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Vaginal Candidiasis among Pregnant Women in Ebonyi State, South East Nigeria.

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ABSTRACT

Vaginal candidiasis is an infection of the genital tract caused by overgrowth of opportunistic *Candida* species in women. The prevalence of this infection among pregnant women attending antenatal clinic in selected hospitals in Ebonyi State, Nigeria was investigated. A total of 816 High Vaginal Swab (HVS) samples of pregnant women who consented to the study were collected between November, 2022 and January, 2023 and subjected to wet mount examination and also cultured on Sabouraud Dextrose Agar (SDA). Isolates were identified to species level using microscopic and morphological features, germ tube and biochemical tests. Results of the structured questionnaire used for demographic data were analyzed statistically. The overall prevalence of candidiasis among the pregnant women was 43.3%, with *Candida albicans* having the highest prevalence (84.1%), followed by *Candida tropicalis* (6.5%), *Candida parapsilosis* (5.4%) and *Candida peudotropicalis* (4.0%). Highest prevalence of infection, 45.4%, 54.2%, 60.9% and 58.9% were observed in age group 26 – 30 years (P=0.062), 3rd trimester (P=0.023), primigravida (P=0.018) and farmers (P=0.054) respectively. Prevalence of vaginal candidiasis among study participants was high with *Candida albicans* implicated as the most prevalence yeast. Early screening of pregnant women for candidiasis and proper education is very important during antenatal visits.

Keywords: Candidiasis, Vulvovaginal candidiasis, *Candida albicans*, Prevalence

INTRODUCTION

Vaginal candidiasis is an infection of the female urogenital tract caused by overgrowth of opportunistic pathogen, *Candida* spp. and is also referred to as vulvovaginal candidosis (Van Schalkwyk *et al*., 2015; Disha and Haquel, 2022). It is the most common cause of vaginitis and affects millions of women yearly (Goncalves *et al*., 2016). While 20-30% of

women may keep this yeast without symptoms of infection (Waikhom *et al*., 2020; Disha and Haquel, 2022, Sobel, 2007 and Sutaria, 2019), reported that about 75% of women at childbearing age contact this infection at least once in a lifetime with 50% of them having recurrent infection.

The most common yeast associated with vaginal candidiasis is *Candida albicans*. They are predominantly normal commensal of the human skin, vagina and gastrointestinal tract but constitute a problem when there are certain changes in its environment (Snydman, 2003; Deorukhkar, 2014). Studies have shown that other *Candida* spp; *Candida krusei*, *Candida parapsilosis*, *Candida tropicalis*, *Candida stelloides*, *Candida pseudotropicalis*, *Candida glabrata* are now emerging as important causes of infection (Van Schalkwyk *et al*., 2015; Altayyar *et al*., 2016; Sule-Odu *et al*., 2020).

Factors that make women susceptible to infection include pregnancy, luteal phase of menstrual cycle, eating of high sugar based foods, underlying diseases like diabetes and HIV, prolonged use of antibiotics and contraceptives, douching and other vaginal infections (Nelson *et al*., 2013; Okonkwo and Umeanaeto, 2011; Yadav and Prakash, 2016). Increase in progesterone and estrogen levels, high amount of glycogen deposition in the vaginal tissues, decrease in vaginal pH, decrease in cell-mediated immunity and gestation period have also been reported as risk factors for vaginal candidiasis among pregnant women (Yadav and Pratash, 2016). Some complications like chorioamnonitis with preterm labor and abortion, low birth weight, congenital infection of the neonate have been associated with the infection in pregnancy (Oviasogie and Okungbowa 2009; Al-Rusan *et al*., 2017; Waikhom *et al*., 2020). Other complications in non-pregnant women include menstrual disorders, pelvic inflammatory disease, pelvic abscess and infertility (Vijaya *et al*., 2014).

Vaginal candidiasis could present mild, moderate to severe symptoms that may include thick, whitish and chessy discharges with vagina or vulvovaginal irritation or pruritis, pain, burning sensation, external dyspareunia or dysuria (Van Schalkwyk *et al*., 2015; Disha and Haquel, 2022).

