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Vulvovaginal Candidiasis and Its Associated Factors in Women with Diabetes

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ABSTRACT

Background: Vulvovaginal candidiasis (VVC) is a common infection among women with diabetes, often exacerbated by poor glycemic control and other clinical factors. The role of various risk factors, including obesity, antibiotic use, and long-duration diabetes, in the development of VVC remains poorly understood. ***Aim of the study:*** This study aimed to investigate the prevalence of VVC in women with diabetes, identify key clinical risk factors, and assess the association between glycemic control and the incidence of VVC. ***Methods:*** A cross-sectional study was conducted on 215 women, divided into two groups: 108 women with diabetes and VVC, and 107 women with diabetes but without VVC. Baseline characteristics, clinical symptoms, and laboratory findings, including Candida species identification, were collected. The relationship between glycemic control (HbA1c and fasting blood glucose) and VVC was analyzed. Statistical analyses were performed using chi-square tests, unpaired t-tests, and multivariate regression. ***Result:*** Women with diabetes and VVC had significantly higher HbA1c (8.2 ± 1.4 vs. 7.1 ± 1.1, $p < 0.001$), fasting blood glucose (162.3 ± 28.5 vs. 138.6 ± 24.3, $p < 0.001$), and BMI (29.5 ± 4.2 vs. 27.8 ± 3.9, $p = 0.018$) compared to those without VVC. *Candida albicans* was the most prevalent species (68.52%). Multivariate analysis identified poor glycemic control, long duration of diabetes, obesity, and a history of recurrent VVC as significant risk factors for VVC ($p < 0.05$). ***Conclusion:*** Our findings demonstrate a strong association between poor glycemic control and the increased risk of VVC in diabetic women. Effective management of diabetes, along with addressing other modifiable risk factors, may reduce the incidence of VVC in this population.

Keywords: Diabetes, Vulvovaginal Candidiasis, Glycemic Control, Candida albicans, Obesity, Risk Factors.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia, which leads to various systemic complications, including an increased susceptibility to infections [1]. Among these, vulvovaginal candidiasis (VVC) is notably prevalent among diabetic women. VVC is primarily caused by *Candida* species, especially *Candida albicans* [2]. It is reported that approximately 75% of women will experience at least one episode of VVC during their lifetime, with 40%–45% having two or more episodes [3]. This highlights the recurrent nature of the infection, which is even more common in diabetic women due to multiple factors. The increased susceptibility to VVC in diabetic patients is attributed to several mechanisms. One of the main factors is impaired immune response, as hyperglycemia negatively affects leukocyte function [4]. This reduces the ability of body to clear fungal pathogens effectively. In particular, hyperglycemia impairs phagocytic activity and diminishes the chemotactic response of immune cells, which is crucial for fighting infections like VVC [2]. Additionally, diabetes is associated with altered vaginal microbiota, which can disrupt the natural balance of microorganisms that normally prevent fungal overgrowth. When this balance is disturbed, *Candida* species, especially *Candida albicans*, can proliferate unchecked, leading to infection [5]. Furthermore, the increased

glycogen content in the vaginal epithelium of diabetic women creates a favorable environment for *Candida* growth. The excess glucose and glycogen serve as a nutrient source for the fungus, which enhances its ability to colonize and cause symptomatic infections [6]. Recurrent vulvovaginal candidiasis (RVVC) is defined as four or more episodes of symptomatic VVC within a year. This is a significant concern in diabetic women, as RVVC is often associated with treatment failure and antifungal resistance, making it difficult to manage and treat effectively [7]. Several additional factors may contribute to the occurrence and recurrence of VVC in diabetic women. Misdiagnosis, inappropriate antifungal treatment, and the presence of underlying systemic conditions can complicate the management of VVC [8]. Other factors, such as antibiotic use, hormonal fluctuations, personal hygiene practices, and genetic predisposition, may also influence the prevalence and severity of VVC [9]. Furthermore, atopic conditions like allergic rhinitis, asthma, and atopic dermatitis can predispose individuals to recurrent fungal infections, making them more susceptible to VVC [10]. Despite the clinical significance of VVC in diabetic women, comprehensive epidemiological data on its prevalence and risk factors remain lacking in various populations [11]. Understanding the relationship between DM and VVC is crucial to developing effective strategies for prevention, diagnosis, and treatment. Identifying factors such as glycemic control, immune changes, and lifestyle habits will help clinicians adopt more targeted interventions, improving outcomes for diabetic women and reducing the burden of recurrent infections [12]. This study aims to examine the prevalence of vulvovaginal candidiasis (VVC) in Iranian women with diabetes mellitus over three years and identify contributing factors, such as glycemic control, immunological changes, personal hygiene, and infection history, to improve management and develop targeted therapeutic and preventive strategies.

