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Epidemiology of *Vaginal candidiasis* and Its Antifungal Susceptibility Pattern at the Buea Regional Hospital in Cameroon

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Authors' contributions

This work was carried out in collaboration among all authors. Authors NAL, TNF and LWS conceptualized and designed the study. Authors LNF and TNF performed research. Authors TNF, LNF, LWS, NAL, TGN, SA and CF wrote the paper. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study aimed to assess the prevalence of Vulvovaginal candidiasis (VVC) and investigate the antifungal susceptibility patterns among both pregnant and non-pregnant women in Buea, Cameroon.
Study Design: Cross-sectional hospital-based design.
Place and Duration of Study: The study was conducted at the Buea Regional Hospital, in the South West Region of Cameroon for a period of 3months.
Methodology: The study included a total of 270 participants, comprising 135 pregnant women and 135 non-pregnant women. Vaginal swab samples were collected and cultured on Sabouraud Dextrose Agar supplemented with chloramphenicol and later sub-cultured on Chromogenic Candida Agar. A Germ tube test was carried out to confirm the presence of *Candida albicans* and served as a confirmatory test in classifying the species as pathogenic or not. Kirby-Bauer disk diffusion technique was used for antimicrobial susceptibility testing. Statistical analysis was performed where a $P < 0.05$ was considered significant.
Results: The overall prevalence of VVC was 20.7%. The prevalence was higher among pregnant women (23.7%) compared to non-pregnant women (17.8%). *Candida albicans* 69.6% was the most prevalent species while C. tropicalis (5.4%) was the least. Predisposing factors such as history of candidiasis was associated with VVC in pregnant women (P=0.009), while the presence of symptoms (P=0.011), and clothing preferences like trousers (P=0.048) were associated with VVC in non-pregnant women. Voriconazole (66.15%) was the most effective antifungal drug while caspofungin (81.25%) was least effective to all species.
Conclusion: VVC has a higher prevalence in pregnant than in non-pregnant women with *Candida albicans*, being the most prevalent species. History of candidiasis, presence of symptoms, and clothing preferences like trousers were statistically associated with the presence of VVC in this study population. Voriconazole could serve as the drug of choice for management of VVC infection.

Keywords: Vulvovaginal candidiasis; pregnant and non-pregnant women; predisposing factors.

1. INTRODUCTION

Vulvovaginal candidiasis (VVC) is a global public health concern [1]. It is caused by Candida species which are opportunistic fungal pathogens with a propensity to harmlessly colonize vaginal mucosa and other organs of the body. However, in immune compromised individuals, VVC is easily established [2,3]. The infection is characterized by abundant vaginal discharge, unpleasant odors, pain or irritation during intercourse or during the passage of urine [4].

Worldwide, VVC affects about 138 million women annually with a global annual prevalence of 3871 per 100,000 women [5], and it could be recurrent [1]. Women aged 25 to 34 years have the highest prevalence of 9% [6]. A high prevalence has been reported in some African countries like Ghana, Nigeria and South Africa [7,8].

About 70 to 75% of women haven experienced at least one episode of infection in their lives, with pregnancy being a predisposing factor [9,10]. During normal pregnancy, candidiasis is frequently encountered without significant risk to the fetus. Nevertheless, pregnancy may be negatively affected by VVC. If untreated, vaginal candidiasis can lead to chorioamnionitis resulting in abortion, prematurity and or congenital infection of the neonate in pregnant women [11].

A previous study conducted in the Far North region of Cameroon revealed a significant prevalence rate of 55.4% for VVC specifically among pregnant women experiencing abnormal leucorrhea [11]. Also, a study conducted in the South West region found a prevalence of 65.3% for vulvovaginal VVC among University students, with *Candida albicans* identified as the most predominant species [12].

The azoles antifungal group of molecules have been reported as the most effective antifungal drugs over the years by several authors for the treatment and management of VVC [13]. However, over-the-counter use and other malpractices of these antifungals have brought about antifungal resistance. Antifungal drug susceptibility of Candida species has been reported to vary from region to region even within the same country [14,15-17]. Indeed, it becomes imperative to carry out a situation analysis concerning antifungal susceptibility per region as

regional data is of great importance in the search for a suitable antifungal agent against Candida species [18,19].

