Vol.2, No.3, Page 303- 308, 2024 https://doi.org/10.59628/jast.v2i3.882 ISSN 2958-9568 JAST

SUN PUBLISHER

مجلة جامعة صنعاء للعلوم التطبيقية والتكنولوجيا

Sana'a University Journal of Applied Sciences and Technology

https://journals.su.edu.ye/index.php/jast/

Prevalence of Bacterial Vaginal Infections among Women in Sana'a City, Yemen

Alshuaibi, W. A.[1] * **and Alghalibi, S. M.**[1]

[1] **Microbiology Department, Faculty of Science, Sana'a University, Sana'a, Yemen.**

*Corresponding author: w.alshuaibi@su.edu.ye

Abstract

Bacterial vaginal infection (BV) is an imbalance in the normal vaginal flora with decreased levels of the usual predominant lactobacilli. This study aimed to determine the prevalence of BV among women attending obstetrics and gynecology clinics in Sana'a city, Yemen; to isolate and identify the causative of VB; to assess risk factors associated with the prevalence of BV, and to determine the effect of some antibiotics. In this cross-sectional study, 150 vaginal swab samples were collected. All specimens were examined by microscope, cultural and biochemical tests, in addition to conducting an antibiotics sensitivity test for positive samples. In this study, BV was the highest among women aged less than 20 years old. The bacteria isolated were *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Enterobacter* spp, *Proteus mirabilis*, *Streptococcus pyogenes* and *Pseudomonas aeruginosa*. The most effective antibiotics were Cefotaxime, Gentamycin and Ciprofloxacin.

Article Info

Keywords:
Bacterial vaginal infection, Risk factors, Antibiotics.

Article History:
Received: 17-February-2024,
Revised: 16-March-2024,
Accepted: 20-March-2024,
Available online: 30 June 2024.

1. INTRODUCTION

An imbalance in the usual vaginal flora, including a decline in the typical dominat lactobacilli and the growth of different pathogenic mixed flora comprising aerobic, anaerobic, and microaerophilic species, is known as bacterial vaginal infection [1]. In addition to abnormal vaginal microflora, which includes aerobic and enteric bacteria such as *Escherichia coli*, *Klebsiella* spp., *Acinetobacter* spp., *Staphylococcus* spp., *Enterococcus* spp., and group B *Streptococcus*, it is characterized by inflammation of the vaginal epithelium [2]. Infectious and non-infectious vaginitis are the two main types of vaginitis. Non-infectious vaginitis can be caused by a variety of factors, including allergies to undergarments, feminine hygiene products, vaginal douches, spermicidal exposure, occupational exposure, irritation from tampons, sanitary napkins, and panty liners; hormonal factors such as hypoestrogenism; and iatrogenic factors such as using chemical products. Finally, damage from an object introduced into the vagina, contact dermatitis of the vulva caused by friction from trousers, constricted jeans, etc [3]. According to Lakshmi, the vaginal mucous membrane possesses natural physiological defenses against microbial invasions [4]. The acidic environment of the vagina is thought to be the source of lactic acid produced by *Lactobacillus*, a member of the normal flora, via the formation of hydrogen peroxide (H_2O_2). Preventing the proliferation of harmful organisms offers a local defense mechanism [5]. Four or more infection episodes per year are considered recurrence of vaginitis. This is caused by re-infection from an untreated partner and poor personal hygiene habits, such as vaginal douching, which disturb the natural vaginal flora. Furthermore, women who experience vaginal infections may self-diagnose and self-treat without microbiological testing to prove their infection [3]. Bacterial vaginal infections (BVs) are the most common vaginal infections among women of reproductive age, with an estimated incidence of 5% to 70% in women. Additionally, Javed found that, this form of illness is more prevalent in certain regions of Africa and is least common in Asia and Europe [6]. According to Al-Haik and Al-Haddad, the percentage of bacterial vaginal infections in Hadramout, Yemen was 39.2%. In Sana'a, these figures were 78.6%, 40% [7], and 27.2% [8–10].

This study provides current data on the prevalence of bacterial vaginosis, a disease that is often ignored, such as bacterial vaginal infections. Future epidemiological studies will be able to use the baseline data produced by this investigation. Thus, this study aimed to ascertain the frequency of bacterial vaginosis in Yemeni women living in Sana'a City.

