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Prevalence and Factors Associated with Trichomoniasis, Bacterial Vaginosis, and Candidiasis among Pregnant Women in a Regional Hospital in Cameroon

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Abstract

Introduction: Several microorganisms cause vaginal infections. Some of them include: *Trichomonas vaginalis*, *Gardneralla vaginalis*, *Bacteriodes* spp., *Mobilincus* and *Candida albicans.* In pregnancy, these infections are associated with considerable discomfort and adverse pregnancy outcome including preterm delivery, low birth weight, spontaneous abortions among others. **Aims:** Bacterial vaginosis, vulvovaginal trichomoniasis and candidiasis in pregnant women are associated with considerable discomfort and adverse pregnancy outcome (preterm delivery and low birth weight). We attempted to determine the prevalence of these conditions in Regional Hospital Bamenda. **Methods:** A total of 200 vaginal swabs were collected from pregnant women after the administration of a semi-structured questionnaire. The samples were analyzed using wet mount (*Trichomonas vaginalis* and *Candida* spp.), and the Gram stain (*Gardnerella vaginalis* and *Candida* spp.). Bivariate and multivariate analyses were used to investigate association between vaginal symptoms and their risk factors. **Results:** The overall prevalence of vaginal infections was 49.5%, with trichomoniasis, bacterial vaginosis, and candidiasis being 2% (4), 27% (54) and 32% (64), respectively. No formal education (AOR = 0.908; 95% CI: −20.72 - 35.62; p = 0.001) and practice of douching (16.93: −0.201 - 29.692; p = 0.005) were found to be independent risk factors for trichomoniasis. Malodourous greenish vagina discharges (18.52; 2.96 - 60.307; p = 0.005) were associated with trichomoniasis and bacterial vaginosis. White (6.566; 17.785 - 21.836; p = 0.004) and yellowish (3.404; 20.127 - 23.457; p = 0.004) vaginal discharges were independent risk factors for mycotic vagina infections. Multivariate analysis revealed that the only risk factor

significantly associated to VVC in this study was the use of both water cistern and pit toilet (AOR = 3.684; 95% CI: 0.388 - 2.649; p = 0.010). **Conclusion:** There was a high prevalence of vaginal infections. Early treatment will reduce the disease burden and avoid complications associated with it.

Keywords

Trichomoniasis, Bacterial Vaginosis, Vulvovagina Candidiasis Infection, Prevalence, Factors Associated, Pregnant Women

1. Introduction

Trichomoniasis, which is caused by the protozoan parasite *Trichomonas vaginalis*, is one of the most common non-viral STDs in the world. It is an important source of reproductive morbidity and has been implicated in the acquisition and transmission of HIV and possibly Herpes simplex virus type two HSV-2 [1].

The World Health Organization in 2008 estimated that there are about 276.4 million cases and nearly 90% of these infections occur among people living in resource-limited settings [2]. The most common route of infection is by direct transmission from an infected to a non-infected person through unprotected sexual intercourse, though it can still be acquired from wet toilet seats, moist towels, contaminated douch nozzles, specula or swimming pool water [3]. The infection is more common in women than men, and older women are more likely to be infected than younger women [4]. A global prevalence ranging between 1.9% and 7.8% was reported in 2015 [5], based on a systematic review and global reporting among individuals aged 15 - 49 years. The highest regional prevalence estimates for *T. vaginalis* for both females and males were 18.12% and 3.82% respectively, in the WHO African Region [6].

Bacterial vaginosis (BV) is a common, complex clinical syndrome characterized by alterations in the normal vaginal flora. It is associated with a severe reduction or absence of the normal lactobacilli flora of the vagina and overgrowth of anaerobic bacteria, including *Gardnerella vaginalis*, *Ureaplasma urealyticum*, *Mycoplasma hominis*, *Mobiluncus species*, *Prevotella species*, and other anaerobes [6] [7] [8]. It is the most common cause of unpleasant vaginal odour and discharge in women of reproductive age worldwide and represents a good proportion of gynaecologist consultation [9] [10] and has been implicated in adverse pregnancy and delivery outcomes by some authors [11] [12]. It has a worldwide distribution and prevalence studies have reported different rates in several countries and regions around the world. In Cameroon, few studies have been carried out on this infection with prevalence rates ranging from 15% to 41% among different study populations [11] [12] [13] [14]. However, Mbu *et al.* [15] recorded a higher prevalence of bacterial vaginosis among HIV positive pregnant women (21.2%) than in their HIV negative counterparts (15.2%) in

2008. In a study among HIV-positive women, bacterial vaginosis was reported to increase the risk of HIV acquisition [16] [17].

An estimated 70% to 75% of healthy adult women have at least one episode of VVC during their lifetimes and 50% of them suffer recurrent events [18] [19] [20] [21]. Studies around Africa report prevalence values among pregnant women ranging from 14% to 63% [21] [22] [23]. However, few works have been reported on the prevalence of vulvovaginal candidiasis in Cameroon. Toua *et al.* [24] in 2013, recorded prevalence values of 54.5% and 35.5% among pregnant and non-pregnant women respectively in Maroua, whereas there was an overall 66% among women attending the Yaounde University Teaching Hospital in 2015, and a 44.11% among pregnant women in the same hospital [13].

1.1. Research Problem

In developing countries including Cameroon, surveillance of genital tract infections is uncommon; hence, prevalence data is limited with respect to trichomoniasis, bacterial vaginosis and vulvovaginal candidiasis. Although some work has been reported in Cameroon, little has focused on pregnant women despite the serious outcomes of the infection in pregnancy such as preterm delivery, low birth weight, miscarriage etc. it is therefore important to obtain baseline data on these infections in different settings in Cameroon including Bamenda.

1.2. Specific Objectives

- To determine the prevalence of trichomoniasis, bacterial vaginosis and vulvovaginal candidiasis infection among pregnant women attending the Bamenda Regional Hospital.
- To determine the factors associated with trichomoniasis, bacterial vaginosis and vulvovaginal candidiasis in the study population.
- To determine the association between vaginal infection (BV, TV and VVC) and clinical symptoms/signs in the study participants.