In pregnancy, symptoms are usually more severe, as itching may be more intense and the vulval and vaginal soreness extremely distressing. There may be a foul, copious, white semi solid discharge. Soreness and excoriation of the skin of the vulva and inner surfaces of the thigh may be involved (Eckert *et al.*, 1998)

Several antifungal agents are used in treatment of vaginal candidiasis. In particular, antifungal agents in polyene and immidazole classes are well indicated for candidiasis. Polyene antifungal agents act by interaction with ergosterol and alter the permeability of the cell membrane (Carolus *et al.*, 2020). Azoles are known to poses wider spectrum antifungal activity and are the most frequently used for treatment of vaginal candidiasis because of their low cost and toxicity. They act by inhibiting ergosterol biosynthesis (Pfaller *et al.*, 2014). Studies have shown that non-*albican Candida* species usually resist the commonly used antifungal drugs and so require prolonged therapy (Nnadi and Singh, 2017). It is speculated that vaginal candidiasis will remain a major problem in developing countries especially in Nigeria, where there is poverty and poor health care delivery. The ability to purchase such drugs as polyene and immidazole antifungal agents over the counter without prescription (self medication), and absence of good diagnosis and treatment or management of candidiasis, are likely to pose great risk among pregnant women. The purpose of this study, therefore, is to determine the prevalence of *Candida* infection among pregnant women attending antenatal clinic in Ebonyi State, Nigeria, and characterize the different species of *Candida* involved.

MATERIALS AND METHODS

Study design/area: A cross sectional study was conducted among pregnant women attending antenatal clinics in Ebonyi State, Southeast Nigeria. The state is delineated into three senatorial zones; Ebonyi North Zone, Ebonyi Central Zone, Ebonyi South Zone, and hospitals used for the study are Alex Ekwueme Federal University Teaching Hospital (AEFUTHA) Abakiliki, Mater Misericordiae Hospital (MMH) Afikpo and General Hospital (GH) Onueke from the three senatorial zones respectively.

Ethical Approval: Ethical Approval with Reference Number: NHREC/16/05/22/222 was obtained for the study.

Study population: Study population comprised pregnant women aged 15-45years at different gestation periods who attended antenatal clinics at the selected hospitals between November 2022 and January, 2023. Women with underlying diseases (diabetes or HIV), vaginal bleeding and/or had taken broad spectrum antibiotics or antifungal agents two weeks before the specimen collection were excluded from the study.

Sample size and participant selection: The sample size was estimated using Kish Leslie (1965) formula. $n = (Z_{0.95})^2 \left(\frac{P(1-P)}{D^2}\right)$

With 95% confidence interval (i.e. $Z_{0.95} = 1.96$), 31% proportion (P), and absolute precision (D) of 5%. The minimum number of participants was calculated to give a total of 816 who were selected using systematic random sampling.

Demographic data: Structured questionnaire was used to collect information on the age, gestation period, parity and occupation of the participants.

Specimen collection: With the aid of a disposable Cusco's speculum, two sets of high vaginal swabs were collected from eight hundred and sixteen (816) participants (AEFUTHA, 376; MMH 290; GH 150) by trained medical personnel using sterile swab sticks and labeled. These specimens were transported in an ice-pack to Microbiology laboratory, Alex Ekwueme Federal Teaching Hospital Abakiliki and processed within 3h of collection.

Laboratory diagnosis:

Direct microscopy: A loopful of sterile normal saline was dropped on a clean grease-free slide and one of the specimen swab stick rolled over it to form a smear. This was covered with glass cover slip and viewed with ×10 and ×40 objective lenses (Frobenius and Bogdan, 2015). The types and arrangements of the spores were noted.

