ORIGINAL RESEARCH ARTICLE

Epidemiological evaluation of risk factors associated with vaginal candidiasis in a cross section of pregnant women in Trinidad and Tobago

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Abstract

Vaginal Candidiasis and associated epidemiological risk factors prevalent among a cross section of pregnant women attending tertiary hospital in Trinidad and Tobago was evaluated. Standardized questionnaire was used to survey 492 pregnant women over a period of 10 months in 2019. Vaginal swab was collected and processed using standard microbiological laboratory methods for phenotypic identification. Data were analyzed using SPSS to identify potential risk factors. Chi-squared (χ^2) test and logistic regression tests examined associations and odds ratios with corresponding 95% confidence intervals. Prevalence of vulvovaginal candidiasis was 44.9% with *Candida albicans* as predominant species identified (62%, N=492). Vaginal candidiasis was statistically significant for several risk factors, including second trimester (p = 0.03), age group 26 – 34 years (p=003), history of masturbation especially during the last 48hours prior to the swabbing (p=0.05), and wearing of pants as opposed to skirt clothes (p=0.04). In conclusion, several epidemiological risk factors are associated vaginal candidiasis among cross section of pregnant women in the country. Patient education, microbiological investigations and appropriate treatment will improve antenatal healthcare delivery in the country. *(Afr J Reprod Health 2022; 26[3]: 46-53).*

Keywords: Vulvovaginal candidiasis, pregnant women, candida species, risk factors, Trinidad and Tobago

Résumé

La candidose vaginale et les facteurs de risque épidémiologiques associés prévalents parmi un échantillon représentatif de femmes enceintes fréquentant un hôpital tertiaire à Trinité-et-Tobago ont été évalués. Un questionnaire standardisé a été utilisé pour interroger 492 femmes enceintes sur une période de 10 mois en 2019. Un écouvillon vaginal a été collecté et traité à l'aide de méthodes de laboratoire microbiologiques standard pour l'identification phénotypique. Les données ont été analysées à l'aide de SPSS pour identifier les facteurs de risque potentiels. Le test du chi carré (χ2) et les tests de régression logistique ont examiné les associations et les rapports de cotes avec les intervalles de confiance à 95 % correspondants. La prévalence de la candidose vulvo-vaginale était de 44,9 % avec Candida albicans comme espèce prédominante identifiée (62 %, N = 492). La candidose vaginale était statistiquement significative pour plusieurs facteurs de risque, y compris le deuxième trimestre (p = 0,03), le groupe d'âge de 26 à 34 ans (p = 003), les antécédents de masturbation, en particulier au cours des dernières 48 heures avant le prélèvement (p = 0,05), et porter des pantalons plutôt que des jupes (p=0,04). En conclusion, plusieurs facteurs de risque épidémiologiques sont associés à la candidose vaginale chez un échantillon représentatif de femmes enceintes dans le pays. L'éducation des patients, les investigations microbiologiques et un traitement approprié amélioreront la prestation des soins de santé prénatals dans le pays. *(Afr J Reprod Health 2022; 26[3]: 46-53).*

Mots-clés: Candidose vulvo-vaginale, femmes enceintes, espèces de candida, facteurs de risque, Trinité-et-Tobago

Introduction

A common disease of the lower reproductive tract of immunocompetent and otherwise healthy women is vulvovaginal candidiasis (VVC) which is most frequently caused by the opportunistic fungal pathogen *Candida albicans*[1]. As has been reported in several literatures, there are common risk factors

associated with or seen among female patients with vaginal candidiasis. These includes among other factors such as pregnancy, use of oral contraceptives and antibiotics, diabetes mellitus[2-4]. The prevalence of candidiasis is almost doubled during pregnancy, particularly in the third trimester, compared with non-pregnant women[5-7]. Although there are over 350 *Candida species*, *Candida albicans* accounts for most cases of Candida infections[8], but the medically significant species are limited[9]. It has been observed that majority of women will have vulvovaginitis caused by *Candida species* during their life span, with nearly 50% of them having a recurrence or suffering from a several episodes[10,6].

Trinidad and Tobago, a twin Island nation is located in the Southeastern West Indies and forms the two southernmost links in the Caribbean chain lying close to the continent of South America, northeast of Venezuela and northwest of Guyana[11]. Despite the high level of health care facilities in the country, vaginal candidiasis is mostly diagnosed and treated clinically, allowing for asymptomatic infections to go undetected. But when clinical samples such as urine or high vaginal swab is sent to the microbiology laboratories, phenotypic identification and methods employed in medical laboratories are time consuming, labour intensive and often result in inconclusive findings like in other areas[12,13].

