A Descriptive Study on Prevalence And Risk Factors of Diabetic Neuropathy among Type II Diabetes Mellitus Patients in A Tertiary Care Hospital

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Abstract: Introduction: Diabetic neuropathy (DN) is a common, predominantly chronic, complex and worrisome complication of diabetes mellitus (DM), whose symptoms and signs typically reside in the toes, feet and legs; affects a significant number of individuals with DM and impacts negatively on their quality of life. Screening and early identification of neuropathy offer a crucial opportunity for the patient with diabetes to actively modulate the course of suboptimal glycemic control to currently recommended targets and to implement improved foot care before the onset of significant morbidity. Clinical trial evidence for the efficacy of screening strategies has demonstrated reduced incidence of amputation and ulceration, and screening for neuropathy is recommended in clinical practice guidelines. Objective: To determine the prevalence of p diabetic peripheral neuropathy among Type 2 DM and its associated risk factors using the DNE and DNS questionnaire in a cross sectional study in a tertiary hospital. Methodology: Patients were selected in this study as per Inclusion and Exclusion criteria after getting the informed consent. At the time of enrollment, socio-demographic data was collected and fasting blood glucose recorded. Using DNE and DNS questionnaire the total score calculated. A DNE score of ≥3 was recorded as diagnostic of DPN. Data collected was analyzed statistically. Result: From a total of 350 patients, 100 patients were included in the study based on inclusion and exclusion criteria. The study suggested that the prevalence of DN in T2DM was nearly 42% and it was found to be increasing with increasing age (P<0.05) and duration of neuropathy. The study consisted of more male subjects compared to female subjects and the prevalence of DN was more in males. The statistical test revealed that age, duration of diabetes, poor glycemic control analysis based on HbA1c as the risk factor for DN.

Keywords: Diabetes Mellitus, Diabetic neuropathy, Prevalence, Risk factors.

INTRODUCTION

Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease. In 2000, India (31.7 million) topped the world with the highest number of people with diabetes mellitus followed by China (20.8 million) with the United States (17.7 million) in second and third place respectively. The level of morbidity and mortality due to diabetes and its potential complications are enormous, and pose significant healthcare burdens on both families and society (Kaveeswar, S. A., & Cornwall, J. 2014).

In 2011, there were 366 million people with diabetes globally, and this is expected to rise to 552 million by 2030 (Whiting, D. R. et al., 2011). According to the ICMR – INDIAB study, there are 62.4 million people living with diabetes in India. T2DM is a progressive disease and hampers the quality of life of the patients due to micro and macro vascular complications (Mohan, V. et al., 2013).

The incidence of chronic complications like CVD, renal diseases or cerebrovascular disease and lower extremity disease like PVD, foot ulcer, lower extremity
amputations and other microvascular complications like retinopathy are higher in diabetic patients than nondiabetic patients. Screening and early identification of DM offers the patients the opportunity to manage the disease condition from worsening and thereby reducing the risk of complications.

By considering all these content this study was designed to access the prevalence and risk factors involved in diabetic neuropathy in T2DM patients.

**Definition**

Diabetes mellitus (DM) is a group of metabolic disorders characterized by hyperglycemia; is associated with abnormalities in carbohydrate, fat and protein metabolism; and results in chronic complications including microvascular, macrovascular, and neuropathic disorders.

The two major classifications of diabetes mellitus are type 1 (insulin deficient) and type 2 (combined insulin resistance and relative deficiency in insulin secretion). They differ in clinical presentation, onset, etiology, and progression of disease. Both are associated with microvascular and macrovascular disease complications (Dipiro, J. T. et al., 2014).

**Epidemiology**

According to ICMR in recent decades, India has witnessed a rapidly exploding epidemic of diabetes. Indeed, India today has the second largest number of people with diabetes in the world. The International Diabetes Federation (IDF) estimates that there are 72.9 million people with diabetes in India in 2017, which is projected to rise to 134.3 million by the year 2045. The prevalence of diabetes in urban India, especially in large metropolitan cities has increased from 2% in the 1970s to over 20% at present and the rural areas are also fast catching up (ICMR. 2018).

**Classification of Diabetes**

According to the American Diabetes Association and the World Health Organisation, diabetes can be classified into four main types (ICMR. 2018).