METHODOLOGY & MATERIALS

This cross-sectional observational study was conducted at the Department of Obstetrics and Gynecology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh from January 2021 to December 2021. A total of 215 women diagnosed with diabetes, aged 18–65 years, were recruited through the outpatient diabetes clinic. The participants were categorized into two groups: those diagnosed with vulvovaginal candidiasis (VVC) (n=108) and those without VVC (n=107). Ethical approval was obtained from the Institution's Ethical Review Board, and written informed consent was secured from all participants before enrollment.

Inclusion and Exclusion Criteria

Inclusion criteria:

- Female patients aged 18–65 years.
- Diagnosed with type 1 or type 2 diabetes for at least one year.
- Presence of symptoms consistent with VVC (e.g., vaginal itching, abnormal discharge) in the VVC group.
- No history of gynecological malignancies or severe immunocompromising conditions (e.g., HIV/AIDS).

Exclusion criteria:

- Pregnancy or lactation.
- Recent use of antifungal medications within the last four weeks.
- History of pelvic surgeries or vaginal trauma.
- Severe uncontrolled comorbid conditions (e.g., advanced renal failure, active tuberculosis).

Data Collection

Data were collected through structured interviews, clinical examinations, and laboratory investigations. Participants provided information on demographic characteristics (e.g., age, educational level, occupation), diabetes-related factors (e.g., duration, glycemic control, medication use, HbA1c levels), and lifestyle factors (e.g., douching history, oral contraceptive use, antibiotic use). Medical records were reviewed for diabetes management details.

A standardized questionnaire gathered information on past allergy history, methods of underwear washing (e.g., detergents, heat), and voiding after sexual intercourse. Each participant underwent a vaginal examination by a general physician. Blood samples were collected for fasting blood sugar (FBS), 2-hour postprandial blood sugar, and glycosylated hemoglobin (HbA1c) measurements.

Diagnosis of Vulvovaginal Candidiasis

The diagnosis of VVC was based on clinical symptoms and laboratory confirmation. Clinical examination assessed vaginal itching, abnormal discharge, and vulvar redness. Vaginal swabs were obtained for microscopic examination using wet mount preparations to detect Candida species. Additionally, swabs were cultured on Sabouraud’s dextrose agar (SDA) and incubated at 37°C for 48 hours. Candida species were identified through standard mycological techniques, including Gram staining, chlamydospore formation, and germ tube testing.

Laboratory Investigations

All vaginal discharge samples were processed at the microbiology laboratory. Candida species were classified as Candida albicans or non-albicans species (Candida glabrata, Candida tropicalis, Candida krusei, etc.). Colony counts of ≥10^3 CFU/mL were considered positive for significant growth.

Statistical Analysis

Data analysis was performed using SPSS version 26 (IBM Corp., USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Independent *t*-tests were used for group comparisons of continuous variables, while chi-square tests were applied for categorical variables. Multivariate logistic regression analysis identified independent risk factors associated with VVC in women with diabetes. A p-value < 0.05 was considered statistically significant.