2. Materials and Methods

2.1. Study Site

The population of the town where this study was carried out has as main economic activities; trading, farming and small scale enterprises such as tailoring, carpentry, weldering and other workshops. The above population consists of people from various ethnic groups namely; Ngemba, Tikari, Chamba, Bamilike, Bororo, Kom etc. The most commonly spoken language is Pidgin-English, with main religious backgrounds being Christianity and Islam. The hospital is the largest public health structure of the region, and serves as the highest referral unit. It offers services to people from the aforementioned ethnic groups, neighbouring towns and beyond the region. It is made up of several services among which is the service of Obstetrics and Gynaecology. Attached to this service is a unit of the Antenal Clinic, which renders its services to all its clients and oper-

ates from Monday to Friday.

2.2. Study Design

The study was a cross-sectional descriptive and analytic study that was carried out within a four months period from January to April 2018.

2.3. Study Population

In this study, 200 pregnant women were recruited. No age limits were set and pregnant women of all gestational ages who visited the antenatal clinic (ANC) of the Regional Hospital Bamenda for routine care or for treatments of any ailments were eligible for enrolment into the study.

2.4. Sampling

Candidates were selected through a random sampling technique whereby all pregnant women who met the inclusion criteria were offered an opportunity to participate. Only those who gave a written informed consent were recruited.

2.4.1. Sample Size

The absolute precision required on either side of the proportion = 0.05 Confidence level 95%.

The Standard normal variate for significance (1.96 if type 1 error is limited to 5% that is if p value is <0.05 for statistical significance)

$$n = \frac{(0.075)\left(1(0.05-0.075)^2\right)(1.96)^2}{0.05^2} = 107 \text{ participants.}$$

2.4.2. Specimen Collection Procedure and Analysis

1) Collection

Candidates were examined in the lithotomy position, in a well-aerated and lighted, but confined specimen collection room with a gynecological examination bed. A sterile speculum was inserted into the vagina, exposing the lateral and posterior fornix and specimen (vaginal secretions) was collected from vaginal walls (lateral, anterior and posterior) using a sterile swab stick. The swab was rotated for about 10 to 30 seconds in the vaginal walls to allow it to absorb fluids. A drop of physiologic saline (0.9% NaCl) was added to the specimen in order to keep *T. vaginalis* alive and it was immediately transported to the laboratory.

2) Wet mount preparation and observation

A sample of the vagina fluid was transferred from the swab onto a microscope slide. A drop of sterile physiological saline (0.9% NaCl) was added to it (in order to keep *T. vaginalis* alive and to ease its identification) and then covered with a cover slip. This preparation was immediately examined under a light microscope at x10 and x40 magnifications, for the flapping/wobbly movement of *T. vaginalis* trophozoites and for yeast cells, which could be budding, or present with pseudo

hyphae. Other indicators for infection such as clue cells, pus cells and epithelial cells were all noted.

3) Gram staining and diagnosis of bacterial vaginosis

The diagnosis of bacterial vaginosis was arrived at by means of microscopic examination of Gram-stained vaginal smear slides and performing a Whiff's test. Vaginal smears were prepared by gently rolling the cotton bud on a clean slide. These smears were then air-dried, heat-fixed and stained manually; using Gram's staining method. Qualified laboratory personnel for BV diagnosis, using the Nugent's criteria scoring system, then examined the gram-stained slides microscopically. Whiffs test was performed by adding a drop of potassium hydroxide on the cotton swab. It was considered whiffs positive with the perception of a fishy odour from cotton swab and negative if no fishy odour was perceived. The laboratory personnel were blinded to the clinical findings of the participants, or any other details, except their study numbers and specimen collection dates.

3. Results

3.1. Socio-Demographic Characteristic of the Study Population

A total of 200 pregnant women aged 18 to 49 years were examined in the study. As shown in Table 1, age group with the highest number of participants was 18 - 29 (59.0%, 118/200), while the lowest was 40 - 49 (4.0%, 8/200).

Table 1. Socio-demographic characteristics of the study population.

Variable	Category	Frequency (%)
Age group (year)	18 - 29	118 (59.0)
	30 - 39	74 (37.0)
	40 - 49	8 (4.0)
Marital status	Married	152 (76.0)
	Single	48 (24.0)
Occupation	Formally employed	57 (28.5)
	Self employed	68 (34.0)
	House wife	16 (8.0)
	Applicant	11 (5.5)
	Student	48 (24.0)
Level of education	No formal education	6 (3.0)
	Primary	25 (12.5)
	Secondary	69 (34.5)
	Tertiary	100 (50.0)

3.2. Hygienic Characteristics of the Study Population

More than half of the sample population (77.5%, 155) used pipe-borne water as their only and only 1% (2) used water from rivers. Those who had wells as their only water source constituted 7% (14) of the study population while subjects who used both pipe-borne water and wells as water sources constituted the remaining 14.5% (29) (Table 2).

3.3. Clinical Characteristics of the Study Population

3.3.1. Age of Pregnancy (Trimester)

Subjects in their second trimester of pregnancy had the highest turnout in this study (54%, 108/200), followed by those in the third trimester (37%, 74). Those in the third trimester were least in proportion of participants (9%, 18).

3.3.2. Colour of Vagina Discharge

As shown in Figure 1, majority (47%, 94) of the participants presented with colours of vagina discharge, different from those mentioned in the study. These colours include but not limited to: cream white, bloody and colourless. Clients presenting with yellowish vagina discharges were 74 (37%) of the study sample. A total of 28 (14%) women presented with whitish discharges, and greenish discharges were present in four (2%) of them.

3.3.3. Odour of Vagina Discharges

At least 70% (146) of the study subjects presented with non-offensive vagina discharges, while malodourous discharges were identified among the rest of the study sample (27%, 54).

Table 2. Hygienic characteristics of the study population.

