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Etiology and Risk Factors in Patients with Vulvovaginal Candidiasis in Abidjan (Côte d'Ivoire)

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Background: Limited data on the molecular identification of vulvovaginal candidiasis (VVC) pathogenesis in Côte d'Ivoire are available.

Objective: We sought to update the data on the causes of VVC in Abidjan, Côte d'Ivoire.

Methods: Conducted between May 2023 and January 2024, this cross-sectional study focused on patients with symptoms suggestive of VVC in Abidjan. Each patient underwent swab collection, direct examination, and culture. *Candida* chromatic agar and Auxacolor®-based identification tests were performed. A molecular-based polymerase chain reaction (PCR) targeting the hyphal wall protein 1 (*hwp1*) gene was used to differentiate between *C. albicans*, *C. africana*, and *C. dubliniensis*.

Results: The overall prevalence of fungal VVC was 53.6% (222/414 patients). After PCR, no *C. africana* or *C. dubliniensis* were observed. *C. albicans* isolates exhibited two PCR profiles: 941 bp and 941+850 bp, with *C. albicans* being the most frequently isolated species (70.7%) after *C. tropicalis* (9.9%). The most affected groups were patients younger than 25 ($p = 0.018$), those living in precarious housing ($p < 0.0001$), and pregnant women ($p = 0.006$). In addition, the presence of vulvovaginal candidiasis was significantly associated with vaginal irrigation (i.e., douching) frequency ($p = 0.003$), douche used (e.g., antibacterial or not) ($p = 0.003$), and underwear type ($p = 0.037$). The most common symptom reported was vaginal itching (46.4%).

Conclusion: No strains of *C. africana* and *C. dubliniensis* were found. The increased prevalence of VVC in Abidjan warrants further studies.

Key Words: *Candida*, Côte d'Ivoire, *hwp1*, Vulvovaginal candidiasis

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INTRODUCTION

Candida vulvovaginitis or vulvovaginal candidiasis (VVC) is the second-most frequent genital infection after bacterial vaginosis[1] and is characterized by *Candida* infections of the vulva and vagina[2]. VVC is often called "bacterial vaginosis", and trichomoniasis is the most common cause[3,4]. VVC causes significant discomfort and is a focus of concern for clinicians and biologists[5]. It is estimated that 75% of all women will experience at least one episode of VVC during their lifetimes[6], 40~50% will experience multiple VVC infections, and 6~10% develop recurrent VVC (RVVC). It is defined as at least four proven episodes of VVC in one year[7,8].

Among the species of *Candida*, *C. albicans* is the most commonly encountered pathogen in clinical settings, and is, therefore, the most researched[9,10]. *C. albicans* is a complex that includes *C. albicans sensu stricto* and the related species of *C. dubliniensis* and *C. africana*[11]. As these species are morphologically indistinguishable, molecular amplification of the hyphal wall protein 1 (*hwp1*) gene is used to discriminate *C. dubliniensis* and *C. africana* from *C. albicans*[12]. While *C. dubliniensis* is predominantly associated with cases of oral candidiasis in patients with human immunodeficiency virus (HIV)[13], *C. africana* is mainly responsible for VVC[14]. However, it has also been isolated outside the vagina (Odds et al., 2007). This work aimed to update the molecular identification of VVC pathogenesis in Abidjan.

The incidence of VVC has increased over the last decade, as has the frequency of non-albicans *Candida* (NAC) species, principally associated with RVVC. The latter represents a therapeutic problem, requiring the identification of risk factors and effective treatment[2,16].

The estimated prevalence of VVC in Côte d'Ivoire is ~43%[17], with *C. albicans* being the most frequently identified fungal species by mycological analysis[18,19]. Importantly, all previous studies of VVC were conducted in outpatient referral healthcare facilities[17,18,20], potentially omitting data from lower-level facilities. Therefore, this study sought to update what is known about VVC, particularly cases caused by *Candida* species, and contributing factors to improve our ability to manage these patients. All study patients were seen at one of two different facilities in Abidjan (Côte d'Ivoire).