2. MATERIALS AND METHODS

2.1. Study Design and Area

From January to December 2020, a cross-sectional study was conducted in Sana'a City's obstetrics and gynecology clinics at a few hospitals (Al-Kuwait, Al-Thwrah, and Al-Gumhorri) and medical centers (Al-Usrah and Saif bin Dhi-Yazan).

2.2. Study Population

During the study period, 150 women who met the inclusion criteria and complained of symptomatic genital tract infections were experienced obstetricians and gynecologists at certain hospitals and medical institutions.

2.3. Inclusion Criteria

The inclusion criteria were willingness to participate in the trial and all women complaining of genital tract infections.

2.4. Data and Specimen Collection

2.4.1. Data Collection

Informed consent was obtained from the researcher after conducting the interviews and outlining the study goals. Relevant information was obtained using a questionnaire, and each participant's current clinical data was recorded. The researcher then completed the questionnaire. The attending physician collected vaginal swabs/discharges using a sterile cotton-tipped applicator swab from the lateral and posterior vaginal fornix. All materials were labeled and promptly shipped to the microbiological lab. Under a microscope, a swab was used for the direct observation of slide smears. Subsequently, the swab was prepared for culturing in a suitable selective medium to isolate and identify bacteria [11]. Every specimen was grown on Blood, MacConkey, and Chocolate agar media. The plates were incubated aerobically for 24 h at 37℃. Bacterial colonies were identified by their morphology, hemolytic properties, lactose fermentation, Gram staining, and biochemical tests, such as the indole test, urease production, citrate utilization, production of H_2S gas, and motility of gram-negative bacteria [12]. The antibacterial susceptibility tests were conducted using the method of disk diffusion (Kirby-Bauer) on MHA inoculated with a bacterial suspension (which was prepared to have the same optical density of 0.5 McFarland) and incubated for 24 hr at 37℃. The agar diffusion method was used to evaluate the antibacterial susceptibility of the isolated bacteria [13]. Ten discs were impregnated with the following: Gentamycin 10m cg (GEN 10), Cefuroxime 30m cg (CXM30), Cefotaxime 30m cg (CTX 30), Cefixime 5m cg (CFM 5), Ampicillin 10m cg (AMP 10), Azithormycin 15m cg (AZM 15), Amoxycillin/Clavulanic Acid 20/10m cg (AMC 20/10) (Augmentin), Cefuroxime 30m cg (CXM30), Ceftazidime 30m cg (CAZ 30), and Cefixime 15m cg (AZM 15).

3. RESULTS AND DISCUSSION

Women are at risk of bacterial vaginosis, particularly when they are fertile [14]. Out of 150 women who complained of genital tract illnesses, 19.3% (N=29) had a vaginal bacterial infection. This finding was lower than those of studies at a Yemeni basic healthcare facility (27.2%) [10],) in Italy (56.8%) [15], in Ethiopia (35.1%) [2], and in Saudi Arabia (20.3%) [16]. The prevalence of bacterial vaginitis in this study was higher than in two previous studies (6% in India [17], and 8% in Colombia [18]. The results obtained in us support the findings in Nigeria (17.3%) [19] and in Iran (18.9%) [20] regarding the prevalence of bacterial vaginitis. Variations in the definition, technique, size, and type of study population may account for discrepancies in the prevalence rates of bacterial vaginal infection between studies. Variations in stressors with geographic variation, behavioral, environmental, and socioeconomic status factors may account for variations in prevalence observed in various settings [21]. According to the current study, women in the under-20 age group had a significant prevalence of BV (26.3%). this closely aligns with research in Cameroon (29.2%) [21] and in Iran (47.8%) [22]. In terms of domicile, women living in urban areas had a higher prevalence of BV (20.0% versus 17.1%), which is consistent with findings in Somalia (74.7%) [23] and in Cameroon (29.5%) [21]. However, this study did not support the findings of Mohamed *et al* in Egypt [3], who discovered that the prevalence of BV was higher in rural than in urban regions (57.5% and 42.5%, respectively) among women living in these locations. Furthermore, compared to women who were employed (17.6%), unemployed women had a higher likelihood of having BV (19.5%). This result is in agreement with Al-Mamari in Somalia (72%) [23] and Mulinganya *et al* in the Congo (89.1%) [24]. There was a substantial link between the number of abortions and BV with factors related to abortion and the prevalence of BV. Previous investigations conducted in Ethiopia corroborated our findings in this regard [24, 25]. Compared to other forms of contraception, women who used the Loop or IUD (17.9%) had a greater prevalence of BV in this study. These findings disagree with those of Sharma *et al* in India [26] (Table 1). Table 2 shows the

