Original Article

Yeast Infection and Diabetes Mellitus among Pregnant Mother in Malaysia

Iylia Liyana Sopian[1], Sa'adiah Shahabudin[2], Mowaffaq Adam Ahmed[1], Leslie Than Thian Lung[3], Doblin Sandai[1]

[1] *Infectomics Cluster, Advanced Medical and Dental Institute, Universiti Sains Malaysia, 13200 Bertam, Penang, Malaysia*

[2] *Craniofacial and Biomaterials Sciences Cluster, Advanced Medical and Dental Institute, Universiti Sains Malaysia, 13200 Bertam, Penang, Malaysia*

[3] *Department of Medical Microbiology and Parasitology, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia*

Submitted: 3 Jun 2015
Accepted: 7 Dec 2015

Abstract

Background: **Vaginal yeast infection refers to irritation of the vagina due to the presence of opportunistic yeast of the genus *Candida* (mostly *Candida albicans*). About 75% of women will have at least one episode of vaginal yeast infection during their lifetime. Several studies have shown that pregnancy and uncontrolled diabetes increase the infection risk. Reproductive hormone fluctuations during pregnancy and elevated glucose levels characteristic of diabetes provide the carbon needed for *Candida* overgrowth and infection. The goal of this study was to determine the prevalence of vaginal yeast infection among pregnant women with and without diabetes.**

Methods: **This was a case-control study using cases reports from Kepala Batas Health Clinic, Penang State, Malaysia from 2006 to 2012. In total, 740 pregnant ladies were chosen as sample of which 370 were diabetic and 370 were non-diabetic cases.**

Results: **No relationship between diabetes and the occurrence of vaginal yeast infection in pregnant women was detected, and there was no significant association between infection and age group, race or education level.**

Conclusion: **In conclusion, *w*ithin radius of this study, vaginal yeast infection can occur randomly in pregnant women.**

Keywords: *Candida albicans, pregnancy, diabetes, vaginal yeast infection, healthy people*

Introduction

Of the approximately 150 species of the yeast *Candida* (1) known more than 20 can cause infection in humans (2). *Candida albicans* is the most important species among the other clinically significant species, including *C. glabrata, C. parapsilosis, C. krusei* and *C. dubliniensis*. *Candida* spp. lives commensally on the skin and in the genitor-urinary tract and gastrointestinal tract. They are harmless in their human host when they do not overgrow and interrupt the human immune system (3). However, under certain conditions, some species exploit the host environment and cause disease. Superficial infection affects mucous membranes and skin, whereas invasive candidiasis can be acute or chronic and can affect the bloodstream and internal organs (1). *Candida* can be found in the oral cavity (oral candidiasis), the gastrointestinal tract (including the esophagus and bladder), at bronchial venous catheter sites, and in skin lesions (4). Multiple factors can increase the potential for *C. albicans* to experience the transition from harmless commensal to virulent pathogen. Injuries or traumatic surgery, the presence of indwelling devices such as catheters or prosthetic devices, and age (new born babies and the elderly are more susceptible) are among triggering factors. In addition, those with a compromised immune system, such as patients receiving chemotherapy, transplant patients, acquired immune deficiency syndrome (AIDS) patients, and patients with bloodstream infection, are more at risk of infection (5). The incidence of yeast infection has increased significantly since the early 1980s due to the advancement in health care management of critically ill patients (6).

Vaginal yeast infection is a common mucosal infection caused by *Candida* species that affects women during their reproductive years (7). Twenty-five percent of all pregnant women carry *Candida* organisms in their vagina (8). Symptoms of yeast infection generally include soreness, burning, itching, and abnormal vaginal discharge (9). Women are diagnosed as having a yeast infection when clinical symptoms are present and when the vaginal yeast count is >105 CFU/mL of vaginal fluid (10). In addition in pregnancy, factors that affect a woman's susceptibility to yeast infection also include the use of antibiotics and oral contraceptives, uncontrolled diabetes mellitus (DM), hormone replacement therapy, and immunosuppressive therapy (11). Several studies reported a high incidence of clinical candidiasis in women taking oral contraceptives, and the incidences grew with an increasing in the duration of oral contraceptive use (12). A higher level of estrogen during pregnancy causes the vagina to produce more glycogen, making it easier for the yeast to grow. Babic and Hukic (13) concluded that estrogen may cause yeast to grow faster and stick to the walls of the vagina.

