

# Study of Incidence and Prevalence of Diabetic Peripheral Neuropathy in Type II Diabetes Mellitus by Bedside Screening Techniques at a Tertiary Care Centre

Karishma Anil Nigoo<sup>1</sup>, Neelima Chafekar<sup>2</sup> and Madhuri Kirloskar<sup>3\*</sup>

<sup>1</sup>Former PG Resident, Department of Medicine, Dr. Vasant Rao Pawar Medical College, Hospital and Research Centre, Nashik – 422003, Maharashtra, India

<sup>2</sup>Professor, Department of Medicine, Dr. Vasant Rao Pawar Medical College, Hospital and Research Centre, Nashik – 422003, Maharashtra, India

<sup>3</sup>Associate Professor, Department of Medicine, Dr. Vasant Rao Pawar Medical College, Hospital and Research Centre, Nashik – 422003, Maharashtra, India; mskirloskar@gmail.com

## Abstract

**Introduction:** Diabetes mellitus commonly leads to peripheral neuropathy in patients with chronically high blood sugar levels. Diabetic peripheral neuropathy leads to numbness, loss of sensation or may have extremely painful symptoms. In some patients there might be marked neuropathic deficit which may be unnoticed. **Objectives:** Hence to evaluate patients with diabetes mellitus helps in early screening of peripheral neuropathy. **Methodology:** This involves using the bedside screening techniques like monofilament test, biothesiometer, tuning fork test and diabetic symptom and examination questioner. **Results:** Diabetic neuropathy was most commonly present in poor control of diabetes (67%) followed by fair control (24%) and good control (9%). It was observed that severity of peripheral neuropathy was related with blood sugar. With high frequency of patients leading to diabetic peripheral neuropathy the observation is that morbidity remains high in such patients. **Conclusion:** Diabetic peripheral neuropathy is a major complication of diabetes mellitus. Rapid diagnosis and management are important, since recent modalities include like tricyclic antidepressants or anticonvulsants and optimal glycemic control can improve outcome of these patients. Early diagnosis of diabetic peripheral neuropathy is considered at risk of foot ulcerations and must receive preventive education and care.

**Keywords:** Bedside Screening, Biothesiometer, Monofilament, Peripheral Neuropathy, Tuning Fork Test, Type 2 Diabetes Mellitus

## 1. Introduction

Diabetes mellitus is the commonest global metabolic disease at present and its prevalence is gradually increasing day by day across the world, especially developing nations.

According to World Health Organization report 2005, the number of diabetic people was around 171 million and would increase to 366 million by year 2030. In India alone, 31.7 million people were affected in year 2000 and are expected to reach 79 million by the year 2030<sup>1</sup>.

The maximum burden of diabetes in society is particularly by diabetes mellitus type-2, which contributes approximately 90% of cases of diabetes<sup>2</sup>, and it has affected

250 million people by year 2010 and estimated to affect around 300 million people by year 2025<sup>3,4</sup>.

India recently has been declared as the Diabetic Capital of the world<sup>5</sup>. Diabetes mellitus is a chronic metabolic disease characterized by high blood sugar levels due to defect in insulin secretion, Insulin action, or both which prevent the body to utilize glucose completely or partially.

The International Association for the Study of Pain (IASP) has defined neuropathic pain as “pain initiated or caused by a primary lesion or dysfunction in the nervous system”<sup>5</sup>. DPN or Distal Symmetrical Polyneuropathy (DSP) is one of the most common complications occurring in type 2 diabetes. Incidence of DPN in diabetes is up to

50%. Complications of Peripheral Neuropathy include severe pain, loss of ambulation, and increased risk of foot ulceration and amputation<sup>6</sup>. Various studies conducted in United States of America have reported the incidence of neuropathic pain syndromes in American population with diabetes to be around 70%<sup>7</sup>. In an observational study in patients with Type 2 diabetes it was found painful symptoms had an occurrence of 26% in patients without neuropathy and 60% of patients with severe neuropathy<sup>8</sup>. DPN is considered as one of the commonest causes of foot complications like amputation and difficulty in ambulation. DPN is also the most common cause of non traumatic amputation<sup>9</sup>. Amongst the various studies conducted in India to screen for the current status of DPN, a study had estimated the overall prevalence of neuropathy in south Indian Type 2 diabetic patients to be 19.1%<sup>10</sup>.

