

# Bacterial Vaginosis and Associated Factors Among Pregnant Women Attending Antenatal Care in Harar City, Eastern Ethiopia

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**Background:** Bacterial vaginosis is one of the most common causes of abnormal vaginal discharge in women of reproductive age, especially pregnant women. It is characterized by the decrement of lactobacilli and increasing proliferation of diverse anaerobic bacteria. The prevalence of bacterial vaginosis and contributing factors vary between countries, within the same country, and among different populations.

**Objective:** The purpose of this study was to determine the prevalence of bacterial vaginosis and associated factors among pregnant women attending antenatal care from May 5–July 15, 2021 in health-care facilities found in Harar town, eastern Ethiopia.

**Methods and Materials:** An institutional-based cross-sectional study was conducted among 248 pregnant women attending antenatal care through systematic random sampling. Data were collected using a structured questionnaire and two vaginal swabs were collected using sterile swabs and transported to the microbiology laboratory. Samples were analyzed using Amsel's criteria or using Nugent scoring criteria and culture. Data were entered into EpiData version 3.1 and transferred to SPSS version 25 for analysis. Binary logistic regression was used to identify variables associated with bacterial vaginosis. P-value <0.05 was considered statistically significant.

**Results:** Altogether 248 pregnant women were included in the study. Overall, 21.4% (95% CI: 16, 27) of study participants had bacterial vaginosis. History of sexually transmitted infection (AOR = 6.0, 95% CI: 1.94, 19.07; P = 0.002), history of spontaneous abortion (AOR = 5.8, 95% CI: 1.55, 22.02; P = 0.009), multiple sex partners (AOR = 8.6, 95% CI: 2.93, 25.79; P = 0.000) and having vaginal discharge (AOR = 5.5, 95% CI: 2.48, 12.41; P = 0.000) were significantly associated with bacterial vaginosis.

**Conclusion:** The prevalence of bacterial vaginosis is higher among symptomatic pregnant women and associated with a history of sexually transmitted infection, vaginal discharge, multiple sexual partners and spontaneous abortion.

**Keywords:** bacterial vaginosis, *Lactobacilli*, *G. vaginalis*, Amsel's criteria, Nugent scoring system

## Introduction

Bacterial vaginosis (BV) is one of the most common causes of vaginitis in women of reproductive age, resulting from decrement of lactobacilli and increasing proliferation of diverse anaerobic bacteria.<sup>1,2</sup> Bacterial vaginosis is the most common vaginal dysbiosis that affects women of childbearing age and comprises around 50% of all cases of vaginitis worldwide.<sup>3,4</sup>

About 50–75% of women with BV are asymptomatic,<sup>5</sup> however, some women with BV experience symptoms such as thin grayish-white discharge, itching, vaginal irritation, and malodorous fishy odor during sexual intercourse which have a significant negative impact on a woman's self-esteem, sexual relationships and quality of life.<sup>6–8</sup>

BV is associated with adverse outcomes, including spontaneous abortion, preterm birth, stillbirth, low birth weight, chorioamnionitis, postpartum endometritis, increased risk of pelvic inflammatory disease and it facilitates the transmission of sexually transmitted infection.<sup>9–11</sup> In addition, BV increases the risk of acquiring human immunodeficiency virus infection by 40–60%.<sup>12,13</sup> BV is also associated with a history of sexually transmitted infection and the number of sex partners.<sup>14</sup>

Globally, the burden of BV infection among reproductive age women varies from country to country, being most common in Africa and less common in America, Europe and Asia, which ranges from 5–70%.<sup>15</sup> The incidence of BV is

higher among low socioeconomic countries including Ethiopia. A few previous studies showed that the prevalence of BV in Ethiopia ranges from 2.8–19.4%, with only a single study among pregnant women.<sup>16,17</sup> Using different methods to diagnose BV may result in variation among the prevalence reports.<sup>18</sup>

