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*Full Length Research Paper*

# **Prevalence of vulvo-vaginal candidiasis among women attending clinics in selected Hospitals in Oyo State, Southwest, Nigeria**

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**Vulvo-vaginal candidiasis (VVC) is a pathogenic fungal infection with a high burden among women of reproductive age (WRA). Healthcare delivery system related constraints in developing countries have made its diagnosis and management unnecessarily complicated leading to poor management of the infection. The study was conducted to determine the prevalence of VVC among women attending clinics in selected hospitals in Oyo State, Nigeria. Two hundred high vaginal swabs were collected from the selected hospitals. These were streaked on chocolate agar, blood agar and sabouraud dextrose agar. Structured tool was used in collecting patients' basic clinical information. The prevalence of Candida species among the 200 subjects was 40% and 45.0% of those infected were aged 20-30 years. Across all Candida species, Candida albicans (83.8%) had the highest prevalence and mostly occurred among patients aged 20-30 years (47.8%). Higher proportion of Candida species infection was detected among patients without vaginal discharge (65.0%) and pelvic inflammation diseases (88.8%) than those with symptoms. Higher proportion of those without vaginal itching (34.5%, n=69) had positive Candida albicans culture compared with those who had symptoms. Among the Candida species reported in this study, C. albicans was the most vulvo-vaginal candida infection. Majority of patients without pelvic inflammatory disease, vaginal discharge and itching symptoms tested positive for VVC. Health education and awareness for routine screening are highly recommended for WRA to aid in early candida diagnosis and treatment. Also, clinicians are advised to essentially emphasize on empirical laboratory diagnosis for speciation of Candida species as against syndromic approach. mic approach.**

**Key words:** Vulvo-vaginal candidiasis, prevalence, *Candida* species, routine screening, diagnosis.

## **INTRODUCTION**

Vulvo-vaginal candidiasis is a fungal or yeast infection of the female lower genital tract (Sobel, 2007) and is

characterized by curd-like vaginal discharge, itching, and erythema, (Achkar and Fries, 2010). It can be referred to

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as candidiasis or moniliasis. About 70-75% of healthy women will at least either experience one episode of vulvo-vaginal candidiasis during their lifetime or during their reproductive life (Ferris et al., 2002). It can be recurrent or relapsing when a woman presents with four or more episodes per year and this condition has been reported among less than 5% of healthy women (Rex et al., 2000).

Also, half of college women by age of 25 years would have had one episode of vulvo-vaginal candidiasis diagnosed by a physician (Sobel, 1997). *Candida* species are part of the lower genital tract flora in 20-50% of healthy asymptomatic women (Akah et al., 2010) and in most cases prevalence of vaginal colonization and symptomatic vaginitis is higher in pregnant women than in those who are not pregnant. This is due to high concentration of reproductive hormones that increase the glycogen content in the vaginal tissue thereby providing a carbon source for candida organisms (Dennerstein and Ellis, 2001). Increasing *Candida* infection colonization had been found among women who douche (Rathod et al., 2012). Infectious Disease Of Obstetrics and Gynecology, and women using certain types of contraceptives, (Tarry et al., 2005) although this is not found in a study among some college students (Demirezen et al., 2005).

Vulvo-vaginal candidiasis has been associated with considerable direct and indirect economic costs (Foxman et al., 2000), enhanced susceptibility to HIV infection (Røttingen et al., 2001) and is being investigated for a potential relationship with preterm birth (Roberts et al., 2011). Carrier rates are higher in women treated with broad spectrum antibiotics (Singh, 2003) pregnant women, diabetic women (Donders et al., 2002; Reed et al., 2003) and women with HIV/AIDS (Nelson et al., 2013). Treatment of vulvo-vaginal candidiasis is warranted when a woman presents with a complaint of symptoms of this condition and laboratory confirmation of the presence of candida from a vaginal specimen.

A study conducted in Ghana, West Africa reported that among a cohort of apparently healthy women, 30% had confirmed cases of diagnosed vulvo-vaginal candidiasis (Maccato and Kaufman, 1991). Also, in a study conducted by Okonofua et al. (1995) reported a prevalence of 36.0% VVC among pregnant women in south-western, Nigeria. Okonkwo (2010) in Nigerian study found no significant difference among patients who were positive with vulvo-vaginal candidiasis and their socioeconomic status. *C. albicans* is the most frequent colonizer, and is incriminated in most cases of vulvo-vaginal candidiasis (Ugwa, 2015). Nelson et al. (2013), showed *C. albicans* as the most common *Candida* species followed by *Candida glabrata* causing vaginal candidiasis among pregnant women. Okonofua et al. (1995), a high prevalence of *C. albicans* among infertile women compared with controls. Over the last 10 years,

research evidence has revealed an increase in frequency of cases caused by non - albicans species, with *C. glabrata* consistently being the leading species (Cheesbrough, 2000). *Candida* species that rarely cause candidiasis include *Candida parapsilosis*, *Candida pseudotropicalis*, *Candida krusei*, *Candida guilliermondi* and *Candida stellatoidea*.