Table 1. Relation of The Prevalence of Bacterial Infection of Vagina with Socio-Demographic Characteristics.

Socio-demographic Characteristics	Variables	Positive BV		Negative BV		Total		COR (95%CI)	AOR (95%CI)	P-value
		n	%	n	%	n	%			
Age Group (Years)	≤20	5	26.3%	14	73.7%	19	12.7%	1	1	
	21-30	17	18.5%	75	81.5%	92	61.3%	2.390 (1.583-36.08)	2.047 (1.182-2.468)	0.011*
	31-40	6	17.1%	29	82.9%	35	23.3%	1.048 (0.165-6.646)	0.824 (0.087-7.817)	0.866
	> 40	1	25.0%	3	75.0%	4	2.7%	2.096 (0.377-11.647)	1.045 (0.132-8.294)	0.967
Residence	Urban	23	20.0%	92	80.0%	115	76.7%	1	1	
	Rural	6	17.1%	29	82.9%	35	23.3%	4.200(0.728-24.222)	1.569(0.188-13.091)	0.678
Occupation Status	Unemployed	26	19.5%	107	80.5%	133	88.7%	1	1	
	Employed	3	17.6%	14	82.4%	17	11.3%	1.870(1.307-2.674	1.463(0.826-2.591)	0.197
Number of abortion Status	< 3	16	18.4%	71	81.6%	87	58.0%	1	1	
	3-6	3	30.0%	7	70.0%	10	6.7%	2.208(1.570-3.106)	2.776(1.597-4.827)	0.001*
	> 6	0	0.0%	0	0.0%	0	0.0%			
	Null	10	18.9%	43	81.1%	53	35.3%	2.086(0.940-5.556)	2.048(0.982-9.457)	0.054

COR=Crude odd ratio, AOR=Adjusted odd ratio; whereas * Indicates statistically significant association.

Table 2. Relation of The Prevalence of Bacterial Infection of Vagina with Clinical Symptoms.

Variables	Positive BV		NegativeBV		Total		COR (95%CI)	P-value
	n	%	n	%	n	%		
Vaginal Discharge								
Yes	29	19.9%	117	80.1%	146	97.3%	1.519(0.955,2.415)	0.077
No	0	0.0%	4	100.0%	4	2.7%	1	
Vulvar Itching								
Yes	28	19.0%	119	81.0%	147	98.0%	1.763(0.975,3.188)	0.061
No	1	33.3%	2	66.7%	3	2.0%	1	
Vulvar Odor								
Yes	25	18.2%	112	81.8%	137	91.3%	1	
No	4	30.8%	9	69.2%	13	8.7%	2.670(1.554,4.588)	0.001*
Dysuria								
Yes	21	18.8%	91	81.3%	112	74.7%	1	
No	8	21.1%	30	78.9%	38	25.3%	1.143(.821,1.592)	0.430
Dyspareunia								
Yes	19	17.9%	87	82.1%	106	70.7%	2.904(1.451,5.813)	0.003*
No	10	22.7%	34	77.3%	44	29.3%	1	

COR=Crude odd ratio, whereas * Indicates statistically significant association.