There could be several challenges in many developing countries in identifying the specific species of the Candida organisms in the laboratory and the prevailing method for detection of candida is mainly by microscopic analysis or traditional culture detection methodology[14]. Epidemiologic factors and confirmatory laboratory methods to confirm diagnosis of candidiasis among pregnant women attending antenatal care in the country has never been delineated. Therefore, this study was aimed at determining *Candida species* infections and associated risk factors in a cross section of pregnant women attending a tertiary hospital in Trinidad and Tobago during their antenatal care.

Methods

Sample collection

A cross section of pregnant women attending the ante-natal clinics of several tertiary hospitals in the country were self-administered a pretested questionnaire, to obtain their socio-demographic information and to assess the risk factors. This was done over a 10-months period in 2019. Data concerning pre-pregnancy weight, previous vaginal candidiasis infection, treatment of past infections, illnesses, antibiotic use, contraceptive use, and type of contraceptive used were collected and analyzed. The questionnaire also sourced for information concerning predisposing factors among the participants and these included sexual habits (frequency, number of partners, oral sex, and masturbation). A high vaginal swab was taken from all consenting participants using sterile swabs containing Amie's media (DELTALAB, Spain) with no charcoal were collected and immediately transported to the microbiology laboratory for analysis.

Candida species identification

Colonies identified on Sabouraud dextrose agar (SDA) and presumptuously confirmed via gram staining and microscopy as yeast were subjected to the germ tube test using standard microbiological methods. Further confirmation of the yeast was carried out using a single colony from SDA sub-cultured onto modified HiCrome™ *(Hi-Media, India) Candida* Differential Agar as reported in literature[15]. Detection of chlamydospore formation on Corn meal agar with tween 80 confirmed Candida species and the carbohydrate assimilation test was performed using several carbohydrate discs which conventionally confirmed the species following reports of Marinho SA *et al*[16].

Statistical analysis

Data were analysed using IBM Statistical Package for the Social Sciences (SPSS) v25. Participants were categorised as positive or negative for *Candida* species, based on identification from specimens. To identify potential risk factors, at an α=0.05 level of significance, chi-squared (χ^2) test and logistic regression were used to examine associations and obtain odds ratios (OR) with corresponding 95% confidence intervals.

Quality control

The following type of *Candida* strains were used in the study as quality control for all test methods – *C.*

albicans, ATCC 18804, *C. tropicalis* ATCC 750, *C. glabrata* ATCC 2001, *C. parapsilosis* ATCC22019, *C. krusei* ATCC 6258, *C. lusitaniae* ATCC 34449, *C. gulliermondii* ATCC 6260 and *C. dubliniensis* ATCC mya-646.

Results

A total of four hundred and ninety-two (N=492) patients participated in this study. Less than half of this number, 44.9% (221/492) had growth for *Candida* species while the rest 55.1% (271/492) were negative. More than half, 60.2% (133/221) of the patients with growth were asymptomatic while the rest 39.8% (88/221) were symptomatic. *Candida albicans* was the most predominant species identified 62% (137/221) while the rest were *non–albicans* species comprising *C. glabrata* (19.3%), *C. tropicalis* (13.9%) and *C. krusei* (4.5%). None of the *Candida species* was observed to be *Candida auris*.

In this study, several risk factors associated with pregnant women developing *Candida* infections were evaluated and the obtained results are summarized and presented in the table below. These epidemiological parameters included: trimester term, age group, gravidity, educational and employment status, current and past medical history including current infections and use of antibiotics. Also, because Trinidad and Tobago comprise several ethnic groups as well as the fact that the participants resided in several locale of the country, ethnicity and area of domicile were also assessed. The participant's history of sexual activities during the pregnancy included intercourse, number of sexual partners, engaging in oral sex, masturbation. The patient's prior history of use of contraceptives, personal hygiene and clothing types were also assessed.

Several interesting results were elucidated but majority were not statistically significant except for the participant being in their second trimester, in 26 to 34-year age group, engaging in sexual intercourse in the past 48 hours prior to participation in the study and practicing masturbation. Also, the type of clothing material of the participant puts on was found to be a significant factor in developing Candidiasis during pregnancy noted to be significant.