There is limited data on the prevalence of VVC in pregnant and non-pregnant women in Buea, Cameroon. Given that pregnancy is a predisposing factor for vulvovaginal candidiasis, posing a real problem in the management of the infection, and coupled with the existing variations on prevalence data, species distribution, predisposing factors, and antifungal susceptibility patterns of VVC among pregnant and non-pregnant women, this study aimed at determining the prevalent species and antifungal susceptibility patterns of VVC in both groups in Buea, South West Region of Cameroon.

2. MATERIALS AND METHODS

2.1 Study Design and Site

The study was a cross sectional study involving pregnant women attending antenatal clinic and non-pregnant women attending the Buea Regional Hospital. The Buea Regional Hospital is located in the capital city of Buea, Fako Division of the South West region of Cameroon. It is located on the Eastern slope of Mount Cameroon. Buea has a population of over 300,000 inhabitants [20].

2.2 Study Population and Sampling Technique

Participants were recruited by convenient sampling. Pregnant women in all trimesters of pregnancy and non-pregnant women who were at least 16 years of age and gave informed consent were recruited for the study. Participants who met the inclusion criteria were administered interviewer-administered questionnaires while ensuring the confidentiality of their responses. Participants who douched before coming to the hospital, women undergoing antifungal therapy or having a history of taking antifungal, and non-pregnant women who were on their monthly period were excluded from the study.

2.3 Sample Collection

A total of 270 participants were recruited for the study. Low vaginal specimens were collected from each participant using a sterile swab stick. The swab was carefully inserted about 2 inches (5cm) past the introitus and rotated for about 10 to 30 seconds, ensuring it touched the lower one-third of the vaginal wall for adequate absorption of moisture prior to withdrawal. The swab sticks containing participant specimens were carefully placed in a sterile tube labelled with the patient's code, and parameters like color, quantity, and odor of discharge were noted. The cap was then tightly screwed into the tube and transported to the laboratory for analysis.

2.4 Culture of Samples

Samples were inoculated on Sabouraud Dextrose Agar supplemented with 50mg/l of chloramphenicol. Chloramphenicol was added in order to inhibit bacteria growth. Inoculated plates were incubated for 24 hours at 37ºC. Cultures presenting with the characteristic cream white colonies were considered positive for the presence of fungi. Positive cultures were sub-cultured on Chromogenic Agar Candida media to identify different species of Candida. *Candida albicans* forms a characteristic green colony, while *C. krusei* forms pink and spreading colonies, *C. glabrata* forms cream white colonies and *C. tropicalis* forms blue colonies on the media.

2.5 Germ Tube Test

A germ tube test was carried to further confirm the presence of pathogenic *Candida albicans* since they are the only species in the genus Candida which are germ tube positive and a normal flora. A pure colony of the organism from a positive culture on Chromogenic Agar Candida media was introduced in 2ml of human serum and incubated for 2 to 3 hours in a water bath. The suspension was later mounted on a glass slide viewed under 10X and 40X objective lens for the formation of pseudo hyphae which is characteristic of a positive germ tube test.

2.6 Susceptibility of Isolates to Antifungal Agent

Antifungal agents used were fluconazole, miconazole, clotrimazole, voriconazole, caspofungin, ketoconazole, and nystatin. Isolates were tested against these 7 antifungals for their susceptibility using the disc diffusion method as previously described by Kirby Bauer. The diameter of the zone of inhibition was measured using a ruler and later interpreted. They were interpreted using the standard by Clinical and Laboratory Standard Institute.

2.7 Statistical Analysis of the Data

Data analysis was carried out using SPSS version 24 (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp). Descriptive statistics were used to present the socio-demographic characteristics of the study participants. Logistic regression was used to assess associations where appropriate. Variables with a p-value < 0.2 in the bivariate analysis were included in the multivariate analysis. A p-value < 0.05 was considered statistically significant.

