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Spectrum of Fungal Infections in Patients with Diabetes Mellitus at a Tertiary Care Hospital in Jharkhand: A Cross-Sectional Study

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ABSTRACT

Background: Diabetes mellitus is associated with impaired immune function and increased susceptibility to fungal infections, which contribute significantly to morbidity and reduced quality of life. Factors such as poor glycemic control and prolonged duration of diabetes further increase the risk of fungal diseases. However, data regarding the spectrum of fungal infections among diabetic patients in Jharkhand are limited. Therefore, the present study was undertaken to evaluate the spectrum of fungal infections in patients with diabetes mellitus and to assess their clinical and mycological characteristics at a tertiary care hospital in Jharkhand.

Materials and Methods: A hospital-based cross-sectional study was conducted in the Department of Microbiology, Medinirai Medical College and Hospital, Palamu, Jharkhand, from January 2025 to January 2026. A total of 120 adult diabetic patients with clinically suspected fungal infections were enrolled. Relevant clinical specimens were subjected to direct microscopy and fungal culture on Sabouraud Dextrose Agar. Fungal isolates were identified using conventional mycological techniques. Data were analyzed using SPSS version 20.0, and associations were assessed using the Chi-square test. A p-value <0.05 was considered statistically significant.

Results: The mean age of the participants was 54.8 ± 12.3 years, and males constituted 54.2% of the study population. Dermatophytosis was the most common fungal infection (38.3%), followed by candidiasis (28.3%), onychomycosis (20.0%), pityriasis versicolor (8.3%), and aspergillosis (5.0%). Fungal growth was obtained in 102 (85.0%) cases. Candida albicans was the most frequently isolated organism (31.4%), followed by Trichophyton rubrum (27.5%). A significant association was observed between glycemic control and the type of fungal infection, with candidiasis and onychomycosis occurring more frequently among patients with HbA1c levels >8% ($\chi^2 = 10.35$, df = 4, p = 0.035). Longer duration of diabetes was also associated with a greater occurrence of these infections.

Conclusion: Superficial fungal infections are highly prevalent among patients with diabetes mellitus, with dermatophytosis being the most common clinical presentation. Poor glycemic control and longer duration of diabetes are important factors associated with an increased risk of fungal infections. Early diagnosis, appropriate mycological evaluation, and optimal glycemic management may help reduce the burden of fungal diseases in diabetic patients.

Keywords: *Diabetes mellitus, Fungal infections, Dermatophytosis, Candidiasis, Onychomycosis, Glycemic control, Candida albicans, Diabetes duration.*

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The prevalence of diabetes has increased rapidly worldwide, making it one of the leading public health concerns of the twenty-first century. India is home to one of the largest populations of individuals with diabetes, and the disease imposes a substantial burden on the healthcare system.[1,2]

Patients with diabetes are more susceptible to infections because of impaired innate and adaptive immune responses. Hyperglycemia adversely affects neutrophil chemotaxis, phagocytosis, and intracellular killing, thereby increasing the risk of microbial infections. In addition, vascular insufficiency, neuropathy, and altered skin and mucosal barriers further predispose diabetic individuals to various infectious diseases, including fungal infections.[3,4]

Fungal infections constitute an important cause of morbidity among diabetic patients. Both superficial and invasive fungal infections occur more frequently in individuals with poor glycemic control. Common superficial fungal infections include dermatophytosis, candidiasis, onychomycosis, and pityriasis versicolor, while invasive infections such as mucormycosis and aspergillosis may occur in immunocompromised patients and are associated with significant mortality.[5,6]

The burden of fungal infections in diabetic patients has gained increased attention in recent years, particularly following the rise in cases of mucormycosis reported during the COVID-19 pandemic. Nevertheless, superficial fungal infections continue to represent a major clinical problem due to their recurrent nature, impact on quality of life, and potential complications if left untreated.[7]

The prevalence and pattern of fungal infections vary according to geographical location, climatic conditions, socioeconomic factors, and healthcare practices. Despite the growing burden of diabetes in eastern India, data regarding the spectrum of fungal infections among diabetic patients in Jharkhand remain limited.[8,9] Identification of the common fungal pathogens and their clinical presentations is essential for timely diagnosis and effective management.

Therefore, the present study was undertaken to evaluate the spectrum of fungal infections in patients with diabetes mellitus attending a tertiary care hospital in Jharkhand and to assess their clinical and mycological characteristics.