Most of the growth of *Candida species* occurred during the third trimester 121 (54.8%) of participants as against second trimester 88 (39.8%) and first trimester 12 (5.4%) respectively. However, even though participants who were in their second trimester were not in the majority, yet the difference between those who had *Candida species* growth were statistically significant [p=0.03, OR (2.24), CI (1.06-4.73]. Although the age group surveyed ranged from 18 to 52 (N=492), the age group of 26 – 34-years group had the highest number 49.2% (242/492) of participants. This group also had the highest number 44.3% (98/221) of subjects yielding *Candida species* from their vaginal swabs compared to the rest of the other age groups; ≥35 years or 18-25 years that had 29.9% (66/221) and 25.8% (57/221) respectively [p=0.03, OR (0.61), CI (0.39-0.96].

Among the study participants, engaging in sexual intercourse more than once a week and those practicing oral sex had the highest yield of the *Candida specie*s, 33.5%, [74/221; OR (1.48), CI 0.67-3.28]; and 57.0% [126/221; OR (1.22), CI (0.86-1.75] respectively. Having more than one partner did not increase the percentage of Candidiasis. There was a noticeable difference in growth between participants that masturbated with saliva 15.8% (35/221) than those that did not 84.2% (186/221), [p=0.05, OR (1.70), CI (0.99-2.91]; with the highest percentage seen in women that performed the act during the previous 48 hours [(p=0.01) OR (3.52), CI (1.35-9.16].

Of the clothing habits studied in relation to developing Candidiasis, only the choice of pants over skirts was of statistically important with wearers of pants 55.7% (123/221) and skirt wearers 44.3% [98/221; p=0.04; OR (1.44), CI (1.01-2.06)]. No other significant association was made although higher percentages were seen in women who choose tight fitting clothes, those who wear pantyhose and underwear that were cotton and dark in colour.

Discussion

This study revealed that the overall prevalence of *Candida species* among pregnant women was 44.9%. This percent is almost like what was obtained in a study from South Libya, that reported a prevalence of 43.8% in the same study population

Table 1: Risk factors for Candida species isolation from vaginal swab among cross section of pregnant women, Trinidad and Tobago (%)

