

Diabetic peripheral neuropathy in diabetic patients attending an urban health and training centre

Sangeetha R. Kamalarathnam, Suresh Varadarajan

Department of Community Medicine, Sri Ramachandra Institute of Higher Education and Research, Chennai, Tamil Nadu, India

ABSTRACT

Introduction: Diabetic neuropathy is a complication affecting almost 50% of the diabetic patients. Diabetic Peripheral Neuropathy (DPN) predominantly affects the hands and lower limbs. It leads to loss of protective sensation resulting in continuous injury to insensitive feet. The early detection of DPN using an objective screening test followed by its appropriate management is important as up to 50% of the patients may be asymptomatic. **Objectives:** To screen Diabetic patients attending an Urban Health and Training Centre of a medical college in Tamilnadu for Diabetic Peripheral Neuropathy. To assess the association between DPN and selected variables such as socio-demographic factors, glycaemic control, duration of diabetes, physical activity, body mass index, smoking and consumption of alcohol. **Methods:** The study was conducted among 204 diabetic patients attending an Urban Health and Training Centre. Participants were assessed using Michigan Neuropathy Screening Instrument (MNSI), which involves using a questionnaire followed by a physical examination. **Results:** Of the 204 patients, 58.8% were male. The mean age was 54.8 years (SD = 8.8 years). About 79.9% were employed of which 29.4% were skilled labourers. Mean duration of diabetes was 6.2 years (SD = 5.3 years). The proportion of diabetics who screened positive for Peripheral Neuropathy was 23% and 45.6% using MNSI questionnaire and examination, respectively. An age of 60 years and above was significantly associated with DPN (OR = 2.505, P value = 0.003). A duration of more than 4 years of diabetes was also significantly associated with DPN (OR = 1.872, P value = 0.02820). **Conclusion:** A high proportion of diabetics with peripheral neuropathy did not express symptoms specific for diabetics. Thus, a simple tool like MNSI would be useful in primary care settings to screen for peripheral neuropathy, and hence prevent disability”.

Keywords: Diabetic Peripheral Neuropathy, diabetic neuropathy, Michigan Neuropathy Screening Instrument

Introduction

It is estimated that there are 463 million diabetics in the world. About 88 million diabetics are from the South East Asia region, of which 77 million are from India.^[1] Diabetic neuropathy is a common complication affecting almost 50% of the diabetic patients.^[2] Diabetic neuropathy is broadly classified

as Diffuse Neuropathy, which consists of Distal Symmetric Poly Neuropathy (DSPN) and Autonomic Neuropathy, Mononeuropathy and Radiculopathy or Polyradiculopathy.^[2] Among these, 75% of the diabetic neuropathies are attributed to DSPN.

DSPN is defined as the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after exclusion of other causes. Several studies suggest that at least 20% of Type 1 diabetics, 10-15% of newly diagnosed Type 2 diabetics and about 50% patients with diabetes over 10 years suffer from DSPN. In India, various studies report a prevalence of diabetic neuropathy ranging from 18 to 51%.^[3-11]

Address for correspondence:

Dr. Sangeetha R. Kamalarathnam,
Senior Resident in Community Medicine, RUHSA,
CMC Vellore. No. 13, Ponni Amman Koil Street, Kottur,
Chennai - 600 085, India.
E-mail: sangeerathnam@gmail.com

Received: 10-03-2021

Revised: 05-07-2021

Accepted: 19-07-2021

Published: 31-01-2022

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_470_21

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Kamalarathnam SR, Varadarajan S. Diabetic peripheral neuropathy in diabetic patients attending an urban health and training centre. *J Family Med Prim Care* 2022;11:113-7.

