

Peripheral Neuropathy and Foot Care Practices Among Patients with Diabetes Mellitus Attending a Tertiary Care Hospital: A Cross-sectional Study

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ABSTRACT:

Introduction: Peripheral neuropathy is the most common microvascular complication of diabetes mellitus. Foot care is an important part of diabetes management. This study aimed to identify the prevalence of peripheral neuropathy and foot care practices among diabetic patients. **Methods:** A descriptive cross-sectional study was conducted in 178 patients diagnosed with diabetes mellitus and attending out-patient and in-patient departments of Internal Medicine at Kathmandu University Hospital, Dhulikhel. The participants were conveniently selected. Face-to-face interviews and a foot examination were used to collect data. The Michigan Neuropathy Screening Instrument and the Nottingham Assessment of Functional Foot Care were used to determine the prevalence of peripheral neuropathy and to assess foot care practices. **Results:** The prevalence of peripheral neuropathy was 41% among the participants, and it was associated with increasing age. The majority (75.8%) of the participants had good foot care practices. Male gender was significantly associated with good foot care practices [AOR = 5.973, 95% CI (2.037-17.515)], whereas past smokers [AOR = 0.296, 95% CI (0.111-0.791)] and not receiving diabetes education [AOR = 0.367, 95% CI (0.151-0.892)] were significantly associated with poor foot care practices. **Conclusion:** The prevalence of peripheral neuropathy was found to be high, and it was linked to an increased age group. The majority of the participants had good foot care practices. However, in comparison, females were found less likely to practice foot care than males.

Key words: Diabetes mellitus, Foot care practices, Foot ulcers, Peripheral neuropathy.

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In 2019, it was estimated that 463 million people would have diabetes, and this number is projected to reach 578 million by 2030 and 700 million by 2045.[1] Diabetic peripheral neuropathy (DPN) is the most common microvascular complication among people with diabetes that involves peripheral nervous system dysfunction.[2]

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INTRODUCTION:

Diabetic peripheral neuropathy can affect the nerves of both the upper and lower extremities. It most commonly starts in the feet and can arise in both feet.[3] Approximately, 50% of DPN may be asymptomatic, putting affected feet at a higher risk of foot injuries and problems.[4] Different studies conducted in India showed the prevalence of diabetic neuropathy to be 32.2% and 60.7%, respectively. [5,6] Similar studies done in Nepal showed 10.7%, 38.1%, and 45.4% prevalence of diabetic peripheral neuropathy, respectively.[7,8,9]

Foot care is an important part of diabetes patient education to prevent foot ulceration. The American Diabetes Association recommends an annual comprehensive foot evaluation to identify predisposing factors for ulcers and amputations among diabetic people.[10] Daily foot and shoe checks, proper foot hygiene, not walking barefoot, wearing appropriate shoes, and trimming toenails are very important for diabetic patients. Similarly, avoiding using anything abrasive on the feet, getting early professional care for wounds and lesions, and having a routine foot examination by a trained health care worker are all part of proper self-foot care practices.[11] In diabetic patients, routine foot examinations and foot care techniques can reduce ulcer incidence by 50% and amputation by up to 85%.[12,13] Though significant relationships between diabetic neuropathy and foot care practices were not found in a previous study, complications from diabetic neuropathy can be decreased through practicing proper foot care practices.[14] This study was conducted to determine the prevalence of peripheral neuropathy and associated factors among patients with diabetes mellitus attending Dhulikhel hospital.

METHODS:

This was a hospital-based cross-sectional study done among patients with diabetes mellitus who visited the out-patient (OPD)

and inpatient departments of Internal Medicine at Kathmandu University Hospital, Dhulikhel Hospital, Kavre, Nepal. The study was initiated after an approval was received from the Institutional Review Committee of Kathmandu University of Medical Science (Approval number: 203/19) and from the head of the department of Internal Medicine at Dhulikhel Hospital.