Bacterial vaginosis can be diagnosed clinically using Amsel's criteria or through the laboratory using the Nugent scoring system.<sup>19</sup> A combination of both Amsel's clinical criteria and Nugent grade scoring system of Gram stain is better for an accurate diagnosis of BV. A few previous studies conducted used either Amsel's clinical criteria or Nugent grade scoring system only, however, none of the previous researchers used culture to isolate *G. vaginalis*; which accelerates formation of the biofilm that largely contributes to the development of BV in combination with other anaerobic organisms. Overall, to the researchers' knowledge, there has been limited information about BV among pregnant women in Ethiopia. Furthermore, bacterial vaginosis is linked to a number of pregnancy complications that warrant global consideration; Ethiopia has neither an intensive analysis nor successful control systems. In order to prevent complications of BV among pregnant women, early diagnosis and treatment are crucial.

Therefore, this study aimed to determine the prevalence of bacterial vaginosis and associated factors among pregnant women attending antenatal clinics (ANC) using clinical and different laboratory diagnostic techniques including microbial culture.

## Methods and Materials

### Study Setting, Design, and Duration

The study was conducted in Harar city, a capital city of the Harari regional state, in the eastern part of Ethiopia. Harar is found 550 km away from the capital Addis Ababa. Based on population projections, the estimated total population of Harar was 226,412 (Central Statistical Agency 2007) and 4300 pregnant women in 2020. The study was conducted in two selected health facilities; Hiwot Fana Specialized University Hospital and Family Guidance Association of Ethiopia (FGAE) from May 5 to July 15, 2021.

An institutional-based cross-sectional study was conducted among pregnant women attending ANC follow up in health facilities in Harar city. Those who had taken antibiotics in the preceding two weeks were excluded from the study.

### Sample Size and Sampling Technique

The sample size ( $n = 248$ ) was calculated using a single population proportion formula with the following assumptions: confidence level of 95%, margin of error 5%, prevalence of bacterial vaginosis among pregnant women 19.4% in Addis Ababa<sup>17</sup> Ethiopia, and 10% non-response rate. Health facilities (hospitals and clinic) in Harar City were stratified to governmental health facilities and non-governmental health facilities. One governmental and one non-governmental health facility were selected using the lottery method. The sample size was proportionally allocated to the selected health facility based on the average ANC follow up in the previous three months. An eligible pregnant woman was included in the study using a systematic random sampling technique.

### Data Collection Method

Training was given to nurses recruited as data collectors. The trained nurses completed the standardized questionnaire after informed, voluntary, written and signed consent was obtained. Data were collected regarding socio-demographic characteristics and associated factors, such as history of spontaneous abortion, previous usage of IUCDs, vaginal discharge, history of preterm birth, number of lifetime sex partners and previous history of an STI. Trained nurses collected two vaginal swabs from the lateral and the posterior vaginal fornix while observing for consistency and color of vaginal discharge. One swab was used for analysis of Amsel's criteria and the second swab was used for Gram staining and culture. The collected swab specimens were tested for PH; then immediately dipped into Amies transport media and transported to the microbiology laboratory.

### Diagnostic Method of Bacterial Vaginosis

In this study, two main diagnostic methods of bacterial vaginosis were applied; clinical criteria and laboratory-based method. The most widely used clinical criteria are Amsel's clinical criteria which include PH measurement (using

a Whatman PH meter that measures pH from 1–14), saline wet mount (for clue cells) and for whiff test (to see for fishy or amine odor) as one indicator of BV by the addition of 10% KOH. Bacterial vaginosis is clinically diagnosed by Amsel's criteria by at least fulfilling three out of four of the following criteria: homogeneous thin gray or white vaginal discharge, positive whiff test, high vaginal PH >4.5 and presence of clue cell.<sup>20</sup>