Most of the available modalities have been evaluated in developed countries where foot care practices are widely followed. But in developing countries, like India, barefoot walking is still prevalent and foot care practices are hardly followed. This can result in alteration of cutaneous morphology. This may influence the outcome of commonly used tools to identify neuropathy like the Diabetic Neuropathy Symptom (DNS) Score, 10-g Semmes-Weinstein monofilament, vibration testing by 128 Hz tuning fork, ankle reflex and the Diabetic Neuropathy Examination (DNE) score.

Therefore, this study was undertaken to evaluate the usefulness of the above modalities with the standard validated screening method of measuring Vibration Perception Threshold (VPT) with a biothesiometer in a population where foot care practices are scantily followed.

## 2. Aims and Objectives

To evaluate subclinical and symptomatic diabetic peripheral neuropathy in patients with Type II diabetes mellitus by bedside screening techniques at a Tertiary Care Hospital.

## 3. Materials and Methods

**Study Design:** Descriptive study  
**Study Setting:** Department of Medicine of a Medical College and a tertiary health care center.  
**Study Duration:** August 2018 to December 2020.  
**Study Participants:** Sample Size: 223

## 3.1 Eligibility Criteria

### 3.1.1 Inclusion Criteria

- Type 2 DM [Known and newly diagnosed cases of Type 2 DM].
- Patients of both sexes visiting IPD and OPD (between age group of 35 to 70 years.)

### 3.1.2 Exclusion Criteria

- Pre-existing or known neuromuscular disease, peripheral arterial disease or a serious medical condition.
- Patient with diabetic foot and limb amputee due to DPN.

## 3.2 Methodology

Detailed medical history and relevant clinical examination data and written consent were obtained from all subjects. Data was recorded in a pre-designed proforma.

- All patients were inquired about detailed history regarding duration of diabetes, family history of diabetes, and symptoms suggestive of peripheral neuropathy.
- The patients, who were diagnosed as type 2 diabetes mellitus for the first time on basis of clinical symptoms and laboratory investigation in our hospital, were labelled as newly diagnosed patients of type 2 diabetes mellitus.
- In patients with diagnosis of diabetic peripheral neuropathy, the severity of neuropathy was documented according to the bedside techniques mentioned below. For evaluation of peripheral neuropathy following bedside screening techniques were used and findings were recorded for each patient.

Bedside screening techniques as follows

- Semmes-Weinstein monofilament test
- Biothesiometer to measure the threshold of perception of vibration in human subjects.
- Tuning fork test for vibration perception

## 4. Observation and Results

**Table 1.** Prevalence of Neuropathy (According to Patient's Symptoms)

Neuropathy	Frequency	Percent
Yes	83	37
No	140	63
<b>Total</b>	223	100

**Table 2.** Age Group

Age group	Frequency	Percent
35 to 40 years	25	11
41 to 50 years	45	20
51 to 60 years	47	21
61 to 70 years	60	27
more than 70 years	47	21
<b>Total</b>	<b>223</b>	<b>100</b>

**Table 3.** Diabetes Control According To HbA1c Values

HbA1C	Frequency	Percent
Fair (5.7%)	20	9
Good (5.8 to 6.4%)	54	24
Poor (>6.4%)	149	67
<b>Total</b>	<b>223</b>	<b>100</b>

**Table 4.** Gender

Gender	Frequency	Percent
Female	109	49
Male	114	51
<b>Total</b>	<b>223</b>	<b>100</b>

