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Research Article

A Descriptive Study to Assess the Prevalence of Fungal Infections among Patients with Diabetes Mellitus and Hypertension and Their Risk Factors in a Community of Delhi

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A B S T R A C T

Introduction: Diabetic patients are at higher risk of various health problemsincluding fungal infections. Fungal infections are taken less seriously but if not identified and treated promptly, may lead to resistant infections, further complications and impaired quality of life.

Objectives: To assess the prevalence of fungal infections among diabetic patients and risk factors of hypertension and diabetes mellitus

Methods: A descriptive survey research design was used. The study was conducted among people residing in a selected area of Delhi. A purposive sampling technique was used to collect 313 samples. A structured interview schedule was used to collect the data,. Permission was obtained from local authorities. An informed consent was obtained prior to study participation. Data was analysed using descriptive statistics.

Results: 28.1% of people are suffering from diabetes, and out of those only 88.6 % of people are taking medication. A total of 90.9% of diabetic participants had a fungal infection. Out of that, 18.7 % had fungal infections more than once a month,33.7 % were not taking any treatment for fungal infection, 31.2% were taking home and natural remedies, 22.5 % were using topical antifungal creams (some containing steroids) or suppositories and 12.5% were taking oral anti-fungal medication.

Conclusion: Diabetic patients have increased susceptibility to various infections, including fungal infections emphasising the need for comprehensive research and effective management strategies. This study highlights the need for effective preventive strategieswhich could significantly reduce healthcare costs and improve patients' quality of life.

Keywords: Candidiasis, Diabetes Miletus, Hypertension, Mycosis, Fungal Infection

Introduction

Diabetes mellitus (DM) is a chronic condition resulting from either insufficient insulin production by the pancreas or inefficient insulin utilisation by the body. One hormone that controls blood sugar is insulin. Uncontrolled diabetes frequently results in hyperglycaemia, which over time causes major harm to numerous body systems, particularly the blood vessels and neurons. Symptoms of DM, such as excessive thirst, increased frequency of urination, impaired vision, fatigue, inadvertent weight loss, etc., might appear unexpectedly. About 422 million people worldwide suffer from diabetes each year, with low- and middle-income nations bearing a disproportionately heavy burden.[1]

DM increases a person's risk of developing heart attacks, strokes, and renal failure. It damages the blood vessels in the eyes, which can result in irreversible vision loss. Due to inadequate blood flow and nerve loss, many patients with DM experience foot issues. This may necessitate amputation due to foot ulcers and gangrene. Diabetic fungal infection may be caused by DM.[1]

Although they are considered less dangerous, fungal infections can be silent killers. Fungal infections put around 300 million individuals at extremely high risk and 25 million at high risk of death worldwide. Fungal infections can range from minor, asymptomatic skin infections to severe, invasive infections.[2] The Global Action Fund for Fungal Infections (GAFFI) estimates that vulvovaginal candidiasis, or thrush, affects around 1 million individuals each year, including 135 million women. 60,000 to 100,000 cases of Candida peritonitis occur, over 300,000 patients get invasive aspergillosis, 400,000 cases of pneumocystis pneumonia are observed, and roughly 500,000 new cases of histoplasmosis are reported worldwide.[3]

Around 8.5% of persons over the age of 18 had DM in 2014. DM was the direct cause of 1.5 million fatalities in 2019, and 48% of all diabetes-related deaths happened in people under 70 years.[4] DM contributed to an additional 460,000 deaths from renal disease. Approximately 20% of cardiovascular fatalities are caused by elevated blood glucose. Age-standardised death rates from diabetes increased by 3% between 2000 and 2019.[1] The death rate from diabetes rose by 13% in lower-middle-income nations. In contrast, between 2000 and 2019, the likelihood of dying from any of the four major noncommunicable diseases—diabetes, cancer, chronic respiratory conditions, or cardiovascular diseases—between the ages of 30 years and 70 years fell by 22% worldwide.[4] The same is true for diabetic fungal infections. The most common infections are invasive mycoses, keratitis, bronchopulmonary aspergillosis, pneumocystis pneumonia, oral infections, and oesophageal candidiasis.[5]

One of the most prevailing mycotic infections worldwide is Candidiasis which is caused by *Candida albicans* species. Other species such as *C. glabrata*, *C. krusei*, and *C. tropicalis* are opportunistic pathogens. An epidemiological study showed that *Aspergillus* species including *A. flavus*, *A. niger*, and *A. fumigatus* cause infection in nails, ears, eyes, respiratory tract, and skin. The morbidity and mortality of fungal infection were more prominent in patients with other comorbid clinical conditions, like immunological impairment, receiving chemotherapy, cancer, and long-term chronic diseases.[6]

Understanding the prevalence, risk factors, and impact of fungal infections in diabetics helps healthcare professionals manage and prevent these infections effectively. By studying the knowledge about these infections, researchers and healthcare providers can develop better diagnostic and treatment strategies to improve patient outcomes.