Diagnosis of BV was also conducted by the Nugent grade scoring system of Gram stain of vaginal discharge. In BV diagnosis, Gram staining classified the bacteria as *Lactobacillus* morphotypes for large Gram-positive bacilli, *Mobiluncus* morphotypes for curved Gram-negative while *Gardnerella vaginalis* (*Bacteroides* morphotypes) were reported as small Gram-variable rod/coccobacilli as indicated in Table 1. The Nugent scoring system is a gold standard test that involves grading of Gram staining of vaginal smear; and Amsel's clinical criteria are non-quantifiable and non-reproducible clinical symptoms.<sup>21–23</sup> The Nugent score is based on the idea that having high numbers of *Lactobacillus* spp. are indicative of health, and their depletion with increased proportions of morphotypes resembling *Gardnerella*, *Bacteroides* spp., and curved Gram-variable rods is indicative of bacterial vaginosis.<sup>24</sup>

Morphotypes were scored as average number of each morphotype seen after examining at least 10–20 high power (oil immersion) fields. The total score of the Gram stain results were added together to get the final score as summarized below.

(*Lactobacillus* spp. + *G. vaginalis*/*Bacteroides* + *mobiluncus* spp). “0” score, no morphotypes present; 1, ≤1 morphotype present; 2, 1–5 morphotypes present; 3, 6–30 morphotypes present; 4, >30 morphotypes present (Table 1). All morphotypes added together to give a final score ranging from 0–10. Nugent score of 7–10 was considered positive for BV, a score of 0–3 was considered “normal”, and a score of 4–6 was considered “intermediate flora”.<sup>25,26</sup>

Those samples that were classified as bacterial vaginosis by either Amsel's criteria or Nugent grading system of Gram stain or both were cultured on blood agar and De Man Rogosa Sharpe (MRS) agar<sup>27</sup> and incubated at 37°C, with 5% CO<sub>2</sub> for 24–48 hours. MRS is a selective culture medium designed to favor the growth of Lactobacilli. *Gardnerella vaginalis* was identified by beta-hemolytic appearance of the transparent colonies on 5% sheep blood agar plate with 5% CO<sub>2</sub> in a candle jar as a facultative anaerobe. For beta-hemolytic organisms, catalase test was performed to identify species of interest. For the catalase negatives, starch hydrolysis and oxidase tests were conducted. *G. vaginalis* was recognized by a positive beta-hemolysis on blood agar and starch hydrolysis test, as well as catalase and oxidase negative. Starch hydrolysis test for *G. vaginalis* culture was inoculated onto starch medium and incubated at 37°C. After overnight incubation, the plate was flooded with Lugol's iodine solution. Presence of clear, colorless zone indicates starch hydrolysis.<sup>28</sup>

## Data and Sample Quality Control

The questionnaire was prepared in English and translated into the local language (Afaan Oromo, and Amharic), as the study subject speaks Afaan Oromo & Amharic. Then the questionnaire was translated back into English to check for consistency. A questionnaire was pretested on 5% of pregnant women attending ANC at Jugal hospital to check for comprehensiveness, order, validity, and reliability. Quality of samples was maintained following aseptic procedure during sample collection, using sterile applicator sticks for sample collection and Amies transport media for transportation to the microbiology laboratory. Quality control of Gram stain was checked using known control slides to ensure the quality of reagents as well as the efficacy of staining procedures. Culture media were tested for sterility and performance tests. The

**Table 1** Summary of the Nugent Grade Scoring System

Score	<i>Lactobacillus</i> Large Gram-Positive Bacilli	<i>Gardnerella vaginalis</i> / <i>Bacteroides</i> Gram-Variable Rods/Coccobacilli	<i>Mobiluncus</i> Small Curved Gram-Negative Rods
0	4+	0	0
1	3+	1+	1–4
2	2+	2+	≥5
3	1+	3+	
4	0	4+	

Note: 1+ ≤ 1/100×/ field; 2+ = 1–5/100×/ field; 3+ = 6–30/100× field; 4+ >30/100×/field.

performance test for culture was improved by strictly following the manufacturer's instructions. Equipment used in the microbiology laboratory such as autoclave, incubators, refrigerator, and other instruments was monitored using standard procedures and by performing proper routine maintenance, maintaining optimum temperature, humidity, and other condition to ensure the results are accurate and reproducible. Sterility of culture media was assessed by incubating 3–5% of batches of prepared culture media at 35–37° for 24 hours and checked for any growth.

