

Original Research Article

Predisposing factors of diabetic foot amputation among the diabetic patients in a tertiary care hospital

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ABSTRACT

Background: Diabetes is one of the major health problems in the world. Along with multiple complications, one of those devastating complications, is diabetic foot and it can even lead to limb amputation. The objective of this study to recognize the risk factors for foot amputation among diabetic patients.

Methods: This cross-sectional study was conducted at Sir Ganga Ram Hospital of Lahore. 268 diabetic patients were recruited through a set of inclusion and exclusion criteria. After taking informed consent from all patients, data was collected via a self-designed proforma. SPSS version 25 was used to analyze data. Chi-square was applied to identify any association.

Results: From the total of 268 patients 72 (26.80%) were advised amputation, whereas, 196 (73.20%) patients were managed conservatively. The correlation between diabetic foot amputation and various factors which included gender ($p=0.0001$), educational status ($p=0.0003$), socioeconomic status ($p=0.004$), diet modification ($p=0.002$), blood sugar monitoring ($p=0.001$), life style ($p=0.0003$), therapy type ($p=0.04$), compliance with treatment ($p=0.001$), smoking ($p=0.02$), hypertension ($p=0.004$), ischemic heart disease ($p=0.03$), stroke ($p=0.01$), peripheral neuropathy ($p=0.003$), and peripheral arterial disease ($p=0.001$) was statistically significant, while, the correlation was not significant between diabetic foot amputation and duration of diabetes ($p=0.07$).

Conclusions: In summary, the incidence of foot amputation among diabetic patients is quite high. The factors that lead to foot amputation are male gender, lower educational status, lower socioeconomic status, no diet modification, no blood sugar monitoring, sedentary life style, inappropriate therapy, poor compliance, history of smoking, hypertension, ischemic heart disease, stroke, peripheral neuropathy, and peripheral arterial disease.

Keywords: Predisposing factors, Foot amputation, Diabetic patients, Tertiary care hospital, Cross-sectional, Pakistan

INTRODUCTION

Diabetes mellitus is a major medical problem with rising prevalence all over the world and in 2015 around 415 million people had diabetes. This number is expected to raise to 642 million of the population by 2040.¹ One in

every 11 individuals is afflicted by diabetes in the world. In Pakistan, almost 7.5 million people are affected by diabetes.²

Diabetes mellitus has multiple chronic complications. These complications impact almost every system of

human body. There are two types of complications including microvascular complications and macrovascular complications. Microvascular complication included retinopathy, nephropathy and neuropathy, whereas, macrovascular complications involved ischemic heart disease, cerebrovascular disease, and peripheral arterial disease.^{3,4}

Along with these aforementioned complications, one of the very lethal complications of diabetes mellitus is diabetic foot. Diabetic foot indicates an area of necrosis and gangrene distal to ankle joint.⁵ The causative agents for diabetic foot consisted of peripheral neuropathy, peripheral arterial disease, and infection.⁶ Diabetic foot is one of the main causes for diabetic patients to get hospitalized and eventually it leads to financial burden over individuals, families, and society as well. Moreover, approximately 90% of non-traumatic lower limb amputations which is caused by diabetic foot only and thus it also leaves people physically paralyzed as well.⁷ The prevalence of diabetic foot around the globe was 3% to 10%, whereas, in Pakistan it was 13.90% in previous years.^{8,9}

People with diabetic foot get managed, either in conservative manner via wound dressing and antibiotics, or through amputation of affected foot.⁷ In literature, many factors have been mentioned which affect diabetic foot prevalence and its treatment among diabetic patients. These factors included gender, educational status, socioeconomic status, duration of diabetes, diet modification, blood sugar monitoring, life style, type of therapy, compliance with treatment, smoking, hypertension, ischemic heart disease, stroke, peripheral arterial disease, and peripheral neuropathy.^{1,7,10,11,12}

Taking into account there is limited information accessible in Pakistan in regards to predisposing factors of amputation of foot among diabetic population, therefore, this study was directed to recognize those factors. Identification of those factors would help to bring down the financial burden over patients and healthcare centers' limited resources of developing countries like Pakistan.