MATERIALS AND METHODS:

This hospital-based cross-sectional study was conducted in the Department of Microbiologyat Medinirai Medical College and Hospital, Palamu, Jharkhand, over a period of one year from January 2025 to January 2026.Ethical approval was obtained by the Institutional Ethics Committee of Medinirai Medical College and Hospital, Palamu. The study included adult patients diagnosed with diabetes mellitus who attended the outpatient or inpatient services of the hospital and presented with clinical features suggestive of fungal infection. Patients aged 18 years and above with either type 1 or type 2 diabetes mellitus and willing to participate in the study were enrolled after obtaining written informed consent. Patients who had received systemic antifungal therapy within the preceding four weeks, those with incomplete clinical records, and individuals with severe immunocompromising conditions unrelated to diabetes were excluded from the study.

A total of 120 consecutive diabetic patients meeting the eligibility criteria were included. Detailed demographic and clinical information was collected using a predesigned and pretested case record form. Data regarding age, sex, duration of diabetes, associated comorbidities, clinical presentation, anatomical site of infection, and history of previous fungal infections were recorded. Information related to glycemic status, including fasting blood glucose, postprandial blood glucose, and glycated hemoglobin (HbA1c) levels, was obtained from laboratory records or assessed during the study period whenever required.

Appropriate clinical specimens were collected depending upon the site of infection. Skin scrapings, nail clippings, hair samples, oral swabs, vaginal swabs, sputum, and other relevant specimens were obtained under aseptic precautions. Direct microscopic examination was performed using potassium hydroxide (KOH) mount for skin, nail, and hair specimens, while Gram staining was carried out wherever indicated. Specimens were cultured on Sabouraud Dextrose Agar and incubated under standard laboratory conditions. Identification of fungal isolates was performed based on colony morphology, microscopic characteristics, germ tube testing, and other conventional mycological techniques.

The primary outcome of the study was to determine the spectrum of fungal infections among patients with diabetes mellitus. Secondary outcomes included the distribution of fungal pathogens according to age, sex, duration of diabetes, glycemic control, and site of infection. Data were entered into Microsoft Excel and analyzed using SPSS version 20.0. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Associations between study variables were assessed using the Chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

The study protocol was reviewed and approved by the Institutional Ethics Committee of Medinirai Medical College and Hospital, Palamu. Confidentiality of patient information was maintained throughout the study, and all procedures were carried out in accordance with ethical principles for biomedical research involving human participants.

RESULTS:

Table 1 presents the demographic profile of the study participants. A total of 120 diabetic patients with clinically suspected fungal infections were included in the study. The mean age of the participants was 54.8 ± 12.3 years, with ages ranging from 21 to 82 years. The highest proportion of patients belonged to the 51–60 years age group (31.7%), followed by the 41–50 years age group (25.0%). Together, these two age groups accounted for more than half of the study population, indicating that fungal infections were most commonly observed among middle-aged and older adults with diabetes. Patients aged 61–70 years constituted 18.3% of the study population, while younger individuals aged 21–30 years and those older than 70 years each represented 6.7% of the cases. Regarding gender distribution, males slightly outnumbered females, accounting for 54.2% and 45.8% of participants, respectively, suggesting a modest male predominance among diabetic patients presenting with fungal infections.

Table 1. Demographic Characteristics of Study Participants (n = 120)

Variable		Number (%)
Age Group (years)	21–30	8 (6.7)
	31–40	14 (11.7)
	41–50	30 (25.0)
	51–60	38 (31.7)
	61–70	22 (18.3)
	>70	8 (6.7)
Gender	Male	65 (54.2)
	Female	55 (45.8)

Figure1 depicts the spectrum of fungal infections identified among the diabetic patients included in the study. Dermatophytosis was the most common fungal infection, accounting for 46 cases (38.3%), indicating that superficial dermatophyte infections constitute a major burden among individuals with diabetes mellitus. Candidiasis was the second most frequently observed infection, affecting 34 patients (28.3%), followed by onychomycosis in 24 patients (20.0%). Pityriasis versicolor was diagnosed in 10 patients (8.3%), while aspergillosis was the least common infection, occurring in 6 patients (5.0%). Overall, superficial fungal infections, including dermatophytosis, candidiasis, and onychomycosis, comprised the vast majority of cases, highlighting their predominance among diabetic patients. The findings suggest that diabetes mellitus is associated primarily with an increased susceptibility to superficial fungal infections, whereas invasive fungal infections were comparatively less frequent in the study population.

