Section: Community Medicine

Original Research Article

RISK FACTORS FOR DIABETIC FOOT: A HOSPITAL-BASED CASE–CONTROL STUDY IN SOUTH TAMIL NADU

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ABSTRACT

Background: Diabetic foot affects nearly 6% of diabetic patients in India.1 The spectrum ranges from infection to tissue destruction culminating in gangrene and amputation. Despite various public health measures aimed at controlling diabetes mellitus and its complications, the number of individuals requiring surgical intervention for diabetic foot complications remains high. Good foot-care practices and risk-factor screening can prevent most amputations. With continued rising trend of diabetes in India, the study aimed to identify and determine the socio-demographic risk factors associated with the development of diabetic foot ulcers (DFUs) among diabetic patients.

Materials and Methods: This hospital-based case control study was done among patients attending the outpatient department of tertiary care hospital of south Kanyakumari district. A total of 30 cases and age, sex matched controls were enrolled in the ratio of 1:1. Data were collected by interviewer method using a pretested structured questionnaire. Information on sociodemographic characteristics, lifestyle behaviours, treatment adherence, anthropometric measurements and HBA1c values were collected. Chi square test for statistical significance and Odds ratio for strength of association was applied. Bivariate and multivariate logistic regression was performed to identify predictors of diabetic foot.

Results: The manifestation of diabetic foot in the study included ulcer 70 %, cellulitis in 16.7 % of the participants and 13.3 % had gangrene. Hypertension (OR=3.05, CI: 1.05-8.84, p-value=0.037), CAHD (OR=8.83, CI: 1.01-76.9, p-value=0.023), history of diabetic peripheral neuropathy (OR=16.79, CI: 2.01-140.8, p-value=0.013), and elevated glycated haemoglobin (HbA1c) were significant risk factors for diabetic foot outcomes ($p < 0.05$), whereas strong family support, early insulin therapy initiation, and self-monitoring of blood glucose using a glucometer were significant protective factors.

Conclusion: The effective control of co-morbid conditions along with proper diabetic management, self-care and adequate social support are essential for prevention of diabetic foot. The results of the study suggest that targeted health education, lifestyle changes and periodic health checkup are key to reducing this burden.

Keywords: Diabetic Foot, Diabetes Mellitus, Risk factors, Complications.

INTRODUCTION

Diabetes Mellitus has reached global pandemic proportion, with nearly one tenth of the adult population in India are living with diabetes mellitus.[1,2] Diabetes care accounts for up to 15 percent of the health care expenditure and 70-80 percent of it is for the hospitalizations due to complications.[3] Diabetic foot ulceration is one of the most frequent and debilitating, with studies reporting

that approximately 15–25% of people with diabetes will develop a foot ulcer during their lifetime.[4] In India, social and economic determinants—including practices such as walking barefoot and poverty—along with suboptimal health-seeking behaviour and the substantial burden on the existing healthcare system, contribute to the increased incidence of diabetic foot disease . Hence, a quantifiable assessment of the risk factors contributing to the development of diabetic foot disease is essential.

Objectives: To identify the risk factors associated with diabetic foot disease among diabetic patients. To determine the association between selected practices and diabetic foot disease.

MATERIALS AND METHODS

The study was conducted in a tertiary care hospital in Kanyakumari district among patients attending the outpatient department between July and August 2018. A sample of 30 cases with diabetic foot and 30 age, sex matched control without the disease were selected after fulfilling the inclusion and exclusion criteria. A written informed consent was obtained from the participant after clearly explaining the purpose of the study. The study was conducted after obtaining the requisite permission from the Institute ethics committee. A pretested, interviewer-administered questionnaire was used to obtain data on sociodemographic details, duration of diabetes mellitus and treatment history, personal habits including smoking and alcohol consumption, self-care practices and associated co-morbid conditions. The anthropometric measurements were measured for each participant and blood results for glycemic control were extracted from the medical records. Data collected were entered in Excel Spreadsheet and analyzed using SPSS Version 16. A $p<0.05$ was considered statistically significant.

RESULTS

Among the 60 participants enrolled in the study, 56.7% were males and the remaining were females (43.3%). The mean age of the study participants was 58.13 years (SD 9.51). The sole of the foot was the most commonly affected site (30%), and ulcers constituted the predominant type of diabetic foot lesion.

Table 1: Site of Diabetic Foot Disease

Site	Number	Percentage
1. Dorsum & Sole	3	10.0
2. Dorsum	7	23.3
3. Sole	9	30.0
4. Leg	5	16.7
5. Ankle	6	20.0
Total	30	100.0

Table 2: Types of Diabetic Foot Disease

Type	Number	Percentage
1. Cellulitis	5	16.6
2. Abscess	0	0.0
3. Gangrene	4	13.4
4. Ulcers	21	70.0
5. Others	0	0.0
Total	30	100.0

Baseline demographic and clinical characteristics are summarized in Table 3. The groups were comparable in terms of age, family size, and income, with no statistically significant differences observed ($p > 0.05$). Cases had longer diabetes duration (10.72 vs. 8.77 years), higher RBS (184.10 vs. 167.53 mg/dL), and lower BMI (24.49 vs. 35.96 kg/m²), though differences were not significant. HbA1c was significantly higher in cases (8.21% vs. 7.14%, $p = 0.002$), indicating poorer glycemic control.