**Table 1. Classification of Diabetes Mellitus**

<table>
<thead>
<tr>
<th>Classification of Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Type 1 diabetes</td>
</tr>
<tr>
<td>• Type 2 diabetes</td>
</tr>
<tr>
<td>• Gestational diabetes</td>
</tr>
<tr>
<td>• Other types of diabetes (Monogenic diabetes, pancreatic diabetes, drug- induced diabetes etc.)</td>
</tr>
</tbody>
</table>

**Differentiating Between Type 1 and Type 2 Diabetes** (Walker, R., & Whittlesea, C. 2012)

**Table 2. Differentiating Between Type 1 and Type 2 Diabetes**

<table>
<thead>
<tr>
<th>Type 1 diabetes</th>
<th>Type 2 diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• β-cell destruction</td>
<td>• No β-cell destruction</td>
</tr>
<tr>
<td>• Islet cell antibodies present</td>
<td>• No islet cell antibodies present</td>
</tr>
<tr>
<td>• Strong genetic link</td>
<td>• Very strong genetic link</td>
</tr>
<tr>
<td>• Age of onset usually below 30</td>
<td>• Age of onset usually above 40</td>
</tr>
<tr>
<td>• Faster onset of symptoms</td>
<td>• Slower onset of symptoms</td>
</tr>
<tr>
<td>• Insulin must be administered</td>
<td>• Diet control and oral</td>
</tr>
<tr>
<td>• Patients usually not overweight</td>
<td>• hypoglycemic agents often sufficient control</td>
</tr>
<tr>
<td>• Extreme hyperglycemia</td>
<td>• Patients usually overweight</td>
</tr>
<tr>
<td>• Causes diabetic ketoacidosis</td>
<td>• Extreme hyperglycemia causes Hyperosmolar hyperglycemic state.</td>
</tr>
</tbody>
</table>

**ETIOLOGY**

Both genetic and environmental factors are relevant in the development of type 1 diabetes, but the exact relationship between the two is still unknown. There is a strong immunological component to type 1 and a clear association with many organ-specific autoimmune diseases. Circulating islet cell antibodies (ICAs) are present in more than 70% of those with type
1 at the time of diagnosis. Family studies have shown that the appearance of ICAs often precedes the onset of clinical diabetes by as much as 3 years. Type 1 has been widely believed to be a disease of clinically rapid onset, but the development is related to a slow process of progressive immunological damage. However, it is not currently possible to use screening methods to reliably identify patients who will develop diabetes in the future. The final event that precipitates clinical diabetes may be caused by sudden stress such as an infection when the mass of β-cells in the pancreas falls below 5–10%.

Type 2 diabetes also has a strong genetic predisposition. It occurs because of the progressive development of insulin resistance and β-cell dysfunction, the latter leading to an inability of the pancreas to produce enough insulin to overcome the insulin resistance. About 85% of people with type 2 diabetes are obese. This highlights the clear association between type 2 and obesity, with obesity causing insulin resistance (Walker, R., & Whittlesea, C. 2012).

**SYMPTOMS OF DM**
- Osmotic symptoms - polyuria, polydipsia
- Weight loss in spite of polyphagia
- Tiredness, weakness
- Generalized pruritus
- Recurrent urogenital infections
- Delayed healing of wounds

More than half of all patients with diabetes will have no symptoms at all (ICMR. 2018)

**2.6. DIAGNOSTIC CRITERIA FOR DM**
- Symptoms of diabetes (see Section 3.2) plus casual or random plasma
- Glucose ≥ 200 mg/dl (Casual means without regard to time of last meal)
- Fasting plasma glucose ≥ 126 mg/dl*
- 2 hour post 75 g glucose ≥ 200 mg/dl (as part of OGTT)*
- Glycated Haemoglobin ≥ 6.5%*

*Diabetes diagnosed using any of these criteria should be confirmed with another test subsequently.

**Diagnostic criteria for diabetes and prediabetes**
(Walker, R., & Whittlesea, C. 2012)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>NORMOGLYCEMIA</th>
<th>PREDIABETES (mg/dl)</th>
<th>DIABETES (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPG</td>
<td>&lt;110</td>
<td>110-125 (IFG)</td>
<td>≥126</td>
</tr>
<tr>
<td>2-h PG</td>
<td>&lt;140</td>
<td>140-199 (IGT)</td>
<td>≥200</td>
</tr>
<tr>
<td>HbA1c</td>
<td>&lt;5.7%</td>
<td>5.7-6.4%</td>
<td>≥6.5%</td>
</tr>
<tr>
<td>Random plasma glucose</td>
<td></td>
<td>≥200(with symptoms of diabetes)</td>
<td></td>
</tr>
</tbody>
</table>

* Individuals with random plasma glucose between 140-199mg/dl are recommended to undergo OGTT.