Vulvo-vaginal candidiasis remains a common problem worldwide affecting all strata of society. They are much more so in the developing country context because of various health care delivery related constraints such as work force shortages and regulatory inadequacies. The absence of rapid, simple, and inexpensive diagnostic tests continues to result in either over-diagnosis, under diagnosis or misdiagnosis, leading to inappropriate treatment (Mohamadi et al., 2015). Although commonly caused by *C. albicans*, non-albicans species immunosuppression has led to the development of recurrent diseases some of which are nonresponsive to conventional antifungal regimes (Mohamadi et al., 2015).

This study aimed to determine, the prevalence of vulvo-vaginal candidiasis and the pattern of *Candida* species in women who attend some selected hospitals in Ibadan, Oyo state, Nigeria. The findings of the study will inform the need for a well sustained health education and awareness programme targeted at women of reproductive age on need for routine and periodic *Candida* specie diagnosis. The findings will also re-affirm the orthodoxy of physicians' basic and mandatory requirement for empirical laboratory diagnosis as a gold-standard for management of vulvo vaginal candidiasis.

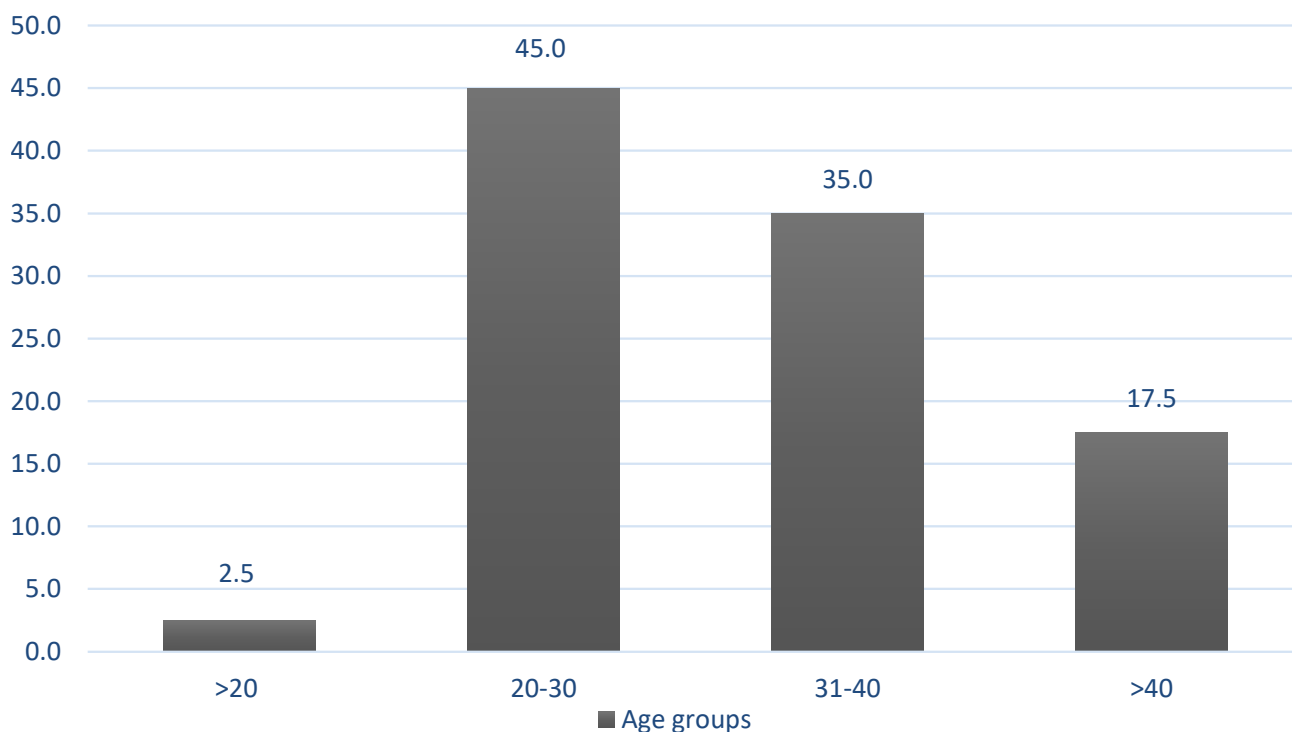
## MATERIALS AND METHODS

### Study area, sampling technique and data collection

A descriptive cross-sectional study was conducted using a purposive selection of a combination of tertiary, secondary and primary health care facilities located in Oyo State namely University College Hospitals, State Hospital; Adeoyo, Ring road and Bowen University Teaching Hospital. Purposive sampling technique was also applied in recruiting women of reproductive age attending General Out-Patient and Ante-natal Clinics of participating hospitals who consented to participate in the study. Women on hormonal contraceptives, who had documented records of HIV antibodies 1 and 2, who were diabetic and those on steroid or antifungal, therapy within the previous 2 weeks or broad-spectrum antibiotics in the past month were excluded from the study. An average of eight to ten samples of women of reproductive age were collected by trained medical personnel on each centre's clinic days for a period of 3 months till sample size was reached. The 200 subjects enrolled into the study were estimated from prevalence of *Candida* specie among women in a previous study (Lisiak et al., 2000) using Leslie Kish formula for cross-sectional study.