Isolation of *Candida*: The second specimen collected was streaked on duplicate Petri dishes containing already prepared and solidified Sabouraud Dextrose Agar (SDA) (BIOTECH). One of the plates was incubated at 25^{o}C for 3-7 days while the duplicate was incubated at 37^{o}C for 24h (Shinkafi *et al*., 2021). Growth on the SDA Petri dish was observed, and the colony morphology of the isolates studied. Pure cultures of the isolates were sub-cultured into sterile SDA Petri dishes and incubated at 37^{o}C for 24h. These were, thereafter, stored in Brain Heart Infusion agar with 15% glycerol at -4^{o}C for further use (Waikhom *et al*., 2020)

Characterization of *Candida* species: All isolates were further characterized using Germ tube and biochemical tests and grouped accordingly.

Germ tube test: A loopful of the pure culture of the yeast was suspended in a test tube containing 0.5ml human serum and incubated at 35^{o}C for 4h. A drop of the incubated suspension was placed on clean, grease-free slide, covered with a glass cover slip and observed under ×40 objective lens (Howell and Hazen, 2017)

Sugar assimilation test: The pure isolate of the yeast culture was prepared in yeast nitrogen base broth and a drop of the broth inoculated on agar slant containing yeast-nitrogen base medium. An un-inoculated tube served as control. The tubes were incubated at 35ºC for 96h and then observed for growth (Thomas *et al*., 2018).

Sugar fermentation test: The sugars used for the study were sucrose, glucose, maltose and lactose. Twenty-four hour (24h) old culture was inoculated into different sterile sugar tubes containing inverted Durham tubes. The tubes were incubated at 37ºC for 10 days. Each sugar was prepared with yeast extract, peptone and bromothymol blue as indicator and the tube observed for acid or acid and gas production or gas production only (Cooper and Hunter, 1991).

Data analysis: Data obtained were statistically described in terms of frequency and percentages. The Pearson Chi-Square test was applied to analyze association of vaginal candidiasis with age, gestation period, parity and occupation of the participants. P value less than 0.05 was considered statistically significant at 95% confidence level.

RESULT

Based on the microscopic features, colony morphology, germ tube test and biochemical tests, four species of *Candida* were identified. They include: *Candida albicans*, *Candida tropicalis*, *Candida parapsilosis* and *Candida pseudotropicalis* (Tables 1).

Table 1: Microscopic features, colony morphology, germ tube and biochemical characteristics of groups of isolates

Characteristics	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Microscopic	Pseudohyphae with terminal chlamydospore, clusters of blastosopore	Blastospores singly along the peudohyphae	Elongated blastospores arranged in parallel	Blastospores along pseudomycelia with giant mycelia cells.
Colony	Moderate to large sized colonies, white to cream, pasty and moist	Creamy colonies and moderate size	Cream and smooth colonies, moderate sized	Cream, glossy colonies, moderate size
Germ tube	+	-	-	-
Sugar fermentation				
Lactose	+	-	AG	-
Maltose	-	AG	-	-
Sucrose	AG	AG	AG	-
Glucose	A	AG	AG	AG
Sugar assimilation				
Lactose	-	-	+	+
Maltose	-	+	-	-
Sucrose	+	+	+	+
Organism	***C. albicans***	***C. tropicalis***	***C. pseudotropicalis***	***C. parapsilosis***

Out of the 816 samples analyzed, 353 (43.6%) were positive for *Candida;* specifically 297 (84.1%) *Candida albicans*, 23 (6.5%) *Candida tropicalis*, 19 (5.4%) *Candida parapsilosis* and 14 (4.0%) *Candida pseudotropicalis*. The result obtained showed a significant relationship between candidiasis and pregnant women (p=0.048). The percentage prevalence of the four species of the *Candida* is as shown in Table 2. It can be observed that *Candida albicans* had the highest prevalence in the three hospitals investigated while *Candida peudotropicalis* had the least.