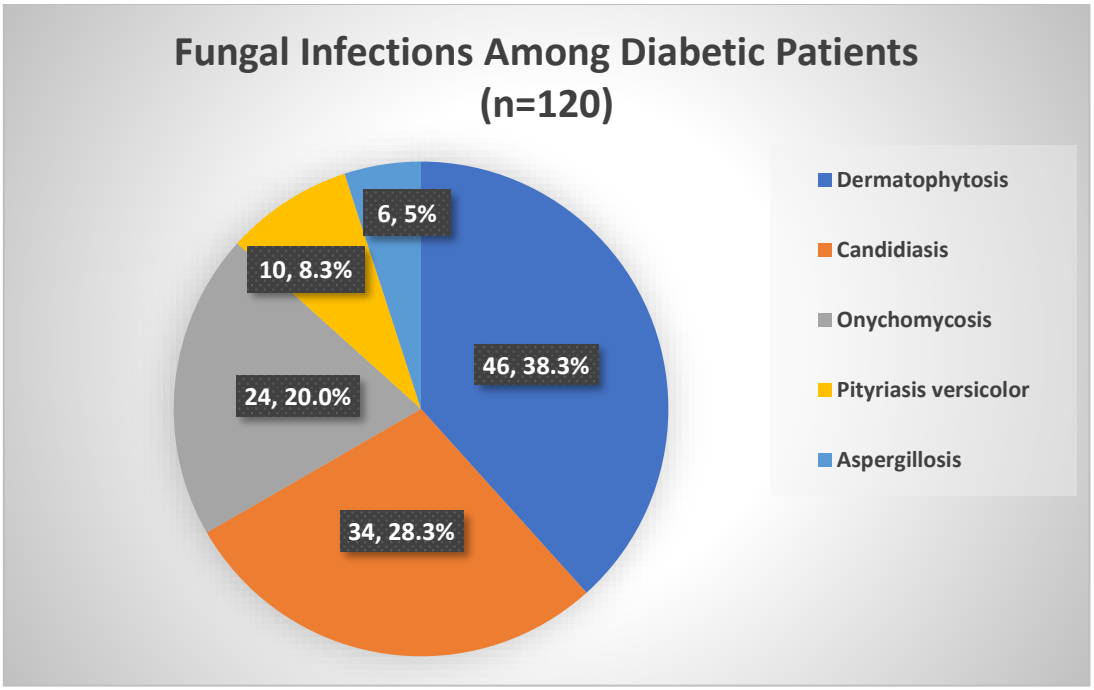

Figure 1: Spectrum of Fungal Infections Among Diabetic Patients (n = 120)

Among the 120 study participants, fungal growth was detected in 102 culture-positive cases, and the distribution of the isolated fungal species is shown in Table 2. *Candida albicans* was the most frequently isolated fungal pathogen, accounting for 32 isolates (31.4%), followed closely by *Trichophyton rubrum*, which constituted 28 isolates (27.5%). *Candida* non-*albicans* species were identified in 12 cases (11.8%), indicating the presence of a substantial proportion of non-*albicans* candidal infections among diabetic patients. Among the dermatophytes, *Trichophyton mentagrophytes* was isolated in 16

cases (15.7%), while *Microsporum* species accounted for 6 cases (5.9%). *Aspergillus* species were recovered from 5 cases (4.9%), and other fungal organisms constituted 3 isolates (2.8%). Overall, *Candida* species (43.2%) represented the predominant group of fungal pathogens, followed by dermatophytes, reflecting the increased susceptibility of diabetic patients to both candidal and dermatophytic infections. These findings emphasize the importance of mycological confirmation for accurate diagnosis and appropriate antifungal therapy in this population.

Table 2: Distribution of Fungal Isolates (n = 102 Culture-Positive Cases)

Fungal Isolate	Number (%)
Candida albicans	32 (31.4)
Candida non-albicans spp.	12 (11.8)
Trichophyton rubrum	28 (27.5)
Trichophyton mentagrophytes	16 (15.7)
Microsporum spp.	6 (5.9)
Aspergillus spp.	5 (4.9)
Other fungi	3 (2.8)
Total	102 (100)

Table 3 illustrates the association between glycemic control and the type of fungal infection among the study participants. Dermatophytosis was more common among patients with HbA1c ≤8%, accounting for 25 of 48 cases in this group, whereas candidiasis and onychomycosis were more frequently observed among patients with poor glycemic control (HbA1c >8%), with 26 and 18 cases, respectively. Pityriasis versicolor and aspergillosis were relatively uncommon and showed no marked variation between the two glycemic categories. Statistical analysis using the Pearson Chi-square test demonstrated a significant association between glycemic control and the type of fungal infection ($\chi^2 = 10.35$, df = 4, $p = 0.035$). These findings suggest that poor glycemic control may predispose diabetic patients to certain fungal infections, particularly candidiasis and onychomycosis, highlighting the importance of optimal glycemic management in reducing the risk of fungal diseases.