$$\text{where } n = z^2 p q/d^2$$

( $n$  = Sample size,  $z$  = Standard normal deviation = 1.96 at 95%



**Figure 1.** Age group distribution of *Candida* species among subjects.

confidence limit,  $p$  = Prevalence rate = 14.0%,  $q = 1 - 14.0\%$  = 0.86,  $d$  = Error margin = 5%).

This study was conducted, in principle with the Helsinki Declaration, and the protocol was approved by the Human Research Ethical Committee of the University College Hospital, Ibadan. All subjects gave written informed consent prior to being included in the study. All data were analyzed anonymously throughout the study. A pro-forma was used to obtain basic information such as age, clinical diagnosis and test result. Data were analyzed using the SPSS version 21. Descriptive statistics were presented as proportions in tables and charts. Inferential statistics were limited to bivariate analysis conducted between *Candida* species test outcome and clinical symptoms at  $p=0.05$ .

#### Sample collection and laboratory analysis

Paired high vaginal swab and endocervical swab samples were collected from each of the 200 participating subjects and analyzed in medical microbiology laboratory of the hospital for the isolation and identification of both *C. albicans* and non-*C. albicans* species. The specimens were routinely cultured for *Candida* species using sabouraud's dextrose agar, incubated in paired sets, one set at 25°C for 3 to 7 days and the other at 37°C for 24 h.

The culture revealed whitish soft cream colonies. Direct gram staining was done with standard procedures to differentiate positive slides of large purple oval yeast cells. Microscopic examination also showed bacteria which are normal cocci and bacilli forms of flora of the body. Wet preparation processes were done and showed budding yeasts and hyphae with buds at points of constriction. *C. albicans* was identified by the production of germ tubes. Other

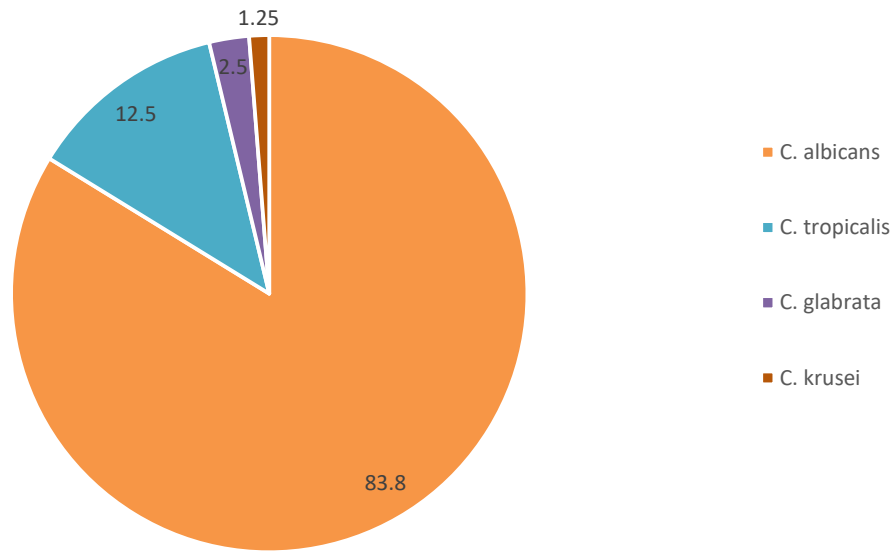
*candida* isolates were speciated with a battery of biochemical tests using sugar fermentation such as glucose, sucrose, lactose, maltose, urease tests. CHROMagar (CAC, Becton Dickinson, Heidelberg, Germany) was also used in the speciation of *C. albicans*, *C. tropicalis*, *C. krusei*, *C. glabrata* by colony, color and morphology.