Risk Factor	**N 492(100)**	**Growth n=221(44.9)**	**No growth n=271(55.1)**	**p-value**	**OR**	**95% CI**	
						Lower	**Upper**
Trimester							
First	38(7.7)	12(5.4)	26(9.6)	-	ref		
Second*	173(35.2)	173(35.2)	85(31.4)	0.03	2.24	1.06	4.73
Third	281(57.1)	121(54.8)	160(59.0)	0.18	1.64	0.79	3.38
Gravity							
Primigravida	113 (23.0)	45 (20.4)	68 (25.1)	-	ref		
Multigravida	379 (77.0)	176 (79.6)	203 (74.9)	0.22	1.31	0.85	2.01
Age							
18 – 25	108(22.0)	57(25.8)	51(18.8)	-	ref		
26 – 34*	242(49.2)	98(44.3)	144(53.1)	0.03	0.61	0.39	0.96
≥35	142(28.9)	66(28.0)	76(28.0)	0.32	0.78	0.47	1.28
Ethnicity							
East Indian	103 (21.0)	43 (19.5)	60 (22.1)	-	ref		
African	217 (44.1)	98 (44.3)	119 (43.9)	0.57	1.15	0.72	1.85
Other	172 (35.0)	80 (36.2)	92 (33.9)	0.44	1.21	0.74	1.99
Locality							
North	118 (24.0	56 (25.3)	62 (22.9)	-	ref		
South	106 (21.6)	44 (19.9)	62 (22.9)	0.37	0.79	0.46	1.33
East	158 (32.1)	68 (30.8)	90 (33.2)	0.47	0.84	0.52	1.35
West	43(8.7)	20(9.0)	23(8.5)	0.92	0.96	0.48	1.94
Central	67(13.6)	33(14.9)	34(12.5)	0.81	1.07	0.59	1.96
Educational level ☥							
Primary/None	32(7.1)	14 (6.3)	21(7.7)	-	ref		
Secondary	277 (56.3)	133 (60.2)	144 (53.1)	0.37	1.39	0.68	2.84
Tertiary	180 (36.6)	74 (33.5)	106 (39.1)	0.90	1.05	050	2.19
Employed							
None	280 (56.9)	123 (55.7)	157 (57.9)	-	ref		
Yes	212 (43.1)	98 (44.3)	114 (42.1)	0.61	0.91	0.64	1.30
Monthly Income							
<$2500	262 (53.3)	122 (55.2)	140 (51.7)	-	ref		
$2500 - $3499.99	63 (12.8)	21(9.5)	42 (15.5)	0.06	0.57	0.32	1.02
$3500 - $4499.99	71(14.4)	38 (17.2)	33(12.2)	0.30	1.32	0.78	2.24
$4500 - $5499.99	42 (8.5)	20 (9.0)	22 (8.1)	0.90	1.04	0.54	2.00
>$5500.00	54 (11.0	20 (9.0)	34(12.5)	0.20	0.68	0.37	1.23
Weight (pre pregnancy)							
Under	31(6.3)	19(8.6)	12(4.4)	0.08	1.95	0.91	4.16
Ideal	290 (60.0)	130 (58.8)	160 (59.0)	-	ref		
Over/obese	171 (34.8)	72 (32.6)	99 (36.5)	0.57	0.90	0.61	1.31
Previous Infection							
No	256 (52.0)	114 (51.6)	142 (52.4)	-	ref		
Yes	236(48.0)	107 (48.4)	129 (47.6)	0.86	1.03	0.72	1.47
Treatment of infection							
None	136 (27.6)	60 (27.1)	76 (28.0)	-	ref		
Go away on its own	52 (10.6)	31 (14.0)	21(7.7)	0.06	1.87	0.98	3.58
Visit a doctor	207 (42.1)	84 (38.0)	123 (45.4)	0.52	087	0.56	1.34
Self-diagnose/medicate	97 (19.7)	46 (20.8)	51 (18.8)	0.62	1.14	0.68	1.93
Current illness/disease§							
None	408 (83.1)	186 (84.5)	222 (81.9)	-	ref		
Diabetes mellitus	36 (7.3)	15 (6.8)	21 (7.7)	0.65	0.85	0.43	1.70
Anaemia	47(9.6)	19 (8.6)	28 (10.3)	0.50	0.81	0.44	1.50
Antibiotics treatment							
No	363 (73.8)	160 (72.4)	203 (74.9)	-	ref		
Yes	129 (26.2)	61 (27.6)	68 (25.1)	0.53	1.14	0.76	1.70
Contraceptives							
No	399 (81.1)	184 (83.3)	215 (79.3)	-	ref		
Yes	93 (18.9)	37 (16.7)	56 (20.7)	0.27	0.77	0.49	1.22
Contraceptive type§							
None	399 (81.4)	184 (83.6)	215 (79.6)	-	ref		
Pill	65 (13.3)	26 (11.8)	39 (14.4)	0.36	0.78	0.46	1.33