METHODS

This comparative cross-sectional study was conducted among the diabetic (diabetes type II) patients who came with problems relevant with diabetic foot in the surgical outpatient department of Sir Ganga Ram hospital of Lahore, Pakistan in the time duration of approximately nine months from April 2021 till December 2021. Ethical approval was taken from IRB (Institutional Review Board) of institute. Study sample size was calculated through WHO sample size calculator and it was 268 with confidence interval of 95%. Only those patients who were willing to participate and who had no trauma history were recruited while patients who had history of any trauma and were not willing to participate were excluded from study. Non-probability convenient sampling was used to select

participants. Patients were categorized into two categories based on the treatment advised to them. One category of patients was treated through amputation whereas, other category of patients was treated with antibiotics and wound dressings.

A self-structured questionnaire was built to collect the required data from patients. Informed consent was taken from all patients and the objectives of study was told to the participants, before the collection of data. Questionnaire had two components. First was related to the demographic information of the participants. Demographic information included age, gender, educational status (Under matric or above matric), and socioeconomic status based on monthly income (lower class= less than 20,000 or middle class= above 20,000) of participants. In second part of questionnaire, data regarding the duration of diabetes (longer= 8 and above 8 years, shorter= below 8 years), diet modification according to diabetes chart (yes or no), life style (sedentary or active), type of therapy for diabetes (insulin, oral hypoglycemic agents, or both), compliance with therapy (good= daily intake of medicine or insulin or both while, poor= medicine or insulin intake when feasible only), daily blood sugar monitoring (yes or no), smoking history (yes or no), hypertension (yes or no), stroke history (yes or no), and ischemic heart disease history (yes or no) was collected. Physical examination was also performed of each patient to check for peripheral neuropathy and peripheral arterial disease. Patients were considered to have peripheral neuropathy, if the vibration sensation was reduced or absent in the foot and it was assessed by a tuning fork of 252 Hz, while patients with absent pulses of posterior tibialis and dorsalis pedis in lower limbs were considered to have peripheral arterial disease. These findings were also written on the used questionnaire.

After data collection, data organization and analysis were performed with the help of SPSS version 25. Descriptive and inferential statistics were used for the evaluation of the study variables. Means and Standard deviations (SD) were determined for quantitative variables while frequency and percentage of qualitative variables were determined. The determinants of diabetic foot were compared between two groups and then chi-square analysis via p value was used to assess the association between the diabetic foot and included determinants. P value less than 0.05 was considered statistically significant.

RESULTS

Out of 268 participants 160 (59.70%) were males while 108 (40.30%) were females. The means of age and duration of diabetes for study population were 57.60 years with SD of ± 10.79 years and 14.56 years with SD of ± 7.89 years respectively.

The percentage of patients who had been advised amputation of foot was 26.80%, whereas, patients who had been advised conservative treatment for diabetic foot were 73.20% as mentioned in Table 1 as well.

Figure 1 shows the percentages of male and female in our study population. Figure 2 manifests the percentages of two groups of participants based on their educational status.

Figure 3 demonstrates the percentages of two categories of patients depending upon their socioeconomic class.

Table 1 indicates that in comparison to non-amputation group of patients, the amputation group of patients had more patients with male gender, lower educational status, lower socioeconomic status, longer duration of diabetes, no diet modification, no blood sugar monitoring, sedentary life style, oral hypoglycemic agent as therapy of choice for diabetes, poor treatment compliance, history of smoking, and peripheral arterial disease.

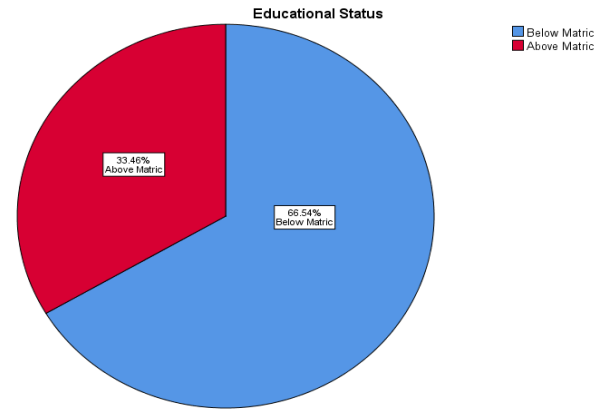


Figure 2: Distribution of participants based on educational status.