**Oral Glucose Tolerance Test (OGTT)**
- Person to be tested should be on a normal diet (with at least 200g carbohydrate/day) for at least 3 days before the test.
- The test should be done after an overnight fast of 8-10 hours and comprises of two blood samples: fasting and 2 hours after glucose load.
- Following the collection of the fasting blood sample for analysis of plasma glucose, the individual should be administered 75 g of glucose (1.75 g/kg body weight for children to a maximum of 75 g) dissolved in at least 250 ml of water. The glucose load should be drunk within a period of 5 minutes.
- The second sample should be collected 2 hours after the glucose load is given.
- The subject should be resting and refrain from smoking and eating in between the two sample collections.
MANAGEMENT OF DIABETES MELLITUS
Non Pharmacological Management

Lifestyle Goals:
- To improve health through optimum nutrition
- To provide energy for reasonable body weight, normal growth and development
- To maintain glycemic control
- To achieve optimum blood lipid levels
- To individualize the diet according to complications and co-morbidities.
- Achieve optimal physical activity.
- Advise other behavioral changes for: smoking, other tobacco products and alcohol.
- Advocate stress management.

Medical Nutrition Therapy (MNT)
MNT for diabetes mellitus requires application of Nutritional and behavioral sciences along with physical activity.
- Dietary management
- Lifestyle management
- Physical activity & exercise

PHARMACOLOGICAL MANAGEMENT (ICMR. 2018).
This section is divided into
1. Oral anti-hyperglycemic drugs
2. Non-insulin injectable therapy
3. Insulin therapy.

Oral anti-hyperglycemic drugs

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DRUG NAME</th>
<th>DURATION OF ACTION(hr.)</th>
<th>DAILY DOSES RANGE(mg)</th>
<th>PER DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIGUANIDES</td>
<td>Metformin</td>
<td>4-8</td>
<td>250-2500</td>
<td>1-3</td>
</tr>
<tr>
<td></td>
<td>Metformin SR</td>
<td>18-24</td>
<td>500-2500</td>
<td>1-2</td>
</tr>
<tr>
<td>SULFONYLUREAS*</td>
<td>First Generation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tolbutamide</td>
<td>6-10</td>
<td>500-2000</td>
<td>1-3</td>
</tr>
<tr>
<td></td>
<td>Chlorpropamide</td>
<td>24-72</td>
<td>100-500</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Second generation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Glibenclamide</td>
<td>16-24</td>
<td>2.5-20</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>Glipizide</td>
<td>8-12</td>
<td>2.5-20</td>
<td>1-3</td>
</tr>
<tr>
<td></td>
<td>Glipizide modified</td>
<td>24</td>
<td>5-20</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>release Gliclazide</td>
<td>8-12</td>
<td>80-320</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>Gliclazide modified</td>
<td>release Glimepiride 24</td>
<td>30-120</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-24</td>
<td>1-8</td>
<td></td>
</tr>
<tr>
<td>DPP4 INHIBITORS*</td>
<td>Sitagliptin</td>
<td>24</td>
<td>25-100</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Vildagliptin</td>
<td>3-12</td>
<td>25-50</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>Saxagliptin</td>
<td>2.5(active metabolites acts for upto 24hrs)</td>
<td>2.5-5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Linagliptin</td>
<td>24</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Teneligliptin</td>
<td>24</td>
<td>20-40</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Gemigliptin</td>
<td>24</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18-24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THIAZOLIDINEDIONES</td>
<td>Pioglitazone</td>
<td>16-24</td>
<td>7.5-30</td>
<td>1</td>
</tr>
</tbody>
</table>

(Glitazones)
Non-insulin injectable therapy (GLP-1 receptor agonists)

Table 5. Non-insulin injectable therapy (ICMR, 2018)

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DRUG</th>
<th>DURATION OF ACTION</th>
<th>DAILY DOSE</th>
<th>DOSES PER DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLUCAGON LIKE PEPTIDE1</td>
<td>Exenatide 10</td>
<td>5-20mcg</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>RECEPTOR AGONIST</td>
<td>Liraglutide 24</td>
<td>0.6-1.8mg</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>(INCRETINE MIMETICS)</td>
<td>Lixisenatide24</td>
<td>10-20 mcg</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dulaglutide 24-72</td>
<td>0.75-1.5 mg</td>
<td>Once per week</td>
<td></td>
</tr>
</tbody>
</table>