Variable	Category	Frequency (%)
Source of water	Pipe-born	155 (77.5)
	Well	14 (7)
	Both pipe-born and well	29 (14.5)
	Rivers	2 (1.0)
Toilet types	Water cistern	85 (42.5)
	Pit toilet	77 (38.5)
	Both water cistern and pit	36 (18.0)
	Others	2 (1.0)
Shared toilet	Yes	183 (91.5)
	No	17 (8.5)
Practice of douching	Yes	119 (59.5)
	No	81 (40.5)

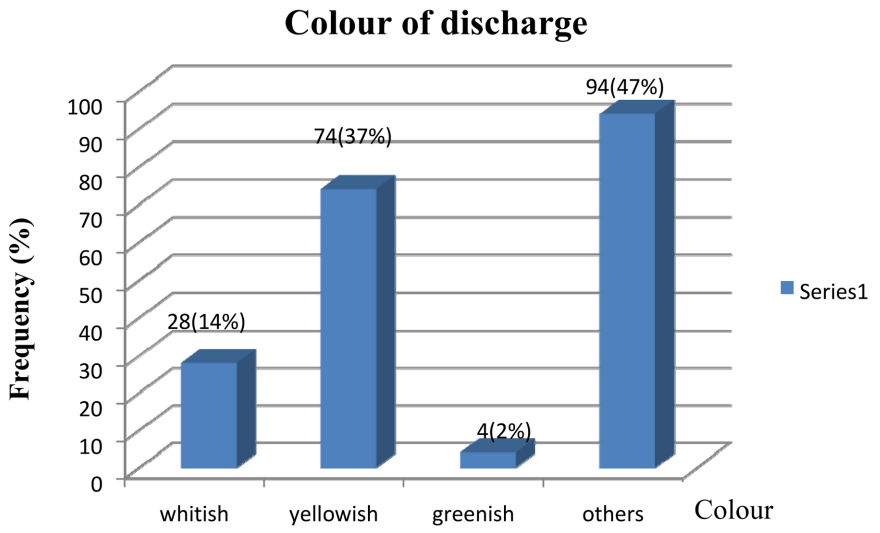

Figure 1. Colour of vagina discharges presented by pregnant women.

3.3.4. Prevalence of Vagina Infections

The overall infection rate in these pregnant women was 49.5% (99). the highest infection rates were mycotic vaginitis (32%, 64) followed by bacterial vaginosis (27%, 54) and lastly trichomoniasis (2%, 4) as shown in **Table 3**.

3.3.5. Factors Associated with Vagina Infections

Socio-demographic Factors Associated with Trichomoniasis (TV)

As shown in **Table 4**, the highest prevalence 2.7% (n = 2) of *Trichomonas vaginalis* infection was recorded among pregnant aged 30 - 39 years, while the lowest was recorded in those aged 4049 years. However, there was no statistically significant difference (OR = 1.72; 95% CI: 0.2 - 12.49; p = 0.62). Formally employed participants had the highest prevalence 3.5% (n = 2) of this infection while the lowest prevalence was recorded among housewives, applicants and students 0% (0). Nonetheless, this difference was not statistically significant (OR = 2.56; 95% CI: 0.35 - 18.65; p = 0.32). Surprisingly, a higher prevalence of *T vaginalis* infection was recorded in married women (2.6%, 4) when compared with their single counterparts (0%), but the difference was not statistically significant (OR = 95%; CI: p = 0.57). The prevalence of trichomoniasis was significantly highest in participants with no formal education (33.3%, 2) when compared with those who had formal education, whatever the level (OR = 48; 95% CI: 5.34 - 431.41; p = 0.04).

3.3.6. Association of Hygiene Practice with Trichomoniasis (TV)

Table 5 shows that the prevalence of trichomoniasis was highest among clients who had both pipe borne and wells as sources of water (6.9%, 2) and was lowest among clients with rivers as their water source (0%). However, this difference was not statistically significant. (OR = 6.26; CI: 0.89 - 46.23; p = 0.10).

With respect to toilet type, prevalence was highest among pregnant women using both water cistern and pit toilets (5.6%, 2) and lowest among those using

water cistern only and other types of toilets (0%). In any case, this difference was not statistically significant (OR = 4.77; CI: 0.6535.02; p = 0.15).

All the positive cases of *Trichomonas vaginalis* infection(n = 4) were recorded among participants who shared toilets with others, giving a higher prevalence in this group (2.2%) when compared with participants who did not share toilets (0%), although the difference was not significant statistically (OR = 8.14; CI: 0.47 - 51.38; p = 1).

A higher prevalence of trichomoniasis (3.4%, 4) was recorded among clients who practiced douching when compared with their counterparts who did not practice douching (0%) though not statistically significant (OR = 0.69 CI: 0.095 - 4.9; p = 1).

Table 3. Prevalence of vagina infections in the study population.

Infection	Number infected (%)	(95%) CI
Trichomoniasis	4 (2)	0.5 - 4.5
Bacterial Vaginosis	54 (27)	21.0 - 33.0
Vulvovagina Candidiasis	64 (32)	25.0 - 38.5
Overall Prevalence	99 (49.5)	42.5 - 56.5

Table 4. Socio-demographic factors associated with trichomoniasis (TV).

	Total No	TV No (%)	OR (95% CI)	P-value
Age group				
18 - 29	118	2 (1.7)	0.69 [0.095 - 4.9]	1
30 - 39	74	2 (2.7)	1.72 [0.2 - 12.49]	
40 - 49	8	0 (0)		
Occupation				
Formally employed	57	2 (3.5)	2.56 [0.35 - 18.65]	0.32
Self employed	68	2 (2.9)	1.97 [0.27 - 14.29]	0.61
Housewife	16	0 (0)		1
Applicant	11	0 (0)		1
Student	48	0 (0)		0.57
Marital status				
Single	49	0 (0)		
Married	151	4 (2.6)		0.57
Level of education				
No formal	6	2 (33.3)	48 [5.34 - 431.41]	0.04
Primary	25	0 (0)		1
Secondary	69	0 (0)		0.30
Tertiary	100	2 (2)	1 [0.14 - 7.24]	1

Table 5. Association of hygiene practice with trichomoniasis (TV).