Patients who had been diagnosed with diabetes for at least six months were included. Patients with other health conditions that can cause peripheral neuropathy, such as congenital neuropathies, hypothyroidism, cerebrovascular disease, chronic renal or liver failure, patients on antiretroviral therapy, or chemotherapy, were excluded from the study.

A total of 178 patients were conveniently sampled for the investigation, which was determined from a prior study by KC A et al. that found a prevalence of 10.74 percent, at a level of error of 5%, and a 95% confidence interval with a 20% attrition rate.[7] The sample size was calculated using the formula $n = Z^2 p (1-p)/d^2$. [15]

Instruments for data collection

Part I: The socio-demographic characteristics consisted of age, gender, level of education, income, and clinical characteristics including smoking status, duration of illness, types of medication received, family history of diabetes, prior diabetes education, and body mass index (BMI).

Part II: Nottingham Assessment of Functional Foot Care Assessment, which consists of 26 items, was used to assess foot care among patients with diabetes. Responses to questions were recorded on a categorical scale (scored 0-3) according to the frequency of occurrence of the behavior. The maximum obtainable score was 78. It was considered good practice if the score was at least 50% and poor practice if the score was less than 50%.[16]

Part III: A Michigan Neuropathy Screening Instrument (MNSI) was used to determine peripheral neuropathy. It consists of two parts, history and physical assessment. A physical assessment was done to determine peripheral neuropathy. The assessment consists of: (1) An inspection of the feet for deformities, dry skin, hair or nail abnormalities, calluses or infection, (2) Semi-quantitative evaluation of vibration sensation at the dorsum of the great toe, (3) Ankle reflex grading and, (4) Monofilament testing. The total score was 10 points, out of which 2.5 points were considered presence of peripheral neuropathy in participants.[17]

Data Collection Procedure

The researcher received training in foot evaluation in diabetic patients from a nurse educator at Dhulikhel Hospital's diabetic counseling section. The study was initiated once the diabetic counseling section granted the verbal permission.

The researcher then approached diabetic patients admitted to medical wards and patients visiting the OPD of Internal Medicine. The study's objectives were conveyed to the participants. Informed consent for voluntary participation was taken from the participants who met inclusion criteria.

The researcher conducted interviews using semi-structured and structured questionnaires to obtain socio-demographic information, diabetes-related information, and foot-care practices information. The researcher evaluated peripheral neuropathy in terms of foot examination, vibration sensitivity with a 125 Hz tuning fork test, muscle stretch responses with a queen square reflex hammer, and monofilament testing with a 10g filament. It took approximately 30 minutes to complete each interview and foot examination. For inpatient participants, interviews were conducted at their bedsides (one corner of

the room) by using a curtain, whereas for those visiting the OPD, interviews were conducted in room number four of the internal medicine OPD. Data was only accessible to the researcher. On average, seven patients participated in the study every day. The data was collected from November 18th to December 23rd, 2020.

Version 23 of the Statistical Package for the Social Sciences (SPSS) was used to tabulate and analyze the gathered data. Both descriptive and inferential statistics were used to analyze the acquired data. The socio-demographic data, clinical characteristics, foot care practice, and prevalence of peripheral neuropathy were described using frequencies, percentages, median mean, and standard deviation (SD). Binary logistic regression was used to investigate the relationship between selected independent variables and foot care practices, as well as peripheral neuropathy, by computing crude and adjusted odds ratios with 95% confidence intervals (CI). The link between peripheral neuropathy and foot care behaviors was investigated using the Chi square test, with a p value of 0.05 considered statistically significant.

RESULTS:

The mean age of the participants was 57.2 ± 11.1 years. Among the participants, 51.1% were from the age group of 41-60 years, and 56.2% were male (Table 1).

Table 2 revealed that more than one-third of the study participants (43.3%) had smoked in the past. Almost two-thirds of the individuals (69.7%) did not have a family history of diabetes. The average length of disease was 6.8 ± 6.0 years. Regarding foot care practice, 69.7% of the participants examined their feet once a week or less. About two-thirds of the participants (65.2%) examined shoes before wearing them, but the majority (73.6%) never did so after taking them off.

