

**Original article:**

## **Prevalence of Diabetic Peripheral Neuropathy (DPN) and associated determinants in individuals having type-2 diabetes mellitus in tertiary care center in Rajasthan, India**

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### **Abstract:**

**Introduction:** India has one of the highest prevalence of type-2 diabetes mellitus (T2DM) in the world. Diabetic Peripheral Neuropathy (DPN) is a well-known micro-vascular complication of T2DM attributed to chronic hyperglycaemia and is defined as the presence of peripheral nerve dysfunction in diabetics after exclusion of other causes.[

**Methodology:** A Hospital based, cross-sectional study was done in Churu district in Rajasthan, India. The objective of the study was to estimate the prevalence of the DPN and its association with determinants and to assess the sociodemographic and economic status of the participants.

**Results:** The overall prevalence [Table 3] of the DPN was 33.76 %. Prevalence of DPN was 36.36% in males and 30.4% in females. Males was having more PN compared to females, but it was not statistically significant ( $p=0.254$ ). The participants who were more than 50 years were had more PN than <50 years, and it was not statistically significant ( $P= 0.786$ ). With respect to BMI, the overweight and obese were having almost similar prevalence of DPN than normal BMI.

**Conclusion:** In the present study, we found that males were having slightly more DPN than the females and with a similar study showing that males being at higher risk in the Diabetes Control and Complications.

**Keywords:** diabetes mellitus , Diabetic Peripheral Neuropathy

### **Introduction**

India has one of the highest prevalence of type-2 diabetes mellitus (T2DM) in the world. Diabetic Peripheral Neuropathy (DPN) is a well-known micro-vascular complication of T2DM attributed to chronic hyperglycaemia and is defined as the presence of peripheral nerve dysfunction in diabetics after exclusion of other causes.[2] The adverse effects of peripheral neuropathy (PN) are compounded by poor foot hygiene, improper footwear, and frequent barefoot walking, in such circumstances complications of foot infections and gangrene are a common cause of hospital admissions.[1] Clinically, diabetic neuropathy is a destructive disease of the peripheral nerve leading to symptoms of pain or paraesthesia or problems arising from neurological deficit.[3] The major problem with the development of DPN is that the changes are subtle and happen as people get older, people tend to ignore the signs of nerve damage, thinking it is just part of getting older.[4] Available evidence

suggests that the presence reduced quality of life, mainly attributable to the morbidity and mortality associated with DPN.<sup>[5]</sup> Hence, the problem of DPN demands the application of the concept of secondary prevention through early diagnosis and treatment. Screening for DPN in the clinical practice using a simple objective tool is essential, as the detection of the various soft and subtle signs of DPN at the earliest could minimize the damaging effects of this serious but manageable microvascular complication and in turn improve the quality of life of such patients. Foot disorders remain a major source of morbidity and a leading cause of hospitalization among people with diabetes mellitus.

### **Methodology**

A Hospital based, cross-sectional study was done in Churu district in Rajasthan, India. The objective of the study was to estimate the prevalence of the DPN and its association with determinants and to assess the sociodemographic and economic status of the participants.

The diabetic individuals were approached to the Churu medical college NCD medicine out patient door (OPD) for checkup. Those who were aged more than 30 years and diagnosed positive for type 2 diabetes at least 1-year duration with random blood sugar >200 mg/dL or fasting blood sugar >126 mg/dL as per the Indian Council of Medical Research guidelines 2005.<sup>[7]</sup>

The study period was from 1<sup>st</sup> June to 30<sup>th</sup> November, 2019, i.e., 6 months duration. For the sample size calculation, we had taken the prevalence as 39.3 %.<sup>[8]</sup> Using formula  $4PQ/d^2$  and taken allowable error 5 % the final sample size was around 382.

Those who were willing to participate were included in the study. Persons with Type 1 diabetes, gestational DM, and maturity-onset diabetes of the young were excluded from the study.

Before the start of the study ethical clearance was obtained by institution ethical committee. The participation information sheet and consent form were taken for permission to participate in the study.

### **Data collection and analysis**

The socio-demographics information (name, age, sex, education, and occupation) and lifestyle characteristics (smoking and alcohol consumption) were collected by interviewing the participant. Biochemical parameters (fasting, postprandial glucose levels, and glycated hemoglobin [HbA1c] levels) were retrieved from the latest laboratory reports. Modified Kuppuswamy's scale-2019<sup>[9]</sup> was used to assess the socioeconomic status. Body mass index (BMI) was calculated as kg/m<sup>2</sup> and for Indian population <sup>[10]</sup> 18.5–22.9 was normal, 23–24.9 as overweight, and  $\geq 25$  was considered as obesity.

