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Determinants of Diabetic Foot Ulcers in Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study at Mardan Medical Complex

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ABSTRACT

Background: Diabetic foot ulcers (DFU) represent a serious complication of type 2 diabetes mellitus and are linked with high morbidity, disability, and healthcare costs, especially in low- and middle-income nations. Risk factors should be detected early to prevent the development of ulcers and to decrease the level of complications. **Objective:** To determine the determinants of diabetic foot ulcers in patients with type 2 diabetes mellitus presenting to a tertiary care hospital. **Methods:** The study was a cross-sectional study carried out at Mardan Medical Complex, a partner of Bacha Khan Medical College between December 2024 and March 2025. Non-probability consecutive sampling was used to include 175 patients with type 2 diabetes mellitus. A structured proforma was used to collect data comprising of demographic, clinical, and behavioral variables. The presence of diabetic foot ulcer was taken as the outcome variable. An analysis was performed on data with the help of SPSS 25. Analysis was done using chi-square test and logistic regression with a p-value of 0.05 considered significant. **Results:** The mean age of participants was 54.6 ± 10.8 years, and the prevalence of diabetic foot ulcers was 35.4%. Significant determinants of DFU included duration of diabetes >10 years (p=0.001), uncontrolled HbA1c (p=0.032), peripheral neuropathy (p<0.001), peripheral vascular disease (p=0.001), smoking (p=0.018), poor foot hygiene (p=0.002), walking barefoot (p=0.019), and previous history of foot ulcer (p<0.001). Logistic regression analysis identified peripheral neuropathy, prolonged disease duration, poor foot hygiene, and previous ulcer history as independent predictors. **Conclusion:** Diabetic foot ulcers are common among patients with type 2 diabetes and are strongly associated with modifiable and non-modifiable risk factors. Early screening, patient education, and strict glycemic control are essential to reduce the burden of DFU

INTRODUCTION

Diabetes mellitus is an emerging health problem in the world and its prevalence is increasing at a very rapid rate, especially in low and middle-income countries like Pakistan. Diabetic foot ulcers (DFU) are some of the most severe and debilitating chronic complications of diabetes, and they result in long hospital stays, the risk of lower limb amputation, and a high cost to healthcare systems. The extent of the problem is estimated to be around 15-25 percent of diabetic patients develop a foot ulcer in their lifetime (1-3).

Diabetic foot ulcers have a multifactorial pathogenesis, which includes a combination of peripheral neuropathy, peripheral vascular disease, inadequate glycemic control, and recurrent trauma or infection. Neuropathy causes loss of protective sensation and vascular insufficiency hinders wound healing. Moreover, behavioral aspects like poor foot care, improper footwear and walking barefoot also predispose the risk involved particularly in resource-constrained environments. It is important to identify and address these determinants early to avoid complications and enhance patient outcomes (4-7).

Although diabetes has a high burden in Pakistan, local data on the joint effects of clinical, behavioral and socioeconomic factors on diabetic foot ulcer development is limited. Majority of the existing literature is based on isolated risk factors or are carried out among other populations and therefore their applicability to the local environment of Mardan and other areas is restricted (8, 9).

There is a lack of comprehensive, hospital-based studies in this region that evaluate the determinants of diabetic foot ulcers using both clinical and behavioral variables in patients with type 2 diabetes mellitus. Identifying the key determinants of diabetic foot ulcers in the local population will help in developing targeted preventive strategies, improving patient education, and reducing the incidence of DFU and its associated

complications. Therefore, this study was designed to determine the determinants of diabetic foot ulcers in patients with type 2 diabetes mellitus.

METHODOLOGY

This cross-sectional study was conducted at the Department of Medicine, Bacha Khan Medical College (BKMC). The study was carried out over a period of four months from December 2024 to March 2025. The objective of the study was to determine the determinants of diabetic foot ulcers in patients with type 2 diabetes mellitus.

The sample size was calculated using the WHO sample size calculator by considering the prevalence of hypertension as a determinant of diabetic foot ulcers to be 66.7%, with a 95% confidence level (Z = 1.96) and an absolute precision of 7%. The final calculated sample size was 175 patients.

A non-probability consecutive sampling technique was used to recruit participants. All patients diagnosed with type 2 diabetes mellitus, aged ≥35 years, presenting to the outpatient and inpatient departments were included in the study. Patients with type 1 diabetes mellitus, gestational diabetes, critically ill patients, and those with foot ulcers due to causes other than diabetes were excluded.