Table 1: Socio-demographic characteristics of the participants (n = 178)

Characteristics	Frequency (%)
Age in completed years	
30-40	14 (7.9)
41-60	91 (51.1)
>60	73 (41.0)
Sex	
Male	100 (56.2)
Female	78 (43.8)
Level of education	
Illiterate	90 (50.6)
Primary level	29 (16.3)
Secondary level	45 (25.3)
Higher secondary level	10 (5.6)
Bachelor or above	4 (2.2)
Income per month in rupees	
≤ 20000	114 (64.0)
>20000	64 (36.0)

More than half (56.8%) of the participants never checked their feet for drying after washing, while 71.3% of the participants rarely/never dried in between the toes. Most of the participants (69.1%) never used moisturizing cream on their feet. More than half (59.5%) of the participants trimmed their toenails about once a month. Almost half (51.1%) of the participants sometimes

Table 2: Clinical characteristics of the participants (n = 178)

Characteristics	Frequency (%)
Smoking status	
Current smoker	27 (15.1)
Past smoker	77 (43.3)
Non smoker	74 (41.6)
Family history of diabetes	
Yes	54 (30.3)
No	124 (69.7)
Duration of diabetes in years	
<1year	12 (6.7)
1-5 years	75 (42.1)
6-10 years	55 (31.0)
>10 years	36 (20.2)
Types of medication	
Oral anti -diabetic medication	146 (82.0)
Injectable Insulin	3 (1.7)
Both	29 (16.3)
Diabetes education received	
Yes	111 (62.4)
No	67 (37.6)
BMI	
Underweight	3 (1.7)
Normal	63 (35.4)
Overweight	66 (37.1)
Obesity	46 (25.8)

wore shoes with lace-up, velcro, or strap fastenings. A majority (87.1%) of the participants had never worn pointed shoes, with two-thirds (68%) of the participants sometimes wearing flip flops. Most of the participants (83.1%) rarely/never broke in new shoes gradually, whereas two-thirds (68.5%) never used nylon socks.

Most of the participants, i.e. (93.3% and 92.7%), never used a hot water bottle in bed

or put their feet on a radiator, respectively. In the present study, 75.8% of the participants had good foot care practices. (Additional file 1)

Table 3 shows the MNSI physical assessment of the patients. The overall prevalence of diabetic peripheral neuropathy was 41% which was calculated based on the MNSI examination score.

Table 3 Michigan Neuropathy Screening Instrument physical assessment findings of the participants (n=178)

Items	Categories	Number (%)	
		Right	Left
Appearance of Feet Normal	Yes	78 (43.8)	81 (45.5)
	No	100 (56.2)	97 (54.5)
Type of abnormal appearance	Deformities	5 (2.8)	4 (2.2)
	Dry skin/callus	53 (29.8)	52 (29.2)
	Fissure	73 (41.0)	74 (41.6)
	Athletes foot	20 (11.2)	17 (9.6)
Ulceration	Absent	176 (98.9)	176 (98.9)
	Present	2 (1.1)	2 (1.1)
Ankle Reflexes	Present	148 (83.1)	152 (85.4)
	Present/Reinforcement	27 (15.2)	23 (12.9)
	Absent	3 (1.7)	3 (1.7)
Vibration perception at great toe	Present	102 (57.3)	95 (53.3)
	Decreased	33 (18.5)	30 (16.9)
	Absent	43 (24.2)	53 (29.8)
Monofilament testing	Normal	140 (78.7)	146 (82)
	Reduced	27 (15.1)	23 (12.9)
	Absent	11 (6.2%)	9 (5.1)

Table 4: Factors associated with peripheral neuropathy among the participants (n=178)