DPN was assessed using Semmes-Weinstein 10-g monofilament test,<sup>[2]</sup> ankle reflex and vibration perception thresholds test. The 10-g monofilament was placed perpendicular to the skin and pressure was applied until the filament just buckled with a contact time of 2 s. The 10-g monofilament was applied for ten points on each foot, and a “yes” response was indicative of the filament sensation. Eight correct responses out of 10 applications were considered as normal; 1–7 correct responses as reduced sensation, and no correct answer as absent sensation. In addition, ankle reflex was also assessed with a percussion hammer and recorded as either present or absent. The test of vibration was performed bilaterally using a 128 Hz tuning fork placed over the dorsum of the great toe on distal interphalangeal joint. A zero-score showed that vibration sensation was intact while “0.5” represented a reduced sensation, and “1” was considered as lack of vibration sensation.

The data were entered into Microsoft Excel and analyzed with using suitable statistical software. The analysis was shown with percentages in frequency tables, and association of the other determinants related to diabetes was shown with  $P < 0.05$  as statistically significant using the Chi-square test.

**Observations:**

Table: 1 Distribution of participants according to the age, sex, religion, and risk factors of type-2 diabetes mellitus

Age (years)	Male (n,%)	Female (n,%)	Total (n,%)
30-40	31(14.1)	32(19.7)	63 (16.5)
41-50	58(26.3)	50(30.9)	108 (28.3)
51-60	75(34.1)	44(27.2)	119 (31.1)
>61	56(25.5)	36(22.2)	92 (24.1)
Total	220(100)	162(100)	382 (100)
Mean age	54.5	50.8	52.6
<b>Religion</b>			
Hindu	158 (71.8)	104 (64.2)	262 (68.6)
Muslim	49 (22.3)	37 (22.9)	86 (22.5)
Others	13 (5.9)	21 (12.9)	34 (8.9)
<b>Body Mass Index (BMI)</b>			
Normal (>25)	22 (10)	20 (12.34)	42 (10.1)
Overweight (22.6-25)	33 (15)	28 (17.2)	61 (13.4)
Obesity (>22.5)	165 (75)	114(70.3)	279 (76.4)

Table 2: Distribution of type-2 diabetes mellitus according to the monofilament test, ankle reflex, and vibration perception test

Variable	n (%)
<b>(a) Monofilament test</b>	
Normal (10)	249 (65.18)
Reduced response (1-7)	133 (34.82)
Absent (0)	0 (0)
<b>(b) Vibration perception test</b>	
Present	287 (75.13)
Absent	70 (24.87)
<b>(c) Ankle reflex</b>	
Present	342 (89.51)
Absent	40 (10.47)

Table :3 Distribution of peripheral neuropathy (as per Monofilament test) according to different variables

Variable		Present	Absent	Total	P Value
Sex	Males	80 (36.36)	140 (63.64)	220	<0.254
	Females	49 (30.42)	113 (29.7)	162	
Age (years)	30-50	56(32.74)	115(67.26)	171	<0.786
	>50	73(34.6)	138(65.40)	211	
BMI	>23	89(34.5)	169(65.5)	258	0.751
	<23	40(32.3)	84(67.7)	124	
HbA1c	>7	49(35)	91(65)	140	0.784
	<7	80 (33.1)	162 (66.9)	242	
Diabetes duration	<5 years	29 (25.8)	83 (74.2)	112	<0.05
	>5 years	100 (37)	170(63)	270	
Hypertension	Present	82 (53.9)	70 (46.1)	152	<0.05
	Absent	47(20)	183 (80)	230	

A total of 382 participants were involved in the study. Among them [Table 1], 220 (57.6%) are male and 162 (42.4%) were female with the mean age of 54.5 years in males and 50.8 years in females with standard deviation  $\pm 6.2$  and the age ranges from 32 to 72 years. As per the religion, more than 68% of them belonged to Hindus and 22.5% of them were Muslims and only 8.9% of them belong to other religion. More than three-fourth (76.4%) were obese, out of which 165 (59.1%) were male and 114 (40.9%) were female and 61 (13.4%) of them were overweight and only 42 (10.1%) of them were normal.

Almost 123 (32%) of the participants were had more than 6–10 years of exposure to diabetes and 153 (40%) of them were exposed to more than 10 years. Only 106 (28%) of them were exposed to diabetes <5 years. More than 60% of them were smokers and 44% were taking alcohol.

Almost all the participants are had the family history of diabetes out of which 249 (65 %) were males and of the participants are having family history of diabetes 43.4% of them are having a history of hypertension. More than 50% of the participants were belonging to middle and high school, 21% were belonging to intermediate, and nearly one-fourth of the participants belong to graduate and above.

52.1% belongs to the upper class, 16.6% belongs to upper middle class, and 25.4% belongs to lower middle class. Only 5.9 % belong to upper lower class and none at the lower class. 63.35% (242) of the participants had HbA1c more than seven and 36.65% of them were had 6.5–7.

260(68%) of study population had burning foot sensation, 122 (32%) of study population were had numbness of the foot, almost half of them were had pricking sensation in the foot and more than one-third 138 (36%) of them were had callosity over foot.