Insulin Therapy

Table 6. Insulin Therapy

<table>
<thead>
<tr>
<th>PREPARATION(h)</th>
<th>ONSET(h)</th>
<th>PEAK(h)</th>
<th>DURATION(h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble insulin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Actrapid (pyr)</td>
<td>0.5</td>
<td>2-5</td>
<td>8</td>
</tr>
<tr>
<td>Humulin S (prb)</td>
<td>0.5</td>
<td>1-3</td>
<td>5-7</td>
</tr>
<tr>
<td>Apidra (insulin glulisine)</td>
<td>0.25</td>
<td>1</td>
<td>3-4</td>
</tr>
<tr>
<td>Humalog (insulin lispro)</td>
<td>0.25</td>
<td>1-1.5</td>
<td>2-5</td>
</tr>
<tr>
<td>Novorapid (insulin aspart)</td>
<td>0.25</td>
<td>1-3</td>
<td>3-5</td>
</tr>
<tr>
<td>Insuman R apid (crb)</td>
<td>0.5</td>
<td>1-3</td>
<td>7-9</td>
</tr>
<tr>
<td>Biphasic insulin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humulin M3 (prb)</td>
<td>0.5</td>
<td>1-8.5</td>
<td>14-15</td>
</tr>
</tbody>
</table>
DIABETIC COMPLICATIONS
Most of the morbidity and mortality due to diabetes arises on account of its complications. Diabetes complications can be broadly divided into acute and chronic complications. Acute complications:
- Hypoglycemia
- Hyperglycemic emergencies (diabetic ketoacidosis and hyperosmolar hyperglycemic state)

Chronic complications
- Macrovascular disease (CVD, PVD)
- Microvascular disease (Retinopathy, Nephropathy, Neuropathy)
- Macro and microvascular disease combined (Diabetic foot problems).

DIABETIC NEUROPATHY
Diabetic neuropathies can lead to a wide variety of sensory, motor and autonomic symptoms. The most common is the symmetrical distal sensory type, which is particularly evident in the feet and may slowly progress to a complete loss of feeling. It is most prevalent in elderly patients with type 2 diabetes but may be found with any type of diabetes, at any age beyond childhood. Painful diabetic neuropathy is another manifestation of sensory neuropathy; it can be extremely disabling and may cause considerable morbidity. Diabetic proximal motor neuropathy is rapid in onset and involves weakness and wasting, principally of the thigh muscles. Muscle pain is common and may require opiate analgesia. Distal motor neuropathy can lead to symptoms of impaired fine coordination of the hands and/or foot slapping. Peripheral neuropathy is the progressive loss of peripheral nerve fibres resulting in nerve dysfunction. Autonomic neuropathy may affect any part of the sympathetic or parasympathetic nervous systems (Walker, R., & Whittlesea, C. 2012)

Diagnosis & clinical recognition: (ICMR. 2018)
- Sensory neuropathy is evidenced by symptoms of paresthesiae (such as tingling, numbness and pain) or loss of sensation of touch, pain, temperature and vibration
- Neuropathy can lead to foot deformities and dryness of planter skin leading to neuropathic foot ulcers. These ulcers are susceptible for infection, cellulitis and osteomyelitis often requiring partial foot amputation
- Motor weakness of small muscles of foot is evidenced by inability to grip footwear and alteration of arch of foot, bringing pressure on the head of first metatarsal and heel
- Quadriceps wasting and absent knee jerk and bilateral hip muscle weakness suggest diabetic amyotrophy
- Cranial motor neuropathy involving 3rd, 6th and rarely 7th nerve must be considered in relevant cases
- Radiculopathy and cranial neuropathies are reversible while sensorimotor symmetrical polyneuropathy is progressive and irreversible.
- Assess for autonomic neuropathy with symptoms such as orthostatic hypotension, gastroparesis,
• Diarrhoea /constipation, impotence, cystopathy and gustatory sweating
• Always exclude other causes of neuropathy for example nutritional deficiency, hypothyroidism, spinal disorders, para neoplastic syndrome, drug induced, alcohol abuse, uremic neuropathies, etc.