	Total No	TV positive n (%)	OR (95% CI)	p-value
Water source				
Pipe borne	155	2 (1.3)	0.28 [0.04 - 2.05]	0.22
Well	14	0 (0)		1
Both	29	2 (6.9)	6.26 [0.89 - 46.23]	0.10
Rivers	2	0 (0)		1
Toilet type				
Water cistern	85	0 (0)		0.14
Pit	77	2 (2.6)	1.61 [0.22 - 11.69]	0.64
Both	36	2 (5.6)	4.77 [0.65 - 35.02]	0.15
Others	2	0 (0)		1
Toilet use				
Shared	187	4 (2.2)	8.14 [0.47 - 51.38]	1
Not shared	17	0 (0)		
Practice of douching				
Yes	119	4 (3.4)	0.69 [0.095 - 4.9]	0.15
No	89	0 (0)		

3.3.7. Association of Clinical Presentation with Trichomoniasis (TV)

There was no significant difference for *T. vaginalis* infection across various gestational ages, although all pregnant women positive for the infection were found among those in their second trimester of pregnancy, (3.7%, 4) when compared with those in the first and third trimesters (0%) (p = 0.13) as shown in Table 6. Greenish vaginal discharge was significantly (OR = 97; 95% CI: 8.76 - 1047.95; p = 0.02) associated with trichomoniasis and 50% (2) of participants as opposed to other colours of vagina discharge (0%). Similarly, malodourous vaginal discharge was significantly associated to *T. vaginalis* infection (OR = 72; 95% CI: 2.76 - 13.854; p = 0.01), expressed in all positive cases (7.3%, 4) as shown in Table 6.

3.3.8. Multivariate Analysis of Factors Associated with Trichomoniasis

After multivariate data analysis, factors found to be significantly associated with trichomoniasis in pregnant women were; no formal education (AOR = 0.908; 95% CI: −20.72 - 35.62; p = 0.001), the use of pipe-borne water (AOR = 16.94; 95% CI: −0.875 - 19.947; p = 0.004) and practice of douching (AOR = 16.93; 95% CI: −0.201 - 29.692; p = 0.005). However, greenish (AOR = 18.52; 95% CI: 2.9660.307; p = 0.005) vaginal discharge and foul-smelling (AOR = 17.99; 95% CI: −31.97 - 19.947; p = 0.001) vaginal discharge were symptoms significantly associated with the infection as shown in Table 7.

Table 6. Association of clinical presentation with trichomoniasis (TV).

Variable	Category	Total No	TV-pos n (%)	OR	p-value
Trimester	First	18	0 (0)		1
	Second	108	4 (3.7)		0.13
	Third	74	0 (0)		0.29
Colour of vaginal discharge	Yellowish	74	2 (2.7)	1.72 [0.24 - 12.49]	0.63
	Greenish	4	2 (50)	97 [8.76 - 1047.95]	0.02
	Others	94	0 (0)		0.12
	Offensive	55	4 (7.3)	72 [2.76 - 13.854]	0.01
	Non-offensive	145	0 (0)		

Table 7. Multivariate logistic regression of factors associated with trichomoniasis.

Variable	n (%)	AOR [95%: CI]	p-value (for AOR)
No formal ed	2 (33.3)	0.908 [−20.72 - 35.62]	0.001
Pipe-borne water	2 (1.3)	16.94 [−0.875 - 19.947]	0.004
Both pit and w/c	2 (5.9)	−0.667 [−1.369 - 0.478]	0.172
Practice of douching	4 (3.4)	16.93 [−0.201 - 29.692]	0.001
Second trimester	4 (3.7)	17.19 [0.55 - 22.89]	0.222
Greenish discharge	2 (50)	18.52 [2.96 - 60.307]	0.005
Offensive discharge	4 (7.3)	17.99 [−31.97 - 19.947]	0.001

Socio-demographic Factors Associated with Bacterial Vaginosis (BV)

Bacterial vaginosis was more prevalent among pregnant women aged 18 to 29 years (28.8%, 34) and least among women aged 40 to 49 years (0%) 0, as shown in Table 7. This difference was however not statistically significant (OR = 1.26; 95% CI: 0.66 - 2.89; p = 0.49). In the same like, the infection was significantly (OR = 5.29; 95% CI: 1.48 - 18.86; p = 0.01) more prevalent among applicant (63%, 7) than in other occupations.

A higher prevalence was recorded among married (27.8%, 42) women as opposed to the singles (24.5%, 12) but the difference was not statistically significant (OR = 0.84 95% CI: 0.40 - 1.77; p = 0.21). Bacterial vaginosis was highest (33.3%, 2) among illiterate clients than in the literate women at each level, but the difference was not significant (OR = 1.37; 95% CI: 0.2477.68; p = 0.66) (Table 8).

3.3.9. Association of Hygiene Practice with Bacterial Vaginosis

In Table 9, most participants (n = 10/29) having both pipe-borne and well as sources of water were diagnosed of bacterial vaginosis, giving the highest prevalence (34.5%) in this subgroup as opposed to participants who used only pipe-borne water (25.6%, 40) or well water(n = 4; 28.6%). This difference was however not significant (OR = 1.52; 95% CI: 0.66 - 3.52; p = 0.33).

Table 8. Socio-demographic factors associated with bacterial vaginosis (BV).

Variable	Category	Total No	BV-pos No (%)	OR (95% CI)	P-value
Age (years) group	18 - 29	118	34 (28.8)	1.26 [0.66 - 2.89]	0.49
	30 - 39	74	20 (27)	1.00 [0.53 - 1.97]	**1**
	40 - 49	8	0 (0)		**0.11**
Occupation	Formally	57	12 (21.1)	0.64 [0.31 - 1.33]	0.23 employed
	Self employed	68	21 (30.9)	1.34 [0.70 - 2.56]	0.79
	Housewife	16	4 (25)	0.89 [0.28 - 2.89]	1
	Applicant	11	7 (63)	5.29 [1.48 - 18.86]	0.01
	Student	48	10 (20.8)	0.65 [0.29 - 1.41]	0.27
Marital status	Single	49	12 (24.5)	0.83 [0.58 - 160]	0.76
	Married	151	42 (27.8)	0.84 [0.40 - 1.77]	0.21
Level of education	No formal	6	2 (33.3)	1.37 [0.2477.68]	0.66
	Primary	25	8 (32.8)	1.32 [0.53 - 3.29]	0.55
	Secondary	69	18 (26.1)	0.93 [0.48 - 180]	0.8
	Tertiary	100	26 (26)	0.90 [0.49 - 1.69]	0.75

Table 9. Association of hygiene practice with bacterial vaginosis.