## Methods of Data Analysis

Collected data were checked for completeness and consistency and entered into EpiData3.1 and transferred into SPSS version 25 for analysis. Bivariate analysis was used to identify variables associated with bacterial vaginosis. Variables with no missing value and having no multicollinearity were included in bivariate analyses. All variables which were shown to be  $P < 0.25$  on bivariate analysis were selected for multivariable analysis to check for possible association with bacterial vaginosis by controlling potential confounding factors through backward LR (likelihood ratio). Model fitness for application of multivariate analysis was checked by using Hosmer-Lemeshow goodness of fit model. AOR and P-values  $< 0.05$  were considered statistically significant.

## Ethical Considerations and Informed Consent

Ethical approval was obtained from Haramaya University College of Health and Medical Sciences' Institutional Health Research Ethics Review Committee (IHRERC) with Ref. No. IHRERC/057/2021. This study was conducted in accordance with the Declaration of Helsinki. Prior to data collection, written informed consent was obtained from participants. The objective of the study was explained to the participants, and those who agreed to participate were included in the study. A female nurse collected the vaginal swab in a separate room to ensure the participant's privacy and confidentiality. Unauthorized persons were unable to access the obtained data. Participants who tested positive for BV by either Amsel's criteria or Nugent grading system of Gram stain or by both methods were immediately reported to their service provider, who gave them recommended therapy. Covid-19 prevention and control measures were briefly addressed with data collectors, and protective equipment (face masks and sanitizer) was provided to data collectors during the data collection process to protect them from Covid-19.

## Results

### Socio-Demographic and Health-Related Characteristics of Study Participants

The study included a total of 248 pregnant women from two health facilities, of which 55.2% were living in rural areas, 97.6% were married and 31.5% had attended primary education. Participants' age ranged from 17–43 years, with mean ( $\pm$ SD) age of 26.29 ( $\pm$ 4.54) years. Most of the study participants (60.5%) were within the 25–34 age group and 51.6% were housewives. Of the total participants, 37.9% had vaginal discharge and a majority (58.9%) were multigravida (Table 2).

**Table 2** Socio-demographic and Health Related Characteristics of Study Participants

Variable Name	Category	N	(%)
Age	≤24	82	33
	25–34	150	60.5
	>35	16	6.5
Residence	Urban	114	44.8
	Rural	134	55.2
Marital status	Single	3	1.2
	Married	242	97.6
	Divorced	1	0.4
	Widowed	2	0.8

(Continued)

**Table 2** (Continued).

Variable Name	Category	N	(%)
<b>Educational status</b>	Unable to read and write	73	29.4
	Primary	78	31.5
	Secondary	62	25
	Higher education	35	14.1
<b>Occupational status</b>	Employee	31	12.5
	Farmer	23	9.3
	Housewife	128	51.6
	Merchant	32	12.9
	Student	24	9.7
	Others	10	4
<b>Having vaginal discharge</b>	Yes	94	37.9
	No	154	62.1
<b>Previous use of IUCDs</b>	Yes	5	2
	No	243	98
<b>History of STI</b>	Yes	22	8.9
	No	226	91.1
<b>History of spontaneous abortion</b>	Yes	16	6.5
	No	232	93.5
<b>Number of sex partners</b>	1	221	89.1
	≥2	27	10.9
<b>History of preterm birth</b>	Yes	21	8.5
	No	227	91.5
<b>Number of pregnancy</b>	Primigravida	102	41.1
	Multigravida	146	58.9

**Abbreviations:** IUCDs, intrauterine contraceptive devices; STI, sexually transmitted infection.

## Magnitude of Bacterial Vaginosis and Associated Factors

In this study the overall prevalence of bacterial vaginosis by Nugent grade scoring system or Amsel's criteria was 21.4% (53/248) (95% CI: 16, 27). *G. vaginalis* was isolated in 25 from the total BV case by the culture method. This accounts for 10.1% of study participants.