The estimated prevalence of the DPN [Table 2] was more than 129(33.76%) assessed with the reduced response on monofilament test, and 70 (24.8%) were had neuropathy on vibration perception. Almost 90% of the participants were had intact ankle reflex which is in good condition, and 75.13% of them were positive on vibration perception testing.

The overall prevalence [Table 3] of the DPN was 33.76 %. Prevalence of DPN was 36.36% in males and 30.4% in females. Males was having more PN compared to females, but it was not statistically significant ( $p=0.254$ ). The participants who were more than 50 years were had more PN than <50 years, and it was not statistically significant ( $P= 0.786$ ). With respect to BMI, the overweight and obese were having almost similar prevalence of DPN than normal BMI.

Similarly, those with high HbA1c were had slightly more prevalence of DPN than the normal HbA1c levels which was not statistically significant. As there was increase in the duration of diabetes, the PN was shown to be increased, and it is statistically significant with the  $P < 0.05$ . Those who are having other associated disease such as hypertension will had more PN than those without and it was statistically significant ( $<0.05$ ).

### Discussion

The present study was conducted to estimate the prevalence of DPN among patients attending the outpatient department included 382 participants from the outpatient department in Churu medical college, Bikaner. Participants were aged more than 30 years with the mean age of 52.6 years with standard deviation of 6.2 and range of 33–72 years. Majority of the studies from India and abroad also taken the similar age group for assessing the prevalence of PN in the T2DM.

The estimates of DPN prevalence in India vary widely from 9.6% to 78% in different populations. [10-13] The prevalence of DPN was found to be 33.76% in the present study which is higher when compared to the other studies from India which is 19.1%[14] and 29.2%, [15] respectively. Similar studies from India, Khawaja N et al [13] and Darivemula, S. et al [8] were reported the almost same estimates of the prevalence of DPN. This could be attributed to different types of diabetes (e.g., type 1 and type 2 diabetes), genetic predisposition, age of onset of diabetes, existing healthcare facilities, sample selection, different diagnostic criteria used (pin-prick perception, clinical signs and symptoms, and quantitative sensory tests or electrodiagnostic tests). The difference in the prevalence could probably be attributed to differences in the population studied, duration of diabetes or the severity of hyperglycaemia in different studies. The present study found statistically significant association with duration of diabetes, and hypertension which was observed similarly in another prevalence study by Pradeepa et al. [16] In a cross-sectional study by D'Souza et al., [17] an increasing prevalence of DPN was associated with an increase in the risk of painful DPN. Thus, earlier screening is also required for preventing or delaying DPN. longer duration of diabetes, dyslipidaemia, and the presence of other microvascular complications were found to be significantly associated with DPN in the present study. In present study no significant association present between age and DPN but Other studies had reported a significant relation between age and DPN. [18,19]

In the present study majority (52.1%) were belong to the upper class 16.6% were belong to upper middle and 25.4% were belong to lower middle class and similar studies were found from India and abroad.[20]

In the present study, we found that males were having slightly more DPN than the females and with a similar study showing that males being at higher risk in the Diabetes Control and Complications Trial.[21] The results in the present study shown that 23 % of participants fell under the moderate and severe neuropathy with the monofilament test, and chances of getting foot ulcers and amputations in the near future if not taken appropriate treatment. The prevalence of microvascular complications was higher in the group of patients with HbA1 c >7%, duration of diabetes, and hypertension similar study done by Shera et al. [14] also reported that the HbA1c levels more than 8 were had higher microvascular complications. The results of this study, demonstrating that

advancing age was not associated with an increased risk of developing DN in T2DM patients. This finding was contrary to studies from Ashok et al.,[19] and Karki et al.

#### **Conclusion:**

In the present study, we found that males were having slightly more DPN than the females and with a similar study showing that males being at higher risk in the Diabetes Control and Complications

#### **Limitations**

This was a hospital-based cross sectional study including only the diabetics attending the hospitals for follow-up and management. Hence, cause effect relationship cannot be established and the findings cannot be generalized. The use of microfilament is less accurate (compared to biothesiometer) at diagnosing PN.

#### **Recommendation**

The severity of DN was significantly and positively associated with duration of diabetes and hypertension. Health-care facilities should incorporate foot care education and services among other routine services being provided to diabetic patients.

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Date of Submission: 01 July 2020

Date of Peer Review: 12 Aug 2020

Date of Acceptance: 28 Aug 2020

Date of Publishing: 5 September 2020

Author Declaration: Source of support: Nil, Conflict of interest: Nil

Ethics Committee Approval obtained for this study? YES

Was informed consent obtained from the subjects involved in the study? YES

For any images presented appropriate consent has been obtained from the subjects: NA

Plagiarism Checked: YES

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DOI: 10.36848/IJBAMR/2020/18215.55545