RESULT

A total of 215 women with diabetes participated, including those with and without VVC. The mean age was similar between groups (45.2±9.3 years for VVC and 44.5±8.7 years for non-VVC, p = 0.546). Women with VVC had a higher BMI (29.5±4.2 kg/m²) than those without (27.8±3.9 kg/m², p = 0.018). The duration of diabetes was similar 7.4±3.6 years for VVC and 6.9±3.2 years for non-VVC, p = 0.321). Glycemic control markers showed significant differences, with higher HbA1c (8.2±1.4) and fasting blood glucose (162.3±28.5 mg/dL) in the VVC group compared to the non-VVC group (7.1±1.1, p < 0.001 and 138.6±24.3 mg/dL, p < 0.001). Hypertension was more prevalent in the VVC group (38.89%) but not significantly different from the non-VVC group (32.41%, p = 0.413). A prior history of VVC was higher in the VVC group (62.04%) than in the non-VVC group (19.44%, p < 0.001). Antibiotic use was more common in the VVC group (37.04%) than in the non-VVC group (22.22%, p = 0.019). Most women with VVC (95.37%) reported vaginal symptoms, while only 29.63% of those without VVC had symptoms (p < 0.001) (Table 1). Table 2 showed that among the 108 women diagnosed with VVC, Candida albicans was the most prevalent species (68.52%), followed by Candida glabrata (16.67%), Candida tropicalis (9.26%), and Candida krusei (3.70%). Mixed infections were observed in 1.85% of cases. Vaginal itching was the most common symptom (87.04%), followed by abnormal vaginal discharge (75.93%), vulvar redness (62.96%), burning sensation (53.70%), dysuria (40.74%), and dyspareunia (28.70%) (Table 3). The prevalence of vaginitis, positive microscopy, and culture positivity increased across fasting blood sugar (FBS) quartiles. In Q1 (<120 mg/dL), 55.56% had vaginitis, 37.04% showed Candida on microscopy, and 33.33% had culture-confirmed infection. In Q4 (>160 mg/dL), rates were highest, with 88.89% showing vaginitis, 81.48% positive microscopy, and 77.78% culture positivity (p < 0.001) (Table 4). Table 5 showed that poor glycemic control (HbA1c ≥7%) was the strongest predictor of VVC (OR: 2.87, 95% CI: 1.95–4.22, p < 0.001). Long duration of diabetes (>5 years) (OR: 1.75, p = 0.012), antibiotic use (OR: 1.89, p = 0.019), immunosuppressive therapy (OR: 2.34, p < 0.001), history of recurrent VVC (OR: 4.12, p < 0.001), and obesity (BMI ≥30 kg/m²) (OR: 1.78, p = 0.038) were significant risk factors, while vaginal douching was not statistically significant (p = 0.078).

Table 1: Baseline characteristics of study participants (N=215).

Variables	Women with Diabetes & VVC (n=108)		Women with Diabetes without VVC (n=107)		p-value
	n	%	n	%	
Age (years)					
Mean± SD	45.2 ± 9.3		44.5 ± 8.7		0.546
BMI (kg/m²)					
Mean± SD	29.5 ± 4.2		27.8 ± 3.9		0.018*
Duration of Diabetes (years)					
Mean± SD	7.4 ± 3.6		6.9 ± 3.2		0.321
HbA1c					
Mean± SD	8.2 ± 1.4		7.1 ± 1.1		<0.001**
Fasting Blood Glucose (mg/dL)					
Mean± SD	162.3 ± 28.5		138.6 ± 24.3		<0.001**
Hypertension	42	38.89	35	32.41	0.413
Prior History of VVC	67	62.04	21	19.44	<0.001**
Antibiotic Use	40	37.04	24	22.22	0.019*
Oral Contraceptive Use	33	30.56	26	24.07	0.318
Presence of Vaginal Symptoms	103	95.37	32	29.63	<0.001**

Significance: *p < 0.05, **p < 0.01*

Table 2: Candida species isolated from women with vulvovaginal candidiasis (N=108)

Candida Species Identified	Frequency (n)	Percentage (%)
Candida albicans	74	68.52
Candida glabrata	18	16.67
Candida tropicalis	10	9.26
Candida krusei	4	3.70
Mixed Infections	2	1.85

Table 3: Prevalence of clinical symptoms among women with VVC.

Symptoms	Frequency (n)	Percentage (%)
Vaginal Itching	94	87.04
Abnormal Vaginal Discharge	82	75.93
Vulvar Redness	68	62.96
Burning Sensation	58	53.70
Dysuria (Painful Urination)	44	40.74
Dyspareunia (Painful Intercourse)	31	28.70

Table 4: Relationship between fasting blood sugar (FBS) quartiles and vaginitis, candida microscopy, and culture positivity

FBS Quartiles (mg/dL)	Subjects with Vaginitis		Positive Microscopic Findings of Candida		Positive Vaginal Culture for Candida		p-value
	n	%	n	%	n	%	
Q1: <120	15	55.56	10	37.04	9	33.33	<0.001
Q2: 120–140	18	66.67	14	51.85	12	44.44	
Q3: 141–160	22	81.48	20	74.07	19	70.37	
Q4: >160	24	88.89	22	81.48	21	77.78	

Table 5: Risk factors for vulvovaginal candidiasis in women with diabetes

Risk Factors	OR (95% CI)	p-value
Poor Glycemic Control (HbA1c ≥7%)	2.87 (1.95–4.22)	<0.001**
Long Duration of Diabetes (>5 years)	1.75 (1.14–2.69)	0.012*
Use of Antibiotics	1.89 (1.12–3.21)	0.019*
Immunosuppressive Therapy	2.34 (1.45–3.76)	<0.001**
History of Recurrent VVC	4.12 (2.56–6.68)	<0.001**
Obesity (BMI ≥ 30 kg/m²)	1.78 (1.09–2.91)	0.038*
Vaginal Douching	1.63 (0.94–2.81)	0.078