MATERIALS AND METHODS

1. Study design and healthcare facilities

This study was conducted over eight months, from May 2023 to January 2024, on patients who presented with suspected VVC to the gynecology departments of two healthcare facilities in Abidjan: the General Hospital of Adjame (GHA) and the Anti-Venereal Dispensary (AVD) of the National Institute of Public Hygiene (NIPH). The GHA, located in Adjame, provides secondary healthcare, while the AVD / NIPH in the Treichville commune specializes in treating sexually transmitted infections (STIs). Women were recruited from the gynecology consultation departments from May to June 2023 in the GHA and from September 2023 to January 2024 in the AVD. Mycological analyses were performed at the Parasitology-Mycology Laboratory of the Diagnosis and Research Center on AIDS and Other Infectious Diseases (CeDReS) in the Teaching Hospital of Treichville. Molecular analyses were done at the Malaria Research and Control Center at the National Institute of Public Health.

2. Patient selection

The sample size was determined using the Schwartz formula: $N = z^2pq/d^2$, where N = the minimum number of patients, z = 1.96 based on an error risk α of 5%, $p = 0.43$ (prevalence found in a similar study conducted in Abidjan[17]), $q = 1 - p$, and $d = 0.05$ (accuracy of our results); thus, at least 376 patients were needed to achieve adequate statistical power.

Non-menstruating women who visited the gynecology departments of GHA and AVD with lesions suggestive of VVC were chosen after providing written informed consent. Before sampling, certain conditions had to be met: (i) no douching for 24~48 hours before the appointment, (ii) no oral or local treatment for the condition for 3~4 days before, and (iii) no sexual intercourse for at least 48~72 hours before.

3. Data collection

Each patient first underwent a complete clinical examination, including an interview and physical examination by a physician. We administered a questionnaire to collect patient-specific sociodemographic (such as age, education level, marital status, and occupation), clinical (burning, itching, and dyspareunia), and behavioral (douching frequency, use of antiseptic douche, condom use, oral contraceptive, and type of underwear) data.

4. Sample collection

The doctor collected vaginal specimens using two sterile cotton swabs moistened with sterile physiological saline. They

swabbed the back part of the vagina after placing a speculum. The first swab was used for direct examination, and the second was used to inoculate the culture medium.

5. Mycological analysis

1) Direct examination and isolation

The direct examination used a saline wet mount to identify budding or non-budding yeast with pseudohyphae. Yeast presence and abundance were noted during the examination. Swabs were cultured under strict aseptic conditions on Sabouraud chloramphenicol agar and Sabouraud chloramphenicol actidione agar for yeast isolation. The incubation conditions were 37℃ for 24~48 hours.

2) Yeast identification

We identified the yeasts after incubation using common macroscopic (appearance and color of clusters) and microscopic morphological features and growth parameters. We used chromogenic media (*Candida* chromatic agar) and sugar assimilation tests (Auxacolor®) to identify the species not recognized by the chromogenic media.

To identify the yeasts using *Candida* chromatic agar, we inoculated the agar by streaking a drop of yeast suspension obtained from a fresh yeast colony in 1 mL of sterile physiological saline, followed by incubation at 37℃ for 24 hours. The ability of the isolates to assimilate carbohydrate sources was determined using an API 20C yeast identification system (BioMérieux, Marcy-l'Étoile, France), according to the manufacturer's instructions. Lastly, identified clusters of *Candida albicans* strains were added to 1 mL of a mixture of Brain Heart Infusion Broth and glycerol and stored at -20℃.

6. Hyphal wall protein 1 genotyping

Before analysis, 1~2 drops of stored *C. albicans* strains were transferred to a fresh Sabouraud chloramphenicol agar under strict aseptic conditions. The agar was then incubated at 37℃ for 24~72 hours, and successful subcultures were extracted.

1) DNA extraction

Parasite DNA was extracted from 1~2 clusters according to the manufacturer's instructions using the Quick-DNA™ Fungal/Bacterial Miniprep Kit (Zymo Research, California, USA).