Table 3: Association Between Glycemic Control and Type of Fungal Infection

Type of Infection	**HbA1c ≤8% (n=48)**	**HbA1c >8% (n=72)**	**Total**
Dermatophytosis	25	21	46
Candidiasis	8	26	34
Onychomycosis	6	18	24
Pityriasis versicolor	6	4	10
Aspergillosis	3	3	6
Total	48	72	120

Table 4 presents the distribution of fungal infections according to the duration of diabetes mellitus. Dermatophytosis was the most common fungal infection across all duration categories, with the highest number of cases observed among patients with diabetes duration of 5–10 years (18 cases). Candidiasis and onychomycosis showed an increasing trend with longer duration of diabetes, accounting for 12 and 9 cases, respectively, among patients with diabetes for more than 10 years. Patients with a disease duration of less than 5 years had comparatively fewer cases of candidiasis and onychomycosis. Pityriasis versicolor and aspergillosis were relatively less common and were distributed across all duration groups. Overall, the findings suggest that prolonged duration of diabetes may be associated with a higher occurrence of certain fungal infections, particularly candidiasis and onychomycosis, possibly due to cumulative effects of chronic hyperglycemia and progressive impairment of host immune defenses.

Table 4: Distribution of Fungal Infections According to Duration of Diabetes (n = 120)

Duration of Diabetes	Dermatophytosis	Candidiasis	Onychomycosis	Pityriasis Versicolor	Aspergillosis	Total
<5 years (n=34)	16	8	5	4	1	34
5–10 years (n=46)	18	14	10	2	2	46
>10 years (n=40)	12	12	9	4	3	40
Total	46	34	24	10	6	120

DISCUSSION:

The present study evaluated the spectrum of fungal infections among diabetic patients attending a tertiary care hospital in Jharkhand. The majority of patients were in the 51–60 years age group, with a slight male predominance. Similar age and gender distributions have been reported by Bansal et al. and Kaur et al., who observed that fungal infections are more common among middle-aged and elderly diabetic individuals, particularly males.[10,11] Advancing age, longer duration of diabetes, and cumulative metabolic abnormalities may contribute to this increased susceptibility.

Dermatophytosis was the most common fungal infection in the present study, accounting for 38.3% of cases. This finding is consistent with previous reports from India, where dermatophytosis has emerged as the predominant superficial fungal infection among diabetic patients.[8,12,13] The high prevalence may be related to favorable climatic conditions, impaired skin barrier function, and altered immune responses associated with diabetes.

Candidiasis was the second most common infection, followed by onychomycosis. Similar observations have been reported by Casqueiro et al. and Nweze and Eke, who documented an increased burden of candidal infections among diabetic patients due to impaired host immunity and elevated tissue glucose levels.[3,14] Among culture-positive specimens, *Candida albicans* was the most frequently isolated organism, followed by *Trichophyton rubrum*. Comparable findings have been described by Gupta and Lyons and by Chander et al., who identified Candida species and dermatophytes as the principal fungal pathogens in diabetic populations.[5,15]

A significant association was observed between glycemic control and the type of fungal infection. Patients with HbA1c levels above 8% showed a higher frequency of candidiasis and onychomycosis. This observation is in agreement with the findings of Agrawal et al., who reported a significant relationship between poor glycemic control and onychomycosis among diabetic patients.9 Similar associations have been described by Geerlings and Hoepelman and by Romano et al., highlighting the role of chronic hyperglycemia in increasing susceptibility to fungal infections.[4,16]

The present study also demonstrated that candidiasis and onychomycosis were more frequently observed among patients with a longer duration of diabetes. Previous studies have similarly reported that prolonged disease duration increases the risk of fungal infections because of progressive immune dysfunction and vascular complications.[17,18] Although aspergillosis was encountered in only a few patients, its occurrence emphasizes the potential for opportunistic fungal infections in individuals with uncontrolled diabetes.[6,19]

Overall, the findings of the present study indicate that superficial fungal infections remain a significant clinical problem among diabetic patients. Early diagnosis, routine screening of high-risk individuals, and maintenance of optimal glycemic control may help reduce the burden of these infections and improve patient outcomes.[20]

CONCLUSION:

The present study highlights that fungal infections are a common clinical problem among patients with diabetes mellitus, with dermatophytosis being the most prevalent infection, followed by candidiasis and onychomycosis. *Candida albicans* and *Trichophyton* species were the predominant fungal isolates recovered from culture-positive cases. Poor glycemic control was significantly associated with an increased occurrence of candidiasis and onychomycosis, while a longer duration of diabetes appeared to further increase susceptibility to fungal infections. These findings emphasize the importance of regular screening for fungal infections in diabetic patients, particularly those with uncontrolled blood glucose levels and longstanding disease. Early diagnosis, appropriate mycological evaluation, and effective glycemic management may help reduce the burden of fungal infections and improve overall patient outcomes.

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Conflict of Interest: None

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