DSPN has a glove and stocking distribution. It often predisposes patients to foot ulceration. As diabetic neuropathy progresses, the neuropathic pain subsides and eventually disappears, but sensory deficit persists and motor defects may develop. DSPN leads to loss of protective sensation resulting in continuous injury to insensitive feet.^[12,13] Motor and sensory impairments result in altered balance and gait, which leads to an increase in falls.^[14] All these factors indirectly affect the quality of life.^[15] DSPN also causes substantial economic burden.^[2]

The early detection of diabetic neuropathy using an objective screening test followed by its appropriate management is important as up to 50% of the patients may be asymptomatic.^[2] Screening for neuropathy at the primary care setting will provide an avenue for early intervention and prevents progression of the disease. Thus, the objective of this study was to screen diabetic patients attending an Urban Health and Training Centre in Tamilnadu for peripheral neuropathy, and also to assess the association between DPN and selected variables such as socio-demographic factors, duration of diabetes, glycaemic control, physical activity, body mass index, smoking and alcohol consumption.

Materials and Methods

A cross-sectional study was conducted among the diabetic patients attending the Urban Health and Training Centre of a medical college. It is located in Thiruvanniyur, Chennai. The study was conducted for a period of one month in August 2019.

The sample size was calculated using a reported prevalence of DPN of 32%,^[3] relative precision of 20% and 95% level of confidence. The required minimum sample size was 204. All diabetic patients including newly diagnosed ones attending the Outpatient Department at Urban Health and Training Centre were eligible for the study. Consecutive diabetic patients who were willing to participate in the study were included.

Michigan Neuropathy Screening Instrument (MNSI) was used to screen the patients for diabetic neuropathy.^[16] It is designed to screen for DPN in outpatient settings by primary care providers. MNSI consists of two parts—a history questionnaire followed by physical assessment. MNSI history questionnaire consists of 15 yes or no questions on symptoms such as numbness, burning sensation, temperature perception, history of open sores or amputation. Questions on history of muscle cramps and feeling of weakness are intended to measure impaired circulation and general asthenia, respectively, and are not included in the scoring. The higher the score, more is the level of neuropathic symptoms. A score of 4 or more on the MNSI questionnaire is considered as positive for diabetic neuropathy.^[17] MNSI examination consists of assessing both the feet for deformities, calluses, fissures, infection, dry skin, ulcerations, ankle reflexes, vibration perception at great toe and monofilament testing for touch sensation. Patients with a score greater than or equal to 2.5 were considered to be positive for diabetic neuropathy.^[17] The tool was pretested in local language and appropriately modified.

After obtaining written informed consent, socio-demographic details, history of smoking, alcohol consumption and physical activity of the patients were noted. Physical activity of at least half an hour of gardening, household chores, brisk walking, etc., was considered as “moderate” and minimum of half an hour of running, heavy shoveling, carrying loads, etc., was considered as “vigorous”.^[18] Information on uncontrolled fasting and postprandial blood sugar levels were based on patients’ records of Fasting Blood Sugar and Post Prandial Blood Sugar values taken in the last 3 months. They were then administered the MNSI.

Data entry and data analysis was done using Statistical Package for Social Sciences (SPSS) version 16 software. A descriptive analysis was done for socio-demographic factors. The prevalence of diabetic neuropathy was calculated with 95% Confidence Interval. The Odds ratio and 95% Confidence Interval were calculated to determine the association between diabetic neuropathy and the following factors—socio-demographic variables, glycaemic control, duration of diabetes, any moderate or vigorous physical activity for at least half an hour, body mass index, smoking and alcohol consumption. Chi-square test was used and a *P* value of <0.05 was considered to be statistically significant.

Ethical approval was obtained from Institutional Ethics Committee (REF: CSP-MED/19/JUN/53/58).

Results

Two hundred and four patients who attended the Urban Health and Training Centre were enrolled for the study. The socio-demographic profile of the participants is provided in Table 1. The mean age of participants was 54.8 years (SD = 8.8 years). Of the 204 patients, 58.8% were male.

Mean duration of diabetes was 6.2 years (SD = 5.3 years). A fasting blood glucose of >130 mg/dl and a postprandial blood glucose of >180 mg/dl was taken as uncontrolled value of blood glucose.^[12] About 56% of the patients had uncontrolled fasting blood glucose levels and 71.6% of the patients had uncontrolled postprandial blood glucose levels. In 106 patients (52%), both fasting and postprandial blood sugar levels were uncontrolled. The clinical characteristics and the history of alcohol and tobacco consumption of the patients are given in Table 2. Any history of moderate or vigorous physical activity for atleast half an hour^[19] was taken as presence of physical activity.