**Table 5.** Duration of Diabetes (In Years)

Duration(years)	Frequency	Percent
1 to 5 years	13	6
6 to 10 years	36	16
11 to 15 years	49	22
16 to 20 years	75	29
more than 20 years	50	27
<b>Total</b>	<b>223</b>	<b>100</b>

**Table 6.** Treatment for Diabetes

Treatment	Frequency	Percent
Insulin	9	4
OHA	127	57
OHA + insulin	87	39
<b>Total</b>	<b>223</b>	<b>100</b>

**Table 7.** Comparison between Monofilament, Tuning Fork and Biothesiometer

	Monofilament Test	Tuning Fork Test	Biothesiometer Test
True Positive	49	65	78
False Negative	34	18	5
False Positive	31	22	3

## 5. Discussion

Diabetes mellitus is a metabolic disorder due to defect in insulin secretion, insulin action, resistance of cells to insulin or all. In 2000, more than 175 million people across the world suffered from diabetes, of which 5% to 10% had type 1 diabetes and 90% to 95% had type 2 diabetes<sup>11,12</sup>. Diabetes can induce long-term complications, including retinopathy, nephropathy, neuropathy and other vascular complications<sup>13</sup>.

DPN is one of the most common microvascular complications in both type 1 and type 2 diabetes. DPN has been defined as “the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes”<sup>14,15</sup>.

### 5.1 Glycemic Control vs Diabetic Neuropathy

In the present hospital based descriptive study aimed to evaluate subclinical and symptomatic diabetic peripheral neuropathy in patients with Type II diabetes mellitus by bedside screening techniques, diabetic neuropathy was most commonly present in poor control of diabetes (67%) followed by fair control (24%) and good control (9%) (Table 3). It was observed that severity of peripheral neuropathy was related with blood sugar. Higher the blood sugar level, severe is neuropathy. Thus it can be concluded that peripheral neuropathy is common in diabetic and who has higher blood sugar levels. However the patients with lower blood sugar level have decreased incidence of peripheral neuropathy. Relationship between impaired glucose tolerance and diabetic neuropathy has not been established and is an area of controversy (Table 1).

## 5.2 Age

In the present study, the most common age group amongst study population was 61 to 70 years (27%) followed by more than 70 years (21%) and 51 to 60 years (21%). The diabetic neuropathy is commonest after 5th decade of life. This finding is very well matched with other studies like Kasturi et al. and Behl et al. showing high diabetic peripheral neuropathy rate among youths with type 2 diabetes that it is likely related to longer duration of diabetes and a more atherogenic lipid profile (Table 2).

## 5.3 Sex

In the present study, radiculopathy, mononeuropathy and polyneuropathy was most commonly present in male population (53.80% vs 70% vs 51.20%) as compared to female population (46.20% vs 30% vs 47.90%) and this difference was statistically not significant (Table 4). Similarly in the study conducted by Monisha D'Souza et al., we also noticed that DPN was significantly higher in male gender. Similar results were obtained in various other studies as well.

## 5.4 Duration of Diabetes Mellitus vs Diabetic Neuropathy

In the present study, diabetic neuropathy was most commonly present in 16 to 20 years of diabetes (60%) followed by 11 to 15 years (21.90%) and this difference was statistically not significant (Table 5). Kasturi et al., also found the positive correlation between duration of diabetes mellitus and incidence of peripheral neuropathy. Present study very well matched with workers like Shaw et al. and Kasturi et al.<sup>16,17</sup>.

Diabetes management remains a challenge for developed and developing countries alike. Implementing evidence based guidelines and rebuilding of clinical care has yielded gains in some countries. Several attempts in generating feasible and effective care system by various developing countries of the world. These initiatives and projects hold promise but depend on the restructuring of the overall health system for effective and sustainable care.

## 5.5 Comparison between Monofilament, Biothesiometre, Tuning Fork Test

The sensitivity, Specificity, PPV, NPV and accuracy of monofilament testing in diagnosing neuropathy was 59.04%, 77.86%, 61.25%, 76.22% and 70.85% respectively.

