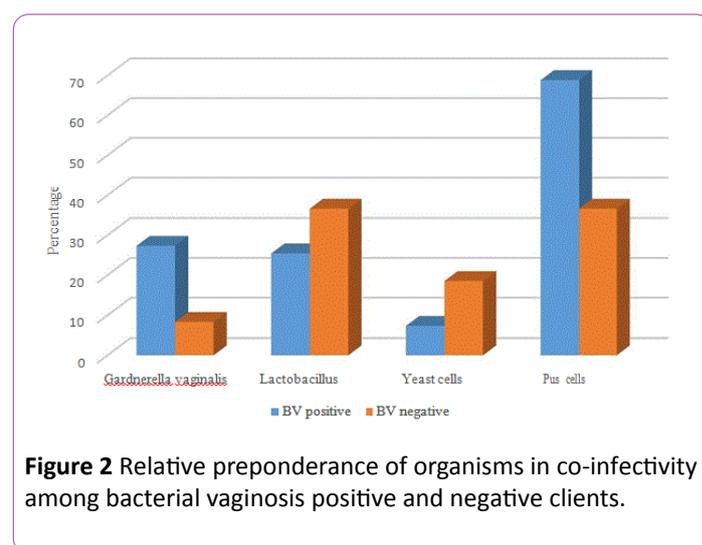
CI: 1.05, 10.38) (**Table 3**). There was also a noteworthy variance in the proportion of BV positive clients among whom Clue cells were observed at microscopy (17, 53.1%) compared to those who were BV negative (47, 25%). Furthermore, patients who were BV positive were about 3½ times more likely to be Clue cell positive than those who were BV negative ( $\chi^2=10.49$ , P-value=0.001, OR=3.40, 95% CI: 1.58, 7.33).

**Table 3** Prevalence of BV by components of the amsel criteria.

Variable	Item	Bacteria vaginalis		$\chi^2$ (P-value)	OR (95% CI)
		Positive	Negative		
		Freq. (%)	Freq. (%)		
Characteristics	pH $\leq$ 4.5	5 (15.6)	10 (5.3)	4.57 (0.03)	3.30 (1.05, 10.38)
	pH>4.5	27 (84.4)	178 (94.7)		
Clue cells	Present	17 (53.1)	47 (25.0)	10.49 (0.001)	3.40 (1.58, 7.33)
	Absent	15 (46.9)	141 (75.0)		
Whiff test	Positive	14 (43.8)	99 (52.7)	0.87 (0.35)	0.70 (0.32, 1.49)
	Negative	18 (56.3)	89 (47.3)		
Vaginal discharge on examination	Yes	18 (56.3)	45 (23.9)	0.78 (0.38)	1.44 (0.64, 3.28)
	Typical (thin, non-offensive, homogenous)	8 (44.4)	17 (37.8)	1.63 (0.20)	2.06 (0.68, 6.23)
	Atypical	8 (44.4)	28 (62.2)		
	No	14 (43.7)	143 (76.1)	-	-

Of the 32 clients who were diagnosed to be BV positive using Nugent score, only 12 (37.5%) were confirmed to be BV-positive while 20 (62.5%) were confirmed to be BV-negative using Amsel's criteria. Using the Nugent score as the gold standard, Amsel criteria has a sensitivity of 37.5%, specificity of 70.7%, positive predictive value (PPV) of 17.9% and a negative predictive value (NPV) of 86.9% (**Table 4**).

Overall, 358 organisms were isolated from all the clients including 55 (15.4%) from the BV positive patients and 303 (84.6%) from BV negative patients (**Table 5**). Clients who were positive for BV were over four times more likely to have *Gardnerella vaginalis* co-infection ( $\chi^2=16.79$ , P-value=0.00004, OR=4.17, 95% CI: 2.03, 8.57) and were 1.15 times more likely to have Pus cells ( $\chi^2=0.23$ , P-value=0.63, OR=1.15, 95% CI: 0.64, 2.08) compared to those who were BV negative. **Figure 2** shows the relative preponderance of these organisms.



**Figure 2** Relative preponderance of organisms in co-infectivity among bacterial vaginosis positive and negative clients.

**Table 4** BV status by method of diagnosis.

	Nugent BV positive	Nugent BV negative	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Amsel positive BV	12 (37.5)	55 (29.3)	37.50%	70.00%	17.90%	86.90%

Amsel negative	BV	20 (62.5)	133 (70.7)			
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## Discussion

Bacteria Vaginosis (BV), the commonest lower female genital tract condition, causes a lot of problems in and outside of pregnancy [3-5]. In pregnancy, it causes late miscarriages, preterm labor, premature rupture of membranes, post-partum endometritis, low birth weight etc. [11-16]. All these impact on perinatal and maternal morbidity and mortality. BV is thus a significant infection in pregnancy.