2) DNA amplification

The hyphal wall protein 1 gene was analyzed using a one-step polymerase chain reaction (PCR). The following primer sequences were used for amplification:

Forward: CR-f 5'-GCT ACC ACT TCA GAA TCA TC-3'
Reverse : CR-r 5'-GCA CCT TCA GTC GTA GAG ACG-3'

PCR amplifications were carried out in a final volume of 25 µL, including 7.5 µL of pure water, 0.5 µL of each primer (10 µM), 12.5 µL of GoTaq® G2 Hot Start Green Master (Promega, Madison, Wisconsin, United States), and 4 µL of extracted DNA. All procedures were performed in a class II Biological Safety Cabinet. The amplifications were conducted in SimpliAmp™ Thermal Cycler 96-well plates (Thermo Fischer Scientific, Waltham, MA, USA). The PCR conditions were as follows: 95℃ for 5 min; 30 cycles at 94℃ for 45 s, 58℃ for 40 s, and 72℃ for 55 s; and a final 10-min extension step at 72℃. Following amplification, PCR products were visualized using electrophoresis on a 1.5% agarose gel at 100 mV for 2 hours. The fragments were observed under a UV transilluminator (Biocom Biotech, Centurion, South Africa), and their sizes were estimated compared to the 100 bp DNA Ladder BenchTop (Promega, Madison, Wisconsin, United States). The expected sizes were 941 bp for *C. albicans*, 569 bp for *C. dubliniensis*, and 700 bp for *C. africana*.

7. Ethical considerations

The study was approved by the National Committee of Ethics and Life and Health Sciences (In French: Comité National d'Ethique et des Sciences de la Vie et de la Santé) with certificate number N° 059-23/MSHPCMU/CNESVS-km. The study was conducted following the principles of the Helsinki Declaration. Before enrolling, the patients, parents, or legal guardians obtained free and written informed consent.

8. Data analysis

All statistical analyses were conducted using IBM SPSS Statistics version 21 (Armonk, NY, USA). The tests included chi-squared and Fisher's exact tests with an alpha risk of 5%. A *p*-value less than 0.05 was deemed significant.

RESULTS

The study's participants were 414 women (213 at the GHA and 201 at the AVD). The study's overall prevalence of fungal

Table 1. Isolated *Candida* species

Isolated species	General Hospital of Adjame		Anti-Venereal dispensary		Total	
	n	%	n	%	n	%
Candia albicans	98	74.2	59	65.6	157	70.7
Candida tropicalis	13	9.8	9	10	22	9.9
Candida krusei	0	0	21	23.3	21	9.5
Candida glabrata	20	15.2	0	0	20	9
Candida parapsilosis	1	0.8	1	1.1	2	0.9
Total	132	100	90	100	222	100

Table 2. Sociodemographic, behavioral data and personal history of patients

	General Hospital of Adjame			Anti-Venereal dispensary			Total		
	Infected patients n,%	Examined patients n,%	*p*-value*	Infected patients n,%	Examined patients n,%	*p*-value*	Infected patients n,%	Examined patients n,%	*p*-value*
Age (years)									
<25	63 (63.6)	99 (46.5)		25 (46.3)	54 (26.9)		88 (57.5)	153 (37.0)	
25~40	64 (59.8)	107 (50.2)	0.743	52 (50.5)	103 (51.2)	0.063	116 (55.2)	210 (50.7)	**0.018**
>40	5 (71.4)	7 (3.3)		13 (29.5)	44 (21.9)		18 (35.3)	51 (12.3)	
Level of education									
None	59 (63.4)	93 (43.7)		2 (40.0)	5 (2.5)		61 (62.2)	98 (23.7)	
Primary	23 (63.8)	36 (16.9)	0.936	16 (43.2)	37 (18.4)	0.991	39 (53.4)	73 (17.6)	0.206
Secondary	37 (58.7)	63 (29.6)		27 (45.8)	59 (29.4)		64 (52.5)	122 (29.5)	
University	13 (61.9)	21 (9.8)		45 (45.0)	100 (49.8)		58 (47.9)	121 (29.2)	
Marital status									
Single	32 (59.3)	54 (25.4)		51 (46.8)	109 (54.2)		83 (50.9)	163 (39.4)	
Concubinage	15 (48.4)	31 (14.5)	0.160	15 (40.5)	37 (18.4)	0.788	30 (44.1)	68 (16.4)	0.063
Married	85 (66.4)	128 (60.1)		23 (42.6)	54 (26.9)		108 (59.3)	182 (44)	
Widow	0 (0)	0 (0)		1 (100)	1 (0.5)		1 (100)	1 (0.2)	
Type of housing									
Common courtyard	93 (63.3)	147 (69.0)		27 (54.0)	50 (24.9)		143 (72.6)	197 (47.6)	
Studio	17 (60.7)	28 (13.1)		8 (72.7)	11 (5.5)		28 (71.8)	39 (9.4)	
Flat	11 (0.5)	22 (10.3)	0.605	4 (30.8)	13 (6.5)	0.062	24 (68.6)	35 (8.5)	**<0.0001**
Villa	9 (64.3)	14 (6.6)		50 (40.0)	125 (62.2)		134 (96.4)	139 (33.6)	
Shanty	2 (100)	2 (1)		1 (50.0)	2 (1.0)		4 (100.0)	4 (1.0)	