The sensitivity, Specificity, PPV, NPV and accuracy of biothesiometer testing in diagnosing neuropathy was 93.98%, 97.86%, 96.30%, 96.48% and 96.41% respectively. The sensitivity, specificity, PPV, NPV and accuracy of tuning fork in diagnosing neuropathy was 78.31%, 84.29%, 74.71%, 86.76% and 82.06% respectively (Table 7).

Hence it is important for the primary care physician to diagnose diabetic patients for peripheral neuropathy by simple bedside screening procedures so as to avoid further complications.

## 5.6 Preventive measures

Few treatment options for symptomatic diabetic peripheral neuropathy patients. Main aim is to slow progression of disease, relieve neuropathic pain and avoid complications like diabetic foot.

- To relieve neuropathic pain: symptomatic neuropathic pain-relieving medication can be prescribed for e.g., antidepressants, anticonvulsants, pregabalin, gabapentin
- Lifestyle modification.
- Strict blood sugar control.
- Strict compliance to antidiabetic treatment.
- Washing feet with lukewarm water.
- Check temperature of water before using.
- Avoid dryness of feet, to use lotion but avoid interdigital space.
- Daily inspection of feet once a day by respondents.
- Trimming of nails with care.
- Avoid barefoot walking.
- Check the footwear from inside before wearing.
- To consult if there are cuts, blister, redness, swelling, nails problems.
- Do not smoke.
- Wear socks which have extra cushions, no elastic top and which wick moisture

## 6. Conclusion

In patients having long standing diabetes, early detection of diabetic peripheral neuropathy by simple bedside techniques, by treating physician and proper counselling of them regarding foot care can help to reduce the incidence and prevalence of diabetic neuropathy and its associated complications of trophic ulcer formation and more serious complications requiring amputation.

Biothesiometer is the most sensitive and specific bedside techniques in diagnosing neuropathy as compared to tuning fork and monofilament testing.

However, Biothesiometer is slightly more expensive instrument and physician needs to get trained in handling it. Physician should enquire about neuropathic symptoms in all diabetics and evaluate these patients by simple bedside techniques, so as to diagnose & treat them early and also to counsel all diabetics and especially those who are sub clinical about foot care.

## 7. Summary

Biothesiometer is the most sensitive and specific bedside techniques in diagnosing neuropathy as compared to tuning fork and monofilament testing. Peripheral neuropathy in diabetics needs to be diagnosed early so as to avoid secondary complications like foot ulcers and more serious complications like amputation.