CLINICAL EXAMINATION AND INVESTIGATIONS:
Various scoring system to screen diabetic peripheral neuropathy:

a) DNS
The diabetic symptom score is for assessing pain, numbness, tingling and ataxia. The maximum score of DNS is four points, one point or more indicates neurological abnormalities.

b) DNE
In this examination, only the right side of the limb is examined, and the maximum score is 16 points. A score of greater than three points is considered abnormal. It is recommended for the daily use in diagnosing DPN in clinical practice.

Touch sensation test
a) 10g monofilament sensation
It delivers a 10 gram force when applied so as to make it buckle.
• Apply the monofilament perpendicular to the skin’s surface
• Apply sufficient force to cause the filament to bend or buckle
• The total duration of the approach, skin contact, and departure of the filament should be approximately 1-2 seconds
• Apply the filament along the perimeter and NOT ON an ulcer site, callus, scar or necrotic tissue. Do not allow the filament to slide across the skin or make repetitive contact at the test site
• A person who cannot feel the 10 gram filament at the selected sites is at increased risk for developing ulcers (ICMR. 2018)

b) Vibration perception (128 Hz tuning fork):
Place the stem of the fork over the bony prominences of the foot (big toe and medial malleolus) and ask the patient if he feels the vibration. Record the result as absent, reduced or present depending on the patient’s response. If absent, check at more proximal sites such as tibial tuberosity and anterior superior iliac spine (ICMR. 2018).

c) Biothesiometer test:
The vibration perception threshold (VPT) is examined using a biothesiometer with the patient in the supine position with or without eyes closed (ICMR. 2018).

d) Vascular assessment:
This involves the manual palpation of the dorsalis pedis and posterior tibial pulses in both feet. Ankle brachial pressure index (ABI) using hand held Doppler should be assessed if peripheral pulsations are absent or clinical suspicion of peripheral ischaemia (Normal ABI is between 0.9 to 1.3) (ICMR. 2018).

Examination of BP in sitting and standing positions and ECG for heart rate variability may be useful in diagnosing autonomic neuropathy

MANAGEMENT
Goals of therapy:
• Slowing progression of the disease
• Relieving pain
• Managing complication and restoring function
• Nerve repair /growth

Initial Therapy and Counseling
Once a diagnosis is established, giving patients a full explanation of their condition, allaying their fears and misconceptions, and informing them that the pain may resolve in time can be extremely reassuring. Simple physical treatments, such as the use of a bed cradle to lift the bed clothes off of hyper aesthetic skin, can be beneficial. Advice on suitable footwear may also be provided. In patients with relatively mild pain, simple analgesics or anti-inflammatory agents may be sufficient to treat the discomfort.

Metabolic Control
• The most effective method of achieving stable normoglycemia is pancreas or islet cell transplantation.
• Although there have been no randomized, controlled trials of intensive insulin therapy in the management of diabetic neuropathy, data from a number of observational studies suggest that stable glycemic control is of the greatest import. A recent study using continuous glucose monitoring confirmed that painful symptoms were associated with erratic blood glucose control. Having said this, there is no evidence that patients whose diabetes has been well controlled on oral hypoglycemic agents will benefit in terms of pain relief by transferring to insulin.

Pharmacological Management
A large number of therapeutic agents have been proposed for the management of painful symptoms. Although there is only limited evidence to support the use of non steroidal and anti-inflammatory drugs in DPN, some would advocate their use for the management of patients with mild symptoms. Such agents must be used with caution in neuropathic diabetic patients because many will have a renal impairment, which often constitutes a contraindication to the use of non-steroidal drugs.
Table 7. Pharmacotherapy of Diabetic Peripheral Neuropathy (Cohen, K. et al., 2015)