Methodology

A quantitative approach with a descriptive study design was used to collect the data. The study was conducted from March to May 2023. The study was conducted among people residing in a selected area of Delhi. A purposive sampling technique was used to collect data from 313 persons. A structured interview schedule was used which had 4 sections. The first one contained questions related to demographic details, risk factors of noncommunicable diseases, and history of hypertension and DM. The second contained questions related to the risk factors leading to non-communicable diseases. The third section was related to the prevalence of hypertension and diabetes. The fourth section was related to the fungal infections among DM, its symptoms, and the treatment being taken by the participants.

Formal administrative and ethical approval was obtained from the local authority. Informed consent was taken from subjects before participation in the study. Confidentiality of responses was assured. Data was analysed using aggregate statistics.

Results

SECTION I: Findings related to Demographic Characteristics of the Sample

The data presented in Table 1 shows that 48.9% of participants were in the age group of 31–50 years. 50.2% were female while 49.8% were male. The majority, i.e. 70.9%, were Hindus. Most (53.4%) of the participants were illiterate. In terms of occupation, the majority (38.1%) of the participants were unemployed.

SECTION II: Findings Related to Risk Factors for Non-Communicable Diseases

The data in Table 2 and Figure 1 shows that 30.9% of people smoked tobacco (6.7% used to smoke previously

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but had stopped). Out of this pool of people, 66% of people smoked every day and around 62.9% took 1 cigarette/ bidi per day.10.8% and 4.7% of respondents currently used and previously used tobacco. Out of this, 59.1% of people used smokeless tobacco every day and around 67.4% consumed it once a day. Only 6.0% and 6.7% currently consumed and previously used alcohol. Out of current users, 22.5% of people consume alcohol every day. Around 51.8% of people did physical activity and out of those, 52.4% did it every day. 48.2% of people did physical activity for 15 minutes at least. In terms of outside food consumption, 45.4% consume it once a week and the majority of the sample i.e. 52.3 % had no family history of hypertension or DM. 17.9% had a hypertension history and 22.4 % had a history of diabetes in the family.

SECTION III: Findings Related to the Prevalence of Hypertension and Diabetes Mellitus

SECTION IV: Findings Related to the Prevalence of Fungal Infection among Patients with Diabetes Mellitus

The data in Table 4 shows that 90.9% of patients with diabetes mellitus were suffering from diabetic fungal infection. The major symptoms observed were: 31.2% observed itchy patches, 26.2% had foot infection, 23.7% observed change in skin colour, 18.7% experienced vaginal itching, 17.5% had oral thrush, 13.7% experienced burning sensation while urinating and eye infection, 12.5% had an unpleasant odour and 6.2% experienced white discharge from the vagina.

Around 40% had these symptoms on feet, followed by 35% on genital, 26.2% on mouth, 11.2% on eyes, 10% on fingers, 8.7% on skinfolds, 6.2% on armpit, 5% on other areas, and 2.5% beneath the breast. In response to symptom frequency, it was noted that 31.2% had it every 2–3 months, 26.2% had it once a month, 18.7% had it more than once a month, 17.5% had it 6 monthly or more, and 6.2% had it for the first time. 33.7% were not taking any treatment to resolve diabetic fungal infection, 31.2% were taking home and natural remedies, 22.5% were using topical creams or suppositories and only 12.5% were taking oral anti-fungal medication.

Data in Table 5 revealed that 43.7% of people having fungal infection were in the age group of 31–50 years. A little more than half, i.e. 53.8%, were female, and the majority (77.5%) were Hindu. Five (7.5%) were having graduation and above qualification, . 40% were labourers or daily wagers in this group.

Table 1.Frequency and Percentage Distribution of Demographic Details

N = 313

A. No.	Demographic Details	Frequency	Percentage
Age (years)			
1.	18–30	87	27.8
	31–50	153	48.9
	> 50	73	23.3
Gender			
2.	Male	156	49.8
	Female	157	50.2
	Transgender	0	0.0
Religion			
3.	Hindu	222	70.9
	Muslim	88	28.2
	Christianity	3	0.9
Education			
4.	Illiterate	167	53.4
	Up to 12th	122	38.9
	Graduation & above	24	7.7
Occupation			
5.	Unemployed	119	38.1
	Labourer/ daily wager	113	36.1
	Private job	72	23.0
	Government service	2	0.6
	Retired professional	7	2.2