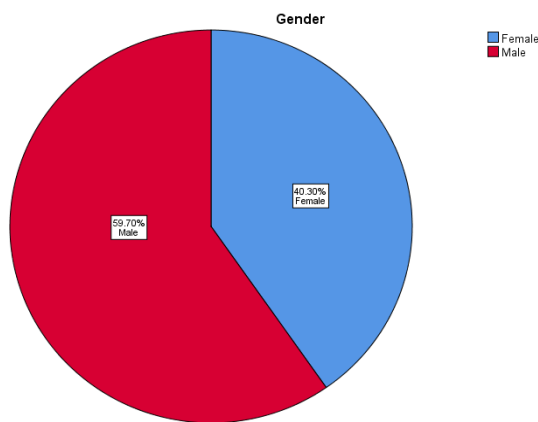


Figure 1: Distribution of participants based on gender.

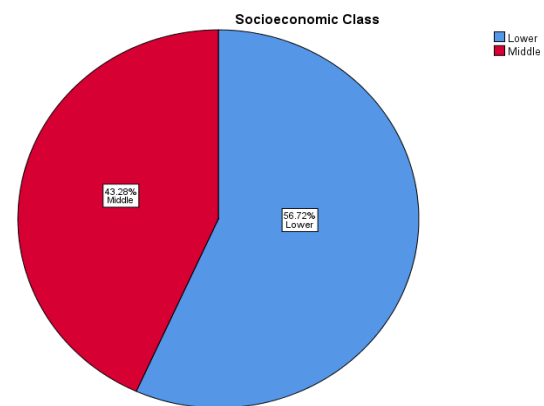


Figure 3: Distribution of participants based on socio-economic status.

Table 1: Association of study variables with diabetic foot amputation.

Parameters	N=268 (%)	Diabetic patients' groups N (%)		Chi square analysis
		Amputation	Non-amputation	
		72 (26.80)	196 (73.20)	
Gender	Male	160 (59.70)	52 (26.80)	0.0001
	Female	108 (40.30)	88 (44.90)	
Educational status	Below metric	178 (66.31)	48 (24.48)	0.0003
	Above metric	90 (33.69)	66 (33.68)	
Socioeconomic status	Lower class	152 (56.71)	55 (27.54)	0.004
	Middle class	116 (43.29)	99 (50.52)	
Duration of diabetes	Longer	148 (55.22)	39 (20.41)	0.07
	Shorter	120 (44.78)	87 (44.38)	
Diet modification	Yes	112 (41.80)	23 (11.71)	0.002
	No	156 (58.20)	107 (54.60)	
Blood sugar monitoring	Yes	53 (19.77)	18 (9.18)	0.001
	No	215 (80.23)	161 (82.14)	
Life style	Active	78 (29.10)	14 (7.14)	0.0003
	Sedentary	190 (70.90)	132 (67.35)	
Type of therapy	Insulin	63 (23.50)	18 (9.18)	0.04
	Oral hypoglycemic agents	183 (68.28)	39 (20.41)	
	Both	22 (8.22)	7 (3.57)	

Continued.

Parameters	N=268 (%)	Diabetic patients' groups N (%)		Chi square analysis
		Amputation	Non-amputation	
		72 (26.80)	196 (73.20)	
Compliance with treatment	Good	69 (25.75)	12 (16.66)	0.001
	Poor	199 (74.25)	60 (83.34)	
Smoking	Yes	55 (20.52)	Yes 55 (20.52)	0.02
	No	213 (79.48)	No 213 (79.48)	
Hypertension	Yes	78 (29.10)	Yes 78 (29.10)	0.004
	No	190 (70.90)	No 190 (70.90)	
Ischemic heart disease	Yes	61 (22.76)	Yes 61 (22.76)	0.03
	No	207 (77.24)	No 207 (77.24)	
Stroke	Yes	17 (6.34)	Yes 17 (6.34)	0.01
	No	251 (93.66)	No 251 (93.66)	
Peripheral neuropathy	Yes	109 (40.67)	Yes 109 (40.67)	0.003
	No	159 (59.33)	No 159 (59.33)	
Peripheral arterial disease	Yes	125 (46.65)	Yes 125 (46.65)	0.001
	No	143 (53.35)	No 143 (53.35)	

DISCUSSION

The prevalence of diabetes mellitus is high but still its increasing all over the world. Diabetes could be very devastating when its complications occur. It has multiple and deadly complications that involve every major system of the body. It could lead to ischemic heart disease, stroke, and peripheral vascular disease by affecting major vessels of body, while, when it impacts microvasculature, it leads to lethal effects on eye (retinopathy), kidneys (nephropathy), and nerves (neuropathy).^{3,4} Along with aforementioned complications it could lead to a very destructive change among the diabetic patients with poor diabetes control in the form of diabetic foot. Inappropriate care of diabetic foot can bring further problems in the life of diabetic patients when poor diabetic foot care leads to its amputation. It all shows that how deadly diabetes could be when it goes beyond proper control.