<table>
<thead>
<tr>
<th>DRUG CLASS</th>
<th>DRUG</th>
<th>DOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTI-DEPRESSANT</td>
<td>Amitriptyline</td>
<td>25–100 mg at bedtime</td>
</tr>
<tr>
<td></td>
<td>Desipramine</td>
<td>10-25 mg titrated to 100-150 mg at bedtime.</td>
</tr>
<tr>
<td></td>
<td>Duloxetine (Cymbalta)</td>
<td>60 mg/day.</td>
</tr>
<tr>
<td></td>
<td>Venlafaxine</td>
<td>75–225 mg/day.</td>
</tr>
<tr>
<td></td>
<td>Carbamazepine</td>
<td>600 mg/day (200 mg TID) to 800 mg/day (200mg QID)</td>
</tr>
<tr>
<td></td>
<td>Gabapentin</td>
<td>900–3,600 mg/day in three divided doses.</td>
</tr>
<tr>
<td>ANTICONVULSANTS</td>
<td>Pregabalin (Lyrica)</td>
<td>150 mg/day (50 mg TID) to 300 mg/day (100mg TID).</td>
</tr>
<tr>
<td></td>
<td>Valproate sodium</td>
<td>500–1,200 mg/day in two or three divided doses.</td>
</tr>
<tr>
<td></td>
<td>Morphine sulfate</td>
<td>15–30 mg every 12 to 24 hours</td>
</tr>
<tr>
<td>OPIOIDS</td>
<td>Oxycodone CR</td>
<td>Maximum dosage: 120 mg/day in two divided doses of CR formulation.</td>
</tr>
<tr>
<td></td>
<td>Dextromethorphan</td>
<td>400 mg/day in four divided doses</td>
</tr>
<tr>
<td></td>
<td>Tapentadol</td>
<td>50–250 mg BID</td>
</tr>
<tr>
<td></td>
<td>Tramadol</td>
<td>210 mg/day in two or four divided doses.</td>
</tr>
<tr>
<td>OPIOID-LIKE ANALGESICS</td>
<td>Capsaicin (cream)</td>
<td>0.075% TID or QID</td>
</tr>
<tr>
<td></td>
<td>Lidocaine patch</td>
<td>Maximum of three 5% medicated patches applied once for up to 12 hours within a 24-hour period</td>
</tr>
</tbody>
</table>

AE=adverse event; AWP = average wholesale price; BID = twice daily; BP = blood pressure; BUN = blood urea nitrogen; CBC = complete blood count; CR = controlled release; CrCl = creatinine clearance; DPN = diabetic peripheral neuropathy; ECG = electrocardiogram; ER = extended release; GI = gastrointestinal; GFR = glomerular filtration rate; QID = four times daily; TCA = tricyclic antidepressant; TID = three times daily.
Other physical therapies
Many other physical therapies have been proposed. Controlled evidence has been provided for the use of percutaneous nerve stimulation, static magnetic field therapy, low-intensive laser therapy, and monochromatic infrared light. These therapies have mainly been described in small single-center studies and require confirmation in larger studies. Electrical spinal cord stimulation has been used to treat several chronic painful conditions, including phantom limb pain, vascular disease, and severe neuropathy. Although anecdotal evidence has been presented to support this, this treatment is invasive, expensive, and needs to be confirmed in randomized trials.

α-lipoic-acid. This free radical scavenger antioxidant has been shown to be efficacious in the management of painful neuropathies when administered parenterally. A large 4-year, multicenter study to confirm the efficacy of this agent in diabetic neuropathy is in progress and should be completed in 2005.

Protein kinase C inhibition. Elevated protein kinase C activity is thought to play a substantial role in the etiology of diabetic microvascular complications. Studies have been conducted using a protein kinase C-β inhibitor (LY333531). A preliminary study suggested the possibility of this agent improving positive symptoms of allodynia and pricking pain. Large, phase III, multicenter clinical trials are in progress.

BACKGROUND
About 371 million people aged from 20 to 79 years, around the globe are estimated to have diabetes mellitus and that at least half of them are unaware of the diagnosis. Among micro vascular complications, diabetic neuropathy is the most prevalent and accounting for the major cause of neuropathy worldwide.

Diabetic neuropathy may have different clinical presentations and among them distal symmetric polyneuropathy is most frequent and major mechanism contributing to the development of diabetic foot. Predominantly it is presented with positive (burning, tingling) and negative (numbness, loss of sensitivity) sensory symptoms. In general it is associated to autonomic signs and symptoms and there is motor manifestation, rarely. Severe cases may lead to amputations and incapacities.

Approximately 20% of patients with distal symmetric polyneuropathy have neuropathic pain, which sometimes becomes chronic and disabling. Early and accurate diagnosis provide opportunity for adequate treatment, prevents progression of neuropathy and severe complications. For such, it is necessary to obtain a precise clinical history, in addition to thorough neurological tests and additional tests, to identify signs of nervous fibers involvement. Its treatment depends on adequate glycemic control and neuropathic pain treatment, if present.

The progression of diabetic neuropathy among diabetic patients is influenced by various socio-demographic factors and other clinical variables. To prevent the progression and for proper management of the disease it is necessary to identify and keep a check on these factors.

This study has focused on the prevalence and risk factors of diabetic neuropathy among type II Diabetes mellitus patients.