Ethical approval for the study was obtained from the Ethical Committee of Bacha Khan Medical College (BKMC), Mardan, under reference number 541/BKMC, dated 11 July 2024. In addition, the study synopsis was approved by the College of Physicians and Surgeons Pakistan (CPSP) under reference number CPSP/REU/MED-2022-028-20069, dated December 1, 2024. Written informed consent was obtained from all participants prior to data collection, and confidentiality of patient information was strictly maintained.

The structured proforma was used to collect data and included the variables of socio-demographic (age, gender, socioeconomic status), clinical (duration of diabetes, treatment modality, HbA1c levels, BMI), and possible risk factors (peripheral neuropathy, peripheral vascular disease, smoking status, foot hygiene practices, barefoot walking, and foot ulcer history). The feet were thoroughly clinically examined to evaluate neuropathy, vascularity, deformities and the presence of ulcers. Diabetic foot ulcer (DFU) was identified as the dependent variable and demographic, clinical, and behavioral variables were regarded as independent variables.

The SPSS version 25 was used to enter and analyze the data. The quantitative variables like age were given in terms of mean standard deviation, whereas the qualitative variables were in terms of frequencies and percentages. In order to determine the relationship between risk factors and diabetic foot ulcers, Chi-square test was used. A p-value ≤ 0.05 was considered statistically significant. Logistic regression was done to find independent predictors of diabetic foot ulcers.

RESULTS

A total of 175 patients with type 2 diabetes mellitus were included in this study. The mean age of participants was 54.6 ± 10.8 years, and 35.4% of patients had diabetic foot ulcers.

The study population was predominantly middle-aged, with a male predominance and a majority belonging to low socioeconomic status.

Table 1

Demographic Characteristics of Participants (n = 175)

Variable	Category	Frequency (%)
Age Group	35–50 years	55 (31.4%)
	51–65 years	75 (42.9%)
	>65 years	45 (25.7%)
Gender	Male	102 (58.3%)
	Female	73 (41.7%)
Socioeconomic Status	Low	98 (56.0%)
	Middle	52 (29.7%)
	High	25 (14.3%)

The average duration of diabetes in most of the patients was longer, with inadequate glycemic regulation and high rate of overweight and obesity.

Table 2

Clinical Profile of Patients

Variable	Category	Frequency (%)
Duration of Diabetes	<5 years	48 (27.4%)
	5–10 years	67 (38.3%)
	>10 years	60 (34.3%)
Treatment	Oral drugs	92 (52.6%)
	Insulin	48 (27.4%)
	Both	35 (20.0%)
HbA1c Status	Controlled	58 (33.1%)
	Uncontrolled	117 (66.9%)
BMI	Normal	42 (24.0%)
	Overweight	76 (43.4%)
	Obese	57 (32.6%)

The percentage of patients with neuropathy, poor foot hygiene, and behavioral risk factors including walking without shoes were significant.

Table 3

Distribution of Risk Factors for Diabetic Foot Ulcers

Variable	Category	Frequency (%)
Peripheral Neuropathy	Yes	88 (50.3%)
	No	87 (49.7%)
Peripheral Vascular Disease	Yes	64 (36.6%)
	No	111 (63.4%)
Smoking	Yes	59 (33.7%)
	No	116 (66.3%)
Poor Foot Hygiene	Yes	95 (54.3%)
	No	80 (45.7%)
Walking Barefoot	Yes	72 (41.1%)
	No	103 (58.9%)
Previous Foot Ulcer	Yes	38 (21.7%)
	No	137 (78.3%)

Significant associations were observed between diabetic foot ulcers and clinical as well as behavioral risk factors.

Table 4

Association of Determinants with Diabetic Foot Ulcers

Variable	DFU Present n (%)	DFU Absent n (%)	p-value
Duration >10 years	34 (54.8%)	26 (23.0%)	0.001
Uncontrolled HbA1c	48 (77.4%)	69 (61.1%)	0.032
Peripheral Neuropathy	46 (74.2%)	42 (37.2%)	<0.001
Peripheral Vascular Disease	35 (56.5%)	29 (25.7%)	0.001
Smoking	28 (45.2%)	31 (27.4%)	0.018
Poor Foot Hygiene	44 (71.0%)	51 (45.1%)	0.002
Walking Barefoot	33 (53.2%)	39 (34.5%)	0.019
Previous Foot Ulcer	26 (41.9%)	12 (10.6%)	<0.001

Neuropathy, long disease history and prior ulcer history were determined as independent predictors of diabetic foot ulcers using multivariate analysis.