Variable	Total No	BV positive n (%)	OR	p-value
Water source				
Pipe borne	155	40 (25.6)	0.77 [0.37 - 1.59]	0.48
Well	14	4 (28.6)	1.09 [0.33 - 3.63]	1
Both	29	10 (34.5)	1.52 [0.66 - 3.52]	0.33
Rivers	2	0 (0)		1
Toilet type				
Water cistern	85	24 (28.2)	1.2 [0.58 - 2.09]	0.74
Pit	77	24 (31.2)	1.40 [0.75 - 2.65]	0.29
Both	36	6 (16.7)	0.48 [0.19 - 1.23]	0.12
Others	2			1
Toilet use				
Shared	183	51 (27.9)	1.80 [0.49 - 6.54]	0.57
Not shared	17	3 (17.6)		
Practice of douching				
Yes	119	31 (26.1)	0.89 [0.47 - 1.67]	0.71
No	81	0 (0)		

Among different types of toilet assessed, bacterial vaginosis was insignificantly (OR = 1.40; 95% CI: 0.75 - 2.65; p = 0.29) most prevalent among users of pit toilet (31.2%, 24). Though not statistically significant (OR = 1.80; 95% CI: 0.49 - 6.54 p = 0.5), bacterial vaginosis was expectedly more prevalent (27.9%, 51) among pregnant women who shared their toilets, than in those who did not share (17.6%, 4). All the participants diagnosed of bacterial vaginosis were among those who practiced douching, thus a higher prevalence (26.1%, 31) was noted among these subjects, than among their peers who did not, but the difference was insignificant statistically (OR = 0.89; 95% CI 0.47 - 1.67; p = 0.71).

3.3.10. Association of Clinical Presentation with Bacterial Vaginosis

From Table 10, bacterial vaginosis was most prevalent among participants in their first trimester of pregnancy (33.3%, 6) and least among those in those in the second trimester (24.1%, 26). This difference was however not statistically significant (OR = 1.39: 95% CI: 0.49 - 3.93; p = 0.58). This infection was significantly associated (OR = 0.46; 95% CI: 0.24 - 0.88; p = 0.02) with vagina discharges other than greenish, yellowish or whitish. Clients who presented with greenish vagina discharges (50%) were more likely to have bacterial vaginosis when compared with the other groups. Bacterial vaginosis was significantly associated with foul smelling vagina discharges, (OR = 7.78; 95% CI: 3.86 - 15.69; p < 0.0001), 58.2% prevalence.

3.3.11. Multivariate Analysis of Factors Associated with Bacterial Vaginosis

Offensive vaginal discharge was the only symptom significantly associated with bacterial vaginosis after multivariate analysis as shown in Table 12 (AOR = 7.077; 95% CI: 1.218 - 3.129; p = 0.001) (Table 11).

Table 10. Association of clinical presentation with bacterial vaginosis.

Variable	Total No	BV-pos n (%)	OR	p-value
Trimester				
First	18	6 (33.3)	1.39 [0.49 - 3.93]	0.58
Second	108	26 (24.1)	0.73 [0.39 - 1.36]	0.31
Third	74	22 (29.7)	1.24 [0.66 - 2.56]	0.51
Colour of vag. discharge				
Whitish	28	6 (21.4)	0.71 [0.27 - 1.84]	0.47
Yellowish	74	28 (37.8)	2.34 [1.24 - 4.43]	0.08
Greenish	4	2 (50)	2.77 [0.38 - 20.17]	0.29
Others	94	18 (19.1)	0.46 [0.24 - 0.88]	0.02
Odour of vag. discharge				
Offensive	55	32 (58.2)	7.78 [3.86 - 15.69]	<0.0001
Non-offensive	145	22 (15.2)		

Table 11. Multivariate analysis of factors associated with Bacterial vaginosis.

Variable	n (%)	AOR [95%: CI]	p-value (for AOR)
Applicant	7 (63.6)	2.23 [−1.107 - 3.326]	0.340
Married	42 (27.8)	0.735 [−1.464 - 0.709]	0.587
Both pit and w/c	24 (31.2)	0.422 [−2.850 - 0.198]	0.169
yellowish discharge	28 (37.8)	0.662 [−1.666 - 0.773	0.482
Other colours of dis.	18 (19.1)	0.497 [−1.794 - 0.507]	0.18
Offensive discharge	32 (58.2)	7.077 [1.218 - 3.129]	0.001

3.3.12. Socio-Demographic Factors Associated with Vulvovaginal Candidiasis (VVC)

As illustrated in Table 12, a significant association (OR = 6.93: 95% CI: 1.36 - 35.35; p = 0.041) was found between vagina yeast infection and the oldest age group (40 to 49 years) in this study, which had the highest prevalence (75%, 6). Concerning occupation, prevalence of vagina mycotic infestation was highest among students (43.8%, 21) and least among housewives (25%, 4) and the difference was statistically significant (OR = 1.79; 95% CI; 1.01 - 3.86 p = 0.04). This infection was insignificantly (OR = 1.68: 95% CI; 0.79 - 3.52: p = 0.17) more prevalent among single women (38.8%, 19) compared to those who were married (29.8%, 45). With respect to level of education the highest prevalence was recorded among the illiterate class of pregnant women (66.7%, 4), and the lowest was surprisingly among those who had primary education. However, the difference was not statistically significant (OR = 4.47; 95% CI: 0.79 - 25.06; p = 0.08).