According to Nugent's scoring system, of the 248 study participants, 51/248 (20.6%) were diagnosed as bacterial vaginosis with a Nugent score of 7–10, and 37/248 (14.9%) as intermediate with a Nugent score of 4–6. The implications of “intermediate flora” are unclear; however, it might proceed to BV or to normal flora. Using Amsel's criteria, 48/248 (19.35%) of the pregnant women were diagnosed with bacterial vaginosis. Only 25/53 of the participants with bacterial vaginosis were found to have *Gardnerella vaginalis* on culture.

Of the 53 BV cases, 46 were positive by both Nugent grade scoring system and Amsel's criteria, 5 were reported as BV by the Nugent grade scoring system, but negative by Amsel's criteria; and 2 were positive by Amsel's criteria, but classified as intermediate (score 4–6) by the Nugent scoring system. From the 53 BV cases, 36/53 (67.9%) pregnant women had vaginal discharge and clue cells were present in 90.6% (48/53) (Table 3).

A total of 53 samples were classified as bacterial vaginosis by Amsel's criteria and Nugent grading system of Gram stain was cultured on blood agar and MRS agar. *G. vaginalis* was recognized by beta-hemolysis on blood agar, positive starch hydrolysis test, catalase and oxidase negative tests. *G. vaginalis* was isolated in 25 of the BV cases by culture.

With bivariable analysis, history of an STI, history of spontaneous abortion, history of preterm delivery, previous IUCD use, vaginal discharge, number of prior pregnancies, and multiple sexual partners were associated ( $P < 0.25$ ) with bacterial vaginosis by a Nugent score system. In the multivariable analysis, history of an STI, vaginal discharge, history of spontaneous abortion and a number of sexual partners were found to be statistically significantly associated with BV ( $P < 0.05$ ). Pregnant women who have a history of STI were 6 times more likely to develop bacterial vaginosis than their counterparts (AOR = 6.0, 95% CI: 1.94, 19.07;  $P = 0.002$ ) (Table 4).

**Table 3** Frequency Distribution of Amsel's Criteria of Study Participants

Amsel's Criteria	Category	With BV (n = 53)	Without BV (n = 195)
Clue cell	Present	48 (90.6)	2 (1.03%)
	Absent	5 (9.4)	193 (98.97%)
Whiff test	Positive	33 (62.3)	2 (1.02%)
	Negative	20 (37.7)	193 (98.97%)
Vaginal PH	≤4.5 PH	7 (13.2)	186 (95.38)
	>4.5 PH	46 (86.7)	9 (4.6%)
Presence of vaginal discharge	Yes	36 (67.9)	58 (29.7%)
	No	17 (32.1)	137 (70.3%)

**Abbreviations:** BV, bacterial vaginosis; PH, potential of hydrogen.

**Table 4** Logistic Regression Analysis of Factors Associated with Bacterial Vaginosis Among Pregnant Women Attending ANC at HFSUH and FGAE from May 5-July 15, 2021

Variable	BV Status		COR (95% CI)	AOR 95% CI	P-value
	Positive N (%)	Negative N (%)			
Having vaginal discharge					
1. Yes	36 (38.3)	58 (61.7)	5.0 (2.60, 9.61)	5.5 (2.48, 12.41)	0.000
2. No	17 (11.0)	137 (89.0)	I*		
History of STI					
1. Yes	11 (50)	11 (50)	4.4 (1.78, 10.78)	6.0 (1.94, 19.07)	0.002
2. No	42 (18.6)	184 (81.4)	I*		
History of spontaneous abortion					
1. Yes	9 (56.2)	7 (43.8)	4.88 (1.68, 14.18)	5.8 (1.55, 22.02)	0.009
2. No	44 (19)	188 (81)	I*		
Number of sex partners					
1. 1	36 (16.3)	185 (83.7)	I*		
2. ≥2	17 (67)	10 (37)	8.7 (3.70, 20.62)	8.6 (2.93, 25.79)	0.000