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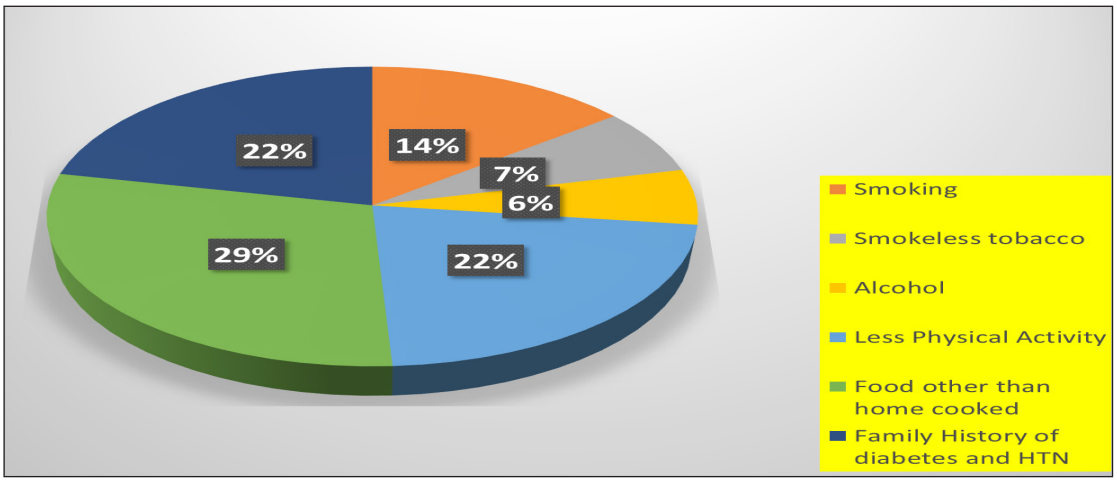

Figure 1.Percentage Distribution of Risk Factors of Non-Communicable Diseases

Table 2.Frequency and Percentage Distribution of Risk Factors Leading to Diseases namely Diabetes Mellitus and Hypertension

N = 313

S. No.	Risk Factors		Frequency	Percentage
1.	**Do you smoke any tobacco products?**			
	Yes		97	30.9
	No		216	69.1
If yes (n = 97),				
a.	How often do you smoke tobacco products?	Everyday	64	66.0
		1–3 times a week	33	34.0
b.	If smoking, how many in a day?	1 cigarette/ bidi	61	62.9
		2–5	33	34.0
		> 5	3	3.1
2.	**Do you take smokeless tobacco?**			
	Yes		49	15.5
	Never		264	84.5
a.	How often do you use smokeless tobacco?	Everyday	29	59.1
		1–3 times a week	20	40.9
b.	If taking smokeless tobacco, how many times in a day?	1	33	67.4
		2–5	15	30.6
		> 5	1	2.0
3.	**Do you consume any alcohol products?**			
	Yes		40	12.8
	Never		273	87.2
If yes (n = 40),				
a.	How often do you consume alcohol?	Everyday	9	22.5
		Once a week	26	65.0
		2–3 times a week	5	12.5

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4.	**Do you do any physical activity such as freehand exercise, walking, cycling, yoga, gym, etc.?**			
	Yes		162	51.8
	No		151	48.2
If yes (n = 162)				
a.	How often do you do physical activity?	Everyday	85	52.4
		1–3 times a week	77	47.6
b.	How long (in minutes) do you do physical activity?	15	78	48.2
		15–30	60	37.0
		≥ 30	24	14.8
5.	**How often do you eat other than home-cooked food?**			
	Everyday		10	3.2
	Once a week		142	45.4
	2–3 times a week		48	15.3
	Never		113	36.1
6.	**Do you have any family history of hypertension/ diabetes?**			
	Hypertension		56	17.9
	Diabetes		70	22.4
	None		164	52.3
	Both a and b		23	7.3

Table 3.Frequency and Percentage Distribution of Prevalence of Hypertension and Diabetes Mellitus

N = 313

S. No.		Prevalence	Frequency	Percentage
1	**Are you suffering from hypertension?**			
	Yes		52	16.6
	No		261	83.4
If yes (n = 52)				
a.	Are you taking any medications?	Yes	50	96.0
		No	2	4.0
b.	How often do you take medication? (n = 50)	As prescribed	39	78.0
		Sometimes miss in between	10	20.0
		Other	1	2.0
c.	Since how long (in years) are you taking medication?	0–5	44	88.0
		6–10	6	12.0
2.	**Are you suffering from diabetes?**			
	Yes		88	28.1
	No		225	71.9
If yes (n = 88)				
a.	Are you taking any medications?	Yes	78	88.6
		No	10	11.4
b.	How often do you take medication? (n = 78)	As prescribed	57	73.1
		Sometimes miss in between	21	26.9
c.	Since how long (in years) are you taking	0–5	72	92.3
		6–10	6	7.7