Condom	13(2.7)	4(1.8)	9(3.3)	0.28	0.52	0.16	1.71
Intrauterine device	6 (1.2)	3 (1.4)	3 (1.5)	0.85	1.17	0.23	5.86
Injectable	7 (0.01)	3 (1.4)	4(1.5)	0.86	0.88	0.19	3.97
Intercourse							
None	31 (6.3)	11 (5.0)	20(7.4)	-	ref		
Once/month	96(19.5)	42 (19.0)	54 (19.9)	0.42	1.41	0.61	3.27
Twice/month	74 (15.0)	36 (16.3)	38 (14.0)	0.22	1.72	0.73	4.09
Once/week	126 (25.6)	58 (26.2)	68 (25.1)	0.29	1.55	0.69	3.50
More than once/week	165 (33.5)	74 (33.5)	91 (33.6)	0.34	1.48	067	3.28
Sexual partners							
One/None	480 (97.6)	216 (97.7)	264 (97.4)	-	ref		
More than one	12 (2.4)	5 (2.3)	7(2.6)	0.82	0.87	0.27	2.79
Engaging in oral sex							
No	225 (45.7)	95 (43.0)	130 (48.0)	-	ref		
Yes	267 (54.3)	126 (57.0)	141 (52.0)	0.27	1.22	0.86	1.75
Last oral sex							
None	225 (45.7)	95 (43.0)	130 (48.0)	-	ref		
Within 48hours ago	42(8.5)	18(8.1)	24 (8.9)	0.94	1.03	0.53	2.00
2 – 7 days	84 (17.1)	42 (19.0)	42 (15.5)	0.22	1.37	0.83	2.26
7 – 14 days	41(8.3)	20(9.0)	21(7.7)	0.44	1.30	0.67	2.54
>14 days	100 (20.3)	46 (20.8)	54 (19.9)	0.53	1.17	0.73	1.87
Masturbate							
No	430(87.4)	186(84.2)	244(90.0)	-	ref		
Yes*	62(12.6)	35(15.8)	27(10.0)	0.05	0.05	0.99	2.91
Last masturbation							
None	429(87.2)	185(83.7)	244(90.0)	-	ref		
Within the last 2 days*	22(4.5)	16(7.2)	6(2.2)	0.01	3.52	1.35	9.16
2 – 6 days	14(2.8)	7(3.2)	7(2.6)	0.61	1.32	0.45	3.83
7 days – 14 days	12(2.4)	7(3.2)	5(1.8)	0.30	1.85	0.58	5.91
>14 days	15(3.0)	6(2.7)	9(3.3)	0.81	0.88	0.31	2.51
Wiping after toilet							
Front to back	335(68.4)	146(66.4)	189(70.0)	-	ref		
Back to front	76(15.5)	37(16.8)	39(14.4)	0.42	1.23	0.75	2.02
Both ways	79(16.1)	37(16.8)	42(15.6)	0.60	1.14	0.70	1.86
Genital washing							
None/once daily	5(1.0)	2(0.9)	3(1.1)	0.81	0.80	0.13	4.90
Twice daily	227(46.1)	103(46.6)	124(45.8)	-	Ref		
Thrice daily	188(38.2)	85(38.5)	103(38.0)	0.97	0.99	0.67	1.46
Four or more times daily	72(14.6)	31 (14.0)	41(15.1)	0.73	0.91	0.53	1.55
Douching †							
No	375 (76.5)	168 (76.4)	207 (76.7)	-	ref		
Yes	115(23.5)	52 (23.6)	63 (23.3)	0.94	1.02	0.67	1.55
Douching material							
None	374 (76.0)	167 (75.6)	207 (76.4)	-	ref		
Water	67 (13.6)	32 (14.5)	35 (12.9)	0.64	1.13	0.67	1.91
Feminine wash	51 (10.4)	22 (10.0)	29 (10.7)	0.84	0.94	0.52	1.70
Clothing type							
Skirts	243(49.4)	98(44.3)	145(53.5)	-	ref		
Pants/trousers*	249(50.6)	123(55.7)	126(46.5)	0.04	1.44	1.01	2.06
Clothing fit							
Lose	388(78.9)	167(75.6)	221(81.5)	-	ref		
Tight	104(21.1)	54(24.4)	50(18.5)	0.11	1.43	0.93	2.21
Underwear material							
Cotton	416(84.6)	188(85.1)	228(84.1)	-	ref		
Synthetic	76(15.4)	33(51.1)	43(15.9)	0.78	0.93	0.57	1.52
Underwear colour							
Dark	236 (49.6)	113 (51.1)	123 (45.4)	-	ref		
Light	248 (50.4)	104 (47.1)	144 (53.1)	0.19	0.79	0.55	1.13
Both	8(1.6)	4(1.8)	4(1.5)	0.91	1.09	0.27	4.46
Pantyhose †							
No	411(83.7)	180(81.4)	231(85.6)	-	ref		
Yes	80(16.3)	41(18.6)	39(14.4)	0.22	1.35	0.85	2.18

N=Total number; OR=Odds ratio; ref=Referent category; † n<492 due to missing values; §One category removed due to only one respondent; *Statistically significant p-values.

over a two-year period[17], and 43% that was recorded among participants in a study done in India[18], although the sample size of these participants was small, and the period or length of study were quite different in both studies from this study. The frequency of the *Candida species* in this study would also be described as approximate to number obtained from a study in Cameroon (55.4%)[19]. In contrast, this was far higher than what was observed in a study done in Saudi Arabia (26%)[20] or Nigeria[21]. Obviously, these variations could be due to several factors that include differences in the study design and study populations even though this study included only pregnant women attending antenatal care at a tertiary hospital. Overall, in a small country such as ours, this number is very high and very concerning or worrisome.

Candida albicans was the most common species (62%) responsible for vaginal candidiasis observed in this study, and this is comparable or almost like the number obtained from a study done in Kenya (63.83%)[22], but less than that in Nigeria (50%)[20]. However, *C. glabrata* was the commonest isolated species, with a frequency of 57.4% in a study carried out in Ghana[23]. The report of predominance of *C. albicans* among these pregnant participants could be attributed to the enhanced ability of this fungus to adhere to the vaginal mucosa, a fundamental step in the establishment of *Candida* vaginitis[6]. Although this line of thought was not part of this study design but as already reported in literature[24] the changes in the epithelial walls of pregnant women due to hormonal changes could very well be a contributing factor for this.