Table 2: Prevalence of *Candida* species among pregnant women examined

Hospital	**Women examined**		**Women with *Candidiasis***		**Women with specific *Candida* infections**							
					C. albicans		*C. tropicalis*		*C. parapsilosis*		*C. pseudotropicalis*	
	No.	Rel. %	No.	%	No.	%	No.	%	No.	%	No.	%
AEFUTHA	376	46.1	166	44.2	137	36.4	14	3.7	9	2.4	6	1.6
MMHA	290	35.5	108	37.2	91	31.4	6	2.1	5	1.7	6	2.1
GHO	150	18.4	79	52.7	69	46.0	3	2.0	5	3.3	2	1.3
Total	816	100.0	353	43.3	297	84.1	23	6.5	19	5.4	14	4.0

AEFUTH: Alex Ekwueme Federal University Teaching Hospital Abakiliki,

MMHA: Mater Misericordiae Hospital Afikpo

GHO: General Hospital Onueke

The distribution of vaginal candidiasis as related to age (Table 3) shows that pregnant women in age group 26-30 years had the highest prevalence of infection 45.4% (n = 149) although there was no significant association between age and vaginal candidiasis (p=0.062). The least infected was the age group 36-40 years.

The prevalence of candidiasis among the pregnant women based on trimester and parity is as recorded in Table 4. The prevalence rate 54.2% (n = 128) was highest during the 3rd trimester (27 - 40 weeks) but least 30.6% (n = 72) in the 1st trimester (0 - 13 weeks). There was a significant relationship (p=0.023) between candidiasis and the trimester of the pregnant women. A statistical difference *(*p=0.018) was also observed in the parity distribution of prevalence among the pregnant women. A higher percentage prevalence 60.9% (n = 98) of candidiasis was recorded in primigravida than in the multigravida 255 (38.9%).

Table 3: Age-distribution of vaginal candidiasis among pregnant women

Age (years)	**Women examined**		**Women with candidiasis**		**P value**
	No.	Relative %	No.	Prevalence (%)	
15-20	86	10.5	34	39.5	
21-25	127	15.6	56	44.1	
26-30	328	40.2	149	45.4	
31-35	221	27.1	99	44.8	
36-40	46	5.6	12	26.1	
41-45	8	1.0	3	37.5	
Total	816	100.0	353	43.3	0.062

Table 4: Vaginal candidiasis according to pregnancy status of women examined

Pregnancy status		**Women examined**		**Women with candidiasis**		**P value**
		No.	Relative %	No.	Prevalence (%)	
Gestation period						0.023
1st trimester	0-13 weeks	235	28.8	72	30.6	
2nd trimester	14-26 weeks	345	42.3	153	44.4	
3rd trimester	27-40 weeks	236	28.9	128	54.2	
Total		816	100	353	43.3	
Parity						0.018
Primigravida		161	19.7	98	60.9	
Multigravida		655	80.3	255	39.1	
Total		816	100	353	43.3	

Table 5 shows the distribution of vaginal candidiasis in pregnant women with respect to their occupation. It can be observed that the farmers had the highest percentage prevalence 76 (58.9%) infection while the public servants had the least 68 (32.9%). As observed, there was no significant difference (P=0.054) in candidiasis in relation to the occupation of the pregnant women.

Table 5: Vaginal candidiasis among pregnant women according to occupation

Occupation /vocation	**Women examined**		**Women with candidiasis**	
	No.	Relative %	No.	Prevalence (%)
Domestic wife	108	13.2	51	47.2
Trading	184	22.5	82	44.6
Farming	129	15.8	76	58.9
Public service	207	25.4	68	32.9
Studentship	110	13.5	45	40.9
Health-care provider	78	9.6	31	39.7
Total	816	100.0	353	43.3

DISCUSSION

The female vagina harbors a lot of microbiota that may become pathogenic if the vaginal environment is tampered with. Vaginal candidiasis has been reported as a common infection that is prevalent in pregnancy and may lead to complications if not treated (Nnadi and Singh, 2017).