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Hyperglycemia, or raised blood sugar, is a common effect of uncontrolled diabetes, and over time, leads to severe damage to many of the body's systems, especially the nerves and blood vessels (World Health Organization, 2013). Diabetes and yeast infection can often co-occur during pregnancy. Pregnant women with diabetes have a high risk of *Candida* infection because the elevated sugar level in the blood provides food for yeast and encourages *Candida* overgrowth. Diabetes can be divided into two broad categories: pre-existing diabetes (DM type 1 and DM type 2) and gestational diabetes mellitus (GDM).

Type 1 DM, previously known as insulin-dependent diabetes or childhood-onset diabetes, develops when the body cannot produce any insulin, and usually begins in childhood. This condition is characterised by deficient insulin production and requires daily administration of insulin to control the patient's blood glucose level. Most women with type 1 DM are aware of their condition before becoming pregnant. Symptoms include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision changes, and fatigue. All of these symptoms may occur suddenly. Type 2 DM develops when the body cannot produce enough insulin or when the insulin that is produced does not work properly. Ninety percent of people with diabetes around the world have this type of diabetes, and it is largely the result of excess body weight and physical inactivity; it is usually diagnosed at age 40 or older, but it can occur at a younger age (14). Type 2 DM can usually be treated with medication to lower the blood glucose level, but in certain cases pregnant women require insulin injections instead. Symptoms may be similar to those of type 1 DM. However, type 2 DM may be diagnosed several years after onset, once complications have already arisen.

GDM is defined as any degree of glucose intolerance with onset or first recognition during pregnancy (15,16). It develops during pregnancy and often ends with pregnancy. Approximately 7% of all pregnancies are complicated by GDM. The prevalence may range from 1 to 14% of all pregnancies, depending on the population studied and the diagnostic tests employed. In 1988, ~8.8% of all pregnancies in the United States were affected by diabetes, of which 1.2% were pre-existing diabetes. GDM complicates 1–14% of pregnancies in the United States annually (17). GDM can usually be treated by diet modification, but needs insulin injections in some cases. Pregnant women with GDM are at an increased risk of developing diabetes, usually type 2 DM, after pregnancy.

The prevalence of *Candida* infection has been reported to be higher in diabetic pregnant women than non-diabetic pregnant women (18). The level of both progesterone and estrogen hormones are also elevated during pregnancy. Progesterone has suppressive effects on the anti-*Candida* activity of neutrophils, whereas estrogen reduces the ability of vaginal epithelial cells to inhibit the growth of *C. albicans* and decreases the level of immunoglobins in vaginal secretions, resulting in increased vulnerability of pregnant women to vaginal candidiasis (18). Babic and Hukic (13) found that pregnant women were more prone to *Candida* infection because the vagina is more sensitive during pregnancy. Thus, the infection occurs significantly more often for pregnant women compared to non-pregnant ones (13).

The aim of this study was to determine the prevalence of vaginal yeast infection using maternal health records among pregnant women with and without diabetic state. The relationship between *Candida* infection and socio-demographic factors was also evaluated.

Materials and Methods

We obtained ethical approval to conduct this study from The Human Research Ethics Committee (JePeM), Universiti Sains Malaysia, Malaysia (FWA Reg. No: 00007718; IRB Re. No: 00004494), and it was registered with the National Medical Research Register (NMRR) (NMRR ID: 13-1351-18409). In addition, the Medical Research and Ethics Committee (MREC) of the Ministry of Health Malaysia approved this study on 10 February 2014. The head of the department and the nursing staff in the Antenatal Clinic, Klinik Kesihatan Kepala Batas were informed about the study.