Table 2. Sociodemographic, behavioral data and personal history of patients (Continued)

	General Hospital of Adjame			Anti-Venereal dispensary			Total		
	Infected patients n,%	Examined patients n,%	*p*-value*	Infected patients n,%	Examined patients n,%	*p*-value*	Infected patients n,%	Examined patients n,%	*p*-value*
Number of sexual partners									
0	0 (0)	0 (0)		8 (47.1)	17 (8.5)		8 (47.1)	17 (4.1)	
1	131 (61.8)	212 (99.5)	–	82 (44.6)	184 (91.5)	1.000	213 (53.8)	396 (95.7)	0.559
≥2	1 (100)	1 (0.5)		0 (0)	0 (0)		1 (100.0)	1 (0.2)	
Condoms use									
Yes	10 (55.6)	18 (8.5)	0.615	10 (47.6)	21 (10.4)	0.820	20 (51.3)	39 (9.4)	0.866
No	122 (62.6)	195 (91.5)		80 (44.4)	180 (89.6)		202 (53.9)	375 (90.6)	
Frequency of intimate toilets									
Per day	88 (57.5)	153 (71.8)	0.132	0 (0)	4 (2.0)	0.092	88 (56.1)	157 (37.9)	**0.003**
Per week	37 (75.5)	49 (23.0)		20 (57.1)	35 (17.4)		57 (67.9)	84 (20.3)	
Per month	2 (0.5)	4 (1.9)		12 (52.2)	23 (11.4)		14 (51.9)	27 (6.5)	
None	5 (71.4)	7 (3.3)		58 (41.7)	139 (69.2)		63 (43.2)	146 (35.3)	
Product used for intime toilet									
Antiseptic	51 (69.9)	73 (34.3)	0.103	8 (50.0)	16 (8.0)	0.424	59 (66.3)	89 (21.5)	**0.003**
Water	74 (56.5)	131 (61.5)		24 (52.2)	46 (22.9)		98 (55.4)	177 (42.8)	
None	7 (77.8)	9 (4.2)		58 (41.7)	139 (69.2)		65 (43.9)	148 (35.7)	
Type of underwear worn									
Cotton	74 (59.7)	124 (58.2)	0.475	86 (44.8)	192 (95.5)	1.000	160 (50.6)	316 (76.3)	**0.037**
Synthetic	58 (65.2)	89 (41.8)		4 (44.4)	9 (4.5)		62 (63.3)	98 (23.7)	
Use of antibiotics									
Yes	34 (61.8)	55 (25.8)	1.00	7 (63.6)	11 (5.5)	0.225	41 (62.1)	66 (15.9)	0.141
No	98 (62.0)	158 (74.2)		83 (43.7)	190 (94.5)		181 (52.0)	348 (84.1)	
Pregnant									
Yes	117 (61.6)	190 (89.2)	0.823	0 (0)	2 (1.0)	0.503	117 (60.9)	192 (46.4)	**0.006**
No	15 (65.2)	23 (10.8)		90 (45.2)	199 (99.0)		105 (47.3)	222 (53.6)	
Personal history									
None	65 (62.5)	104 (48.8)	0.578	60 (40.5)	148 (73.6)	0.114	125 (49.6)	252 (60.9)	0.091
Diabete	6 (85.7)	7 (3.3)		0 (0)	0 (0)		6 (85.7)	7 (1.7)	
VVC	40 (58.8)	68 (31.9)		23 (54.8)	42 (20.9)		63 (57.3)	110 (26.6)	
STI	21 (61.8)	34 (16.0)		7 (63.6)	11 (5.5)		28 (62.2)	45 (10.9)	