3. RESULTS

3.1 Socio-demographic Data of the Study Participants

A total of 270 women were included in this study of which 135 were pregnant and 135 non-pregnant with age varying from 15 to 43 years and mean age of 25.87+ 5.85 years. For pregnant women, the age range was 16 to 43 years, with a mean age of 26.93 ± 5.45. Non-pregnant women had an age range of 15 to 38 years, with a mean age of 24.81 ± 6.06 (Table 1).

3.2 Prevalence of Vulvovaginal Candidiasis

Of the samples collected from participants enrolled in this study, a prevalence of 20.7% of the different Candida species associated with VVC was recorded. Candida species were isolated in 17.8% of non-pregnant women compared to 23.7% from pregnant women. There was no statistically significant differences between the two group with *P* = 0.293.

3.3 Distribution of VVC among Symptomatic and Asymptomatic Women

In this study, 19 women (6 pregnant and 13 non pregnant women) manifested symptoms of VVC, and 251 were asymptomatic. A higher prevalence rate of VVC infection was noted in both pregnant and non-pregnant women presenting with symptoms 47.4 % while a lower prevalence rate was noted among asymptomatic women 18.7%. There was significant association between symptom manifestation and VVC (*P*=.006).

Table 1. Socio-demographic Characteristics of the study population

	Total (%)	Pregnant (%) Test group	Non-pregnant (%) Control group
Age group			
15 – 25	140(51.9)	59 (43.7)	81(60.0)
26 – 35	108(40.0)	64 (47.4)	44 (32.6)
>36	22(8.1)	12 (8.9)	10 (7.4)
Total	270(100)	135 (100.0)	135 (100.0)
Level of education			
Primary	21(7.8)	7 (5.2)	14 (10.4)
Secondary	102(37.8)	51 (37.8)	51 (37.8)
University	147(54.4)	77 (57.0)	70 (51.9)
Total	270(100)	135 (100.0)	135 (100.0)
Marital status			
Married	133(49.3)	88 (65.2)	45 (33.3)
Single	137(50.7)	47 (34.8)	90 (66.7)
Total	270(100)	135 (100.0)	135 (100.0)
HIV status			
Negative	261(96.7)	130 (96.3)	131 (97.0)
Positive	9(3.3)	5 (3.7)	4 (3.0)
Total	270(100)	135 (100.0)	135 (100.0)
Trimester			
First	/	19 (14.1)	/
Second	/	54 (40.0)	/
Third	/	62 (45.9)	/
Total	/	135(100)	/

Table 2. Association between Vulvovaginal Candidiasis and predisposing factors in pregnant women

Factor	Total (N)	Culture Positive (%)	COR (95% Cl)	*P*-value	AOR (95% Cl)	*P*-value
Age-group						
≤ 20	14	5 (35.7)	1		1	
21 - 25	45	14 (31.1)	0.81 (0.23 – 2.87)	.748	0.91 (0.18 – 4.56)	.904
26 - 30	47	8 (17)	0.37 (0.10 – 1.40)	.143	0.28 (0.53 – 1.42)	.123
>30	29	5 (17.2)	0.38 (0.09 – 1.61)	.187	0.20 (0.02 – 1.64)	.133
Level of education						
Primary	7	2 (28.6)	1			
Secondary	51	12 (23.5)	0.77 (0.13 – 4.48)	.771		
University	77	18 (23.4)	0.76 (0.14 – 4.27)	.758		
Marital status						
Single	88	19 (21.6)	1			
Married	47	13 (27.7)	0.72 (0.32 – 1.63)	.431		
Trimester						
1st	12	4 (33.3)	1			
2nd	54	10 (18.5)	0.455 (0.11 – 1.81)	.264		
3th	69	18 (26.1)	0.71 (0.19 – 2.63)	.604		
HIV status						
Negative	130	30 (23.1)	1			
Positive	5	2 (40.0)	2.22 (0.36 – 13.92)	.394		
Symptomatic						
No	129	29 (22.5)	1			
Yes	6	3 (50.0)	3.45 (0.66 – 18.01)	.142	1.44 (0.01 – 3.73)	.711
Clothing preference						
Skirt	130	31 (23.8)	1			
Trouser	5	1 (20.0)	0.80 (0.09 – 7.41)	.843		
Wear tight under wear						
No	125	28 (22.4)	1			
Yes	10	4 (40.0)	2.31 (0.61 – 8.76)	.218		
Use soaps and perfumes						
No	130	30 (23.1)	1			
Yes	5	2 (40.0)	2.22 (0.36 – 13.92)	.394		
History of candidiasis						
No	122	25 (20.5)	1			
Yes	13	7 (53.8)	4.53 (1.40 – 14.67)	**.012**	7.269 (1.93 – 32.46)	**.009**