This was a report study using maternal health records from Kepala Batas Health Clinic, Penang State, Malaysia. All data was collected on weekdays during normal working hours. The study population consisted of pregnant women attending the Antenatal Clinic from the year 2006 to 2012 for routine checkups. Pregnant women who were HIV positive or who were diagnosed with a sexually transmitted disease (STD), including chlamydia, gonorrhea, trichomoniasis, and genital herpes, were excluded from the study.

The sample size required for this study was calculated using Power and Sample size Program PS version 3.1.2, 2014 and 2 proportions method (19). To achieve 80% certainty (power) at an alpha of 0.05, 330 data records were needed for each group (pregnant with and without DM) to test for a significant association between *Candida* infection and DM in pregnant women (20). To account for the anticipated 10% attrition rate, the final sample size needed for each group was 370 (i.e., a total of 740 records).

Maternal health records were placed in boxes and labeled by year. Each box contained approximately 200–250 records. The records were not arranged by registration numbers. The fifth record was pulled for analysis from each box. Data were retrieved from the selected maternal health records and recorded on the data collection form. Patient complaints of vaginal yeast infection symptoms and treatment by the medical officer in charge were noted. For patients with diabetes, the chart indicated whether the patient had DM before pregnancy or had developed GDM. For pregnant women without DM, the chart indicated if there was a family history of diabetes. In the event that there was a history of diabetes in the patient's family, the medical officer may have recommended that the patient undergoes a modified glucose tolerance test (MGTT).

In addition, data for age group, race, and education level was also retrieved. The education level of each patient was noted as follows: primary school from Standard 1 to Standard 6; secondary school from Form 1 to Form 6; professional certificate or diploma; and a university degree or higher. Data was entered and analysed using Microsoft Excel and the Statistical Package for Social Science SPSS 20. The data was double checked to minimise data entry errors. Descriptive data, such as the percentage of frequency, mean, and standard deviation were used primarily to summarize and describe the data. Chi-square tests were conducted to assess the association between different variables.

Results

Eight hundred and nine maternal health records from Kepala Batas Health Clinic were included in this study. Of these patients, 118 (14.6%) of them had vaginal yeast infection. The data show that the prevalence of vagina yeast infection among pregnant patients diagnosed with diabetes is 38.1% (45/118) and prevalence of the disease in patients without diabetes is 61.9% (73/118). This prevalence is comparably higher among pregnant women without diabetes, with the largest numbers being recorded in 2011, followed by 2010 and 2012 (Table 1).

Table 2 shows the occurrence of vaginal yeast infection among the participants varied by age group. The infection rate is highest among pregnant women aged 27 to 32 years, followed by ages 33 to 38 and 21 to 26 years old. Only 2 out of 42 patients (4.8%) aged 39 to 45 years old have yeast infection, with one of them having diabetes. The results of chi-square analysis identified no relationship between age and vaginal infection among pregnant women with and without diabetes.

Table 3 shows the prevalence of vaginal yeast infection based on race. Vaginal yeast infection is most common among Malay patients due to them being the majority population in this area, followed by non-Malay population (Indian, Chinese and others). The vaginal yeast infection cases are divided into two groups, Malay and non-Malay, for chi-square analysis. The results of chi-square analysis identified no relationship between vaginal yeast infection among pregnant women with and without diabetes and the race of the patients. The findings show that fewer cases are found among Chinese patients, and only six patients fall under the foreigner category. However, this is due to the low population of the Chinese citizens and foreigners within the studied

Table 1: Vaginal yeast infections cases reported at Kepala Batas Health Clinic from year 2006 to 2012.