prevalence of bacterial vaginosis in associated with clinical symptoms. Patients with vaginal discharge, vulvar itching, vulvar odor, dysuria, and dyspareunia reported having it in 19.9%, 19.0%, 18.2%, 18.8%, and 17.9% of patients, respectively. Odor and dyspareunia were statistically linked to bacterial vaginosis (P= 0.001 and 0.003, respectively), which is consistent with the research conducted in India [27]. In this study, 29 distinct bacterial isolates were obtained from BV patients. *Escherichia coli* was the most frequently identified bacterium, accounting for eight (27.5%). This finding is consistent with those of studies conducted in Poland [28] and Italy [15]. While our findings disagreed with those in Nepal; where *Pseudomonas spp.* was the most prevalent bacterium [29] and in Libya; that *Streptococcus agalactia* was the most frequently isolated bacterium (35.7%) [30]. *Staphylococcus aureus* was the second most frequently identified pathogen (24%) in women in our study who had bacterial vaginal infections. This was in line with the research conducted in Gabon by Bignoumba *et al* who discovered that *Streptococcus* (23.9%) was the most pathogenic bacteria and the second pathogenic bacteria was *Staphylococcus aureus* (17.7%) followed by *Klebsiella* spp., and *Escherichia coli* (11.6% and 5.8%)

Table 3. Effect of Some Common Antibiotics Against Isolated Gram- Negative Bacteria.

Antibiotic / Bacteria		CIP 5	CAZ 30	DOX 30	AMC 20/10	GEN 10	CXM 30	CTX 30	CFM 5
E. coli	IZR mm	12-30	0-30	0-18	0-27	15-27	0-29	20-40	0-0
	MIZ mm	20	11	13.6	11.3	21.5	7	28.6	0
K. pneumoniae	IZR mm	0-32	0-26	8-18	10-28	21-26	10-21	13-32	10-21
	MIZ mm	20.6	16	14.3	19	24	15.3	24.7	17.3
P. aeruginosa	IZR mm	22-26	18-23	11-12	11-30	24-27	12-16	27-30	20-24
	MIZ mm	24	20.5	11.5	20.5	26.5	14	28.5	22
***Enterobacter* spp**	IZR mm	12-20	10-12	0-0	0-14	7-24	0-12	18-25	0-17
	MIZ mm	16.4	10.7	0	8.7	17	7.7	21	10.7
P.mirabilis	IZR mm	15-20	11-22	0-21	10-25	16-24	0-0	17-30	7-23
	MIZ mm	18.3	15.7	12.4	16.3	21	0	24	17

IZR = Inhibition zone range
MIZ = Mean inhibition zone
CIP 5 = Ciprofloxacin 5
CAZ 30 = Ceftazidime 30
DOX 30 = Doxycycline 30
GEN 10 = Gentamycin 10
CXM 30 = Cefuroxime 30
CTX 30 = Cefotaxime 30
CFM 5 = Cefixime 5
AMC 20/10 = Amoxycillin / Clavulanic acid 20/10 (Augmentin)

Table 4. Effect of Some Common Antibiotics Against Isolated Gram-Positive Bacteria.

Antibiotic / Bacteria		CIP 5	CAZ 30	DOX 30	AMP 10	AZM 15	AMC 20/10	GEN 10	CXM 30	CTX 30
S. aureus	IZR mm	15-25	0-3	2-7	0-6	10-18	8-18	19-24	14-21	20-33
	MIZ mm	21.7	0.6	4.7	3	12.7	10.3	22	17	27.6
S. pyogenes	IZR mm	12-31	0-3	0-9	0-3	2-16	0-15	20-30	10-36	27-40
	MIZ mm	23.3	1	3	1	10.7	5	24	22	32.3

IZR = Inhibition zone range
MIZ = Mean inhibition zone
CIP 5 = Ciprofloxacin 5
CAZ 30 = Ceftazidime 30
DOX 30 = Doxycycline 30
AMP 10 = Ampicillin 10
AZM 15 = Azithromycin15
AMC 20/10 = Amoxycillin / Clavulanic acid 20/10 (Augmentin)
GEN 10 = Gentamycin 10)
CXM 30 = Cefuroxime 30
CTX 30 = Cefotaxime 30