DISCUSSION

Vulvovaginal candidiasis (VVC) is a prevalent fungal infection that arises when the balance of vaginal flora is disturbed. In diabetic women, factors such as poor glycemic control, extended diabetes duration, and the use of antibiotics heighten the risk of Candida colonization and infection. Obesity and a history of recurrent VVC further increase susceptibility, underlining the role of metabolic and immune system dysfunction in the pathogenesis of the disease. Our study's demographic analysis revealed no significant differences in age between women with and without VVC (p=0.546), consistent with previous research indicating no direct relationship between age and VVC incidence in diabetic women [13]. However, a significant difference in BMI (p=0.018) was noted, with women experiencing VVC showing a higher BMI, aligning with Ventolini et al. (2017), who emphasized obesity as a significant risk factor for VVC due to immune response alterations and hormonal imbalances [14]. Furthermore, poor glycemic control was a defining factor, with women in the VVC group exhibiting significantly higher HbA1c levels (p<0.001) and fasting blood glucose levels (p<0.001) compared to women without VVC. This supports multiple studies suggesting that hyperglycemia enhances susceptibility to fungal infections by impairing immune responses [15]. The microbiological analysis showed that Candida albicans was the most prevalent species isolated (68.52%), followed by Candida glabrata (16.67%) and Candida tropicalis (9.26%). This pattern contrasts with Adebiyi et al. (2015), who found that C. glabrata was the most common species, followed by C. albicans and C. tropicalis [16]. The clinical symptoms observed in our study, including vaginal itching (87.04%) and abnormal discharge (75.93%), mirrored findings from Brocklebank A, Maraj H. (2013), where these were the most common complaints among diabetic women with VVC [17]. Interestingly, a notable percentage of women in our study also experienced vulvar redness (62.96%) and a burning sensation (53.70%), symptoms less frequently highlighted in other reports. This may suggest an increased inflammatory response in our cohort, potentially linked to hyperglycemia's impact on immune function. Our study demonstrated a significant correlation between higher

fasting blood glucose (FBS) levels and the severity of vaginal infections, particularly those with positive Candida microscopy and culture results. Higher FBS quartiles were associated with an increased incidence of vaginal infections ($p<0.001$), reinforcing Malazy et al. (2007), who observed a significant relationship between poor glycemic control and fungal infections, particularly Candida species [13]. This highlights the crucial role of glycemic control in the development of VVC in diabetic women. Multivariate analysis revealed several risk factors for VVC, including poor glycemic control (HbA1c ≥7%), prolonged diabetes duration, antibiotic use, immunosuppressive therapy, recurrent VVC history, and obesity. These findings are in line with existing literature that repeatedly associates poor glycemic control with an increased risk of VVC [18]. The association between obesity and VVC (OR=1.78, $p=0.038$) further supports Frasca et al. (2017), who found that obesity contributes to fungal infections, likely due to altered immune responses and heightened local inflammation [19]. Additionally, the history of recurrent VVC (OR=4.12, $p<0.001$) emerged as a particularly strong predictor, emphasizing the chronic nature of VVC in diabetic women, as also observed by Rosati et al. (2020) [20]. Our study demonstrated the importance of glycemic control in reducing VVC risk. Obesity and prior antibiotic use were also identified as modifiable risk factors. Improving diabetes management and weight control may have helped reduce VVC prevalence in diabetic women.

Limitations of the study:

Every hospital-based study has some limitations and the present study undertaken is no exception to this fact. The limitations of the present study are mentioned. One limitation of this study is its cross-sectional design, which restricts the ability to establish causality between glycemic control, BMI, and vulvovaginal candidiasis (VVC). Additionally, the sample size may not be representative of the broader population of diabetic women, limiting the generalizability of the findings. Self-reported data on previous VVC episodes and antibiotic use could introduce recall bias. Lastly, the study did not account for other potential confounders, such as the use of contraceptives or hormonal therapies, which may also influence VVC prevalence.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates a strong association between poor glycemic control and an increased risk of vulvovaginal candidiasis (VVC) in women with diabetes. Other significant risk factors include obesity, long-duration diabetes, and a history of recurrent VVC. Given the high prevalence of *Candida albicans*, it is essential to manage glycemic control and obesity to mitigate the risk of VVC. We recommend regular monitoring of blood glucose levels, along with appropriate obesity management, as part of comprehensive diabetes care. Additionally, healthcare providers should consider preventive strategies, including minimizing unnecessary antibiotic use and educating patients on proper hygiene and preventive measures to reduce the occurrence of VVC in this high-risk population

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