*Fisher's exact test

Table 3. Clinical aspects of vulvovaginal candidiasis

	General Hospital of Adjame			Anti-Venereal dispensary			Total		
	Infected patients n,%	Examined patients n,%	*p*-value*	Infected patients n,%	Examined patients n,%	*p*-value*	Infected patients n,%	Examined patients n,%	*p*-value*
Appearance of vaginal mucosa									
Healthy	102 (58.3)	175 (82.2)		65 (41.7)	156 (77.6)		167 (50.5)	331 (80.0)	
Vulvitis	9 (75.0)	12 (5.6)	0.112	0 (0)	0 (0)	0.126	9 (75.0)	12 (2.9)	**0.030**
Vaginitis	14 (77.8)	18 (8.5)		25 (55.6)	45 (22.4)		39 (61.9)	63 (15.2)	
Vulvovaginitis	7 (87.5)	8 (3.7)		0 (0)	0 (0)		7 (87.5)	8 (1.9)	
Vaginal itching									
Yes	72 (71.3)	101 (47.4)	**0.011**	59 (64.8)	91 (45.3)	**<0.0001**	131 (68.2)	192 (46.4)	**<0.0001**
No	60 (53.6)	112 (52.6)		31 (28.2)	110 (54.7)		91 (41.0)	222 (53.6)	
Dyspareunia									
Yes	5 (50.0)	10 (4.7)	0.510	1 (20.0)	5 (2.5)	0.383	6 (40.0)	15 (3.6)	0.304
No	127 (62.6)	203 (95.3)		89 (45.4)	196 (97.5)		216 (54.1)	399 (96.4)	
Dysuria									
Yes	20 (74.1)	27 (12.7)	0.205	4 (40.0)	10 (5.0)	1.000	24 (64.9)	37 (8.9)	0.169
No	112 (60.2)	186 (87.3)		86 (45.0)	191 (95.0)		198 (52.5)	377 (91.1)	
Pelvic pain									
Yes	35 (46.7)	75 (35.2)	**0.001**	3 (42.9)	7 (3.5)	1.000	38 (46.3)	82 (19.8)	0.174
No	97 (70.3)	138 (64.8)		87 (44.8)	194 (96.5)		184 (55.4)	332 (80.2)	
Appearance of vaginal discharge									
Creamy	69 (58.0)	119 (55.9)		66 (38.2)	173 (86.1)		135 (46.2)	292 (70.5)	
Curd	29 (87.9)	33 (15.5)	**0.007**	21 (87.5)	24 (11.9)	**<0.0001**	50 (87.7)	57 (13.8)	**<0.0001**
Fluid	24 (52.2)	46 (21.6)		1 (50.0)	2 (1.0)		25 (52.1)	48 (11.6)	
Bubbly/foaming	10 (66.7)	15 (7.0)		2 (100)	2 (1.0)		12 (70.6)	17 (4.1)	
Color of vaginal discharge									
Whitish	80 (53.0)	151 (70.9)		47 (34.6)	136 (67.7)		127 (44.3)	287 (69.3)	
Yellowish	45 (81.8)	55 (25.8)	**<0.0001**	42 (71.2)	59 (29.4)	**<0.0001**	87 (76.3)	114 (27.5)	**<0.0001**
Greenish	7 (100)	7 (3.3)		0 (0)	0 (0)		7 (100.0)	7 (1,7)	
Hematic	0 (0)	0 (0)		1 (16.7)	6 (3.0)		1 (16.7)	6 (1.4)	
Duration of disorder (week)									
1	57 (52.3)	109 (51.2)		10 (50.0)	20 (10.0)		67 (51.9)	129 (31.2)	
2	18 (75.0)	24 (11.3)		25 (45.5)	55 (27.4)		43 (54.4)	79 (19.1)	
3	8 (61.5)	13 (6.1)	**0.022**	8 (50.0)	16 (8.0)	**0.004**	16 (55.2)	29 (7.0)	**<0.0001**
≥4	49 (73.1)	67 (31.4)		30 (63.8)	47 (23.4)		79 (69.3)	114 (27.5)	
Unspecified	0	0		17 (27.0)	63 (31.3)		17 (27.0)	63 (15.2)	

*Fisher's exact test

VVC was estimated to be 53.6%. The prevalence was 62% (132/213) in the GHA and 44.8% (90/201) in the AVD.