Years	Vaginal yeast infection	Vaginal infection with diabetes	Vaginal yeast infection without diabetes
	n, %	n	n
2006	4 (7.3)	0	4
2007	19 (11.9)	6	13
2008	12 (14.0)	5	7
2009	10 (20.4)	3	7
2010	22 (15.5)	9	13
2011	29 (21.3)	14	15
2012	22 (12.2)	8	14
Total	**118**	**45**	**73**

Table 2: Vaginal infection cases based on age in Kepala Batas Health Clinic from year 2006 to 2012.

Age (Years old)	Data for each age group	Vaginal yeast infection	Vaginal yeast infection with diabetes	Vaginal yeast infection without diabetes
		n, %	n, %	n, %
15-20	32	5 (15.6)	1 (20.0)	4 (80.0)
21-26	189	26 (13.8)	8 (30.8)	18 (69.2)
27-32	351	57 (16.2)	23 (40.4)	34 (59.6)
33-38	195	28 (14.8)	12 (42.9)	16 (57.1)
39-45	42	2 (4.8)	11 (50.0)	1 (50.0)
Total	**809**	**118**	**45**	**73**

Table 3: Vaginal infection cases based on races in Kepala Batas Health Clinic from year 2006 to 2012.

Race	Vaginal yeast infection	With diabetes	Without diabetes
	n	n	n
Chinese	6 (5.1%)	2 (4.4%)	4 (5.5%)
Indian	11 (9.3%	4 (8.8%)	7 (9.6%)
Malay	95 (80.5%)	38 (84.4%)	57 (78.1%)
Others	6 (5.1%)	1 (2.2%)	5 (6.8%)
Total	**118**	**45**	**73**

area.

The prevalence of vaginal yeast infection based on educational level is shown in Table 4. In this study, pregnant women with a secondary education level are more likely to have a yeast infection, followed by pregnant women with a certificate or diploma. However, the results of chi-square analysis show no significant relationship between different education levels and the occurrence of vaginal yeast infection among pregnant women with and without diabetes.

Table 5 shows the results of chi-square analysis conducted to identify relationships between age group, race, and education level among pregnant women with vaginal yeast infection with and without diabetes. Based on chi-square analysis, is found that age group, race, or education level and did not show influence on the frequency of vaginal yeast infection in pregnant women with and without diabetes.

Table 4: Vaginal infection cases based on education level in Kepala Batas Health Clinic from year 2006 to 2012

Education levels	Data for each education level	Vaginal yeast infection	Vaginal yeast infection with diabetes	Vaginal yeast infection without diabetes
		n,%	n, %	n, %
Primary education	28	3 (10.7)	1 (33.3)	2 (66.7)
Secondary education	204	66 (32.4)	29 (43.9)	37 (56.1)
Higher certificate or Diploma	159	25 (15.7)	6 (24.0)	19 (76.0)
University degree or higher	418	24 (5.7)	9 (37.5)	15 (62.5)
Total	**809**	**118**	**45**	**73**

Table 5: Association between age group, race and education level with status of diabetes (with and without) among pregnant women with vaginal yeast infection (2006 to 2012)

Variable	n	With diabetes	Without diabetes	X^2 statistic[a] (df)	*P* value
		n, (%)	n, (%)		
Age group					
15-26	31	9 (29.0)	22 (71.0)	1.551	0.460
27-32	57	23 (40.4)	34 (59.6)	(2)	
>32	30	13 (43.3)	17 (56.7)		
Race					
Malay	95	38 (40.0)	57 (60.0)	0.718	0.397
Non Malay	23	7 (30.4)	16 (69.6)	(2)	
Education					
Primary school	69	30 (43.5)	39 (56.5)	2.956	0.228
Professional certificate & diploma	25	6 (24.0)	19 (76.0)	(2)	
First degree and higher	24	9 (37.5)	15 (62.5)		

[a]Chi-square test.