3.3.13. Association of Hygiene Practice and Vulvovaginal Candidiasis

With respect to source of water, a statistically near significant (OR = 2.2; 95% CI: 0.99 - 4.9; p = 0.05) highest prevalence (35.5%, 55) was documented among subjects who used only pipe-bone water while there was no positive case recorded among those who used water from the rivers (0%, 0). All clients using other toilet types apart from water cistern and pit toilets or both, were diagnosed of genital mycotic infestation, giving a 100% (2) prevalence rate and highest among this subgroup in comparison with the 27.1% (23) recorded among those using water cistern, and the other toilet types. This difference was however not significant (OR = 0.53; 95% CI: 0.3 - 5.03; p = 0.10). Although not statistically significant (OR = 1.14; 95% CI: 0.39 - 3.99; p = 0.81), a higher prevalence was recorded among subjects who shared their toilets with others (32.2%, 59), than in those who did not share (29.4%, 5). All those infected with genital yeast (33.6%, 40) were among the pregnant women who douched, although the difference was not significant (1.20; 95% CI: 0.65 - 2.21; p = 0.55) when compared with those not practicing douching (Table 13).

Table 12. Socio-demographic factors associated with vulvovaginal candidiasis (VVC).

Variable	Total No	VVC No (%)	OR (95% CI)	P-value
Age group				
18 - 29	188	34 (28.8)	0.702 [0.39 - 1.28]	0.247
30 - 39	74	24 (32.4)	1.03 [0.56 - 1.91]	1
40 - 49	8	6 (75)	6.93 [1.36 - 35.35]	0.041
Occupation				
Formally employed	57	15 (26.3)	0.69 [0.35 - 1.36]	0.28
Self employed	68	20 (29.4)	0.83 [0.44 - 1.57]	0.32
Housewife	16	4 (25)	0.69 [0.21 - 2.23]	0.39
Applicant	11	4 (36.4)	1.23 [0.35 - 4.36]	0.75
Student	48	21 (43.8)	1.79 [1.01 - 3.86]	0.04
Marital status				
Single	49	19 (38.8)	1.68 [0.79 - 3.52]	0.17
Married	151	45 (29.8)	1.49 [0.76 - 2.92]	0.24
Level of education				
No formal	6	4 (66.7)	4.47 [0.79 - 25.06]	0.08
Primary	25	4 (66.7)	0.64 [0.24 - 1.68]	0.36
Secondary	69	22 (31.9)	0.99 [0.53 - 1.85]	0.98
Tertiary	100	32 (32)	1.00 [0.55 - 181]	1

Table 13. Association of hygiene practice and vulvovaginal candidiasis.

	Total No	VVC-pos n (%)	OR [CI 95%]	p-value
Water source				
Pipe borne	155	55 (35.5)	2.2 [0.99 - 4.9]	0.05
Well	14	3 (21.4)	0.56 [0.15 - 2.08]	0.56
Both	29	6 (20.7)	0.51 [0.19 - 1.32]	0.16
Rivers	2	0 (0)		1
Others				
Toilet type				
Water cistern	85	23 (27.1)	0.67 [0.37 - 1.25]	0.19
Pit	77	24 (31.2)	0.94 [0.51 - 1.73]	0.84
Both	36	15 (41.7)	1.68 [0.79 - 3.52]	0.17
Others	2	2 (100)	0.53 [0.3 - 5.03]	0.10
Toilet share				
Yes	183	59 (32.2)	1.14 [0.39 - 3.99]	0.81
No	17	5 (29.4)		
Practice of douching				
Yes	119	40 (33.6)	1.20 [0.65 - 2.21]	0.55
No	71	0 (0)		

3.3.14. Association of Clinical Presentation with Vulvovaginal Candidiasis (VVC)

Table 14 shows that vagina candidiasis was most prevalent and approaching significance (38%, 41) (OR = 1.84; 95% CI: 0.99 - 3.38; p = 0.05) among women in their second trimester of pregnancy and least prevalent among those in the first trimester (27%, 20). Concerning colour of vagina discharge, prevalence of mycotic vaginitis was highest among participants who presented with whitish discharges (45.4%, 34) (OR = 2.72; 95% CI: 1.47 - 5.03; p = 0.01). Other colours of discharges closely followed it (25.5%, 24), (OR0.57; 95% CI: 0.31 - 1.04; p = 0.06) but the difference was not statistically significant.

3.3.15. Multivariate Analysis of Factors Associated with Vulvovaginal Candidiasis

As shown in Table 15, using both pit and water cistern toilets was significantly associated with mycotic vaginal infection (AOR = 3.684; 95% CI: 0.388 - 2.649; p = 0.010). Symptoms significantly associated with this infection after multivariate analysis were whitish vagina discharges (AOR = 6.566; 95% CI: 17.785 - 21.836; p = 0.004) and yellowish vagina discharges (AOR = 3.404; 95% CI: 20.127 - 23.457; p = 0.004).

4. Discussion

Genital infections constitute a global problem and are common among sexually active women. The disease has an important medical implication especially among pregnant women, with adverse pregnancy and delivery outcomes including premature rupture of membranes, preterm delivery, and delivery of low birth weight infants among others (7). To the best of our knowledge, the present study was the first to explore the prevalence and risk factors associated with these infections among pregnant women in the Bamenda Regional Hospital and therefore forms a baseline data for the study area.

Table 14. Association of clinical presentation with vulvovaginal candidiasis (VVC).

	Total No	VVC-pos n (%)	OR (95% CI)	p-value
Trimester				
First	18	3 (16.7)	0.39 [0.11 - 1.42]	0.14
Second	108	41 (38)	1.84 [0.99 - 3.38]	0.05
Third	74	20 (27)	0.69 [0.3 - 1.29]	0.25
Colour of vag. discharge				
Whitish	28	6 (21.4)	0.54 [0.21 - 1.39]	0.19
Yellowish	74	34 (45.4)	2.72 [1.47 - 5.03]	0.01
Greenish	4	0 (0)		0.31
Others	94	24 (25.5)	0.57 [0.31 - 1.04]	0.06
Odour of vag. discharge				
Offensive	55	21 (38.2)	1.47 [0.77 - 2.81]	0.25
Non-offensive	145	43 (29.7)		

Table 15. Multivariate logistic regression of factors associated with vulvovaginal candidiasis.