Non-*albicans* species found in this study constituted 38% of all species recovered from clinical samples analyzed and they include *C. glabrata, C. tropicalis* and *C. krusei*. Sobel *et al* suggested that this pronounced finding of non-*albicans* species can be credited to incomplete local or systemic therapeutic regimens, self-diagnosis, and self-medication as well as the increase in prolonged exposure to antifungals to prevent recurrence of infection[25]. Although we do not have data to support this view in our present study, we are however inclined to assume that the same might the case in this study.

In this study, a high incidence of vaginal candidiasis was seen among the participants during their third trimester period, but statistically, significant candidiasis was found to be among participants in their second trimester. Similarly, the proportion of *Candida* was higher in the second trimester in a study carried out in Nigeria[26]. And this contrasted with what was noted in a different study in Kenya another African country, where most of the confirmed vulvovaginal Candidiasis (VVC) among participants were in their third trimester[22]. The increase of vaginal Candidiasis during the second trimester in this study could probably be because as pregnancy progresses, emotional stress increases along with estrogen and corticoid hormones causing lower vaginal immunity and defense mechanisms against *Candida* species[5]. As has been reported in literature, vaginal acidity also declines in pregnant women, especially in the later trimesters, decreasing the ability to fight infections thus influencing the rate of occurrence of vaginal candidiasis[27]. The inconsistency in the prevalence and associated risk factors of vaginal candidiasis worldwide can be explained and determined from a cultural perspective, as vaginal hygiene varies with demographic traditions, the socioeconomic levels, and health service standards of each country[28]. The current findings in this study showed that there was a significant difference between gestational period and Candidiasis among the participants in this study. This was most pronounced during the second trimester whereas in studies elsewhere there were no significant difference between the gestational periods[29]. Even though significant observation of Candidiasis was made in the participants during the second trimester, it is important to note that iron deficiency leads to immunosuppression, allowing proliferation of opportunistic pathogens such as *Candida*. Pregnant women in the third trimester have greater rate of iron deficiency anemia with concurrent vaginal candidiasis, than those in the first trimester[30].

No statistically significant association was found between vaginal *Candida* infection and socio-economic data. The age group with the highest frequency of *Candida* isolation was the 26 - 34 years. Although not specifically observed in this current study, but this could be possibly due to the higher sexual activity, vaginal flora changes as well as indiscriminate antibiotic and contraceptive use which had been noted in a study in Iran[31]. Of the

clothing patterns examined, the only significant association ($p<.05$) was seen between vaginal candidiasis and choice of pants (49.4%) over skirts (40.3%). Clothing that is poorly ventilated and tight would facilitate vaginal candidiasis by trapping bacteria and increasing the temperature and moisture of the perineum[10]. A higher prevalence was also seen in women that wore underwear that were cotton over synthetic (45.2% vs. 43.4%) and were dark colored over light colored (48.0% vs. 41.9%). Synthetic underwear may trigger local allergic and hypersensitivity reactions which can alter the vaginal milieu and may result in *Candida* infection[32].

Ethical approval

The study was approved by the Campus Ethics Committee of the University of the West Indies, St. Augustine Campus.

Conclusion

This study may have the limitations of population size and short period of time, but despite that the study still reveals that *C. albicans* was the major fungal species implicated in the women with gestational vaginal candidiasis and that factors such as second trimester, age group with 26 -34, practice of masturbation and wearing of tight panty clothes were significantly implicated. These are factors that could be addressed with health education, routing performing microbiological investigations and treating appropriately pregnant women in the country as a way of improving healthcare delivery during antenatal care in the country.

Competing interests

The authors declare that they have no competing interests.

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Contribution of authors

EPA, KA and CU conceived, designed and coordinated the study. KA, AK and MI collected and analyzed the data. EPA and KA prepared the initial manuscript. AK, CU and MI managed the study. All authors reviewed and approved the manuscript.