#### RESULTS

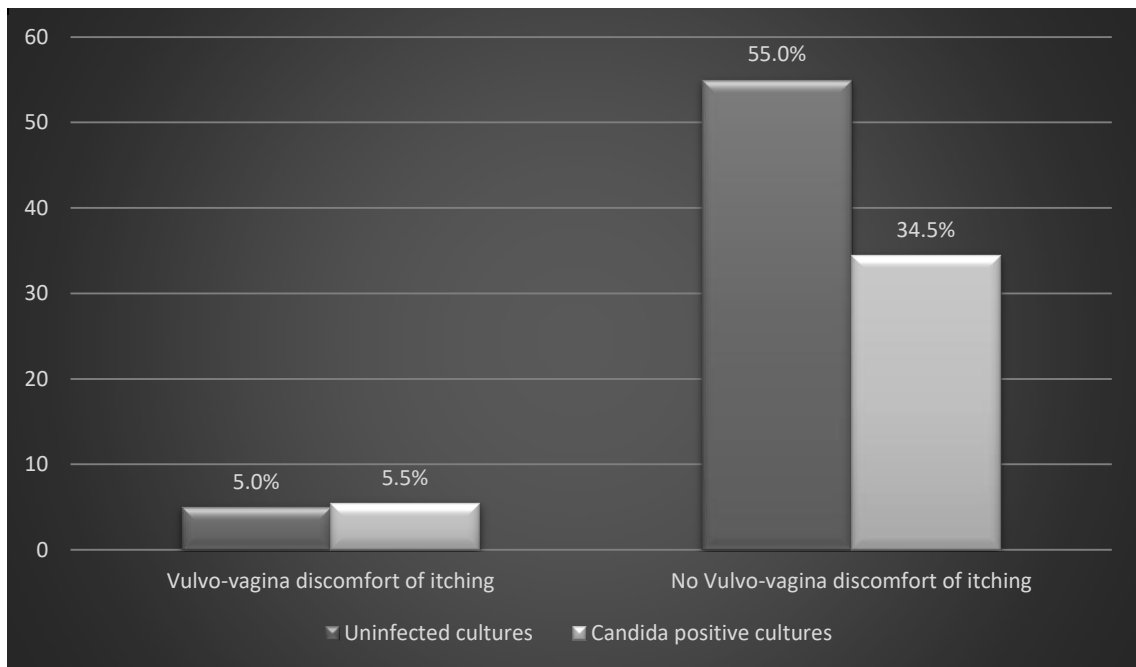
Of the 200 subjects recruited, 80 respondents had *Candida*-positive cultures from both High Vaginal Swab and Endocervical Swab samples, giving a prevalence of vulvo-vaginal candidiasis as 40.0%.

*Candida*-positive cultures were observed mostly among those aged 20–30 years, at 36 (45.0%) and lowest among those less than 20 years, 2 (1%) (Figure 1). There was no significant statistical relationship between the prevalence of vulvo-vaginal candidiasis and age ( $P>0.05$ ).

With respect to speciation of cultures, *C. albicans* had the highest prevalence 67 (83.8%) (Figure 2) and was diagnosed mostly among patients aged 20-30 years (47.8%) followed by those aged 31-40, 32 (37.30%). The laboratory investigations yield low prevalence of the remaining *Candida* species; *C. tropicalis* 10 (12.5%); *C. glabrata* 2 (2.5%) and *C. krusei* 1 (1.25%). The Bar-chart representation of *Candida*-positive cultures among those



**Figure 2.** The distribution of the isolated *Candida* species.



**Figure 3.** Bar-chart representation of *Candida*-positive cultures among those with vulvo-vaginal discomfort of itching and those with no vulvo-vaginal discomfort.

with vulvo-vaginal discomfort of itching and those with no vulvo-vaginal discomfort (Figure 3).

There were unequal *Candida*-positive cultures between women who presented with clinical symptoms of vaginal discharge and those who were without discharge. Of

the 79 test subjects who are presented with vaginal discharge 28 (35.0%) had candidiasis while those without discharge accounted for 52 (65.0%). High prevalence of *C. albicans* (64.2 %) and *C. tropicalis* (60.0%) were diagnosed in women without vaginal discharge

**Table 1.** Age group distribution of *Candida* species speciation.

Age-group	Test subjects (No.)	<i>Candida albicans</i> [No. (%)]	<i>Candida tropicalis</i> [No. (%)]	<i>Candida krusei</i> [No. (%)]	<i>Candida glabrata</i> [No. (%)]
<20	6	2 (2.9)	0 (0.0)	0 (0.0)	0 (0.0)
20-30	79	32 (47.8)	3 (30.0)	1 (100.0)	0 (0.0)
31-40	78	25 (37.3)	3 (30.0)	0 (0.0)	0 (0.0)
>40	37	8 (11.9)	4 (40.0)	0 (0.0)	2 (100.0)
<b>Total</b>	200	67 (100.0)	10 (100.0)	1 (100.0)	2 (100.0)

symptoms. Table 1 shows the age distribution of *Candida* species speciation in the study of the work.