Candida species have been implicated as the major cause of vulvovaginal candidiasis among pregnant women (Van Schalkwyk *et al.* 2015; Disha and Haquel, 2022). From the microscopic features and colony morphology of the samples investigated, 43.3% of the isolates recovered were positive for *Candida* species. This result supports the works of Altayyar *et al.* (2016), Mukasa *et al.* (2015) and Idowu *et al.* (2022), who reported prevalence rates of 43.8% in Libya, 45.4% in Uganda and 40% in Oyo State (Nigeria). Higher prevalence of candidiasis, however, have been reported by Akah *et*

al.,(2010) in Enugu State (62.2%), Nnadi and Singh (2017) in Sokoto, Northwest Nigeria (60.76%), Edress *et al.,* (2010) in Yamen (61.5%) and Akortha *et al.,* (2009) in Benin City, Nigeria (82.91 %). On the contrary, Masri *et al.* (2015) reported a low prevalence rate of 17.2% in Malaysia. This shows that results of the studies on the prevalence of vaginal candidiasis among pregnant women varied with different geographic regions (Robertson 1988). It is suggested that the high prevalence of candidiasis among the pregnant women may be as a result of hormonal changes and compromised immune system due to pregnancy (Nelson *et al.,* 2013; Mumuney and Abalaka 2019), prolonged and misuse of antibiotics which destroys beneficial bacteria, leading to reduction of vaginal immunity (Altayyar *et al.,* 2016), dietary habits and disease history (Ghaddar *et al.,* 2019). Douching and development of gestational diabetes during pregnancy may likely be a predisposing factor to the infection.

The most common yeast associated with vaginal candidiasis is *Candida albicans* but other species as *C. parapsilosis, C. tropicalis, C. krusei, C. glabrata, C. pseudotropicalis, C. stelloides* are now emerging as important causes of infection (Van Schalkwyk *et al*., 2015; Altayyar *et al*., 2016; Sule-Odu *et al*., 2020). Four species of *Candida,* namely *Candida albicans* (84.1%), *Candida tropicalis* (6.5%), *Candida parapsilosis* (5.4%) and *Candida pseudotropicalis* (4.0%) were recovered from the samples of the pregnant women which implicate *C. albicans* as the most common species of *Candida* involved in vaginal candidiasis. This observation has earlier been reported by Shekufeh *et al.* (2017), Brandao *et al.* (2018) and Idowu *et al.*, (2022). Waikhom *et al.,* (2020) isolated more of non albican *Candida* (NAC) (74.1%). Although, *C. glabrata* was not isolated in this study, it has been reported by Deorukhkar *et al.* (2014) and Waikhom *et al.* (2020), as the most prevalent non- *albican Candida* causing vaginal candidiasis.

As can be observed, *C. tropicalis* is the most prevalent NAC (6.5%) obtained in this study and this corroborates the work of Edress *et al*. (2020). *Candida pseudotropicalis* had not been frequently indicted in vaginal candidiasis but Morgan *et al.,* (1984) and Enweani *et al.,* (1994) reported its implication in fungemia, invasive diseases and diarrhea. The involvement of NAC in vaginal candidiasis may likely be due to self medication in pregnant women without proper diagnosis. It is also speculated that misuse of antifungal drugs may eliminate *C. albicans*, which is more susceptible to the antifungal drugs, thereby leading to emergence of the NAC that are more resistant to the drugs (Altayyar *et al*., 2016). Ability to obtain these antifungal drugs over the counter is also of great concern and encourages self medication.

Age group 26-30 years (45.4%) had the highest prevalence although not statistically significant (p=0.062). The result obtained is similar to the work of Shinkafi *et al.,* (2021) and Disha and Haque (2022). It is suggested that the high sexual activities among this age group and the indiscriminate use of antibiotics and contraceptives may be responsible for the high rate of candidiasis (Shinkafi *et al.,* 2021). Their choice of high sugar based diet may also have contributed to the high prevalence. On the contrary, Moses and Michael (2012) and Altayyar *et al.,* (2016), recorded the highest percentage prevalence among the age brackets 16-25 (44.44%) and 36-40 (33.33%) respectively.