Characteristics		Peripheral neuropathy Number (%)		COR (95% CI)	AOR (95% CI)	p value
		Absent	Present			
Age in years	30-40	13 (92.9)	1 (7.1)	0.05 (0.01-0.41)	0.04 (0.01-0.38)	0.005
	41-60	63 (69.2)	28 (30.8)	0.29 (0.15-0.56)	0.22 (0.10-0.49)	<0.001
	>60	29 (39.7)	44 (60.3)	1.0	1.0	
Sex	Male	57 (57.0)	43 (43.0)	1.21 (0.66-2.21)	0.70 (0.30-1.66)	0.419
	Female	48 (61.5)	30 (38.5)	1.0	1.0	
Smoking status	Current smoker	15 (55.6)	12 (44.4)	1.77 (0.72-4.38)	2.00 (0.69-5.82)	0.203
	Past smoker	39 (50.6)	38 (49.4)	2.16 (1.11-4.20)	1.66 (0.76-3.62)	0.202
	Non-smoker	51 (68.9)	23 (31.1)	1.0	1.0	
Family history of diabetes	No	70 (56.5)	54 (43.5)	1.42 (0.73-2.75)	1.18 (0.54-2.57)	0.679
	Yes	35 (64.8)	19 (35.2)	1.0	1.0	
Duration of diabetes	<1 year	7 (58.3)	5 (41.7)	0.64 (0.17-2.40)	0.82 (0.18-3.73)	0.797
	1-5 years	50 (66.7)	25 (33.3)	0.45 (0.20-1.01)	0.70 (0.25-1.96)	0.493
	6-10 years	31 (56.4)	24 (43.6)	0.69 (0.30-1.61)	0.73 (0.25-2.07)	0.550
	> 10 years	17 (47.2)	19 (52.8)	1.0	1.0	
Type of medication	Only one	88 (59.1)	61 (40.9)	0.98 (0.44-2.20)	1.12 (0.39-3.19)	0.835
	Both	17 (58.6)	12 (41.4)	1.0	1.0	
Diabetes education received	No	41 (61.2)	26 (38.8)	0.86 (0.46-1.60)	0.73 (0.35-1.53)	0.403
	Yes	64 (57.7)	47 (42.3)	1.0	1.0	
BMI	Under-weight/normal	38 (57.6)	28 (42.4)	0.96 (0.45-2.05)	0.66 (0.27-1.63)	0.370
	Over-weight	41 (62.1)	25 (37.9)	0.79 (0.37-1.07)	0.56 (0.24-1.34)	0.191
	Obesity	26 (56.5)	20 (43.5)	1.0	1.0	

Note: AOR: adjusted odds ratio, COR crudes odds ratio, CI: confidence interval

Table 5 Factors associated with foot care practices among the participants (n=178)

Characteristics		Practice level		COR (95% CI)	AOR (95% CI)	p value
		Poor	Good			
Age in years	30-40	6 (42.9)	8 (57.1)	0.61 (0.19-1.97)	0.30 (0.06-1.37)	0.12
	>41-60	14 (15.4)	77 (84.6)	2.5 (1.19-5.37)	2.48 (0.99-6.24)	0.054
	>60	23 (31.5)	50 (68.5)	1.0	1.0	
Sex	Male	14 (14.0)	86 (86)	3.64(1.75 -7.52)	5.97 (2.04-17.52)	<0.001
	Female	29 (37.2)	49 (62.8)	1.0	1.0	
Education	Illiterate	30 (33.3)	60 (66.7)	0.54 (0.14-2.10)	1.92 (0.36-10.36)	0.449
	Primary	4 (13.8)	25 (86.2)	1.70 (0.32-8.93)	2.33 (0.37-14.52)	0.364
	Secondary	6 (13.3)	39 (86.7)	1.77 (0.38-8.26)	2.82 (0.49-16.22)	0.244
	Higher	3 (21.4)	11 (78.6)	1.0	1.0	
Income per month in rupees	≤20000	29 (25.4)	85 (74.6)	0.82 (0.40-1.70)	0.79 (0.33-1.91)	0.599
	>20000	14 (21.9)	50 (78.1)	1.0	1.0	
Smoking status	Current smoker	5 (18.5)	22 (81.5)	1.12 (0.36-3.44)	0.55 (0.14-2.10)	0.378
	Past smoker	23 (29.9)	54 (70.1)	0.60 (0.28-1.26)	0.30 (0.11-0.79)	0.015
	Non-smoker	15 (20.3)	59 (79.7)	1.0	1.0	
Family history of diabetes	No	29 (23.4)	95 (76.6)	1.15 (0.55-2.40)	1.74 (0.69-4.38)	0.239
	Yes	14 (25.9)	40 (74.1)	1.0	1.0	
Diabetes education	No	21 (31.3)	46 (68.7)	0.54 (0.27-1.09)	0.37 (0.15-0.89)	0.027*
	Yes	22 (19.8)	89 (80.2)	1.0	1.0	