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Table 4.Frequency and Percentage Distribution of Prevalence of Fungal Infection among Patients with Diabetes Mellitus

N = 88

S. No.	Prevalence	Frequency	Percentage
1.	**Are you suffering from any diabetic fungal infection?**		
	Yes	80	90.9
	No	8	9.1
2.	**Do you have any of the following (n = 80)**		
	Change in skin colour	19	23.7
	Itchy patches	25	31.2
	Eye infection (redness, blurred vision, discharge)	11	13.7
	Foot infection (ulcer, shoe bite,.0 oedema, dryness, ingrown toenail)	21	26.2
	Oral thrush (white patches on the inside of the cheek, redness or pain in the mouth, loss of taste, cracking and redness in the corner of the mouth)	14	17.5
	Vaginal itching	15	18.7
	White discharge from the vagina	5	6.2
	Burning sensation while urinating	11	13.7
	Unpleasant odour	10	12.5
3.	**Where does the above symptom appear?**		
	Genital	28	35.0
	Feet	32	40.0
	Mouth	21	26.2
	Eye	9	11.2
	Skinfolds	7	8.7
	Fingers	8	10.0
	Beneath breast	2	2.5
	Armpit	5	6.2
	Other	4	5.0
4.	**How often does the symptom appear?**		
	More than once a month	15	18.7
	Once a month	21	26.2
	Every 2–3 months	25	31.2
	6 monthly or more	14	17.5
	First time	5	6.2
5.	**Are you taking any treatment?**		
	Topical creams (anti-fungal) or suppository	18	22.5
	Oral anti-fungal medication	10	12.5
	Home and natural remedies	25	31.2
	No treatment	27	33.7

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Table 5.Frequency and Percentage Distribution of People with Diabetic Fungal Infection

N = 80

Demographic Details	Frequency	Percentage
Age (years)		
18–30	26	32.5
31–50	35	43.7
≥ 51	19	23.8
Gender		
Male	37	46.2
Female	43	53.8
Religion		
Hindu	62	77.5
Muslim	17	21.2
Christianity	1	1.3
Education		
Illiterate	46	57.5
Upto 12th	30	37.5
Graduation & above	4	5.0
Occupation		
Unemployed/ housewife	22	27.5
Labourer/ daily wager	32	40.0
Private job	24	30.0
Government service	0	0.0
Retired professional	2	2.5

Discussion

The current research aligns with the findings of Azharuddin et al., who reported a 23.3% prevalence of fungal infections among patients with DM. The most frequently isolated fungus was *Candida tropicalis* at 27.08%, followed by *C. Albicans* at 20.83%. Additionally, a significant incidence of fungal infections was observed in patients experiencing mild diabetic foot infections or diabetic foot ulcers (DFU) lasting between 7 to 14 days.[7]

The present study findings agreed with the findings of Saud et al., which indicate that the occurrence of fungal infections is significantly greater in individuals with diabetes (34.0%) compared to those without diabetes (4.7%). The analysis revealed that fungal growth was most prevalent in oral wash samples, followed by samples from the toes, urine, hair, and nails. The most commonly identified fungi included *Candida* species (57.5%), *Aspergillus* species (28.4%), and *Trichophyton* species (10.7%).[8]

A study carried out by Nigotia et al. indicated that a significant proportion of individuals with DM experienced fungal infections, with a higher incidence observed among the elderly population. The prevalence of fungal infections was notably greater in those with Type II DM. Furthermore, the mean random blood sugar, fasting blood glucose, and postprandial blood glucose levels were significantly elevated in patients suffering from fungal infections, aligning with the findings of the present study.[9]

The study results of Lugo-Simolinos and Sanchez concluded that there is no increased prevalence of dermatophytosis in diabetic patients compared to a control, nondiabetic patient. This result is contrary to our findings, which show a high prevalence of fungal infection in diabetic patients.[10]

A total of 262 people were enrolled in the study conducted by Abu-Elteen et al.; 132 of them were diabetics and 130 were healthy controls. 8.3% of diabetics with oral candidiasis had clinical evidence; of these, 36% were smokers and wearers of overnight dentures. No non-diabetic controls exhibited any clinical evidence of oral candidiasis. Compared to 30% of healthy controls, 58.3% of diabetics had positive yeast tests.[11] The study results are in congruence with the result of the present study which also depicts a higher prevalence of fungal infection in diabetics.

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Conclusion

Fungal infections are common in patients with diabetes mellitus. Therefore, it is necessary to raise awareness and identify risk factors, promote diabetic self-management, and implementation of targeted antifungal prophylaxis for high-risk patients which can significantly reduce healthcare costs and improve the quality of life of patients.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: None

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