Discussion

In the present study, 14.6% of the 809 pregnant female participants had vaginal yeast infection. The prevalence of infection in the current study was lower than that reported by Nelson et al. (2013a) for a study conducted in Kenya (42.7%) and Amadi and Feyi (21) for a study conducted in Tanzania (42.9%). The difference in results may be due to different methodologies. In these two studies, pregnant women were interviewed at a baseline visit and isolation and identification of vaginal *Candida* species was conducted for asymptomatic vaginal infection. In contrast, in the current study, maternal health records were used, and laboratory work was not conducted for any of the recorded cases. In this study, patients who complained of typical symptoms (e.g., yellowish or whitish discharge with a foul smell, vaginal discharge changing color from white to yellow, and itchiness) (22) were considered to have a yeast infection. However, only some patients with

clinical symptoms underwent a high vaginal swab (HVS) procedure to obtain a sample of discharge from the vagina for laboratory culture (23). A higher level of estrogen during pregnancy causes the vagina to produce more glycogen, making it easier for the yeast to grow. Babic and Hukic (13) concluded that estrogen may cause yeast to grow faster and stick to the walls of the vagina.

Some researchers believe that factors such as the use of antibiotics and oral contraceptives, uncontrolled DM, pregnancy, hormone replacement therapy, and immunosuppressive therapy make a woman more susceptible to developing a yeast infection (24). The prevalence of *Candida* infection has been reported to be higher in diabetic pregnant women compared to non-pregnant women because the increased levels of glucose in diabetes and the suppression of the immune system during pregnancy contribute to the development of vaginal candidiasis (25). However, when diabetes and pregnancy were considered in this study, no association between diabetes and the frequency of occurrence of vaginal yeast infection in pregnant women was found (X^2 (1, N=537) = 3.495, P = 0.062). In addition neither age group, race, nor education level notably affected the prevalence of vaginal yeast infection was detected.

Based on the chi-square test results, there was no significant association between age and vaginal yeast infection cases. Oriel et al. (12), Jombo et al. (26), and Nelson et al. (27) reported similar results. However, the prevalence of yeast infection was higher in the younger age groups, Younger and more sexually active women may be more prone to develop vaginal yeast infection. They may be more likely to use contraceptives to prevent pregnancy or to space pregnancies and misuse antibiotics. However, Kent (28) reported a contradictory result; he found that women in the 26–35 year age group were sexually active have low vaginal defense mechanisms against *Candida* species. In the current study, only 2 out of the 42 cases of vaginal yeast infection occurred in pregnant women in the 39–45-year old group. Women in this age group are nearing their menopause age and are becoming less sexually active. They rarely use contraceptives to prevent pregnancy and vaginal immunity may increase as the levels of estrogen and corticoids decrease (29). Okungbowa et al. (30,31) reported a prevalence rate of 10% and 2% within the 36–45 and over 46 years age groups, respectively, and they suggested that this low incidence was probably due to the increased of vaginal immunity with age.

In this study, most of the patients with vaginal yeast infection were Malay (80.5%), followed by a much smaller proportions of Indian (9.3%) and Chinese (5.1%) patients. Malaysia is a multiracial country, and race is thought to be a contributing factor to the prevalence of vaginal yeast infection. However, in this study, ultimately race could not be considered a valid factor due to sampling bias, as the statistical population was not equally balanced. Because the majority of the population in Kepala Batas are Malays in the sample and the Malay population was overrepresented.

The chi-square analysis revealed no significant relationship between age group, educational level and vaginal yeast infection in pregnant women. All women had relatively equal exposure to factors encourage vaginal yeast infections and ignorance can play significant role in predisposing the lower socio-economic class to higher infection rates (32). This study only evaluated academic education, thus it did not consider the participants' level of education and their awareness about health care during pregnancy. All participants received similar advice and recommendations by the nurses regarding hygiene and diet during pregnancy.

Conclusion

There is no significant relationship between age, race, and educational level the the status of diabetes among pregnant women who suffer from yeast infection.