respectively [31] (Fig. 1). The isolated Gram-positive bacteria underwent an antibiotic sensitivity test, and the results showed that cefotaxime and gentamycin were the most effective antibiotics against *E. coli*, *K. pneumonia*, *P. aeruginosa*, *Enterobacter* spp., and *P. mirabilis*, respectively. Ciprofloxacin was found to be the next most effective antibiotic. Sangeetha *et al* found that, ciprofloxacin and gentamycin were the two antibiotics that worked best against Enterobacteriaceae [32] (Table 3). This finding is consistent with that of the present study. Among the Gram-positive bacteria isolates, cefotaxime, Gentamycin, and Ciprofloxacin were the most efficient antibiotics against *S. aureus* and *S. pyogenes*, respectively. All isolates were shown to be susceptible to cefuroxime by Younus et al [33], with ampicillin accounting for 97.9%, ciprofloxacin for 85.1%, gentamycin for 56.8%, and doxycycline for 40.4% (Table 4). Gram-negative bacteria are more resistant to most antibiotics than Gram-positive bacteria, as demonstrated by the results. This could be because of the biological structure of Gram-negative bacteria, which is considerably harder and serves as a permeability barrier as well as a drug efflux pump [14].

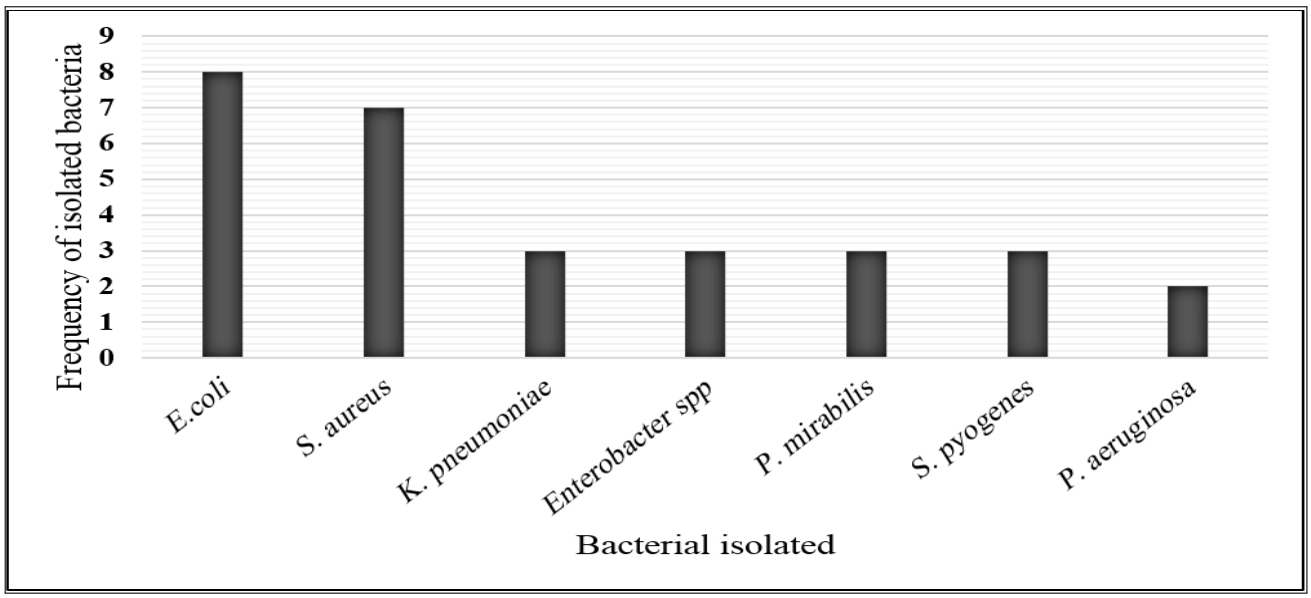

Figure 1. Spectrum of Bacterial Isolates (N =29) among Bacterial Infection of Vagina Patients.

4. CONCLUSION

Numerous factors, including age groups, economic levels, history of recurrent infections, status of abortions, and use of contraceptives, influence the occurrence of bacterial vaginal infections. In cases of bacterial vaginal infections, *Escherichia coli* was the most often isolated bacteria, followed by *Staphylococcus aureus*. The two medicines that were most efficient against isolated bacteria were cefotaxime and gentamycin.

REFERENCES

[1] A. Seth, S. Chaitra, S. Vaishnavi, and C. Sharath, "Prevalence of bacterial vaginosis in females in the reproductive age group in kadur, karnataka, india," Int. J. Reproduction, Contraception, Obstet. Gynecol. **6**, 4863–4865 (2017).