VVC; Vulvovaginal candidiasis, COR; Crude odd ratio, AOR; Adjusted odd ratio, HIV; Human Immunodeficiency Virus

Table 3. Association between Vulvovaginal Candidiasis and predisposing factors in non-pregnant women

Factor	Total (N)	Culture Positive (%)	COR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Age-group						
≤ 20	31	5 (15.1)	1			
21 – 25	50	10 (20.0)	1.3 (0.40 – 4.24)	.663		
26 – 30	28	3 (10.7)	0.62 (0.14 – 2.89)	.547		
>30	26	6 (23.1)	1.56 (0.42 – 5.85)	.510		
Level of education						
Primary	14	3 (21.4)	1			
Secondary	51	10 (19.6)	0.89 (0.21 – 3.82)	.880		
University	70	11 (15.7)	0.68 (0.16 – 2.87)	.602		
Marital status						
Single	45	9 (20.0)	1			
Married	90	15 (16.7)	1.25 (0.50 – 3.13)	.633		
Symptomatic						
No	122	18 (14.8)	1		1	
Yes	13	6 (46.2)	4.95 (1.49 – 16.44)	**.009**	7.2 (1.56 – 32.88)	**.011**
Take oral contraceptives						
No	101	21 (20.8)	1			
Yes	34	3 (8.8)	0.37 (0.10 – 1.32)	.126	0.25 (0.05 – 1.32)	.103
Clothing preference						
Skirt	62	7 (11.3)	1			
Trouser	73	17 (23.3)	0.42 (0.16 – 1.09)	.075	0.3 (0.09 – 1.0)	**.048**
Wear tight under wear						
No	106	16 (15.1)	1		1	
Yes	29	8 (27.6)	2.14 (0.81 – 5.67)	.125	0.25 (0.05 – 1.32)	.091
Use soaps and perfumes						
No	113	18 (15.9)	1			
Yes	22	6 (27.3)	1.98 (0.68 – 5.74)	.209		
History of candidiasis						
No	111	19 (17.1)	1			
Yes	24	5 (20.8)	1.27 (0.42 – 3.84)	.666		

VVC; Vulvovaginal candidiasis, COR; Crude odd ratio, AOR; Adjusted odd ratio

Table 4. Frequency of isolated *Candida species*

***Candida species* isolated**	**Distribution of Isolate per study group**		**Total (%)**
	Pregnant No. (%)	**Non-pregnant No. (%)**	
Candida albicans	21 (65.6)	18 (75.0)	39 (69.6)
Candida krusei	5 (15.6)	5 (20.8)	10 (17.9)
Candida glabrata	3 (9.4)	1 (4.2)	4 (7.1)
Candida tropicalis	3 (9.4)	0	3 (5.4)
Total	32 (57.1)	24 (42.9)	56 (20.7)

Table 5. Antifungal susceptibility pattern of Vulvovaginal Candidiasis isolated in pregnant women