This pattern was also observed for pelvic inflammatory disease. Positive cultures of individuals without PID (88.8%) were higher than those with symptoms of PID (11.2%). Also *C. albicans* and *C. tropicalis* had the highest prevalence of 89.6% and 90.0% among those without PID symptoms compared to 10.4% and 10.0% among those with the symptoms respectively (Table 2). A higher prevalence of 34.5% positive cultures of Candidiasis was reported among those without clinical diagnosis of vaginal itching compared with those who had symptoms (5.5%).

## DISCUSSION

Vulvo-vaginal candidiasis is a common fungal infection among women worldwide. The infection occurs commonly at the lower female genitalia and is reported in 35% - 80% of cases without any symptoms (Mohamadi et al., 2015). Symptomatic vulvo-vaginal candidiasis has been found in up to 70% of the sexually active women (Lisiak et al., 2000). Chronic vulvo-vaginal candidiasis severely affects the quality of life for millions of women in

the world and is frequently refractory to antifungal treatments (Sobel, 2007).

The prevalences of vaginal candidiasis reported by different studies were 14, 16.5, 21.31, and 19% (Emeribe et al., 2015; Yadav et al., 2016; Mahadani et al., 1998; Nandan et al., 2011). In this study, the prevalence was found to be 40%. This relatively high prevalence of vaginal candidiasis among women in this study may be due to by a combination of habits such as poor personal hygiene, the use of contraceptives, and drug abuse (Lisiak et al., 2000; Mahadani et al., 1998). The disparity in prevalence in studies of vulvo-vaginal candidiasis might be due to the fact that vulvo-vaginal candidiasis shows different frequency of occurrence from region to region and some studies have disclosed that the incidence differs in various areas. It can be related to geographical conditions, social and cultural factors, hygiene practices, and diagnostic techniques (Salvi, 2019).

*Candida*-positive cultures were observed mostly among women aged 20–30 years (45.0 %). The high prevalence is consistent with Emeribe et al. (2015) which reported a prevalence of 60.0% among the specified age-group.

Salvi (2019) and Ugwa (2015) in a similar study of prevalence of vulvo-vaginal candidiasis among reproductive age group of pregnant and non-

pregnant women done separately in Dubai and North-west Nigeria reported of 39.1 and 53.0% of VVC among mid-upper interval of 26-30 years age group, respectively. While Yadav and Prakash (2016) found the highest of vulvo-vaginal candidiasis among 21-25 years age group (40.4%) followed by 26-30 years with 32.6%. These findings could essentially be attributed to exposure to risk of sexually transmitted diseases of the group because of their high sexual activity during this period for procreative purposes and possibly due to financial benefits that arise from prostitution.

Whereas, the lowest prevalence among those less than 20 years of age in this study with the finding of (Ugwa, 2015) who reported that women above 40 years had the lowest rate of infection (14.0%). Except women of this age group are still using contraceptives (Tarry et al., 2005), their risk of candida infections are likely to be low due to the fact that they have entered menopausal period of their lives. The study also revealed the isolation of *C. albicans* and non-*C. albicans* organisms to be the causative fungal agents associated with vulvo-vaginal candidiasis among women in selected hospitals in Oyo-state.

*C. albicans* showed the highest prevalence at 83.8% followed by *C. tropicalis* (12.5%) while *C. glabrata* (2.5%) and *C. krusei* (1.25%) recording

**Table 2.** *Candida* specie test outcome and clinical symptoms.

Clinical symptom	<i>Candida</i> species		$\chi^2$	p-value
	Positive (%)	Negative (%)		
<b>Vaginal discharge</b>				
<i>Candida</i> species				
Yes	28 (35.0)	52 (65.0)	1.204	0.273
No	51 (42.5)	69 (57.5)		
<i>Candida albicans</i>				
Yes	24 (35.8)	43 (64.2)	0.571	0.45
No	55 (41.4)	78 (58.6)		
<i>Candida tropicalis</i>				
Yes	4 (40.0)	6 (60.0)	0.974	xxx
No	75 (39.5)	115 (60.5)		
<b>Pelvic inflammatory disease</b>				
<i>Candida</i> species				
Yes	9 (11.2)	71 (88.8)	0.304	0.189
No	8 (6.7)	112 (93.3)		
<i>Candida albicans</i>				
Yes	7 (10.4)	60 (89.6)	0.592	0.326
No	10 (7.5)	123 (92.5)		
<i>Candida tropicalis</i>				
Yes	1 (10.0)	9 (90.0)	0.861	0.597
No	16 (8.4)	174 (91.6)		

the lowest.