The diabetic foot could be managed conservatively with proper wound dressing and antibiotics. But when the tissues of diabetic foot get infected and necrosed then only option we left with is foot amputation.⁷

The incidence of the diabetic foot amputation among the diabetic population of our study was high 26.80%. Little lower incidence (22.50%) of diabetic foot amputation has been noted in a study that was also conducted among Pakistani population.⁷ In a study at China 21.50% amputation has been noted as well.¹⁴

The incidence of diabetic foot amputation could be affected by many factors as mentioned in literature.^{1,7} Diabetic foot amputation incidence was higher among males as compared to females in our study. A study in revealed same link between gender and diabetic foot amputation.¹³ The lower educational status and lower socioeconomic status were found to raise the incidence of amputation among this study population. Educational

status and socioeconomic status were correlated with amputation of diabetic foot in other literature as well.^{1,7}

Almost all factors that are related to diabetes management including diet modification, blood sugar monitoring, life style, type of therapy, and compliance with therapy were associated with amputation of diabetic foot significantly except the duration of diabetes. No change in diet, irregular blood sugar monitoring, sedentary life style, oral hypoglycemic agents, and poor compliance were associated with higher incidence of diabetic foot amputation. Similar findings have been noted in other studies that were conducted in various countries.^{7,15}

In the next step of data analysis, we observed that history of comorbidities which comprised of smoking, hypertension, ischemic heart disease, and stroke were strongly involved in the rise of foot amputation incidence among diabetic patients. Relationship between smoking and diabetic foot amputation has also been noted in a study of China.¹⁶ Likewise, the association between cardiovascular system related diseases hypertension and ischemic heart disease and amputation of diabetic foot, is also established in literature.^{7,17} Furthermore, stroke has also been labelled as culprit in causation of amputation among diabetic patients like our study has indicated.⁷

Diabetic complications including peripheral neuropathy and peripheral arterial disease that occur in the advance stage of the diabetes were also noted as factors that predispose to the foot amputation to the diabetic patients with diabetic foot.

Amputation incidence could be higher among diabetic patients with peripheral vascular disease, as this disease brings obstruction in the flow of the blood to the peripheries which lead to gangrenous changes in the limbs and consequently amputation of limbs becomes the only treatment for diabetic foot.

A study in literature showed that almost all its participants who went through amputation of foot, had peripheral vascular disease.¹⁸ Peripheral neuropathy among diabetic patients has been considered as risk factor for amputation of foot in other study, similar to this study.¹⁹

The awareness of these factors is very important among the both general population and authorities who make policies of health system. A multidisciplinary team should establish a plan for the prevention of controllable factors that lead to amputation of foot. Because amputation of foot among patients not only bring economic burden over diabetic population and healthcare but also mental problems among patients which further worsen the situation. Thus, by applying suitable interventions for the prevention of preventable factors we could reduce diabetic foot amputation incidence and issues related with it among diabetic patients.

Limitations

Although our study has highlighted the factors are very crucial in the determination of the incidence of diabetic foot amputation and its prevention as well, however, our study has also some limitations. First one is that we could not add the co-existing factors like nutritional deficiencies and autoimmune diseases of vessels which might have led to peripheral neuropathy and peripheral vascular disease respectively. Second one is that we only considered those diabetic patients who came in hospital for management and therefore, these factors are more specific to those diabetic patients whose disease was severe that's why they came to hospital, and factors for diabetic foot among patients with less severity might have different results.

CONCLUSION

In a nutshell, our study has highlighted the high incidence of diabetic foot amputation in study population. The incidence of foot amputation was high among the patients who had male gender, lower educational status, lower socioeconomic status, longer duration of diabetes, no diet change, no proper blood sugar monitoring, sedentary type of life style, inadequate therapy, poor compliance with treatment, history of smoking, hypertension, ischemic heart disease, stroke, peripheral neuropathy, and peripheral arterial disease and these factors were correlated with incidence of diabetic foot amputation significantly except duration of diabetes. So, by controlling the controllable factors we could prevent the foot amputation among diabetic patients. Consequently, the decrease in diabetic foot amputation incidence would lead to reduction in financial burden over families and over economy of a country.

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