References

1. Hong E, Dixit S, Fidel PL, Bradford J and Fischer G. Vulvovaginal candidiasis as a chronic disease: diagnostic criteria and definition. J Low Genit Tract Dis. 2014;18(1):31-8. doi: 10.1097/LGT.0b013e318287aced. PMID: 23760143.
2. Reed BD. Risk factors for Candida vulvovaginitis. Obstet Gynecol Surv. 1992;47(8):551-60. doi: 10.1097/00006254-199208000-00015. PMID: 1513528.
3. Sobel JD. Epidemiology and pathogenesis of recurrent vulvovaginal candidiasis. Am J Obstet Gynecol. 1985;152(7 Pt 2):924-35. doi: 10.1016/s0002-9378(85)80003-x. PMID: 3895958.
4. Gonçalves B, Ferreira C, Alves CT, Henriques M, Azeredo J and Silva S. Vulvovaginal candidiasis: Epidemiology, microbiology and risk factors. Crit Rev Microbiol. 2016;42(6):905-27. doi: 10.3109/1040841X.2015.1091805. Epub 2015 Dec 21. PMID: 26690853.
5. Fernández Limia O, Lantero MI, Betancourt A, de Armas E and Villoch A. Prevalence of Candida albicans and Trichomonas vaginalis in pregnant women in Havana City by an immunologic latex agglutination test. Med Gen Med. 2004;6(4):50. PMID: 15775877; PMCID: PMC1480570.
6. Grigoriou O, Baka S, Makrakis E, Hassiakos D, Kapparos G and Kouskouni E. Prevalence of clinical vaginal candidiasis in a university hospital and possible risk factors. Eur J Obstet Gynecol Reprod Biol. 2006;126(1):121-5. doi: 10.1016/j.ejogrb.2005.09.015. Epub 2005 Oct 26. PMID: 16256258.
7. Altayyar IA, Alsanosi AS and Osman NA. Prevalence of vaginal candidiasis among pregnant women attending different gynecological clinic at South Libya. European Journal of Experimental Biology. 2016; 6(3): 25-29.
8. Tanwar J, Das S, Fatima Z and Hameed S. Crusade for opportunity: *Candida albicans* from commensalism to pathogenicity. J Hum Dis. 2013; 112:160-167.
9. Vazquez JA and Sobel JD. Candidiasis. In: Dismukes WE, Pappas PG, Sobel JD, eds. *Clinical Mycology*. New York: Oxford University Press. 2003: p143-187.
10. Zeng X, Zhang Y, Zhang T, Xue Y, Xu H and An R. Risk Factors of Vulvovaginal Candidiasis among Women of Reproductive Age in Xi'an: A Cross-Sectional Study. Biomed Res Int. 2018; 2018:9703754. doi: 10.1155/2018/9703754. PMID: 29977925; PMCID: PMC6011108.