*C. albicans* having the highest prevalence in this study corroborate different previous studies. For example, (Shekufe et al., (2017) in an Iranian study among women of reproductive age conducted traditional tests such as gram-staining, microscopic examination, and culture for species identification and reported *C. albicans* as the most prevalent species (83.5%), followed by *Candida glabrata* (16%). (Mucci et al., (2016) showed that the occurrence of vulvo-vaginal candidiasis was 25% among pregnant women and *C. albicans* with a prevalence of 80.7% was the predominant *Candida* species. Also, the study of Nnadi and Singh (2017) reported that out of 288 pregnant women, 212 were positive for *c. albicans* giving a prevalence rate of 73.7%. *C. albicans* can colonize on the mucous membrane of genitourinary tracts of healthy humans (Singh, 2003).

In contrast to this study, (Emeribe et al., (2015) revealed a lower prevalence of *C. albicans* 13 (6.5%), than that of non-*albicans* candidiasis 15 (7.5%). Their study reported that among the non-*albicans* species, *C. glabrata* was the commonest type (10.5%) and *C. krusei* the least among the *Candida* species (3.5%). The reasons for the increase in incidence of *C. glabrata* in his

study were as a result of single-dose antifungal treatment, low-dosage azole-maintenance regimens, and the use of over-the-counter antimycotics (Alo et al., 2012). Therefore, for effective control of candidiasis, laboratory diagnosis must be a pre-requisite for candida infection management.

In this study, cultures from the patients who did not present with clinically diagnosed symptoms of vagina discharge and pelvic inflammatory disease had higher rate of VVC than those with symptoms. Of the 79 subjects who presented with vaginal discharge, 28 (35.0%) had candidiasis while those without discharge had 65.0% (n=52). Also, positive cultures of individuals without PID (88.8%) were higher than those with symptoms of PID (11.2%). The Subjects whose cultures were positive, for *Candida* species and were without symptoms of PID and vaginal discharge are likely to have built some level of resistance to the infection as a result of drug abuse of antifungal prescription and self-medication (Mucci et al., 2016). Also, those who had symptoms of discharge and PID but did not have *Candida* specie positive cultures could have other diseases causing infectious agents which could be from known or unknown origin (Hofs et al., 2016). Subjects



with no vulvo-vaginal discomfort of itching had a higher percentage of Candida-positive cultures (34.5%) than those with no discomfort (5.5%). This report is in agreement with the findings of (Emeribe et al., 2015) Vaginal discomfort of itching irrespective of the fungal test outcome could be as a result of infections such as enterobiosis from poor personal hygiene and some deep socio-cultural beliefs that encourage poor hygiene (Burkhart et al., (2005). Itching could also be as a result of sexually transmitted diseases. According to (Aurora and Aurora (2014) approximately 10% of vulvo-vaginitis is due to infection to *Trichomonas vaginalis* (Hofs et al., 2016).

### Limitation of the study

This is a cross-sectional study to assess the pattern and prevalence of candida spp to strengthen the need for careful diagnosis of VVC infection. This study did not assess life-style and behavioral information that could be associated with incidence of VVC.

### Conclusion

The highest prevalence of candida infection was among respondents age 20-30 years. *C. albicans* was the commonest pattern of species in the area. The findings also revealed that the majority of the respondents without symptoms of pelvic inflammatory disease, vaginal discharge tested positive for Candida infection.

### RECOMMENDATIONS

The prevalence of vulvo-vaginal candidiasis among women has been a fast growing and serious burden in our environment which can result in a lot of future health challenges. Emergence of *C. albicans* and non-*albicans* species among clinical specimens are crucial concern in medical mycology. For better management of fungal infections like vulvo-vaginal candidiasis this study thus recommend that medical practitioners through their various channels of engagement such as workshop and conferences should emphasis on laboratory diagnosis of Candida infection for precise identification of fungal isolates prior to commencement of treatment. Also, health education and awareness for routine screening are highly recommended for women of reproductive age to aid early Candida diagnosis and treatment.