The outcome of studies as related to gestational age, shows that candidiasis was more prevalent and statistically significant among pregnant women at their 3rd trimester (54.24%), *P*=0.023. This result is in line with the reports of Sobel (2007), Okonkwo and Umeanaeto (2011), Nelson *et al.,* (2013), Nnadi and Sign (2017) and Waikhom *et al*., (2020). Sobel (2007) and

Waikhom *et al.*, (2020), however, attributed it to the high levels of estrogen produced by the women in their 3rd trimester, which results in higher glycogen deposits in vagina that supports *Candida* growth. Sobel (2007) and Okonkwo and Umeanaeto, (2011), in another report suggested that emotional stress caused by anxiety in the last trimester, coupled with frequent vaginal and pelvic examinations, may also put the women at risk of infection of candidiasis.

Prevalence with respect to parity shows that the primigravida (60.87%) were more susceptible to candidiasis and was statistically significant *P*=0.018. The findings of Okonkwo and Umeanaeto (2011), is corroborated by the high prevalence of candidiasis among the primigravida (60.87%) observed in this study. They attributed it to the inexperience of the women in things relating to pregnancy and infection. Poor knowledge of risks associated with candidiasis in pregnancy may also have contributed to their not seeking immediate treatment when infected.

Based on occupation of the pregnant women, farmers 76 (58.91%) had the highest prevalence of candidiasis. The pregnant women are subsistence farmers that can barely produce enough for themselves and their families. Poor economic status is a factors that could predispose one to poverty, making it difficult for them to obtain proper diagnosis and unable to purchase the necessary antifungal drugs for treatment. There could also be issues of poor hygiene and poor diet among the farmers which can alter the immunity of the pregnant women thereby predisposing them to infection.

Conclusion: Prevalence of vaginal candidiasis among study participants indicates that *Candida albicans* is the most prevalent species. Three species of non *albicans Candida* were identified in this study, indicating their emergence as opportunistic pathogens. Age group 26 – 30, pregnant women in 3rd trimester, the primigravida, and farmers recorded high prevalence of candidiasis. There is, therefore, the need for early screening of pregnant women for candidiasis and proper treatment during antenatal visits.

Conflict of interest: Authors declare no conflict of interest

REFERENCES

Akah, P. A., Nnamani, C. E. and Nnamani, P. O. (2010). Prevalence and treatment outcome of vulvovaginal candidiasis in pregnant women in a rural community in Enugu State, Nigerian Journal of Medical Sciences 20(1):1-14

Akortha, E., Nwaugo, V. and Chikwe, O. (2009). Antifungal resistance among *Candida* species from patients with genitourinary tract infection isolated in Benin City, Edo State Nigeria. African Journal of Microbiology Research 3(11): 694-699

Altayyar, I. A., Alsanosi, A. S. and Osman, N. A. (2016). Prevalence of vaginal candidiasis among pregnant women attending different gynecological clinics at South Libya. European Journal of Experimental Biology 6(3): 25-29

Al-Rusan, R. N., Darwezeh, M. C. and Lataifeh, I. M. (2017). The relationship of Candida colonization of the oral and vaginal mucosa of mothers and oral mucosa of their new born at birth, Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology 123(4): 459-463

Brandao, L. D. S., Boniek, D., Resende Stoianoff, M. A., da Mata F. M. R., Fernandes, J. V. and Andrade, V. S. (2018). Prevalence and antifungal susceptibility of *Candida* species among pregnant women attending a school maternity at Natal, Brazil. Letters in Applied Microbiology 67(3): 285-291

Carolus, H., Pierson, S., Lagrou, K. and Van Dijck, P. (2020). Amphotericin B and other polyene-Discovery, clinical, use,

mode of action and drug resistance. Journal of Fungi 6: 321

Cooper, B. H. and Hunter, M. S. (1991). Yeasts of medical importance. Manual of Clinical Microbiology 5th Edition American Society for Microbiology Publication.