11. Brereton BM, Robinson ANR and Watts D. [Internet] "Trinidad and Tobago". Encyclopedia Britannica, 25 Jul. 2021, https://www.britannica.com/place/Trinidad-and-Tobago. Accessed 25 July 2021.
12. Cheesbrough M. Fungal pathogens. In: *District Laboratory Practice in Tropical Countries* part 1 – 2nd edition. Cambridge, UK: Cambridge University Press; 2000:235–248.
13. Dou N, Li W, Zhao E, Wang C, Xiao Z and Zhou H. Risk factors for candida infection of the genital tract in the tropics. Afr Health Sci. 2014;14(4):835-9. doi: 10.4314/ahs.v14i4.10. PMID: 25834491; PMCID: PMC4370062.
14. Verghese S, Padmaja P, Asha M, Elizabeth SJ, Anitha A, Kundavi KM, Jayanthi N and Varma T. Prevalence, species distribution and antifungal sensitivity of vaginal yeasts in infertile women. Indian J Pathol Microbiol. 2001;44(3):313-4. PMID: 12024920.
15. Pravin Charles MV, Kali A and Joseph NM. Performance of chromogenic media for Candida in rapid presumptive identification of Candida species from clinical materials. Pharmacognosy Res. 2015;7(Suppl 1):S69-73. doi: 10.4103/0974-8490.150528. PMID: 26109791; PMCID: PMC4466772.
16. Marinho SA, Teixeira AB, Santos OS, Cazanova RF, Ferreira CA, Cherubini K and de Oliveira SD. Identification of Candida spp. by phenotypic tests and PCR. Braz J Microbiol. 2010;41(2):286-94. doi: 10.1590/S1517-83822010000200004. Epub 2010 Jun 1. PMID: 24031493; PMCID: PMC3768677.
17. Altayyar IA, Alsanosi AS and Osman NA. Prevalence of vaginal candidiasis among pregnant women attending different gynecological clinic at South Libya. European Journal of Experimental Biology. 2016; 6(3): p. 25-29
18. Kombade SP, Abhishek KS, Mittal P, Sharma C, Singh P and Nag VL. Antifungal profile of vulvovaginal candidiasis in sexually active females from a tertiary care hospital of Western Rajasthan. J Family Med Prim Care. 2021; 10(1): 398–402.
19. Toua V, Djaouda M, Gaké B, Menye DE, Christie EA, Tambe E, Akindoh VVand Njiné T. Prevalence of vulvovaginal candidiasis amongst pregnant women in Maroua (Cameroon) and the sensitivity of *Candida albicans* to extracts of six locally used antifungal plants. Int Res J Microbiol. 2013;4(3):89–97.
20. Al-Nakheel RA, El-Kersh TA, Al-Sheikh YA and Al-Ahmadey ZZ. Prevalence and comparison for detection methods of Candida species in vaginal specimens from pregnant and non-pregnant Saudi women. Afr J Microbiol Res. 2013; 7(1):56–65
21. Donbraye Emmanuel OOB, Dombraye E, Okonkwo IO, Alli JA, Ojezele MO and Nwanze JC. Detection and prevalence of Candida among pregnant women in Ibadan Nigeria world. Appl Sci J. 2010;10(9):986–91.
22. Nelson M, Wanjiru W and Margaret MW. 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*. 2013;03(04):264–272. doi: 10.4236/ojmm.2013.34040
23. Waikhom SD, Afeke I, Kwawu GS, Mbroh HK, Osei GY, Louis B, Deku JG, Kasu ES, Mensah P, Agede CY, Dodoo C, Asiamah EA, Tampuori J, Korbuvi J and Opintan JA. Prevalence of vulvovaginal candidiasis among pregnant women in the Ho municipality, Ghana: species identification and antifungal susceptibility of Candida isolates. BMC Pregnancy and Childbirth 2020; 20:266. https://doi.org/10.1186/s12884-020-02963-3
24. Richardson JP, Willems HME, Moyes DL, Shoaie S, Barker KS, Tan SL, Palmer GE, Hube B, Naglik JR and Peters BM. Candidalysin Drives Epithelial Signaling, Neutrophil Recruitment, and Immunopathology at the Vaginal Mucosa. Infect Immun. 2018;86(2):e00645-17. doi: 10.1128/IAI.00645-17. PMID: 29109176; PMCID: PMC5778364.
25. Sobel JD, Faro S, Force RW, Foxman B, Ledger WJ, Nyirjesy PR, Reed BD and Summers PR. Vulvovaginal candidiasis: epidemiologic, diagnostic, and therapeutic considerations. Am J Obstet Gynecol. 1998;178(2):203-11. doi: 10.1016/s0002-9378(98)80001-x. PMID: 9500475.
26. Oyewole OA, Okoliegbe IN, Alkhalil S and Isah P. Prevalence of vaginal candidiasis among pregnant women attending Federal University of Technology, Minna, Nigeria, Bosso Clinic. Res J Pharm Biol Chem Sci. 2013; 4:113-20.
27. Bagga R and Arora P. Genital Micro-Organisms in Pregnancy. Front Public Health. 2020; 8:225. doi: 10.3389/fpubh.2020.00225. PMID: 32612969; PMCID: PMC7308476.
28. Shaaban OM, Abbas AM, Moharram AM, Farhan MM and Hassanen IH. Does vaginal douching affect the type of candidal vulvovaginal infection? Med Mycol. 2015;53(8):817-27. doi: 10.1093/mmy/myv042. Epub 2015 Jun 30. PMID: 26129887.
29. Parveen N, Munir A, Ikram-Din A and Majeed R. Frequency of vaginal candidiasis in pregnant women attending routine antenatal clinic. J College Phys Surgeons Pakistan. 2008;18(3):154–7.
30. Aguin TJ and Sobel JD. Vulvovaginal candidiasis in pregnancy. Curr Infect Dis Rep. 2015;17(6):462. doi: 10.1007/s11908-015-0462-0. PMID: 25916994.
31. Hedayati MT, Taheri Z, Galinimoghadam T, Aghili SR, Yazdani Cherati J and Mosayebi E. Isolation of different species of Candida in patients with vulvovaginal candidiasis from Sari, Iran. Jundishapur J Microbiol. 2015;8(4):e15992. Published 2015 Apr 18. doi:10.5812/jjm.8(4)2015.15992
32. Neves NA, Carvalho LP, De Oliveira MA, Giraldo PC, Bacellar O, Cruz AA and Carvalho EM. Association between atopy and recurrent vaginal candidiasis. Clin Exp Immunol. 2005;142(1):167-71. doi: 10.1111/j.1365-2249.2005.02891.x. PMID: 16178872; PMCID: PMC1809489.