[2] G. Yalew, S. Muthupandian, K. Hagos, *et al.*, "Prevalence of bacterial vaginosis and aerobic vaginitis and their associated risk factors among pregnant women from northern ethiopia: A cross-sectional study," Plos One **17** (2022).

[3] H. Mohamed, N. Shalaby, N. El-Maraghy, and Z. Baraia, "Prevalence of vaginal infection and associated risk health behaviors among married women in ismailia city," Int. J. Curr. Microbiol. Appl. Sci. **4**, 555–567 (2015).

[4] K. Lakshmi, S. Chitralekha, V. Illamani, and G. Menezes, "Prevalence of bacterial vaginal infections in pre and post-menopausal women," Int. J. Pharma Bio Sci. **3**, 949–956 (2012).

[5] R. Jesus, L. Calil, R. Reis, and A. Fuentefria, "Bacterial vaginosis: some aspects for clinical practice," Revista Panam. de Infectologia **13**, 49–56 (2011).

[6] A. Javed, F. Parvaiz, and S. Manzoor, "Bacterial vaginosis: an insight into the prevalence, alternative treatments regimen and its associated resistance patterns," Microb Pathog **127**, 21–30 (2019).

[7] W. Al-Haik and A. Al-Haddad, "Bacterial vaginosis among pregnant women in hadhramout-yemen," Alandalus Univ. for Sci. Technol. J. **7**, 21–33 (2017).

[8] N. Amer, "Prevalence and risk factor for bacterial infections of the vagina among women visiting obstetrics and gynecology clinics in sana'a city-yemen," Master's thesis, Faculty of Medicine and Health Sciences (2007).

[9] G. Noman, "Bacterial vaginosis as risk factor for preterm labor in al-sabeen hospital, sana's city-yemen," Master's thesis, Faculty of Medicine and Health Sciences (2011).

[10] M. Abdul-Aziz, M. Mahdy, R. Abdul-Ghani, *et al.*, "Bacterial vaginosis, vulvovaginal candidiasis and trichomonal vaginitis among reproductive-aged women seeking primary healthcare in sana'a city, yemen," BMC Infect. Dis. **19**, 879 (2019).

[11] M. Cheesbrough, *Microbiological tests, District Laboratory Practice in Tropical Countries* (Cambridge University, 2006), 2nd ed.

[12] G. Garrity, J. Brenner, R. Krieg, and T. Staley, *Bergey's Manual of Systematic Bacteriology*, vol. Part 2 (Springer Science Business Media, Inc, New York, USA, 2005), 2nd ed.

[13] A. Humaid, M. Al-maqtari, A. Alzomor, and A. Thabit, "Carbapenem-resistant klebsiella pneumoniae in yemeni patients: Prevalence, phenotypes, and resistance profile to last-resort antibiotics," aUniv. J. Appl. Sci. Technol. **2**, 168–174 (2024).

[14] A. Bitew, A. Mengist, H. Belew, *et al.*, "The prevalence, antibiotic resistance pattern, and associated factors of bacterial vaginosis among women of the reproductive age group from felege hiwot referral hospital, ethiopia," Infect. Drug Resist. **14**, 2685–2696 (2021).

[15] E. Serretiello, B. Santella, V. Folliero, *et al.*, "Prevalence and antibiotic resistance profile of bacterial pathogens in aerobic vaginitis: a retrospective study in italy," Antibiotics **10** (2021).

[16] V. Bhakta, S. Aslam, and A. Aljaghwani, "Bacterial vaginosis in pregnancy: prevalence and outcomes in a tertiary care hospital," Afr. J. Reproductive Health **25**, 6 (2021).

[17] S. Dhobe and M. Mahakarkar, "To assess the prevalence of bacterial vaginosis among women in selected rural areas," J. Pharm. Res. Int. **33**, 410–414 (2021).

[18] L. Gomes-Rodriguez, M. Campo-Urbina, N. Ortega-Ariza, *et al.*, "Prevalence of potentially pathogenic microbiological agents in vaginal exudates of asymptomatic pregnant women, barranquilla, colombia, 2014-2015," Revista Colombiana De Obstet. Y Ginecologŏ0eda **70**, 49–56 (2019).