## 8. References

- American Diabetes Association. Standards of Medical Care in Diabetes. *Diabetes Care*. 2015; 38(Suppl 1):S1-S94
- Ali MK, Bullard KM, Saaddine JB, Cowie CC, Imperatore G, Gregg EW. Achievement of goals in U.S. diabetes care, 1999-2010. *N Engl J Med*. 2013; 368:1613-24. <https://doi.org/10.1056/NEJMsa1213829>. PMID:23614587
- Stellefson M, Dipnarine K, Stopka C. The chronic care model and diabetes management in US primary care settings: A systematic review. *Prev Chronic Dis* 2013; 10:E26. <https://doi.org/10.5888/pcd10.120180>. PMID:23428085 PMID:PMC3604796
- Piatt GA, Anderson RM, Brooks MM, et al. 3 year follow-up of clinical and behavioral improvements following a multifaceted diabetes care intervention: Results of a randomized controlled trial. *Diabetes Educ*. 2010; 36:301-9. <https://doi.org/10.1177/0145721710361388>. PMID:20200284
- Merskey H, Bogduk N. *Classification of Chronic Pain: Descriptions of Chronic Pain Syndromes and Definitions of Pain Terms*, 2nd ed. Seattle: IASP Press; 1994. p. 209-14.
- Dyck PJ, Thomas PK. Disease of peripheral nervous system. In: Ehlers J, editor. *Peripheral Neuropathy*. 4 th ed. Philadelphia: Elsevier Saunders; 1999. p. 1135-37.
- Tesfaye S, Vileikyte L, Rayman G, Sindrup S, Perkins B, Baconja M, et al. On behalf of the Toronto Expert Panel on Diabetic Neuropathy. Painful diabetic peripheral neuropathy: Consensus recommendations on diagnosis, assessment and management. *Diabetes Metab Res Rev*. 2011. <https://doi.org/10.1002/dmrr.1225>. PMID:21695762
- Abbott CA, Malik RA, van Ross ER, Kulkarni J, Boulton AJ. Prevalence and characteristics of painful diabetic neuropathy in a large community-based diabetic population in the U.K. *Diabetes Care*. 2011; 34:2220-4. <https://doi.org/10.2337/dc11-1108>. PMID:21852677 PMID:PMC3177727
- Bansal V, Kalita J, Misra UK. Diabetic neuropathy. *Postgrad Med J*. 2006; 82:95-100. <https://doi.org/10.1136/pgmj.2005.036137>. PMID:16461471 PMID:PMC2596705
- Ashok S, Ramu M, Deepa R, Mohan V. Prevalence of neuropathy in type 2 diabetic patients attending a diabetes centre in South India. *J Assoc Physicians India*. 2002; 50:546-50.
- Yach D, Stuckler D, Brownell KD. Epidemiologic and economic consequences of the global epidemics of obesity and diabetes. *Nature Medicine* 2006; 12(1):62-6. <https://doi.org/10.1038/nm0106-62>. PMID:16397571
- Creager MA, Luscher TF, Cosentino F, Beckman H. Diabetes and vascular disease: Pathophysiology, clinical consequences, and medical therapy: Part I. *Circulation*. 2003; 108(12):1527-32. <https://doi.org/10.1161/01.CIR.0000091257.27563.32>. PMID:14504252
- American Diabetes Association. Standards of medical care in diabetes-2013. *Diabetes Care*. 2013; 36(Suppl 1):S11-66. <https://doi.org/10.2337/dc13-S011>. PMID:23264422 PMID:PMC3537269
- Boulton AJ, Gries FA, Jervell JA. Guidelines for the diagnosis and outpatient management of diabetic peripheral neuropathy. *Diabetes Medicine*. 1998; 15(6):508-14. [https://doi.org/10.1002/\(SICI\)1096-9136\(199806\)15:6<508::AID-DIA613>3.0.CO;2-L](https://doi.org/10.1002/(SICI)1096-9136(199806)15:6<508::AID-DIA613>3.0.CO;2-L)
- Soliman E, Gellido C. Diabetic Neuropathy. *eMedicine.com*; March 29, 2002. Dorsey RR, Eberhardt MS, Gregg EW, Geiss LS. Control of risk factors among people with diagnosed diabetes, by lower extremity disease status. *Prev Chronic Dis*. 2009 Oct. 6(4):A114.
- Shaw JE, Hodge AM, deCoruten M, Dowse GK, Gareeboo H, Tuomilehto J et al.; Diabetic peripheral neuropathy in Mauritius: Prevalence and risk factors. *Diabetes Res Clin Pract*. 1998; 43(2):131-139. [https://doi.org/10.1016/S0168-8227\(98\)00100-4](https://doi.org/10.1016/S0168-8227(98)00100-4)
- Kasturi AS, Yadhav RPS, Kurian G, Gupta MM. Cardiac autonomic neuropathy in diabetes mellitus. *JAPI*. 1991; 39(11):477

**How to cite this article:** Nigoo, K.A., Chafekar, N. and Kirloskar, M. Study of Incidence and Prevalence of Diabetic Peripheral Neuropathy in Type II Diabetes Mellitus by Bedside Screening Techniques at a Tertiary Care Centre. *MVP J. Med. Sci.* 2021; 8(2): 253-257.