AIM AND OBJECTIVE

AIM
The aim of the study was to assess the prevalence and risk factors of diabetic neuropathy among type II diabetic mellitus patients in a tertiary health care set up.

OBJECTIVE

- To find out the prevalence of diabetic neuropathy among T2DM patients based on demographic parameters (age, gender, duration of DM), diabetes parameters (FBS, RBS, HbA1c) and clinical parameter like blood pressure.
- To find out the presence of DN among T2DM patients based on DNS and DNE scores
- To analyses drug prescribing pattern among T2DM patients in a simple descriptive method
- To identify the risk factors of Diabetic neuropathy among T2DM patients.

REVIEW OF LITERATURE
Sonaalika Gogia et al., 2017, conducted the study to assess the prevalence and risk factors for diabetic neuropathy among T2DM patients attending a tertiary care hospital. T2DM patients' ≥30 years of both gender, presenting to the Medicine Department at a tertiary care hospital were included in the study. Diabetic Neuropathy Symptom (DNS) questionnaire to assess symptoms and Diabetic Neuropathy Examination (DNE) scoring to assess clinical signs were used. A total of 273 patients were included. The mean age was 57.8 ± 11.5 years. The male to female distribution was 75% (202) and 25% (71), respectively. According to DNS instrument, 41.4% patients scored positive for the presence of neuropathy while only 24.5% had neuropathy according to DNE score. The proportion of males affected by neuropathy was more than females. 43.1% males had a positive DNS score while only 27.2% of them had a positive DNE score. Duration of the disease was positively correlated with neuropathy. Neuropathy was more prevalent among people who had higher systolic and diastolic blood pressure as per DNS and DNE instruments. The present study identified a higher proportion of males to be affected by
neuropathy. Hence, more detailed evaluation must be accorded to elderly male diabetic patients with longer duration of the disease. Lifestyle modifications and watchful screening need to be incorporated as part of routine patient health education during follow-up clinic visits (Gogia, S., & Rao, C. R. 2020).

Pradeepa P R et al., 2008 conducted the study to determine the prevalence of, and risk factors for, diabetic neuropathy (DN) in south Indian Type 2 diabetic subjects. Subjects were recruited from the Chennai Urban Rural Epidemiology Study, conducted on a representative cohort from Chennai city. A total of 1629 diabetic subjects were included, of whom 1291 were known to have diabetes (KD) subjects and 338 were randomly selected newly detected diabetic (NDD) subjects. Neuropathy was diagnosed if vibratory perception threshold at the great toe, measured by biothesiometry, exceeded mean +2 sd of a healthy non-diabetic study population aged 20-45 years (cut point > or = 20 V). The overall prevalence of DN was 26.1% (age-adjusted 13.1%) with no significant difference in gender. The prevalence of neuropathy was significantly higher in KD subjects compared with NDD subjects (27.8 vs. 19.5%, P = 0.002). The prevalence of diabetic retinopathy (24.1 vs. 15.3%, P < 0.0001) and hypertension (51.1 vs. 40.0%, P < 0.0001) were higher in those with neuropathy compared with those without. The odds ratio for neuropathy in subjects with duration of diabetes > 15 years compared with < or = 5 years was 5.7 (95% confidence interval: 3.52-9.08, P < 0.0001). Regression analysis showed adjusted 13.1%) with no significant difference in age, sex, duration of diabetes, HbA1c value, hypertension, and body mass index.

Srinivasan S et al., 2019, conducted the study to assess the four-year incidence of diabetic peripheral neuropathy (DPN) and the risk factors that can predict incident neuropathy in a south Indian population with type 2 diabetes.1175 diabetic individuals were identified with known diabetes at baseline. At baseline, individuals underwent assessment of fasting plasma glucose and HbA1c levels, body mass index, waist-hip ratio, blood pressure, blood cholesterol and lipid levels, ophthalmic evaluation including visual acuity, specular microscopy of the corneal endothelium, cataract grading and diabetic retinopathy assessment. Subjects were re-examined after four years for the assessment of incident neuropathy; 713 individuals were found eligible at follow-up. The presence of neuropathy was assessed at baseline and at follow-up and was defined as a Vibration Perception Threshold of ≥ 20 Volts. The four-year incidence of any neuropathy was 28.4%. Factors predictive of incident diabetic neuropathy were greater age at baseline (OR =1.068), higher body mass index (OR =1.034), presence of diabetic retinopathy (OR =4.879) and lower socioeconomic status (OR =4.841), when adjusted for several potential confounding factors. The four-year incidence of diabetic neuropathy in a south Indian population with type 2 diabetes is 28% and can be predicted by ophthalmic and clinical variables. These factors may be utilized in the assessment, monitoring and intervention in individuals with diabetes in an effort to prevent or delay the development of diabetic peripheral neuropathy.