Candida species		CLOT (%)	FCZ (%)	MIZ (%)	VCZ (%)	NYS (%)	KCZ (%)	CSP (%)
C. albicans	S	3 (14.3)	12 (57.1)	0 (0)	12 (57.1)	10 (47.6)	0 (0.0)	0 (0)
	I	13 (61.9)	3 (14.3)	17 (81)	2 (9.5)	11 (52.4)	15 (71.4)	3 (14.3)
	R	5 (23.8)	6 (28.6)	4 (19)	7 (33.3)	0 (0.0)	6 (28.6)	18 (85.7)
C. krusei	S	0 (0.0)	0 (0.0)	0 (0)	4 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)
	I	4 (80.0)	4 (80.0)	2 (40.0)	0 (0.0)	4 (80.0)	1 (20.0)	0 (0.0)
	R	1 (20.0)	1 (20.0)	3 (60.0)	1 (20.0)	1 (20.0)	4 (80.0)	5 (100)
C. glabrata	S	0 (0.0)	2 (66.7)	0 (0)	2 (66.7)	1 (33.3)	0 (0.0)	0 (0.0)
	I	1 (33.3)	0 (0.0)	2 (66.7)	0 (0.0)	2 (66.7)	0 (0.0)	0 (0.0)
	R	2 (66.7)	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)	3 (100)	3 (100)
C. tropicalis	S	0 (0.0)	3 (100)	0 (0)	3 (100.0)	1 (33.3)	0(0)	0 (0)
	I	2 (66.7)	0 (0.0)	3 (100)	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)
	R	1 (33.3)	0 (0)	0 (0)	0 (0.0)	1 (33.3)	2 (66.7)	2 (66.7)
Total	S	3 (9.4)	17 (53.1)	0 (0.0)	21 (65.6)	12 (37.5)	0 (0.0)	0(0.0)
	I	20 (62.5)	7 (21.9)	24 (75)	2 (6.3)	18 (56.2)	17 (53.1)	4 (12.5)
	R	9 (28.1)	8 (25)	8 (25)	9 (28.1)	2 (6.3)	15 (46.9)	28 (87.5)

C; Candida, KCZ; Ketoconazole, CSP; Caspofungin CLOT; Clotrimazole, FCZ; Fluconazole, MIZ; Miconazole, VCZ; Voriconazole, NYS; Nystatin

Table 6. Antifungal susceptibility pattern of Vulvovaginal Candidiasis isolated in non-pregnant women

Candida species		CLOT (%)	FCZ (%)	MIZ (%)	VCZ (%)	NYS (%)	KCZ (%)	CSP (%)
C. Albicans	S	5 (27.8)	12 (66.7)	1 (5.6)	12 (66.7)	9 (50.0)	7 (38.9)	2 (11.1)
	I	8 (44.4)	3 (11.1)	7 (38.9)	1 (5.6)	3 (16.7)	9 (50.0)	1 (5.6)
	R	5 (27.8)	6 (22.2)	10 (55.6)	5 (27.8)	6 (33.3)	2 (11.1)	15 (83.3)
C. krusei	S	1 (20.0)	0 (0.0)	1 (20.0)	3 (60.0)	1 (20.0)	1 (20.0)	2 (40.0)
	I	0 (0.0)	1 (20.0)	0 (0.0)	0 (0.0)	2 (40.0)	3 (60.0)	1 (20.0)
	R	4 (80.0)	4 (80.0)	4 (80.0)	2 (40.0)	2 (40.0)	1 (20.0)	2 (20.0)
C. glabrata	S	0 (0.0)	1 (100)	0 (0)	1 (100)	0 (0.0)	1 (100)	0 (0.0)
	I	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	1 (100)	0 (0.0)	0 (0.0)
	R	1 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0)	1 (100)
Total	S	6 (25.0)	13 (54.2)	2 (8.3)	16 (66.7)	10 (41.7)	9 (37.5)	4(16.7)
	I	8 (33.3)	3 (12.5)	8 (33.3)	1 (4.2)	6 (25.0)	12 (50.0)	2 (8.3)
	R	10 (41.7)	8 (33.3)	14 (58.3)	7 (29.2)	8 (33.3)	3(12.5)	18(75.0)

C; Candida, KCZ; Ketoconazole, CSP; Caspofungin CLOT; Clotrimazole, FCZ; Fluconazole, MIZ; Miconazole, VCZ; Voriconazole, NYS; Nystatin

3.4 Association between VVC and Predisposing Factors in Pregnant Women

History of candidiasis was significantly associated with VVC in pregnant women (AOR: 7.27; 95% CI: 1.3-32.46, *P*= .009) with higher frequency of VVC Candida infectious species in pregnant women compared to non-pregnant women (Table 2).