Association between behavioral risk factors, social support and diabetic foot. [Table 4] showed that smoking was more common among cases than controls, with 53.3% of cases being smokers compared to 36.7% of controls, although it was not found to be statistically significant (OR 1.97, $p>0.05$). similarly, alcohol consumption was more common among cases (50%) than controls, but not significantly associated with diabetic foot. Domestic help showed a significant inverse association with diabetic foot (OR = 0.28, $p < 0.05$); domestic help was reported by 43.3% of cases versus 73.3% of controls.

Table 3: Comparison of Basic Characteristics of cases and controls

Site	Cases (N=30) Mean (SD)	Controls (N=30) Mean (SD)	t - Value	p- Value
Age	58.50 (8.88)	57.77 (10.24)	0.088	0.768
Family Size	4.47 (1.46)	4.30 (1.06)	0.258	0.614
Income	22150 (18087)	17516 (13402)	1.271	0.264
Duration of Diabetes	10.72 (6.75)	8.77 (5.03)	1.610	0.102

BMI	24.49 (3.51)	35.96 (3.34)	2.738	0.102
RBS	184.10 (44.69)	167.53 (35.37)	2.534	0.117
HbA1c	8.21 (0.91)	7.14 (0.51)	12.533	0.002*

Association between Comorbidities and diabetic foot: Hypertension was significantly more common among cases than controls (65.4% vs. 34.6%), and showed a significant association with diabetic foot disease (OR = 3.05, 95% CI: 1.05–8.84; p = 0.037). Similarly, a history of coronary artery heart disease (CAHD) was more frequent among cases compared to controls (87.5% vs. 12.5%) and was significantly associated with diabetic foot disease (OR = 8.83, 95% CI: 1.01–79.96; p = 0.023). A past history of diabetic foot disease was reported by 91.7% of cases compared to 8.3% of controls and demonstrated a strong association with current diabetic foot disease (OR = 16.79, 95% CI: 2.00–140.9; p = 0.001).

Table 4: Risk factors for Diabetic Foot Disease

Factors	Category	Case (N=30)	Control (N=30)	OR (95% CI)	p- Value
Smoking	Yes (27)	16 (59.3%)	11 (40.7%)	1.97 (0.70 – 5.54)	0.194
	No (33)	14 (42.4%)	19 (57.6%)		
Alcohol	Yes (26)	15 (57.7%)	11 (42.3%)	1.73 (0.62 – 4.84)	0.297
	No (34)	15 (44.1%)	19 (55.9%)		
Hypertension	Yes (26)	17 (65.4%)	9 (34.6%)	3.05 (1.05 – 8.84)	0.037*
	No (34)	13 (38.2%)	21 (61.8%)		
CAHD	Yes (8)	7 (87.5%)	1 (12.5%)	8.83 (1.01 – 76.96)	0.023*
	No (52)	23 (44.2%)	29 (55.8%)		
Past History of Diabetic Foot	Yes (12)	11 (91.7%)	1 (8.3%)	16.79 (2.00 –140.9)	0.001**
	No (48)	19 (36.9%)	29 (60.4%)		
Having Someone to Help at Home	Yes (35)	13 (37.1%)	22 (62.9%)	0.28 (0.09 – 0.82)	0.018*
	No (25)	17 (68.0%)	8 (8.0%)		

*Significant at 5% level. **Significant at 1% level.

Practices associated with Diabetic Foot Diseases: [Table 5] presents practices related to diabetic foot care among cases and controls. Regular physician visits were reported by 57.9% of cases and 42.1% of controls, with no statistically significant difference between the groups (p = 0.35). Regular blood glucose monitoring was practiced by 64.0% of cases and 36.0% of controls, and the difference was not statistically significant (p = 0.07). Regular foot examination was reported by 45.2% of cases and 54.8% of controls, with no significant difference observed (p = 0.26).

Table 5: Practices associated with Diabetic Foot Disease

Factors	Category	Case (N=30)	Control (N=30)	Chi2 Value	p- Value
Visiting Physician Regularly	Yes (38)	22 (57.9%)	16 (42.1%)	0.866	0.352
	No (22)	10 (45.5%)	12 (54.5%)		
Checking Sugar values Regularly	Yes (25)	16 (64.0%)	9 (36.0%)	3.360	0.067
	No (35)	14 (40.0%)	21 (60.0%)		
Examining the Foot regularly	Yes (42)	19 (45.2%)	23 (54.8%)	1.270	0.260
	No (18)	11 (61.1%)	7 (38.9%)		
Treating with Insulin	Yes (18)	16 (88.9%)	2 (11.1%)	5.556	0.001**
	No (42)	14 (33.3%)	28 (66.7%)		
Having Glucometer at Home	Yes (13)	10 (76.9%)	3 (23.1%)	4.812	0.028*
	No (47)	20 (42.6%)	27 (57.4%)		
Using MCR Chappal	Yes (25)	10 (40.0%)	15 (60.0%)	1.714	0.190
	No (35)	20 (57.1%)	15 (42.9%)		

*Significant at 5% level. **Significant at 1% level.