**Abbreviations:** BV, bacterial vaginosis; STI, sexually transmitted infection; COR, crude odd ratio; AOR, adjusted odd ratio; CI, confidence interval; I\*, reference.

## Discussion

According to the current study, the overall prevalence of bacterial vaginosis among pregnant women attending ANC at selected health facility in Harar city was 21.4% (95% CI; 16, 27) by Nugent scoring system or Amsel's criteria. History of STI, history of spontaneous abortion, having vaginal discharge and having multiple sexual partners were factors associated with bacterial vaginosis.

This study found a consistent finding with a study done in India that reported 19%.<sup>29</sup> Another study conducted in North India showed a prevalence of 20.5%<sup>30</sup> and a study conducted in Brazil reported 22%.<sup>31</sup> The prevalence of bacterial vaginosis found in this study is also comparable with the 17.3% in North-Eastern Nigeria,<sup>32</sup> 17.7% (95% CI 12.9, 23.4) in South Africa<sup>33</sup> and 19.3% (95% CI 15.7, 27.0) in Kenya.<sup>34</sup> It is also more or less comparable with 24.8% pooled prevalence report of BV in Africa.<sup>14</sup> A similar study finding was also reported from Ethiopia, Addis Ababa of 19.4%.<sup>17</sup> This comparable sample size, method used and similarity of study population may contribute to the very close findings among different studies.<sup>14</sup>

In contrast to the current study, lower bacterial vaginosis prevalence of 3.88% was reported from Portugal,<sup>35</sup> 13% from Lucknow<sup>30</sup> and 8.6% from India.<sup>36</sup> This might be related to the nature of bacterial vaginosis, which greatly varied by geographical distribution, socioeconomic and behavioral differences of the study population.<sup>14,15</sup>

However, this study found a lower prevalence of bacterial vaginosis compared with a study done in Brazil, Ouro Preto 32.5% (95% CI: 27.7, 37.7),<sup>37</sup> Tanzania 28.5%,<sup>38</sup> Ghana 30.9%,<sup>39</sup> Zimbabwe 32.6%,<sup>40</sup> Nigeria 38%<sup>41</sup> and Sudan 49.8%.<sup>2</sup> The lower prevalence of BV in the current study might be attributed to the difference in sampling techniques, sample size difference and other sociodemographic characteristics of the participants.<sup>42–45</sup>

Despite the fact that many laboratories utilize non-culture-based approaches, isolation of *G. vaginalis* is critical. It is usually difficult to isolate and identify *G. vaginalis* from a polymicrobial sample such as a vaginal swab containing vaginal microbiota. Culture-based identification is challenging and time-consuming when dealing with slow-growing and fastidious organisms.<sup>46</sup>

In the current study *G. vaginalis* were isolated from 10.1% of pregnant women. This is consistent with studies reported from different countries: 8.7% in Northeast India,<sup>47</sup> 9.6% in Boston, USA,<sup>48</sup> 8% in England<sup>49</sup> and 10.2% in Turkey.<sup>50</sup> However, it is lower than some studies conducted in India 16.7%, Pakistan 17%, and 38.7% in central Nigeria.<sup>29,51–53</sup> The prevalence of *G. vaginalis* worldwide ranges from 6–94%.<sup>49,54</sup> Low isolation rate of *Gardnerella vaginalis* might be attributed to the poor viability and fastidiousness of the organism to grow in various media.<sup>47</sup> To grow *G. vaginalis* and other anaerobic bacteria species involved in bacterial vaginosis through culture is difficult and it was not a satisfactory diagnostic tool for bacterial vaginosis.<sup>29,55</sup>