3.5 Association between VVC and Predisposing Factors in Non-pregnant Women

The presence of symptoms (symptomatic women) was significantly associated with VVC in non-pregnant women (*P*=.009). The odds of having VVC infections was significantly higher in non-pregnant women presenting with symptoms of candidiasis infection (AOR: 7.2; 95% CI: 1.56-32.88, *P*=.011) compared to non-pregnant women presenting no symptom. (Table 3).

3.6 Frequency of Occurrence of Isolated Candida Species in the Study Population

Among the 56 samples positive for Candida species, 57.1% of the species were isolated from pregnant women and 42.9% from non-pregnant women. Among the 32 samples from pregnant participants, C. albicans presented with the highest occurrence 65.6%, followed by *C. krusei* 15.6% (Table 4).

3.7 Frequency of Occurrence of Isolated Candida Species in the Study Population

Antifungal susceptibility pattern of 32 isolates of Candida species from pregnant women was determined. The sensitivity of the isolated Candida species varied from 0.0% to 65.6%, with voriconazole being the most sensitive 65.6% followed by fluconazole 53.1% (Table 5).

Antifungal susceptibility pattern of the 24 isolates of Candida species from the non-pregnant women was also investigated. The sensitivity of the isolated Candida species to the various antifungal drugs varied from 8.3% to 66.7%, with voriconazole being the most sensitive drug 66.7% followed by fluconazole (54.2%) (Table 6).

4. DISCUSSION

VVC represents one of the most frequent infections of the genital tract affecting millions of women each year [1]. Several studies previously carried out to evaluate the prevalence of candidiasis among pregnant women showed that the distribution of isolated Candida species varies between countries, and is greatly dependent on several risk factors [7,21,22].

In this study, 20.7% participants tested positive for Candida with 32 participants being pregnant women and 24 participants, non-pregnant women. There wasn't any significant difference in the prevalence of VVC between the two groups. This low prevalence could be due to adequate knowledge about VVC and its risk factors. This prevalence is similar to the study by Al-Akeel et al. [23] who reported a prevalence of 22.2% in Saudi women. However, the results obtained in this study was lower than those of other studies in the West Region of Cameroon by Kountchou et al. [22] where the prevalence was 32.86%, and Far North Region of Cameroon by Vroumsia et al. [11] where the prevalence was 55.4%. Moreover, Kechia et al. [21] reported a 35.92% prevalence in their study in Yaoundé. These discrepancies in prevalence between these studies could be linked to the fact that those studies focused only on pregnant women with suspicious vaginal leucorrhea, differences in geographical location and socioeconomic factors.

Pregnant women aged less than or equal to 20 years (35.7%) were the most affected by VVC while non-pregnant women greater than or equal to 30 years of age (23.1%) were the most affected by VVC. Women with primary level of education were most affected by VVC and among them were pregnant and non-pregnant women, who reported a prevalence of 28.6% and 21.4% respectively. This is similar to findings by Vroumsia et al. [11], Ibrahim et al. [24] who reported a prevalence of 50% and 55.8% among women with the primary level of education respectively. Frequency of VVC with regards to the gestational trimester revealed women in their third trimester of pregnancy were the most affected by VVC. This is in conformity with the results obtained by other authors [7,24,25]. This can be explained by the fact that increase in gestational age causes a decrease in immunity thus, exposing these women to a high frequency of VVC in the last trimester of pregnancy [7,25]. Significantly, in the last trimester, the pregnancy is near term and there may be repeated vaginal

examination as well as pelvic examinations in preparation for delivery which may lead to greater chances of exposure to the causative agents of VVC. Also, when pregnancy is near term there maybe reduction in the hygienic status of some pregnant women such as failure to wash their underwear and pubic areas properly due to fatigue or tummy size thereby encouraging vaginal infections.