Note: AOR: adjusted odds ratio, COR: crudes odds ratio, CI: confidence interval

Table 4 revealed the significant association found between age and peripheral neuropathy [AOR 0.041, 95% CI (0.005-0.375)]. The prevalence of peripheral neuropathy was less likely to occur in the age group 30-40 years than other age groups.

Table 5 showed that, the statistically significant association was found between foot care practices and sex of participants [AOR=5.973, 95% CI (2.037-17.515), $p < 0.001$]. Male participants were about six times more likely to practice foot care than females. Foot care practice and smoking status [AOR = 0.296, 95% CI (0.111-0.791), $p = 0.015$], and foot care practice and diabetes education [AOR=0.367, 95% CI (0.151-0.892), $p=0.027$] were also found to have significant associations. Past smokers were less likely to practice foot care than nonsmokers and current smokers. The participants who had received diabetes education were more likely to practice adequate foot care ($p=0.027$).

There was no statistically significant association found between peripheral neuropathy and foot care practices among the participants [$\chi^2=1.675$, $p > 0.05$].

DISCUSSION:

The aim of the study was to identify the prevalence of peripheral neuropathy and foot care practices among diabetic patients. In this study, the prevalence of peripheral neuropathy was 41%. Similar findings were observed in other studies.[8,9,18,19] A systematic review and meta-analysis conducted in Africa also showed a 46% prevalence of peripheral neuropathy, which was consistent with the present study.[20] In contradiction, the studies conducted in Tanzania by Amour et al. and in India by

Begum et al. reported the prevalence of peripheral neuropathy 72.2% and 52.9% respectively, which were higher than the present study.[21,22] Likewise, the prevalence of peripheral neuropathy found in our study was higher than in the studies conducted by D'Souza M, KC A, Sun J, and Kisozi T et al. which reported prevalence of 32.2%, 10.7%, 30%, and 29.4%, respectively.[5,7,23,24] Few other studies showed that the prevalence of peripheral neuropathy was 29.2% among them, 33.7% of which was found in known diabetic mellitus, and 9.2% was found in newly detected diabetes mellitus.[5,25] The results of the studies suggested that the peripheral neuropathy can be prevented if the problem is screened timely and detected early enough. The major determinants associated with diabetic peripheral neuropathy were found to be male gender, smoking, and age > 40 years of age.[5,7] The variation in prevalence may be due to diabetes types, sample size, and instruments used to detect peripheral neuropathy.

The mean age of the patients in this study was 57.2 ± 11.1 years. In the present study, one of the contributing factors for diabetic peripheral neuropathy was increasing age. Likewise, other studies conducted by Shrestha HK, Karki D, Amour AA, and Katulanda P et al. demonstrated that increasing age, gender, longer duration of diabetes, smoking, obesity, and glycemic control were found to be significantly associated with diabetic peripheral neuropathy.[8,9,21,26]. Old age is an independent risk factor for the development of diabetic neuropathy in type II diabetes mellitus. Another probable reason may be that type II DM usually diagnosed in old age because they are asymptomatic.