Table 5

Logistic Regression Analysis (Predictors of DFU)

Variable	Odds Ratio (OR)	95% CI	p-value
Peripheral Neuropathy	3.2	1.7–6.1	0.001
Duration >10 years	2.8	1.5–5.2	0.002
Poor Foot Hygiene	2.5	1.3–4.6	0.004
Previous Foot Ulcer	4.1	2.0–8.3	<0.001

DISCUSSION

This study evaluated the determinants of diabetic foot ulcers (DFU) in patients with type 2 diabetes mellitus and found a prevalence of 35.4%, which reflects a substantial burden of disease. This prevalence is comparable to regional studies conducted in South Asia, where DFU prevalence ranges between 25% and 40%, highlighting the persistent challenge of diabetic complications in low- and middle-income settings (10-12).

The age factor and male pre-eminence were noted to be prevalent among patients in the current study, which is consistent with the current literature that implies that older patients and males are more likely to develop DFU because of the prolonged presence of the disease and their occupation and low health-seeking behavior. The fact that the percentage of patients with a low socioeconomic status is high also highlights the impact of inadequate access to healthcare and low awareness in the emergence of complications (13, 14).

A significant finding of this study was the association between longer duration of diabetes (>10 years) and DFU ($p = 0.001$). Long-term chronic hyperglycemia causes both microvascular and macrovascular damage which predisposes risk of developing ulcers. The same results have been reported in earlier studies, with the duration of the disease being a significant determinant of diabetic foot complications.

DFU was also significantly related to poor glycemic control, as shown by uncontrolled HbA1c levels ($p = 0.032$). Continued hyperglycemia affects wound healing, immunity and makes patients susceptible to infections. The importance of optimal glycemic control to eliminate long-term complications is critical as supported by this finding (15-17).

Peripheral neuropathy was also one of the strongest predictors of risk factor among them (OR = 3.2, $p = 0.001$). Neuropathy causes loss of protective sensation and patients do not sense any minor injuries which may advance to ulcers. The world evidence considerably supports this observation as neuropathy has been discussed as the most significant risk factor to develop DFU (18).

Likewise, the peripheral vascular disease (PVD) was also significantly associated ($p = 0.001$), meaning that poor wound healing and high chances of tissue breakdown are influenced by the poor blood supply. Neuropathy with vascular insufficiency is a significant factor that deteriorates the results of the disease as it has been observed in the past clinical studies (19).

Lifestyle and behavioral aspects were also critical. Poor foot hygiene ($p = 0.002$) and walking barefoot ($p = 0.019$) were significantly associated with DFU. These results underline the significance of patient education because such basic preventive actions like proper foot care and wearing of correct footwear can significantly lower the risk of ulcers (20).

Past history of foot ulcer was also found to be the best predictor (OR = 4.1, $p < 0.001$). This implies that there is a high incidence of DFU, which is well-reported in the literature. Individuals with history of ulcers need regular follow-up and intensive preventive measures to prevent the recurrence (21).

Another important determinant ($p = 0.018$) was smoking, which probably is caused by its negative impact on microcirculation and wound healing. This observation highlights the importance of smoking cessation interventions in management of diabetes.

Over all, the results of this study agree with the national and international research, which proves that DFU is a multifactorial condition that depends on clinical, behavioral, and metabolic factors. The study highlights the need for a multidisciplinary approach, including glycemic control, early screening for neuropathy, patient education, and lifestyle modification.

CONCLUSION

Diabetic foot ulcers are a common and serious complication among patients with type 2 diabetes mellitus, with a prevalence of 35.4% in the present study. Significant determinants included peripheral neuropathy, prolonged duration of diabetes, poor glycemic control, poor foot hygiene, and previous history of foot ulcers.

Early identification of high-risk patients and implementation of preventive strategies, including patient education, regular foot examination, and strict glycemic control, are essential to reduce the burden of diabetic foot ulcers and associated morbidity.

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