Symptomatic women in both groups of participants especially those with itches, abnormal discharge, and abdominal discomfort had a higher prevalence of Candida positive cultures than those who were asymptomatic. Presence of symptoms was statistically significant to infection in non-pregnant women. This finding is similar to a study by Jombo et al. [26] who had a high prevalence of symptomatic vulvovaginal candidiasis. This could be explained by the fact that women who displays all those symptoms are more likely to visit health care centers due to the uncomfortable nature of the symptoms than those who are healthy or asymptomatic. The study showed that previous infection with VVC or known history of candidiasis was significantly associated with VVC in pregnant women. This corroborates other studies by Khan et al. [27] and Kombade et al. [28] who reported a high prevalence in of VVC among women who had previous Candida infection. Furthermore, pregnant women who wore trousers more often than skirts had a higher risk of developing vulvovaginal candidiasis. This is due to increase temperature and humidity of the vagina thus providing a more favorable environment for the growth of the organism. This is similar to findings by Ekpenyong et al. [29], who reported tight fitting garments, tight trousers and synthetic underwear as a statistically significant cause of VVC. These results were however contrary to results obtained by Ane-Ayangwe et al. [12].

Analysis and identification of various Candida species causing VVC in pregnant women using Chromogenic Agar Candida reported C. albicans (65.6%) as seen in studies by Disha and Haque [30], Paulitsch et al. [31] as the most prevalent species while *C. glabrata* 3(9.4%) and *C. tropicalis* 3(9.4%) were the least represented. This is contrary to findings by Tsega and Mekonnen, [32] who reported *C. krusei* as the most prevalent Non-albicans Candida species followed by the other species. In non-pregnant women *C. albicans* (75.0%) was the most frequent and this was similar to results obtained by Ane-Ayangwe et al. [12]. No *C. tropicalis* was isolated from non-pregnant women. This result was similar to a study carried out in Baghdad by Saif et al. [33]

As compared to the NAC species, *C. albicans* was more frequently isolated from pregnant women compared to non-pregnant women, presumably due to the opportunistic plasticity nature of *C. albicans* as triggered by estrogenized vagina and/or the high glycogen content during pregnancy [34]. There is also an increased level of estrogen during pregnancy and all of these provide a good source of carbon, which favors the growth of Candida species.

We examined the antifungal susceptibility patterns of Candida isolates to commonly used antifungals. The results showed that the percentage of susceptibility to the azoles, was higher than that of polyenes and echinocandins. This could be due to the fact that azoles are the most effective group of antifungals against the fungus Candida. Voriconazole with a sensitivity of 65.6% and 66.7% in pregnant and non-pregnant women respectively was the most active antifungal against all fungal species in this study. Similar results were obtained by Khan et al. [27]. Fluconazole-resistant *C. krusei* were also susceptible to voriconazole. Similar results were observed in studies by Khan et al. [27] and Kombade et al. [28]. Resistance was seen with caspofungin to most species of Candida with 87.5% and 75.0% in pregnant and non-pregnant women respectively thus it is not recommended for the management of VVC in this locality.

5. CONCLUSION

The prevalence of vulvovaginal candidiasis is relatively low in both groups of participants though higher in pregnant women than in non-pregnant women. History of candidiasis was a statistically significant predisposing factor to VVC in pregnant women while pregnant women who had history of candidiasis and wore more trousers than skirts had a statistically significant level of infection in this study area. *C. albicans* was the predominant species followed by Non-Albicans Candida like *C. krusei, C. tropicalis* and *C. glabrata*. Voriconazole could be recommended for the management and treatment of VVC candidiasis in this locality. We advocate for the sensitization and education of pregnant and non-pregnant women on the risk of developing vulvovaginal candidiasis.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of the manuscript.

CONSENT

As per international standards or university standards, participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical clearance for this study was obtained from the Faculty of Health Science University of Buea Ethical Review Board (2022/1703-03/UB/SG/IRB/FHS). Administrative clearance was obtained from the Regional Delegation of Public Health for the South West Region (R11/MINSANTE/SWR/RDPH/PS/525/725) and from the Director of the Buea Regional hospital (MPH/SWRDPH/BRH/IRB) where samples were collected and analyzed.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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