The prevalence of Bacterial vaginosis among this study population was 14.6% and this falls within 10-40% of the prevalence reported among women in the literature worldwide [11]. This is quite significant considering the complications of

Bacterial vaginosis such as miscarriages, premature rupture of membranes and preterm birth, especially in an environment in sub-Saharan Africa, where facilities for neonatal resuscitation and intensive care are inadequate. Using polymerase chain reaction (PCR) method combined with Nugent score, Anukam et al. [4] also reported similar prevalence of BV (14.6%) among non-pregnant women in the southern part of Nigeria. This possibly indicates that pregnancy may not necessarily influence presence or absence of bacterial vaginosis. Certain key findings in this study need further discussion. The first is that Bacterial vaginosis was found to be most prevalent in certain socio-demographic spectrum.

**Table 5** Organisms seen on microscopy according to presence of BV, NB: Some organisms were mixed on a single microscopy.

Organism	BV positive (n=32)	BV negative (n=188)	Total	$\chi^2$ (P-value)	OR (95% CI)
	Freq. (%)	Freq. (%)			
<i>Gardnerella vaginalis</i>	15 (46.9)	25 (13.3)	40 (11.2)	16.97 (0.00004)	4.17 (2.03, 8.57)
Lactobacillus	14 (43.8)	111 (59.0)	125 (34.9)	2.56 (0.11)	0.59 (0.31, 1.13)
Yeast cells	4 (12.5)	56 (29.8)	60 (16.8)	3.43 (0.06)	0.35 (0.12, 1.00)
Pus cells	22 (68.8)	111 (59.0)	133 (37.1)	0.23 (0.63)	1.15 (0.64, 2.08)
Total number of organisms	55	303	358	-	-

It is interesting to note that this condition was not observed in pregnant women aged 40 years and above but was seen more in the age group of 25-29 years in consonance with what Turovskiy et al. [17] reported. Taking age group of 20-25 years into consideration, 75% of pregnant women consulting for ANC in this tertiary hospital would have been positive for Bacterial vaginosis. Early sexual debut and possible multiple sexual partners due to frequent divorce, are observed in Northern Nigeria and may be risk factors for BV as reported in some studies [18-21].

Bacteria vaginosis was not prevalent among clients with tertiary education but was more commonly found among those with little or no education. This finding agrees with what Harville et al. [11] reported that poor education and income are linked with higher risk of BV.

Bacteria vaginosis was rarer (9.4%) among women in their first pregnancy that among those who had had one child or more. In fact, the proportion of women with Bacterial vaginosis increased as parity increased till 4 after which the proportion declined. Also, more pregnant women in polygamous (16/79, 20.4%) than in monogamous (16/141, 11.3%) marriage presented with Bacterial vaginosis. One of the possible reasons for these situations is exposure to either multiple sexual partners and/or exposure to several heterosexual activities which are identified risk factor for BV [22].

Another key finding was that Bacterial vaginosis was more prevalent in the second and third trimester. The mean gestational age at which pregnant women in this study booked for ANC was 21 weeks. Trabet and Misra [23] reported increased likelihood of BV among women who have greater frequency of intercourse during the first trimester of pregnancy. On the other hand, after an 8 week follow-up from 14 weeks of gestation, Krauss-Silva et al. [24] observed a reversal to BV negative in about 40% of pregnant women who were initially positive. Presence or absence of BV at any stage of pregnancy seems to be a controversial issue. For example, a study reported that certain cytokines produced in mid-pregnancy were protective against BV, while others, such as IL6-174 G>C polymorphism increased the risk of developing BV [25]. The diagnosis of BV in the second trimester has been linked with high risk of preterm delivery and premature rupture of the membrane [26] though there may be other causes of preterm delivery and premature rupture of the membrane.

Incidentally, the proportion of pregnant women who practiced douching among the BV positive and BV negative clients was not significantly different, though among the 188 pregnant women who claimed they practiced douching, 26 (13.8%) were BV positive in contrast to the 6 (18.8%) of the 32 who claimed to not practice douching. Douching is a strong risk factor for BV, preterm birth, low-birth-weight infants, pelvic inflammatory disease, chlamydial infection, tubal pregnancy, higher rates of HIV transmission, and cervical cancer [27, 28].