Variable		AOR [95%:CI]	p-value (for AOR)
Student	21 (43.8)	1.78 [0.27 - 1.601]	0.179
Pipe-borne water	55 (35.5)	3.709 [−0.500 - 38.277]	0.156
Both p/b and well	6 (20.7)	1.634 [−1.775 - 37.435]	0.551
Water cistern toilet	23 (27.1)	0.727 [−1.775 - 37.435]	0.469
Both pit and w/c	15 (41.7)	3.684 [0.388 - 2.649]	0.010
Second trimester	41 (38)	1.248 [−0.610 - 1.122]	0.587
Whitish discharge	6 (21.4)	6.566 [17.785 - 21.836]	0.004
Yellowish discharge	34 (45.9)	3.404 [20.127 - 23.457	0.004
Offensive discharge	21 (38.2)	1.731 [−0.422 - 1.583]	0.206

The overall prevalence of genital tract infections among pregnant women in this study was at 49.5% (99). This prevalence is comparable with those reported in previous studies carried out in other regions and study populations in Cameroon, Africa and beyond. It is smaller than the 68.7% reported in 2015 by Nsagha *et al.* [13], among women attending the Yaounde Teaching Hospital and 53.3% among pregnant women experiencing full term labour [24]. However, these same results were found to be very similar to 49.0% prevalence rate reported among pregnant women experiencing preterm labour in the same study as above [24]. Discrepancies in results perhaps are explained by the fact that studies were carried out in different study populations. Prevalence is generally expected to be higher among pregnant women experiencing preterm labour since it has been reported to be a direct consequence of genital tract infections in pregnancy. A similar study carried out among women of reproductive age attending a catholic hospital in Nkoldongo Yaounde, Bobrick *et al.* [14] reported a general prevalence of 20% and attributed this rate to the antisepsis products used by the patients were mostly basic with varied pH leading to favourably destroy the vaginal flora and the formation of a new non-protective flora.

The prevalence of *Trichomonas vaginalis* in this study was 2% with confidence interval (0.5 - 4.0). This rate is smaller than the 5% obtained by Bobrick *et al.* [14] among women of reproductive age in Nkoldongo, Yaounde, and higher than 1.2% reported among women attending the University Teaching Hospital, also in Yaounde [13], and the s same diagnostic methods (wet mount) were used. Differences in prevalence could be because of the differences in sample size and study population. Mbu *et al.* [15] in a study among pregnant women in 2008, obtained prevalence rates of 21.2% and 10.6% respectively in HIV-positive and negative women. He likened this difference to be a function of the immune status of the participants.

A similar study among pregnant women by Abioye *et al.* [4] had prevalence of 7.5%, with the use of gemsa staining technique as diagnostic method. This high-

er value was perhaps as a function of the more reliable diagnostic method used. Using culture technique and wet mount, rates of 3.18% and 2.73% respectively were obtained by Nouraddin *et al.* [25] among women in Ebril, Iraq. The author likened this difference in results to the competence of the diagnostic methods applied. In this study, trichomoniasis was strongly associated with malodourous greenish vaginal discharges both in bivariate and multivariate analysis ($p < 0.05$). This is similar to findings of Maufi *et al.* [26] and Al-Mekhlafil *et al.* [4] among pregnant women in Tanzania and Yemen respectively. No level of formal education was found to be an independent risk factor for trichomoniasis both in the unadjusted and adjusted analysis in this study. This is in consonant with the reports of AlMekhlafil *et al.* [4] and could be likened to the fact that these illiterate women have very little knowledge on the practice of hygiene and preventive measures against this infection. However, level of education was not associated to the infection among women in Southern Brazil [27] [28] [29] [30] [31]. After multivariate analysis, practice of douching was found to be significantly associated with *T. vaginalis* infection ($p = 0.001$). This is explained by the fact that most substances used in douching end up destroying the normal flora of the vagina thus, encouraging growth of pathogens. This finding was by the way different from reports of Oluwe *et al.* [32], who found no significant association between douching and infection with *T. vaginalis*. Toilet sharing was significantly associated with this infection among pregnant women as reported by Muafi *et al.* [26] in Tanzania and said to be secondary to the high level of contamination of these shared toilets by the multiple users. The same was common among those who tested positive for *T. vaginalis* infection in this study, although no significant association was established.

All client positive for TV in this study were married (2.6%, 4) and in their second trimester of pregnancy (3.7%, 4). Although not statistically significant, this could be because many women turn to start ANC only in the second trimester of pregnancy as such, this particular trimester tends to have majority of attendees with a higher chance of occurrence of anything within this group.

Vulvovaginal candidiasis (VVC) had a prevalence of 32% (64) in this study, ranking it the highest individual genital infection among pregnant women. These results were similar to 26.5% 30%, 35%, 38.5%, reported in Yaounde by Nsagha *et al.* [13], Nigeria by Nnaemeka *et al.* [33], Havana City by Limia *et al.* [34] but lower than those obtained in Maroua by Toua *et al.* [35], (55.4%). It should however be noted that culture and Immunologic Latex Agglutination Test were diagnostic methods applied by these authors, rather than the less reliable wet mount and gram staining technique used in this study. This perhaps explains the relatively lower prevalence in this study. In a similar study but with the use of Immunologic Latex Agglutination Test, Limia *et al.* [34] reported vaginal candidiasis and trichomoniasis prevalences in immunocompetent pregnant women of Havana to be 38.5% to 46.2 % (95% CI) and 7.5% to 12.1% (95% CI), respectively. He also recommended that this diagnostic method be adopted for

prevalence studies as a uniform sensitivity and specificity would be achieved for all participants.