In the 204 diabetics who took part in the study, legs hurting while walking (46.6%) and burning sensation in the feet (37.7%) were the most common symptoms among those specific for diabetic neuropathy. The proportion of diabetics who were screened positive for Peripheral Neuropathy by MNSI questionnaire was 23% (95% CI = 17.79-29.28).

The proportion of diabetics who were screened positive for peripheral neuropathy based on clinical examination criteria of MNSI was 45.6% (95% CI = 38.9-52.44). An age of 60 years

Table 1: Socio-demographic characteristics of the study participants

Characteristics	Frequency	Percentage	
Age	30-39	6	2.9
	40-49	51	25.0
	50-59	85	41.7
	60 and above	62	30.4
Sex	Male	120	58.8
	Female	84	41.2
Education	Illiterate	49	24.0
	Literate	155	76.0
Occupation	Unemployed	41	20.1
	Employed	163	79.9
Socio-Economic Status*	Upper class	16	7.8
	Upper middle class	77	37.7
	Middle class	72	35.3
	Lower middle class	35	17.2
Marital status	Lower class	4	2.0
	Married	174	85.3
	Not married	3	1.5
	Widowed	27	13.2

*Using Modified BG Prasad Classification 2019

Table 2: Clinical characteristics and history of alcohol and tobacco consumption of the patients attending UHTC

Characteristics	Frequency	Percentage	
Fasting Blood Sugar	Controlled	90	44.1
	Uncontrolled	114	55.9
Postprandial Blood Sugar	Controlled	58	28.4
	Uncontrolled	146	71.6
Duration of diabetes	0-5 years	126	61.8
	6-10 years	48	23.5
	>10 years	30	14.7
Physical activity	Present	179	87.7
	Absent	25	12.3
Body Mass Index	Underweight	7	3.4
	Normal	61	29.9
	Overweight	97	47.6
	Obese	39	19.1
H/o alcohol consumption	Yes	36	17.6
	No	168	82.4
H/o smoking tobacco	Yes	13	6.4
	Used to smoke, but has quit now	21	10.3
	Never smoked	170	83.3

and above was significantly associated with DPN (OR = 2.50, P value = 0.003). A duration of more than 4 years of diabetes was also significantly associated with DPN (OR = 1.87, P value = 0.028). The association between these variables and DPN is given in Table 3.

Males, illiterate diabetics, unmarried or widowed, unemployed, those with uncontrolled blood sugar levels, longer duration of diabetes, history of smoking and obese individuals were found to be at greater risk for peripheral neuropathy, though their association with diabetic neuropathy was not statistically significant.

Discussion

The proportion of diabetics who were screened positive for peripheral neuropathy was 23% and 45.6% using MNSI questionnaire and examination, respectively. In a study done by Monisha D'Souza *et al.*^[3] in a government hospital in Mangalore, the prevalence of diabetic neuropathy was 18.3% and 32.2% by MNSI questionnaire and examination, respectively. Juma M Al-Kaabi *et al.*^[20] in Saudi Arabia reported a prevalence of 10.4% by MNSI questionnaire and 25.6% by MNSI examination. Some studies by Hanu George *et al.* (47%)^[6] and Vibha *et al.*^[5] (51.8%) reported a similar prevalence using only MNSI examination. The difference in the prevalence reported could be due to the different cut-off points used to diagnose Diabetic neuropathy, though they all used the same instrument. Difference in populations studied, difference in prevalence of diabetes and duration of diabetes in the population studied could have also affected the rate of prevalence. Also, the difference in the prevalence rates using the questionnaire and the examination demonstrates the limitations of patient's self-perception of symptoms,^[3] reinstating the need for routine screening by examination for DPN in primary care settings to enable early interventions. Studies have suggested that up to 50% of diabetics with diabetic neuropathy may be asymptomatic.^[21] Jasmine *et al.*^[22] reported a similar prevalence of 44.9% in a rural area in Chennai, though they had used a different study instrument.