Acknowledgements

We gratefully acknowledge and thank Dr Rohaizan Rodzi and Dr Ismailiza Ismail from Kepala Batas Health Clinic, Penang, for their permission and help in retrieving medical record in the medical record unit. Iylia Liyana Sopian was funded by a Scholarship from Universiti Sains Malaysia and Ethical Approval USM; (FWA Reg. No: 00007718; IRB Re. No: 00004494) and National Medical Research Register (NMRR) (NMRR ID: 13-1351-18409).

Conflict of Interest

None.

Funds

None.

Authors' Contribution

Conception and design: DS, SS, LTTL
Obtaining of funding, analysis and interpretation of the data: DS, ILS
Provision of study material or patients, collection and assembly of the data: ILS, SS
Drafting of the article: ILS, DS, SS
Critical revision of the article: DS, SS, MAA
Final approval of the article: DS, LTTL
Administrative, technical or logistic support: MAA, DS

Correspondence

Dr Doblin Anak Sandai
PhD Medical Sciences (Aberdeen, UK)
Infectomics Cluster
Advanced Medical and Dental Institute
Universiti Sains Malaysia, Bertam
13200 Kepala Batas
Penang, Malaysia
Tel: +604-562 2386, ext. 2386
Fax: +604-562 242348
Email: doblin@usm.my

References

1. Calderone AR. *Candia and Candidiasis*. Candidemia. Washington (DC): ASM Press; 2002.

2. Centers for Disease Control and Prevention USA. Fungal disease: Candidiasis [Internet]. United States (US): Centers for Disease Control and Prevention; 2014 [cited 2014 Jun 12]. Available from: http://www.cdc.gov/fungal/diseases/candidiasis/index.html.

3. Brown AJP, Odds FC, Gow NAR. Infection-related gene expression in Candida albicans. *Curr Opi Microb*. 2007;**10(4)**:307–313. doi: 10.1016/j.mib.2007.04.001.

4. Solomkin J, & Simmons R. Candida infection in surgical patients. *World J Surg*. 1980;**4(4)**:381–392.

5. Hitchcock CA, Pye GW, Troke PF, Johnson M, & Warnock DW. Fluconazole resistance in Candida glabrata. Antimicrob *Agents and Chemother*. 1993;**37(9)**:1962–1965.

6. Odds FC, Brown AJP, and Gow NAR. Antifungal agents: mechanisms of action. *Trends Microbiol*. 2003;**11(6)**:272–279. doi: 10.1016/S0966-842X(03)00117-3.

7. Fidel PL, Sobel JD. *Candida and Candidiasis. Host defense against vaginal candidiasis*. Washington (DC): ASM Press; 2002.

8. Calderone AR. *Candia and Candidiasis. Taxonomy and biology of Candida*. Washington (DC): ASM Press; 2002.

9. Barousse MM, Espino T, Dunlop K, Fidel PL. Vaginal epithelial cell anti-Candida albicans activity is associated with protection against symptomatic vaginal candidiasis. *Infect Immun*. 2005: **73(11)**;7765–7767. doi: 10.1128/IAI.73.11.7765-7767.2005.

10. Carlson P, Richardson M, & Paavonen J. Evaluation of the Oricult-N Dipslide for laboratory diagnosis of vaginal candidiasis. *J Clin Microbiol*. 2000;**38 (3)**;1063–1065.

11. Sobel JD. Pathogenesis and Epidemiology of Vulvovaginal Candidiasis. *Ann N Y Acad Sci*. 1988;**544**:547-557. doi: 10.1111/j.1749-6632.1988.tb40450.x.

12. Oriel JD, Patridge BM, Denny J, Coleman JC. Genital yeast infection. *Brit Med J*. 1972;**4(5843)**:761–764.

13. Babic M, Hukic M. Candida albicans and non-albicans species as etiological agent of vaginitis in pregnant and non-pregnant women. *Bosn J Basic Med Sci*. 2010;**10(1)**:89–97.

14. World Health Organization. Diabetes [Internet]. Geneva (CH): World Health Organization;2013[cited 2014 Jun 26]. Available from: http://www.who.int/diabetes/en/ 2013.