With respect to occupation, Toua *et al.* [35] reported the lowest prevalence (16.1%) of VVC among students. This was contrary to the data from the current study, in which the prevalence of VVC was 43.8% among students making up for the highest subgroup and being a student was found to be strongly associated with VVC at bivariate analysis (OR = 1.97; 95% CI; 1.01 - 3.86; p = 0.04). This strong association between student hood and VVC is probably because students at most times, may not have enough resources to take proper care of themselves. In the same study in Maroua, practice of douching was identified to be a risk factor associated with mycotic vaginitis and was linked to the destruction of the normal lactobacilli flora of the vagina by antiseptics and other substances used in the douching process. This was still not in line with the present study.

5. Conclusions

There was a high prevalence of vaginal infections among pregnant women attending the Regional Hospital concerned, especially VVC and BV. VVC was the most predominant (32%, 64/200) vaginal infection followed by BV (27%, 54/200) and the least was TV (2%, 4/200).

The only risk factor significantly associated to VVC in this study after multivariate analysis was the use of both water cistern and pit toilet.

Recommendations

- Because of these high prevalence rates of vaginal infections, pregnant women attending antenatal clinics should have prompt and adequate investigations with appropriate treatment to prevent adverse effect of the infection on mother and child.
- Future studies should employ more reliable methods of diagnosis and explore more factors like co-infection with HIV, HSV and other STIs.

Authors' Role (From Left to Right)

- Conceptual design of the work;
- Data collection and methodology;
- Proof reader.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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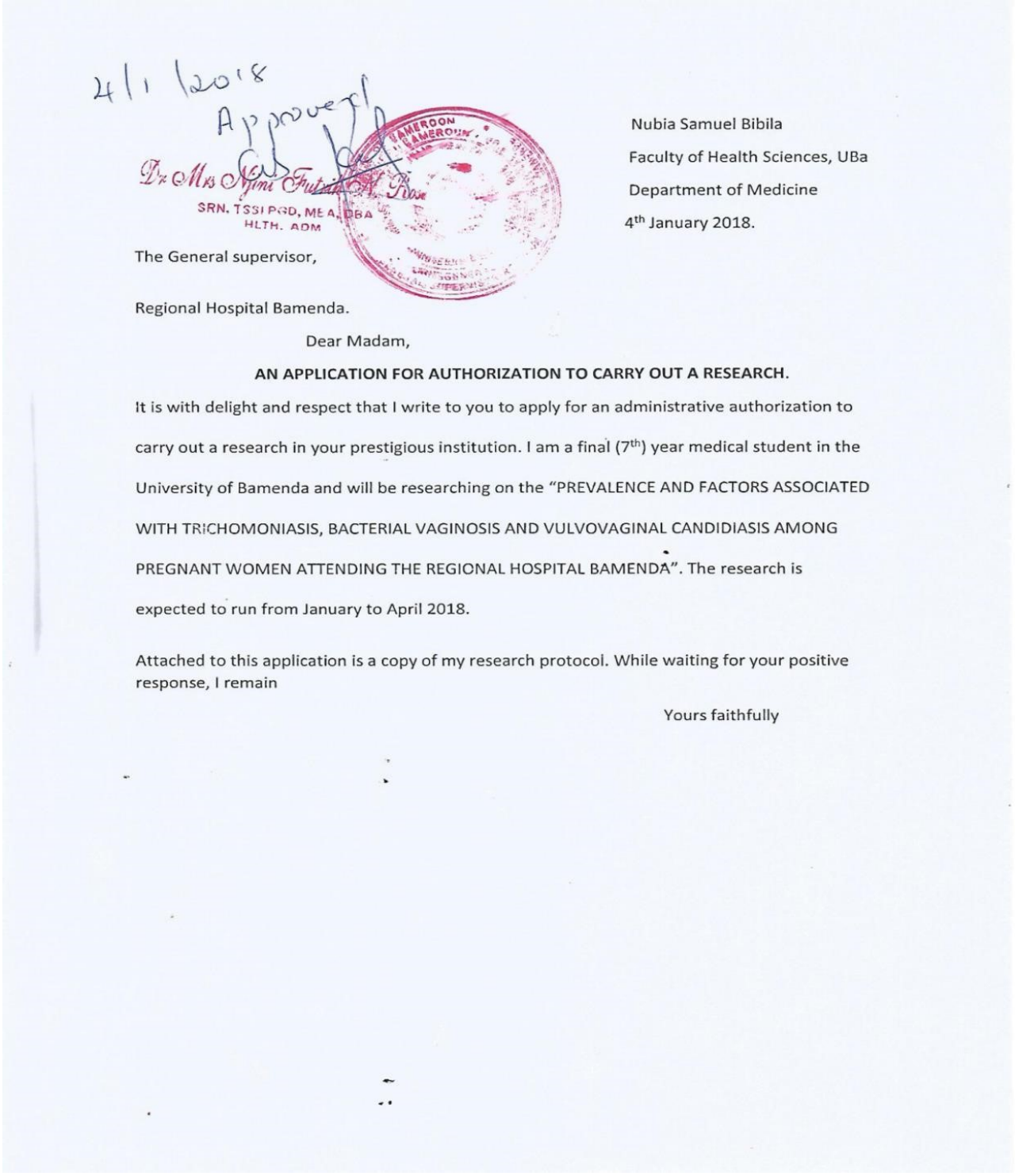

4/1/2018
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Nubia Samuel Bibila
Faculty of Health Sciences, UBa
Department of Medicine
4th January 2018.

The General supervisor,

Regional Hospital Bamenda.

Dear Madam,

AN APPLICATION FOR AUTHORIZATION TO CARRY OUT A RESEARCH.

It is with delight and respect that I write to you to apply for an administrative authorization to carry out a research in your prestigious institution. I am a final (7th) year medical student in the University of Bamenda and will be researching on the "PREVALENCE AND FACTORS ASSOCIATED WITH TRICHOMONIASIS, BACTERIAL VAGINOSIS AND VULVOVAGINAL CANDIDIASIS AMONG PREGNANT WOMEN ATTENDING THE REGIONAL HOSPITAL BAMENDA". The research is expected to run from January to April 2018.

Attached to this application is a copy of my research protocol. While waiting for your positive response, I remain

Yours faithfully