Deorukhkar, S. C., Saini, S. and Mathew, S. (2014). Non-*albicans Candida* infection: an emerging threat. *Interdisciplinary Perspectives on Infectious Diseases: 615958*

Disha, T. and Haque, F. (2022). Prevalence and risk factors of vulvovaginal candidosis during pregnancy: A Review. Infectious Diseases in Obstetrics and Gynecology Article ID 6195712

Edress, A. A., Al-Asbali. A. A., Al-Shehari, W. A. and Qasem, E. A. (2020). Vulvovaginal candidiasis prevalence among pregnant women in different hospitals in IBB Yamen. Universal Journal of Pharmaceutical Research 5(4): 1-5

Eckert, L. O., Hawes, S. E., Sterens, C. C., Konsky, I. A., Eschenbach, D. A. and Holmes, K. K. (1998). Vulvovaginal candidiasis, clinical manifestations, Risk factors, management algorithm. Obstetrics and Gynecology 92: 757-768

Enweani, I. B., Obi, C. and Jokpeyibo, M. (1994). Prevalence of Candida species in Nigerian children with diarrhea. *Journal of Diarrhoeal Diseases Research* 12(2): 133 - 135

Frobenius, W. and Bogdan, C. (2015). Diagnostic value of vaginal discharge, wet mount and vaginal pH- An update on the basics of gynecologic infectiology. Geburtshilfe und Frauenheilkunde 75(4): 355-366

Ghaddar, N., El Roz, A., Ghssein, G and Ibrahim, J. N. (2019). Emergence of vulvovaginal candidiasis amongLebanese pregnant women: Prevalence, risk factors and species distribution. Infectious diseases in obstetrics and Gynecology 8pages

Goncalves, B., Ferreira, C., Alves, C. T., Henriques, M., Azeredo, J. and Silva, S. (2016). Vulvovaginal candidiasis: Epidemiology, Microbiology and Risk factors. Critical Reviews in Microbiology 42 (6): 905-927

Howell, S. A., Hazen, K. C. and Brandt M. E. (2017). *Candida, Cryptococcus* and other yeasts of medical importance. Manual of Clinical Microbiology 11th Edition: American Society for Microbiology, Chapter 117.

Idowu, M. O., Makinde, G. I., Olurati O. O., Adebayo, M. O. and Adekunle, O. A. (2022). Prevalence of vulvovaginal candidiasis among women attending clinics in selected hospitals in Oyo State, Southwest Nigeria. Journal of Public Health and Epidemiology 14 (5): 45-52

Kish, L. (1965). Survey sampling. New York: John Wiley and Sons, Inc.

Masri, S. N., Noor, S. M., MatNor, L. A., Osman, M. and Rahman, M. M. (2015). *Candida* isolates from pregnant women and their antifungal susceptibility in a Malaysian tertiary-care hospital. Pakistan Journal of Medical Sciences 31(3):658-661

Mukasa, K. T., Herbert, I., Daniel, A. Sserunkuma, K. L. and Fredrick, B. (2015). Antifungal susceptibility patterns of vulvovaginal *Candida* species among women attending antenatal clinic at Mbarara Regional referral hospital, South Western Uganda. British Microbiology Research Journal 5(4): 322

Mumuney, K. T. and Abalaka, M. E. (2019). Comparative study of vaginal candidiasis in pregnant and non pregnant women attending Ibrahim Badamasi Babangida specialist hospital and General hospital Minna, Niger State, Nigeria. Journal of Advances in

Microbiology 14(2) Article number JAMB 45762

Morgan, M. A., Wikowske, C. J. and Robert, G. D. (1984). Candida pseudotropicalis fungemia and invasive disease in an immunocompromised patient. *Journal of Clinical Microbiology* 20(5): 1006-7

Moses, A. and Michael, E. (2012). Asymptomatic co-infection of candidiasis and vaginal trichomoniasis among pregnant women in Southeastern Nigeria. Clinical Microbiology and Infection 18(7): 242-245

Nelson, M., Wanjiru, W and Margaret, M. (2013). Prevalence of vaginal candidiasis and determination of the occurrence of *Candida* species in pregnant women attending antenatal clinic of Thika District Hospital, Kenya. Open Journal of Medical Microbiology 3(4) Article ID 41031 9 pages