### CONFLICT OF INTERESTS

The author has not declared any conflict of interests

### REFERENCES

- Alo MN, Anyim C, Onyebuchi AK, Okonkwo EC (2012). Prevalence of asymptomatic co-infection of candidiasis and vaginal trichomoniasis among pregnant women in Abakaliki, South-Eastern Nigeria. *Prevalence* 2(7):87-91.
- Achkar JM, Fries BC (2010). Candida infections of the genitourinary tract, *Clinical Microbiology Reviews* 23(2):253-273.
- Akah PA, Nnamani CE, Nnamani PO (2010). Prevalence and treatment outcome of vulvovaginal candidiasis in pregnancy in a rural community in Enugu State, Nigeria. *Journal of Medicine and Medical Sciences* 1(10):447-452.
- Aring BJ, Mankodi PJ, Jasani JH (2012). Incidence of vaginal Candidiasis in leucorrhoea in women Attending in OPD of Gynecology and Obstetrics Department. *International Journal of Biomedical and Advance Research* 3(12):867-869.
- Arora DR, Arora BB (2014). *Medical Parasitology* 4<sup>th</sup> (46):41-71.
- Burkhart CN, Burkhart CG. Assessment of frequency, transmission, and genitourinary complications of enterobiasis (pinworms). *Int J Dermatol.* 2005;44:837-40.
- Cheesbrough M (2000). Fungal pathogens. In: *District Laboratory Practice in Tropical Countries*. Cambridge, UK: Cambridge University Press;:235-248.
- Demirezen S, Dirlik OO, Beksaç MS (2005). The association of *Candida* infection with intrauterine contraceptive device. *Central European Journal of Public Health* 13:32-34.
- Dennerstein GJ, Ellis DH (2001). Oestrogen, glycogen and vaginal candidiasis. *Australian and New Zealand Journal of Obstetrics and Gynaecology* 41:326-328.
- Donders GG, Prenen H, Verbeke G, Reybrouck R (2002). Impaired tolerance for glucose in women with recurrent vaginal candidiasis. *American Journal of Obstetrics and Gynecology* 187:989-993.
- Emeribe AU, Nasir IA, Onyia J, Ifunanya AL (2015). Prevalence of vulvovaginal candidiasis among nonpregnant women attending a tertiary health care facility in Abuja, Nigeria. *Research and Reports in Tropical Medicine* 6:37-42.
- Ferris DG, Nyirjesy P, Sobel JD, Soper D, Pavletic A, Litaker MS (2002). Over-the-counter antifungal drug misuse associated with patient diagnosed vulvovaginal candidiasis. *Obstetrics Gynecology* 99(3):419-425.
- Foxman B, Barlow RH, D'Arcy H, Gillespie B, Sobel JD (2000). Candida vaginitis: self-reported incidence and associated costs, *Sexually Transmitted Diseases* 27(4):230-235.
- Hofs S, Mogavero S, Hube B (2016). Interaction of *Candida albicans* with host cells: virulence factors, host defense, escape strategies, and the microbiota. *Journal of Microbiology* 54(3):149-169.
- Jombo GT, Opajobi SO, Egah DZ, Banwat EB, Denen Akaa P (2010). Symptomatic vulvovaginal candidiasis and genital colonization by *Candida* species in Nigeria. *Journal of Public Health and Epidemiology* 2(6):147-151
- Kwawukume EY, Arhin RA (2002). Vulvovaginitis. In: Kwawukume EY, Emuveyan EE, editors. *Comprehensive Gynaecology in the Tropics*. 1st ed. Dansoman: Asante and Hittscher, pp. 72-74.
- Lisiak M, Kłyszajko C, Pierzchała T, Marcinkowski Z (2000). Vaginal candidiasis: frequency of occurrence and risk factors. *Ginekologia polska* 71(9):964-970.
- Maccato ML, Kaufman RH (1991). Fungal vulvovaginitis. *Current opinion in obstetrics and gynecology* 3(6):849-852.
- Mahadani JW, Dekate RR, Shrikhande AV (1998). Diagnosis of discharge per vaginum. *Indian Journal of Pathology and Microbiology* 41(4):403-411.
- McCormack Jr WM, Zinner SH, McCormack WM (1994). The incidence of genitourinary infections in a cohort of healthy women. *Sexually Transmitted Diseases* 21(2):63-64.
- Mirza NB, Nsanze H, D'Costa LJ, Piot P (1983). Microbiology of vaginal discharge in Nairobi, Kenya. *British Journal on Venereal Diseases* 59:186-188.
- Mohamadi J, Havasian MR, Panahi J, Pakzad I (2015). Antifungal drug resistance pattern of *Candida* spp isolated from vaginitis in Ilam-Iran during 2013-2014. *Bioinformation* 11(4):203-206.