[19] S. Ibrahim, M. Bukar, G. Gadzama, and B. Audu, "Prevalence of bacterial vaginosis in pregnant women in maiduguri, north-eastern nigeria," Niger. J. Clin. Pract. **17**, 154–158 (2014).

[20] S. Sabour, M. Arzanlou, H. Vaez, *et al.*, "Prevalence of bacterial vaginosis in pregnant and non-pregnant iranian women: a systematic review and meta-analysis," Arch. Gynecol. Obstet. **297**, 1101–1113 (2018).

[21] Y. Kamga, J. Ngunde, and J. Akoachere, "Prevalence of bacterial vaginosis and associated risk factors in pregnant women

receiving antenatal care at the kumba health district (khd), cameroon," BMC Pregnancy Childbirth **19**, 166 (2019).
[22] J. Ayatollahi, M. Ghahiri, M. Hamidfar, and S. Shahcheraghi, "The frequency of causes of vaginitis with pap smear test in patients specially based on age as an effective agent on genetic factors," Health Biotechnol. Biopharma **5**, 15–23 (2021).
[23] A. Al-Mamari, "Determining the prevalence of bacterial vaginosis and vulvovaginal candidiasis among married and unmarried women and evaluating the association socio-demographic risk factors and symptoms-related variables in women attending gynecology clinic in hargeisa group hospital, hargeisa city, somaliland," Open J. Med. Microbiol. **10**, 114–128 (2020).
[24] G. Mulinganya, A. De-Vulder, G. Bisimwa, *et al.*, "Prevalence, risk factors and adverse pregnancy outcomes of second-trimester bacterial vaginosis among pregnant women in bukavu, democratic republic of the congo," PLOS ONE **16**, 10 (2021).
[25] W. Mulu, M. Yimer, Y. Zenebe, and B. Abera, "Common causes of vaginal infections and antibiotic susceptibility of aerobic bacterial isolates in women of reproductive age attending at felegehiwot referral hospital, ethiopia: a cross-sectional study," BMC Women's Health **15**, 42 (2015).
[26] R. Sharma, P. Dogra, S. Sharma, and S. Tiwari, "Sociodemographic profile of women with abnormal vaginal flora: a prospective study," Int. J. Clin. Trials **8**, 196–201 (2021).
[27] M. Nayak, P. Purohit, A. Debta, *et al.*, "Prevalence of bacterial vaginosis in postmenopausal women in the state of odisha, india," Al Ameen J. Med. Sci. **13**, 266–272 (2020).
[28] J. Wojkowska-Mach, M. Pomorska-Wesołowska, M. Romanik, and D. Romaniszyn, "Prevalence and antimicrobial susceptibility profiles of microorganisms associated with lower reproductive tract infections in women from southern poland— retrospective laboratory-based study," Int. J. Environ. Res. Public Health **18**, 335 (2021).
[29] E. Ranjit, R. Raghubanshi, S. Maskey, and P. Parajuli, "Prevalence of bacterial vaginosis and its association with risk factors among nonpregnant women: a hospital-based study," Int. J. Microbiol. **2018**, 2018 (2018).
[30] A. Atia, "Prevalence of bacterial vaginosis and their antibiotic susceptibility among women attending different private clinics in tripoli, libya," Libyan J. Med. Sci. **5**, 79–82 (2021).
[31] M. Bignoumba, K. Mbombe, J. Muandze-Nzambe, *et al.*, "Vaginal infections' etiologies in south-eastern gabon - an overview," Int. J. Women's Health **14**, 505–515 (2022).
[32] T. Sangeetha, S. Golia, and C. Vasudha, "A study of aerobic bacterial pathogens associated with vaginitis in reproductive age group women (15–45 years) and their sensitivity pattern," Int. J. Res. Med. Sci. **3**, 2268–2273 (2015).
[33] N. Younus, R. Gopinath, R. Jegasothy, *et al.*, "An update on gardnerella vaginalis associated bacterial vaginosis in malaysia," Asian Pac. J. Trop. Biomed. **7**, 831–835 (2017).