One interesting finding was that BV positive patients were over 2½ times more likely to be HIV positive than BV negative patients. The prevalence of HIV among this cohort of pregnant women studied was 4.5% which agrees with the national HIV prevalence of 4.4% reported from the National Sentinel Survey [29]. This is in line with the documented suggestion that BV enhances heterosexual HIV transmission [30, 31].

The finding of typical vaginal discharge – thin, non-offensive and homogenous and non-offensive – in about 56% of the BV positive women correlates with the 58% reported by Srinivasan et al. [32]. The use of gram stained smear has been found to have higher sensitivity and specificity [33-35]. Using the Nugent score, only 14.6% had Bacterial vaginosis compared to 25% who had a combination of at least 3 of the 4 composite Amsel clinical criteria. Only 12 (37.5%) of the clients were BV positive by both Nugent score and Amsel clinical criteria [36]. Although Amsel criteria method is convenient and relatively inexpensive it is not always reliable. In this study, it had a low sensitivity compared to Nugent score. Kurki et al. [37] claimed that determination of vaginal pH is deficient in specificity since elevated vaginal pH may also depend on a variety of other conditions of the female lower genital tract.

Final major findings were the isolations of various organisms such as *Gardnerella vaginalis* more in BV positive (15/32, 46.9%) pregnant women similar to the 44.4% reported in The Gambia [6]. This was not surprising as this organism has been implicated as the causative agent of Bacterial vaginosis. For example, some authors [38, 39] proposed *Gardnerella vaginalis* biofilms as hazardous in BV pathogenesis and symptomatology. *Lactobacillus* spp., recorded less among BV positive pregnant women, was found to be one of most prevalent natural microbiota of the lower genital tract in women; others being *L. crispatus*, *L. jensenii* and *L. iners* [40-42], together creating a critical frontline guard against possible invading pathogens. Circulating hormones were thought to modulate the delicate symbiotic balance between Lactobacilli and the vaginal tract. Our finding of decreased concentration of Lactobacilli spp. was in accord with the explanation that BV, a poly microbial syndrome, resulted in milieu of decreased *Lactobacilli* spp. concentration and in increased pathogenic bacteria, including *Gardnerella vaginalis* [43, 44].

These findings have some clinical and practical implications. The high prevalence of BV among first time antenatal attendees (and by extension pregnant women in this study) reflects the potential negative effects BV can have on pregnancy and its outcome such as miscarriages, preterm births and increased risk of infection to the pregnant woman among other negative effects. The fact that most of the women in this study first presented for ANC relatively late (in their second trimester) when the damage may have been done is worrisome. Our study will therefore recommend early commencement of ANC and screening for BV at least in high risk women. Women in child-bearing age should have access to health education on prevention of BV at school, or through radio and television. The clinical impact of the right measures taken as a result of the findings from this study will be a reduction of perinatal and maternal morbidity and mortality related to BV.

## Conclusion

The overall prevalence of Bacterial vaginosis in pregnant women attending antenatal care for booking at ABUTH, Zaria is high and thus should be considered as an important condition in pregnant women by clinicians. The presence of clue cells on microscopy and isolation of *Gardnerella vaginalis* were significant indicators of presence of Bacterial vaginosis. There was no significant difference in mean pH of BV positive and BV negative patients and douching and other intra-vaginal practices were common practices among women in the study population. Screening for bacterial vaginosis preferably using the Nugent score, at least in high risk pregnant women may be worthwhile even if they are asymptomatic especially in the second trimester. A larger prospective study should be carried out to better demonstrate risk factors and possible adverse effects of Bacterial vaginosis.

## Study Limitations

This study had some limitations that need explanation. Firstly, this was a facility-based study on a small non-representative sample of pregnant women. Therefore, extrapolating our findings to the general population may not be possible.

Secondly, first-time ANC clients typically presented during the later stages of pregnancy at ABUTH. Screening at earlier gestation would have been preferred. The study was unable to establish the temporality of BV infections, past pregnancy outcomes and risk factors for BV acquisition.

Thirdly, a prospective study to look at the effect of BV on pregnancy outcome was hampered by ethical issues and lack of consensus on whether to treat BV in pregnancy or not and the effect of either action. Equally of concern was the fact that follow up was difficult because patients/clients who enrolled at ABUTH ANC may not deliver in the hospital. Deliveries at home and elsewhere were still prevalent in Northern Nigeria when this study was carried out. These and other risk factors such as use of IUCD, previous STI, frequency of coitus and cigarette smoking could not be linked with presence of Bacterial vaginosis.

Lastly, the study was carried out in only one out of six geo-political zones and several ecological locations such as the Atlantic Ocean coastline in the south and the mountainous regions on the eastern flank of the country. As such, conclusions based on findings may lack external validity.

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