1. Mycological analysis

Mycological analysis revealed that the most commonly identified fungal species was *C. albicans* (70.7%), followed by *C. tropicalis* (9.9%), as shown in Table 1. No strains of *C. krusei* were found in the GHA group, and no strains of *C. glabrata* were found in the AVD group.

2. Molecular analysis

We stored 155 strains identified as *C. albicans* through mycological analysis. We observed a high subculture success rate of 97.42% (151 out of 155). The success rate of molecular tests for the *hwp1* gene was 96.03% (145 out of 151). All 145 strains identified as *C. albicans* by mycological analysis were confirmed through molecular analysis. We did not find any *C. africana* or *C. dubliniensis* species. The *C. albicans* isolates provided two genotypes: 941 bp (93.10%) and 941+850 bp (6.90%).

The analysis of sociodemographic, behavioral, personal history, and clinical data was conducted based on mycology results. The average age of the patients was 29.3 years (standard deviation, 8.6 years), with the age group of 25~40 years being the most common (50.7%). Regarding sociodemographic and behavioral aspects, it was found that patients under 25 years old ($p = 0.018$), those living in precarious housing ($p < 0.0001$), and pregnant women ($p = 0.006$) were significantly more affected than other patients. Additionally, the use of intimate toilets ($p = 0.003$), products used for intimate toilets ($p = 0.003$), and the type of underwear worn ($p = 0.037$) were associated with the presence of VVC. No significant differences were observed between the two healthcare facilities. The most common clinical sign was vaginal itching (46.4%). The presence of VVC showed significant correlation with vaginal itching ($p < 0.0001$) and the duration of the disorder ($p < 0.0001$). Additionally, the appearance of vaginal mucosa ($p = 0.030$), as well as the appearance of vaginal discharge ($p < 0.0001$) and its color ($p < 0.0001$), were found to be significantly associated with VVC. The sociodemographic, behavioral, personal history and clinical data of the patients are presented in Tables 2 and 3.

DISCUSSION

The purpose of this study was to update the data and improve the management of VVC cases. It also aimed to assess the epidemiological profile of VVC based on the level of care required, as the AVD is a referral center and the GHA is a secondary-level center.

According to this study, the overall prevalence of VVC was 53.6%. The higher prevalence in the GHA than in the AVD can be attributed to differences in the characteristics of women seeking care at the two healthcare facilities. In the GHA group, most participants were pregnant (89.2%), while in the AVD group, only two women were pregnant (1.0%). It is generally observed that vaginal colonization by *Candida* species occurs in at least 20% of all women and increases to 30% during pregnancy[22]. The risk of VVC during pregnancy is likely increased by factors such as immune system changes, elevated estrogen levels, and heightened vaginal glycogen production[23]. The prevalence of VVC reported in this study was higher than in Abidjan (43%[17]; 38.7%[18]).

The prevalence of *C. albicans* as the primary pathogen responsible for vulvovaginal candidiasis (VVC) is approximately 90%[24]. In our study, *C. albicans* was the most common species in both healthcare facilities. The *C. albicans* complex includes *C. albicans sensu stricto*, *C. africana*, and *C. dubliniensis*. This study is the first to explore the genetic diversity of the *hwp1* gene within the *C. albicans* complex in our country. After conducting PCR analysis, no strains of *C. dubliniensis* or *C. africana* were identified. The two genetic profiles described in the study have previously been classified as *C. albicans*[25]. Notably, *C. dubliniensis* causes both superficial and invasive infections in both HIV-positive and HIV-negative patients[21].