In this study, there were no statistically significant association between bacterial vaginosis and sociodemographic characteristics of participants such as age, marital status, residence, occupation and level of education ( $P > 0.05$ ). This is in line with studies conducted in Tanzania,<sup>38</sup> Brazil<sup>37</sup> and Turkey.<sup>56</sup> But, studies conducted in the USA, Poland, China, Indonesia and Nigeria<sup>32,57–60</sup> revealed an association between BV and different sociodemographic characteristics such as marital status, age, level of education and occupational status. This might be due to the variation in prevalence of bacterial vaginosis by the community, which could be attributed to factors such as hygiene practices and difference in sociodemographic characteristics.<sup>58,61,62</sup>

Factors that are statistically associated with BV were multiple sexual partners and history of sexually transmitted disease ( $P < 0.05$ ). This is consistent with earlier studies performed in Germany, Australia, Cameroon, Ethiopia and Nigeria.<sup>17,61–65</sup> Even if the mechanism is unknown, having multiple sexual partners and a history of STI can upset/disturb the normal flora of the vagina (lactobacilli) and facilitate the growth of diverse anaerobic bacteria.<sup>14</sup>

Pregnant women with vaginal discharge were among the factors statistically associated with bacterial vaginosis ( $P < 0.05$ ). This is comparable with studies conducted in Brazil, the USA, Botswana and Nigeria.<sup>31,66–68</sup> The results of this study indicated that pregnant women with vaginal discharge have a high diagnostic value, since nearly two-third s (67.9%) of BV positive individuals reported vaginal discharge in this study. This might be because the most prevalent clinical sign and symptom of BV infection is abnormal vaginal discharge.<sup>1,8</sup> History of spontaneous abortion was also an independent predictor of bacterial vaginosis in this study ( $P < 0.05$ ). This is consistent with studies performed in Belgium, Burkina Faso, Nigeria and Ethiopia.<sup>16,52,69,70</sup> This might be related to lytic enzymes produced by BV-associated bacteria, such as proteases and phospholipase, which cause lysis of phospholipids in fetal membranes and cell membranes of clue cells. Arachidonic acid is generated during phospholipid lysis; this acid induces prostaglandin induction (PGs). PGs cause uterine muscle contraction, sulfated glycosaminoglycan (GAG) reduction, collagen fibril restructuring, and cervical resistance reduction. In addition, PGs stimulate the release of metalloproteinases from neutrophils via inducing the release of inflammatory cytokines. Metalloproteinases break down connective tissue such as the chorioamniotic membrane, which leads to spontaneous abortion.<sup>71–73</sup>

## Limitations of the Study

Lack of gas producing kits for cultivation of strictly anaerobic bacteria such as *Bacteroides* species, *Prevotella*, *A. vaginae* and others. Some confidence intervals were wide due to the small sample size.

Drug susceptibility was not conducted for *G. vaginalis* due to lack of antibiotic drugs in powder form.

## Conclusion

The overall prevalence of bacterial vaginosis among pregnant women is higher than found in previous studies conducted by Nugent's scoring system and Amsel's criteria. The prevalence of bacterial vaginosis is higher among symptomatic

pregnant women and associated with a previous history of sexually transmitted infection, vaginal discharge, multiple sexual partners and history of spontaneous abortion. Therefore, as BV is common in pregnant women, early diagnosis of pregnant women with the above factors should be an integral part of the laboratory investigation, which is vital for good pregnancy outcomes and necessary to reduce the complications.

## Data Sharing Statement

Due to the privacy policy, the datasets are not publicly available. On reasonable request, the corresponding author will provide the data that support the findings of this study.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting the manuscript, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work. In the amended draft, the English version was edited.

## Disclosure

The authors declare that they have no conflicts of interests.

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