An age of 60 years and above was significantly associated with diabetic neuropathy in this study (OR = 1.31, P value = 0.3517). Yadav *et al.*^[23] found that diabetics above 60 years of age were 1.7 times at greater risk for diabetic neuropathy compared to those who were less than 60 years of age. Several other studies also reported the increasing risk of diabetic neuropathy with increasing age.^[8-10] Higher risk of diabetic neuropathy with increasing age can be due to various biological processes that come with ageing. These biological processes facilitate the establishment of peripheral neuropathy in these elderly diabetics.^[24] As those diabetics above 60 years are already at an increased risk for foot ulceration and falls due to age-related vascular changes and poor vision, early diagnosis and management of diabetic neuropathy would go a long way in reducing morbidity.

Duration of diabetes was also significantly associated with diabetic neuropathy in this study (OR = 1.872, P value = 0.02820). Gous *et al.*, Rani PK *et al.* and Pradeepa *et al.* reported similar findings.^[9-11] Various structural and metabolic changes in the neurons that accompany longer duration of diabetes have been implicated in the causation of diabetic neuropathy in animal and human models.^[25] In a study by N. A. Jatoti *et al.*,^[26] occurrence of DPN

Table 3: Association between selected variables and Diabetic Peripheral Neuropathy

Characteristic		Screened positive for DPN by MNSI examination (n)	(%)	Odds ratio	Confidence interval	P
Sex	Male	58	(48.3)	1.31	0.75-2.30	0.35
	Female	35	(41.7)			
Age group	60 yrs and above	38	(61.3)	2.50	1.36-4.62	0.00
	Less than 60 yrs	55	(38.7)			
Literacy	Illiterate	26	(53.1)	1.48	0.78-2.83	0.23
	Literate	67	(43.2)			
Employment Status	Unemployed	20	(48.8)	1.15	0.58-2.28	0.70
	Employed	73	(44.8)			
Socio-economic status	Class 3,4,5	51	(45.9)	1.03	0.59-1.79	0.91
	Class 1,2	42	(45.2)			
Marital status	Unmarried/Widowed	18	(58.6)	1.81	0.83-3.92	0.14
	Married	75	(43.4)			
FBS control	Uncontrolled	53	(46.5)	1.09	0.62-1.89	0.77
	Controlled	40	(44.4)			
PPBS control	Uncontrolled	69	(47.3)	1.27	0.69-2.35	0.45
	Controlled	24	(41.4)			
Duration of diabetes	More than 4 years	53	(53.5)	1.87	1.07 to 3.27	0.03
	4 years and less	40	(38.1)			
Alcoholism	Present	14	(38.9)	0.72	0.34-1.50	0.38
	Absent	79	(47)			
Smoking	Present	8	(61.5)	2.00	0.62-6.32	0.25
	Absent	85	(44.5)			
Physical activity	Present	79	(44.1)	0.62	0.27-1.44	0.28
	Absent	14	(56)			
BMI	Normal and underweight	32	(47.1)	1		
	Overweight	39	(40.2)	0.76	0.40-1.41	0.39
	Obese	22	(56.4)	1.46	0.66-3.21	0.36

was higher in those aged more than 55 years and with more than one year of diabetes. Similar observation was made in a recent study in Mali by Maiga Y *et al.*^[27]

The higher prevalence of diabetic neuropathy among the illiterate, the unemployed and the unmarried/widowed patients may be due to deficient foot care, which is common in these vulnerable groups. This highlights the importance of foot care in managing diabetic neuropathy.

American Diabetes Association recommends that patients should be assessed for DSPN using a validated clinical tool such as the MNSI at the time of diagnosis of Type 2 diabetes.^[2] The screening for the disease enables early detection and management of diabetic neuropathy and helps prevent morbidities like foot ulcerations, amputation, etc. Also, it provides an excellent opportunity in providing health education to patients about diabetic foot care practices.