Katulanda P et al. observed that females were more likely to develop diabetic peripheral neuropathy than males which were similar to our study although it was not statistically significant.[26] Our study

also demonstrated that longer duration of diabetes (>10 years) was more prevalent (52.8%) in peripheral neuropathy, but it was not significant, which was supported by a study done by Shrestha et al.[8]. Another study revealed that the duration of diabetes mellitus more than one year and elevated fasting blood glucose levels were significant predictors for patients to have diabetic peripheral neuropathy.[27] The lack of association between the duration of diabetes and peripheral neuropathy may be due to other risk factors for peripheral neuropathy like glycemic control, dyslipidemia, and hypertension, which were not included in this study. In the present study, there was no association found between peripheral neuropathy and smoking status, which was in contrast to the study conducted by Begum et al.[22] While the study conducted by Ugoyo et al. showed that there was no significant association found between body mass index and peripheral neuropathy, which was comparable with our study.[21] Whereas, Amour et al. demonstrated that obesity was found to be statistically significant with peripheral neuropathy.[28]

Moreover, the present study also found that about three-fourth of the participants had conducted good foot care practices, while 24.2% had poor foot care practices. This finding was consistent with the studies conducted by George H, Shrestha TM and Gholap MC et al. which reported that more than two-third of the participants had good foot care practices.[18,29,30] The possible reason for good foot care practice may be that the majority of the patients were literate and had received diabetic education. On the contrary, few other studies have indicated that the majority of participants had poor foot care practice.[31,32,33,34] Similarly, Chatterjee S et al., Pavithra H et al. and Seid A et al. also reported that 40%, 41.6% and 53% participants respectively had good foot care practice, but lower than the present study.[35,36,37]

Chatterjee S et al. revealed that nearly two-thirds of the study participants examined their feet everyday, which is contradictory to the current study (22.5%).[35] The results of this study are comparable to those of Pavithra H et al., who reported 30.9% of participants in their study.[36] According to the study conducted by Seid S et al. 38.7% and 45.7% of the participants had never checked their shoes before putting them on and after taking them off, respectively which is higher in the present study (56.7%, 71.3%).[37]

Furthermore, our study also demonstrated the significant association of gender, smoking status, and diabetes education with foot care practices. Male participants were about six times more likely to practice foot care than female participants, which is statistically significant and this finding is comparable with the study conducted by D'Souza et al.[5] The reason could be the better education of male gender than female in Nepal. Similarly, Abu-Elenin et al. also showed the significant association among foot care practices and diabetic educations.[33] Muhammad-Lotfi et al. revealed that age, level of education, and duration of diabetes had no significant relationship with foot practice.[31] This finding was consistent with that of the current study, but it is not comparable with the studies conducted by Pourkazemi et al. and Magbanua et al. which showed significant associations between foot care practices and duration of diabetes.[38,39]

Moreover, in the present study, there was no significant association found between peripheral neuropathy and foot care practices among the participants, which was in line with the study done in Iraq by Saber et al.[14] Although there was no association between peripheral neuropathy and foot care practices, good foot care practice can help in decreasing diabetic foot complications. So it is very important to practice good foot care among all diabetic patients, especially those who have diabetic peripheral

neuropathy, to prevent diabetic foot ulcers. The limitations of the study are that the questionnaires regarding types of shoes were only asked verbally to the participants, but if the shoes were shown in a real setting, it would have decreased the distortion of the questionnaires. Apart from that, the study participants did not have equal opportunities to engage in the study due to the convenient sampling technique, which reduced the generalizability of the findings.

CONCLUSION:

The prevalence of peripheral neuropathy was found to be high, and it was linked to an increased age group. The participants thought foot care was a useful practice. Foot care practices were shown to be substantially linked with gender, smoking status, and diabetes education. As a result, it is critical to give all diabetics frequent clinical foot examinations, diabetic education, and encouragement of proper self-foot care practices.

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