Insulin therapy was significantly more common among cases than controls (88.9% vs. 11.1%; p = 0.001). Similarly, availability of a glucometer at home was more frequently reported by cases compared to controls (76.9% vs. 23.1%; p = 0.03). Use of protective footwear (MCR chappal) was reported by 40.0% of cases and 60.0% of controls, with no statistically significant difference between the groups (p = 0.19).

DISCUSSION

In this study of 30 cases and 30 controls, all diabetic foot disease (DFD) cases involved unilateral lower limbs, with 63.3% affecting the dorsum or sole and 36.7% involving the leg or ankle. Ulceration was the predominant presentation (70.0%), followed by cellulitis (16.7%) and gangrene (13.3%).[5] Diabetic foot ulcers remain the most frequent and clinically significant manifestation of diabetic foot disease globally, often preceding major amputations and contributing substantially to morbidity and mortality. For example, a recent comprehensive review notes that foot ulcers account for the majority of lower extremity amputations in diabetes and are associated with high rates of infection and mortality if not managed promptly. Although cases had a higher mean duration of diabetes (10.72 years) compared with controls (8.77 years), this difference was not statistically significant in our sample. However,

extensive evidence supports longer diabetes duration as a risk factor for foot ulceration, which was similar to the North Indian study by Shahi et al. that identified increased duration of diabetes (particularly > 8 years) was significantly associated with the presence of diabetic foot ulcers compared to shorter disease duration.[6] Higher random blood sugar and HbA1C values were significantly associated with diabetic foot, the findings of which were similar to a study done by Zubair et al., in the north Indian population.[7]

Regarding personal habits, smoking and alcohol consumption were more prevalent in cases than controls, but these differences did not reach statistical significance in our study. Although studies show mixed associations between individual habits and foot ulcer risk, systematic evidence collected by Tao yan et al., identifies smoking and alcohol use as consistent modifiable risk factors for first-ever diabetic foot ulcers, along with hyperglycemia and duration of diabetes.[8]

Comorbid hypertension (OR 3.05) and coronary artery heart disease (OR 8.8) were significantly associated with diabetic foot disease in our analysis. Cardiovascular risk factors are increasingly recognized as part of the multifactorial risk profile for diabetic foot complications. Hypertension, for example, contributes to peripheral vascular disease and impaired perfusion, which can exacerbate ulcer development and delay healing. In the hospital-based study done in South Ethiopia by Deribe M et al., diabetic patients with co-morbidities had 7.8 times more chance to develop foot ulcers than those without co-morbidities.[9]

A past history of diabetic foot disease was reported in 12 participants, of whom 91.7% (11/12) were cases and 8.3% (1/12) were controls, with the difference reaching statistical significance (p = 0.001). This finding is consistent with the study by Abbott et al. in England, where the relative risk for past history of ulcer was 3.05 (95% CI: 2.16-4.31).[10]

In this study, practices related to diabetic foot care such as regular physician visits, routine blood glucose monitoring, and regular foot inspection were more frequent among cases than controls, although these differences were not statistically significant. Similarly, the distribution of protective footwear (e.g., MCR chappal) did not differ significantly between groups. The findings were consistent with the study done by Selvam et al., in rural population of Tamil Nadu that showed only 51.7% of participants did inspection of their feet daily.[11]

Insulin therapy was significantly more prevalent among cases (53.3%) than controls (6.7%). This was consistent with a large cross-sectional study done by Rubeaan et al., among Saudi Arabian diabetic patients which showed increased association of insulin therapy for diabetic foot disease, probably due to confounding effect.[12]

Although few studies have directly examined glucometer availability and diabetic foot ulcer prevalence, evidence suggests that ownership of a glucometer is associated with better self monitoring behaviours and improved foot self-care practices, which are established protective factors against foot complications. In a cross-sectional study of 267 patients done by Wogene Negash et al., those who had a glucometer at home were twice as likely to demonstrate good foot self-care practice (AOR = 2.05; 95% CI: 1.09–3.85).[13]

CONCLUSION

In this study, co-morbid conditions such as hypertension, coronary artery heart disease (CAHD), and a past history of diabetic foot disease were significantly associated with the development of current diabetic foot complications. Among patient practices, insulin therapy and the presence of a glucometer at home were also significantly associated, likely reflecting more advanced disease and closer monitoring requirements. These findings highlight the importance of targeted health education focusing on modifiable risk factors, promotion of effective foot self-care, and implementation of preventive strategies to reduce the incidence and complications of diabetic foot disease in diabetic populations.

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