Though this was not a community-based study, a high proportion of the patients attending the out-patient department of the Urban Health and Training Centre were found to be positive for DPN. The prevalence was more in those aged more than 60 years, those with diabetes duration of more than 4 years, those with uncontrolled postprandial sugars a smoking history, illiteracy, unemployment, the obese and the physically inactive. In this

study, both the questionnaire-based and the clinical assessments have been done, contrary to many other studies.

MNSI is an objective, simple, inexpensive, easy-to-administer screening tool that can be conveniently employed by primary care providers in outpatient settings. Thus, the incorporation of screening for diabetic neuropathy into the facility-based services provided for diabetics under National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) at the Primary Health Centre, Community Health Centre and District Hospitals will help diagnose and treat DPN at an early stage and will also serve as an avenue for health education.

Conclusions

A high proportion of diabetics with peripheral neuropathy did not express symptoms specific for diabetics. Thus a simple tool like MNSI would be useful in primary care settings to screen for peripheral neuropathy and hence prevent disability.

Acknowledgement

Michigan Neuropathy Screening Instrument (MNSI) was offered free of cost by Michigan Diabetes Research Center. It was provided by Grant Number P30DK020572 (MDRC) from the National Institute of Diabetes and Digestive and Kidney Diseases.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

- Members. Available from: <https://idf.org/our-network/regions-members/south-east-asia/members/94-india.html>. [Last accessed on 2021 Jan 19].
- Pop-Busui R, Boulton AJM, Feldman EL, Bril V, Freeman R, Malik RA, *et al*. Diabetic neuropathy: A position statement by the American Diabetes Association. *Diabetes Care* 2017;40:136-54.
- D'Souza M, Kulkarni V, Bhaskaran U, Ahmed H, Naimish H, Prakash A, *et al*. Diabetic peripheral neuropathy and its determinants among patients attending a tertiary health care centre in Mangalore, India. *J Public Health Res* 2015;4:120-4.
- Darivemula S, Nagoor K, Patan SK, Reddy NB, Deepthi CS, Chittooru CS. Prevalence and its associated determinants of Diabetic Peripheral Neuropathy (DPN) in individuals having type-2 diabetes mellitus in Rural South India. *Indian J Community Med* 2019;44:88-91.
- Vibha SP, Kulkarni MM, Kirthinath Ballala AB, Kamath A, Maiya GA. Community based study to assess the prevalence of diabetic foot syndrome and associated risk factors among people with diabetes mellitus. *BMC Endocr Disord* 2018;18:43.
- Rakesh P, Abraham V, Alex R, George H, George K, Krishna M, *et al*. Foot care knowledge and practices and the prevalence of peripheral neuropathy among people with diabetes attending a secondary care rural hospital in southern India. *J Fam Med Prim Care* 2013;2:27.
- Bashar A. Prevalence and determinants of diabetic peripheral neuropathy/foot syndrome in a rural population of North India. *Research Square* 2020. Available from: <https://doi.org/10.21203/rs.3.rs-59734/v1>. [Last accessed on 2021 Jan 5].
- Bansal D, Gudala K, Muthyala H, Esam HP, Nayakallu R, Bhansali A. Prevalence and risk factors of development of peripheral diabetic neuropathy in type 2 diabetes mellitus in a tertiary care setting. *J Diabetes Investig* 2014;5:714-21.
- Pradeepa R, Rema M, Vignesh J, Deepa M, Deepa R, Mohan V. Prevalence and risk factors for diabetic neuropathy in an urban south Indian population: The Chennai Urban Rural Epidemiology Study (CURES-55). *Diabet Med* 2008;25:407-12.