- Mucci MJ, Cuestas ML, Cervetto MM, Landaburu MF, Mujica MT (2016). A prospective observational study of vulvovaginitis in pregnant women in Argentina, with special reference to candidiasis. *Mycoses*. 59(7):429- 435.
- Nandan D, Gupta YP, Krishnan V, Sharma A, Misra SK (2011) Reproductive tract infection in women of reproductive age group in Sitapur/ Shahjahanpur district of Uttar Pradesh. *Indian Journal of Public Health* 45(1):8-13.
- Nelson M, Wanjiru W, Margaret MW (2013). Prevalence of Vaginal Candidiasis and Determination of the Occurrence of Candida Species in Pregnant Women Attending the Antenatal Clinic of Thika District Hospital, Kenya. *Open Journal of Medical Microbiology* 3:264-272.
- Nnadi DC, Singh S (2017).The prevalence of genital *Candida* species among pregnant women attending antenatal clinic in a tertiary health center in North-west Nigeria. *Sahel Medical Journal* 20(1):33-37.
- Okonkwo NJ (2010). Prevalence of vaginal candidiasis among pregnant women in Nnewi town of Anambra State, Nigeria. *African Research Review* 24:539-548.
- Okonofua FE, Ako-Nai KA, Dighitoghi MD (1995). Lower genital tract infections in infertile Nigerian women compared with controls. *Genitourinary Medicine* 71:163-168.
- Olowe, O. A., Makanjuola, O. B., Olowe, R., & Adekanle, D. A. (2014). Prevalence of vulvovaginal candidiasis, trichomoniasis and bacterial vaginosis among pregnant women receiving antenatal care in Southwestern Nigeria. *European journal of microbiology & immunology*, 4(4), 193–197. <https://doi.org/10.1556/EUJMI-D-14-00027>
- Parveen N, Munir AA, Din I, Majeed R (2008). Frequency of vaginal candidiasis in pregnant women attending routine antenatal clinic. *Journal of College Physicians and Surgeons Pakistan* 18:154-157.
- Rathod SD, Klausner JD, Krupp K, Reingold AL, Madhivanan P (2012). Epidemiologic features of vulvovaginal candidiasis among reproductive-age women in India. *Infectious Diseases of Obstetrics and Gynecology*, 859071.
- Ray D, Goswami R, Banerjee U, Dadhwal V, Goswami D, Mandal P, Kochupillai N (2007). Prevalence of *Candida glabrata* and its response to boric acid vaginal suppositories in comparison with oral fluconazole in patients with diabetes and vulvovaginal candidiasis. *Diabetes Care* 30(2)-312-317.
- Reed BD, Zazove P, Pierson CL, Gorenflo DW, Horrocks JJ ((2003). *Candida* transmission and sexual behaviors as risks for a repeat episode of *Candida* vulvovaginitis. *Journal of Women's Health* 12(10):979-989.
- Rex JH, Walsh TJ, Sobel JD, Filler SG, Pappas PG, Dismukes WE, Edwards JE (2000). Practice guidelines for the treatment of candidiasis. *Clinical Infectious Diseases* 30(4):662-678.
- Roberts CL, Morris JM, Rickard KR, Giles WB, Simpson JM, Kotsiou G, Bowen JR (2011). Protocol for a randomised controlled trial of treatment of asymptomatic candidiasis for the prevention of preterm birth [ACTRN12610000607077]. *BMC Pregnancy and Childbirth* 11(1):1-9.
- Røttingen JA, Cameron DW, Garnett GP (2001). A systematic review of the epidemiologic interactions between classic sexually transmitted diseases and HIV: how much really is known? *Sexually Transmitted Diseases* 28(10):579-597.
- Salvi M (2019). Prevalence of vulvovaginal candidiasis in females in the reproductive age group. *International Journal of Reproduction, Contraception Obstetrics and Gynecology* 8:647-651.
- Shekufeh P, Minoo M, Rasoul M (2017). Clinical and Mycological study of vulvovaginal candidiasis (VVC), Identification of clinical isolates by polymerase chain-fragment size polymorphism (PCR-FSP) technique. *Archives of Clinical Infectious Diseases* 12(2).
- Singh SI (2003). Treatment of vulvovaginal candidiasis. *Clinical Review* 136(9):26-30.
- Sobel JD (2007). *Vulvovaginal candidosis*. *Lancet* 369 (9577):1961-1971.
- Sobel TD (1997). Vaginitis. *New England Journal of Medicine* 337(26):1896-1903.
- Tarry W, Fisher M, Shen S (2005). Mawhinney M. *Candida albicans*: The estrogen target for vaginal colonization. *Journal of Surgical Research* 129:278–282.
- Ugwa EA (2015) Vulvovaginal Candidiasis in Aminu Kano Teaching Hospital, North-West Nigeria: Hospital-Based Epidemiological Study. *Annals of Medical and Health Science Research* 5(4):274-278.
- Yadav K, Prakash S (2016).Prevalence of vulvovaginal candidiasis in pregnancy. *Global Journal of Medical Sciences* 4(1):108-106.