Nnadi, D. C. and Sign, S. (2017). The prevalence of genital *Candida* species among pregnant women attending antenatal clinic in a tertiary health center in Northwest Nigeria. Sahel Medical Journal 20 (1): 33-37

Okonkwo N. and Umeanaeto P. (2011). Prevalence of vaginal candidiasis among pregnant women in Nnewi Town of Anambra State, Nigeria. African Research Review 4(4): 539-548

Oviasogie, F. and Okungbowa, F. (2009). *Candida* species among pregnant women in Benin City, Nigeria: Effects of predisposing factors. African Journal of Clinical and Experimental Microbiology 10(2): 92-98

Pfaller, M. A., Andes, D. R., Diekema, D. J., Horn, D. L., Reboli, A. C., Rostein, C., Franks, B. and Azie, N. E. (2014). Epideiology and outcomes of invasive candidiasis due to non-*albicans* species of *Candida* in 2, 496 patients: data from the prospective antifungal therapy (PATH) registry 2004-2008. PLoS ONE 9(7): e101510

Robertson, W. H. (1988). Mycology of vulvovaginitis. American Journal of Obstetrics and Gynecology 158(4): 989-991

Shekufeh, P., Minoo, M. and Rasoul, M. (2017). Clinical and microbiological study of vulvovaginal candidiasis (VVC), identification of clinical isolates by polymerase chain-fragment size polymorphyim (PCR-FSP) techniques. Archives of Clinical Infectious Diseases 12(2): e62761

Shinkafi, S. N., Salisu, N., Mohammed, N. and Isah, K. (2021). Prevalence of vaginal candidiasis among pregnant women attending antenatal clinic in selected hospitals within Gausau, Zamfara State, Nigeria. Nigerian Journal Botany 34(2): 229-234

Snydman, D. R. (2003). Shifting patterns in the epidemiology of nosocomial *Candida* infections. Chest 124(5): 500S- 503S.

Sobel, J. D. (2007). Vulvovaginal candidiasis. Lancet 369: 1961-1971

Sule-Odu, A. O., Akadri, A. A., Oluwole, A. A., Osinupebi, O. A., Andu, B. A., Akiseku, A. K . and Lawal, A. I. (2020). Vaginal candida infections in pregnancy and its implications for fetal well-being. African Journal of Reproductive Health 24(3): 33-40

Sutaria, P., Chidera, M. and Donga, S. B. (2019). A prevalence study of vaginal candidiasis among pregnant women. International Journal of Advances in Medicine 6(3): 922-926.

Thomas, J. W., Randall, T. H. and Larone, D. H. (2018). Larone's medically important fungi: A guide to identification 6th Edition ASM Press

Van Schalkwyk, J. and Yundin, M. H. Infectious Disease Committee. (2015). Vulvovaginitis: Screening for management of trichomoniasis,

vulvovaginal candidiasis and bacterial vaginosis. Journal of Obstetrics and Gynecology Canada 37 (3):266 -274

Vijaya, D., Dhanalakshmi, T. A. and Kulkami, S. (2014). Changing trends of vulvovaginal candidiasis. Journal of Laboratory Physicians 6:28-30

Waikhom, S. D., Afeke, I., Kwawu, G. S., Mbroh, H. K., Osei, G. Y., Louis, B., Deku, J. G., Kasu, E. S., Mensah, P., Agede, C. Y., Dodoo, C., Asiamah, E. A., Tampouri, J., Korbuvi, J and Opinta, J. A. (2020). Vulvovaginal candidiasis among pregnant women in the HO municipality, Ghana, species identification and antifungal susceptibility of *Candida* isolates. BMC Pregnancy Childbirth 20: 226.

Yadav, K. and Prakash, S. (2016). Prevalence of vulvovaginal candidiasis in pregnancy. The Global Journal of Medicine and Medical Science 4(1): 108-116