- Rani P, Raman R, Rachapalli S, Pal S, Kulothungan V, Sharma T. Prevalence and risk factors for severity of diabetic neuropathy in type 2 diabetes mellitus. *Indian J Med Sci* 2010;64:51-7.
- Samiyodhin Gous S, Suhail M, Shafee M. Study of prevalence of diabetic peripheral neuropathy and associated risk factors in type diabetes patients attend Maharashtra. *Int J Recent Trends Sci Technol* 2015;16:620-3. Available from: <http://www.statperson.com>. [Last accessed on 2021 Jan 30].
- Jameson JL, Fauci A, Kasper D, Hauser S, Longo D, Loscalzo J. *Harrison's Principles of Internal Medicine*. McGraw-Hill Education; 2018.
- Amin N, Doupis J. Diabetic foot disease: From the evaluation of the "foot at risk" to the novel diabetic ulcer treatment modalities. *World J Diabetes* 2016;7:153.
- Ramdharry G. Peripheral nerve disease. In: *Handbook of Clinical Neurology*. Elsevier B.V.; 2018. p. 403-15.
- Feldman EL, Callaghan BC, Pop-Busui R, Zochodne DW, Wright DE, Bennett DL, *et al*. Diabetic neuropathy. *Nat Rev Dis Prim* 2019;5:42.
- How to Use the Michigan Neuropathy Screening Instrument. Available from: https://medicine.umich.edu/sites/default/files/downloads/MNSI_howto.pdf.
- Herman WH, Pop-Busui R, Braffett BH, Martin CL, Cleary PA, Albers JW, *et al*. Use of the michigan neuropathy screening instrument as a measure of distal symmetrical peripheral neuropathy in type 1 diabetes: Results from the diabetes control and complications trial/epidemiology of diabetes interventions and complications. *Diabet Med* 2012;29:937-44.
- NCDs | What is Moderate-intensity and Vigorous-intensity Physical Activity? WHO. World Health Organization; 2018. Available from: <http://www.who.int/ncds/prevention/physical-activity/intensity/en/>. [Last accessed on 2021 Jan 29].
- Pandey VK, Aggarwal P, Kakkar R. Modified BG Prasad socio-economic classification, update-2019. *Indian J Commun Health* 2019;31. Available from: <https://www.iapsmupuk.org/journal/index.php/IJCH/article/view/1055>. [Last accessed on 2021 Feb 18].
- Al-Kaabi JM, Al Maskari F, Zoubeidi T, Abdulle A, Shah SM, Cragg P, *et al*. Prevalence and determinants of peripheral neuropathy in patients with type 2 diabetes attending a tertiary care center in the United Arab Emirates. *J Diabetes Metab* 2014;5:3.
- Diabetic Neuropathy: A Position Statement by the American Diabetes Association. 2017. Available from: <http://www.diabetesjournals>. [Last accessed on 2019 Jun 1].
- Jasmine A, Shriraam V, Durai V, Anitha Rani M, Samya V, Akila GV, *et al*. Prevalence of peripheral neuropathy among type 2 diabetes mellitus patients in a rural health centre in South India. *Int J Diabetes Dev Ctries* 2020;1-8. Available from: <https://link.springer.com/article/10.1007/s13410-020-00885-6>. [Last accessed on 2021 Jan 22].
- Yadav S, Ramesh V, Bhatia E, Gill H. A prospective study of prevalence and association of peripheral neuropathy in Indian patients with newly diagnosed type 2 diabetes mellitus. *J Postgrad Med* 2014;60:270.
- Belmin J, Valensi P. Diabetic neuropathy in elderly patients: What can be done? *Drugs Aging* 1996;8:416-29.
- Diabetic Neuropathy - an overview | ScienceDirect Topics. Available from: <https://www.sciencedirect.com/topics/neuroscience/diabetic-neuropathy>. [Last accessed on 2021 Jan 30]
- Jatooi NA, Alsulaiman ASA, Alromaih NJ, Abdullah Albahrani B, Alkhattaf IM, Alyami F, *et al*. Prevalence of diabetic peripheral neuropathy among type II diabetic patients in King Fahd University Hospital, Khobar, Kingdom of Saudi Arabia. *Hosp Pract (1995)* 2021;49:63-70.
- Maiga Y, Diallo S, Konipo F, Dite N, Sangho O, Sangaré M, Diallo SH, *et al*. Diabetic polyneuropathy with/ out neuropathic pain in Mali: A cross-sectional study in two reference diabetes treatment centers in Bamako (Mali), Western Africa. *PLoS One* 2020;15:e0241387.