Most infected patients in this study were pregnant and visited health facilities for prenatal consultations. We did not consider HIV status in our analysis. *C. africana*, it is an opportunistic pathogen that causes vaginal infections and, which it can produce germ tubes in serum, *C. africana* will not produce chlamydospores in nutrient-poor media[26], and no tests for chlamydospore production were conducted. *C. africana* was initially described in 1995 as an atypical strain of *C. albicans* and later set forth as a new *Candida* species based on its distinct morphological, biochemical, and physiological characteristics compared to *C. albicans*[27]. Although *C. africana* initially appeared to be restricted to Africa and Europe and isolated mainly from genital samples, it is now clear that it has a worldwide distribution and is recoverable from various clinical specimens[15,21,28-31].

The NAC proportion was also high in our study cohort. This center serves as a referral center for managing STIs in the country. Therefore, women attending this center exhibit unusual pathological profiles. NAC species like *C. glabrata*, *C. krusei*, *C. parapsilosis*, and *C. tropicalis* can cause compli-

cations in patients with VVC[32,33]. These species have recently gained scientific and epidemiological interest because of their increasing global presence[32]. These species were detected in the present study, with *C. tropicalis* dominating. *C. tropicalis* is genetically similar to *C. albicans*[34]. Previous studies have reported the predominance of *C. tropicalis* among NAC[35]. A survey of pregnant women identified *C. tropicalis* as the most prevalent *Candida* species, with a higher prevalence than that of *C. albicans*[36]. *C. glabrata* was the second-most common species after *C. albicans* at GHA, and the second-most common species was *C. krusei* at the AVD. Previous studies in Abidjan found that *C. glabrata* was the second-most common species after *C. albicans*[17,18,20]. *C. krusei* is generally less prevalent[36]. The emergence of NAC species can be attributed to selective pressure due to women's prolonged exposure to RVVC, use of over-the-counter antifungal medications, and low-dose azole treatments[37,38]. These *Candida* species—especially *C. glabrata*—are primarily implicated in cases of RVVC[32]. The study did not collect follow-up data on women, so the prevalence of RVVC was not determined. However, VVC was the main issue for patients with a personal history in both healthcare facilities.

Common signs and symptoms of VVC include vaginal itching or burning, with or without redness and vulvar swelling, white discharge, and burning or stinging during urination[39]. In the current study, VVC was significantly correlated with some of these symptoms. Vaginal itching—a leading clinical sign of VVC[5]—is also a predisposing factor and is associated with vaginal discharge. The present study observed white and curdled discharge as a predisposing sign. The duration of the disorder was also noted as a contributing factor in this study, as reported previously[17].

Factors that predispose women to developing VVC include antibiotic use, hormone replacement therapy, pregnancy, diabetes mellitus, and genetic and behavioral factors[40]. In the current study, a typical patient was younger than 25, pregnant, living in a shanty, douching once per week (including with antiseptic products), and wearing synthetic underwear. Antibiotic use and diabetes did not increase the occurrence of VVC in this study, contradicting many studies' prior findings[16,41,42].

CONCLUSION

The results from this study emphasize the molecular identification of species within the *C. albicans* complex. No strains of *C. africana* and *C. dubliniensis* were identified. We also observed an increasing prevalence of VVC in Abidjan. Therefore, gaining a better understanding of the risk factors associated with this disease will help improve women's hygiene standards and enable better prevention of its occurrence.

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CONFLICT OF INTEREST

In relation to this article, we declare that there is no conflict of interest.

LIST OF ABBREVIATIONS

AVD: Anti-Venereal Dispensary
GHA: General Hospital of Adjame
NIPH: National Institute of Public Hygiene
NAC: Non-albicans *Candida*
PLVIH: People Living with HIV
RVVC: Recurrent Vulvovaginal Candidiasis
STI: Sexually Transmitted Infection
VVC: Vulvovaginal Candidiasis
CeDReS: Diagnosis and Research Center on AIDS and Other Infectious Diseases

DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ETHICAL APPROVAL STATEMENT

The study was approved by the Institutional Review Board of (IRB No. N° 059-23/MSHPCMU/CNESVS-km). This study was conducted in accordance with the principles of the Declaration of Helsinki.

AUTHOR'S CONTRIBUTIONS

WY. EIHM supervised the study and reviewed the manuscript. GAP, KKF, and KTA supervised the sample collection and analysis. KTA and KKF analyzed the data and prepared this paper. All authors contributed to the drafting of the manuscript.

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