15. Meztger BE, Coustan CD. Proceeding of the fourth international workshop-conference on gestational diabetes mellitus. *Diabetes Care*. 1998;**21**:B1–B167.

16. American Diabetes Association. Gestational diabetes mellitus. *Diabetes Care*.2003;**26 (Suppl 1)**:103–105.

17. Lawrence JM, Contreras R, Chen W, Sacks DA. Trends in the prevalence of preexisting diabetes and gestational diabetes mellitus among a racially/ethnically diverse population of pregnant women, 1999-2005. *Diabetes Care*. 2008;**31(5):**899–904. doi: 10.2337/dc07-2345.

18. Solanki A, Sharma M. Prevalence of Candida infection in pregnant women with and without diabetes. *Int J Curr Microbiol Appl Sci*. 2014;**3**:605–610.

19. Dupont WD, Plummer WD. PS power and sample size program available for free on the internet. *Contemp Clinl Trials*. 1997;**18**:274.

20. Nowakowska D, Alicja K, Stray-Pedersen B, Wilczynski J. Prevalence of fungi in the vagina, rectum and oral cavity in pregnant diabetic women: relation to gestational age and symptoms. *Acta Obstet Gynecol Scand*. 2004;**83(3)**;251–256.

21. Amadi A, Feyi P. The prevalence and pattern of vaginal candidiasis in pregnancy in Abia. *J Med Invest Prac*. 2001;**2**:25–27.

22. Gugnani HC, Nzelibe, FK, Gini PC, Chukudebelu WO, Njoku-Ob ANU. Incidence of yeasts in pregnant and non-pregnant women in Nigeria. *Mycoses*. 1987;**32(3)**:131–135. doi: 10.1111/j.1439-0507.1989.tb02220.x.

23. Noble H, Estcourt C, Ison C, Goold P, Liye L, & Carter YH. How is the vaginal swab used to investigate vaginal discharge in primary care and how do GP's expectations of the test match the tests performed by their microbiology services? Sex Transm Infect. 2004;**80(3)**:204–206.

24. Sobel JD. Pathogenesis and epidemiology of vulvovaginal candididasis. *Ann Ny Acad Sci.* 1997;**544(1)**:547–557.

25. Carrol C, Hurley R, Stanley V. Criteria for diagnosis of Candida vulvovaginitis in pregnant women. *J Obstet Gynecol Br Common.* 2003;**80(3)**:258–263.

26. Jombo GTA, Opajobi SO, Egah DZ, Banwat EB, Denen P. Symptomatic vulvovaginal candidiasis and genital colonization by Candida species in Nigeria. *J Public Health Epi.* 2010;**2(6)**:147–151.

27. Nelson M, Manjiru W, 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. *Op J Med Microbiol.* 2013;**3**:264–272.

28. Kent H. Epidemiology of vaginitis. *Am J Obstet Gynecol.* 1991;**165(4)**:1168–1176.

29. Nelson M, Manjiru W, Margaret MW. Identification and susceptibility profile of vaginal Candida species to antifungal agents among pregnant women attending the antenatal clinic of Thika District Hospital, Kenya. *Op J Med Microbiol.* 2013;**3**:239–247.

30. Okungbowa F, Isuehuemhen O, Dede A. The distribution, frequency of Candida species in the genitourinary tract among symptomatic individuals in Nigeria cities. *Rev Iberoam Microbiol.* 2003;**20(2)**:60–63.

31. Chong PP, Lee YL, Tan BC, & Ng KP. Genetic relatedness of Candida strains isolated from women with vaginal candidiasis in Malaysia. *J Med Microbiol.* 2003;5**2(8)**:657–666.

32. Okonkwo J, Umeanaeto U. Prevalence of Vaginal Candidiasis among Pregnant Women in Nnewi Town of Anambra State, Nigeria. *Int Mul Dis Ethio.* 2010;**4(4)**:539–548.