Darivemula S et al., 2019 conducted a multi-centric facility-based cross-sectional study with the objectives to assess the sociodemographic and economic status of the participants, to estimate the prevalence of the DPN using the screening methods, and to see the association with other factors. A predesigned semi-structured questionnaire, Semmes-Weinstein 10-g monofilament test, ankle reflexes, and vibration perception threshold test was used for the data collection and blood sugars levels were taken from the recent laboratory report. Among 336, 202 (60.1%) were male and 134 (39.9%) were female. The prevalence of the DPN was 39.3% among them 28.9% in males and 10.4% in females, respectively. The other determinants of the participants, 264 (78.6%) had the Glycated hemoglobin (HbA1c) >7, 205 (61%) had a burning foot sensation, 124 (36.9%) of them were had numbness of the foot, almost 50% of them had pricking sensation in the foot and more than one-third (130) of them had callousity over foot. The study showed the severity of DPN was significantly associated with age, sex, duration of diabetes, HbA1c value, hypertension, and body mass index.

Lazo Mde et al., 2014, conducted the study aimed to estimate the morbidity rate and associated factors for diabetic peripheral neuropathy (DPN) in a low-middle income country setting. It was a Cross-sectional study, data was gathered at Peru’s Ministry of Health national specialized hospital for endocrinological conditions through standardized interviews, anthropometric measurements and blood tests for glycated haemoglobin (HbA1c). DPN was evaluated using two techniques: the Semmes-Weinstein monofilament test and the diabetic neuropathy symptom score. Overall prevalence and 95% confidence intervals (95% CI) were calculated. Potential factors related to DPN explored included body mass index, years with disease (<10 vs. ≥10 years), glycemic control (HbA1c <7% vs. ≥7%), microalbuminuria, retinopathy, and current pharmacological treatment.

Multivariable analysis was performed using Poisson analysis to calculate prevalence ratios. DPN was observed in 73/129 (56.6%) patients. In multivariable analysis adjusted by age and sex, the prevalence ratio of neuropathy was 1.4 times higher (95% CI 1.07-1.88) in patients who took insulin plus metformin compared to patients who used one treatment alone, and 1.4 higher (95% CI 1.02-1.93) in patients with ≥10 years of...
disease compared to those with a shorter duration of disease. DPN is highly frequent among patients with diabetes in a national specialized facility from Peru. Associated factors to DPN included being a diabetic patient for over ten years, and receiving insulin plus metformin (Lazo, M. D. L. A. et al., 2014).

Su JB et al., 2018, conducted the study to investigate the association of HbA1c variability with DPN in patients with type 2 diabetes. This was a cross-sectional study, 563 type 2 diabetic patients who had been screened for DPN and undergone quarterly HbA1c measurements during the year preceding enrolment were recruited. DPN was confirmed in patients displaying both clinical manifestations of neuropathy and abnormalities in a nerve conduction evaluation. HbA1c variability was assessed by the coefficient of variation of HbA1c (CV-HbA1c), and the mean of HbA1c (M-HbA1c) was calculated. presented with a higher (Coefficient of variation) CV-HbA1c In addition, medical history and clinical data were collected. Among the recruited patients, 18.1% (n = 102) were found to have DPN, and these patients also than the patients without DPN (p < 0.001). The proportion of patients with DPN increased significantly from 6.9% in the first to 19.1% in the second and 28.5% in the third tertile of CV-HbA1c (p for trend < 0.001). After adjusting for initial HbA1c, M-HbA1c and other clinical factors via multiple logistic regression analysis, the odds ratios (ORs) for DPN in the second and third versus those in the first CV-HbA1c tertile were 3.61 (95% CI: 1.628.04) and 6.48 (2.86-14.72), respectively. The area under the receiver operating characteristic (ROC) curve of CV-HbA1c was larger than that of M-HbA1c, at 0.711 (95% CI: 0.659-0.763) and 0.662 (0.604-0.721), respectively. ROC analysis also revealed that the optimal cutoff value of CV-HbA1c to indicate DPN was 15.15%, and its corresponding sensitivity and specificity were 66.67% and 65.73%, respectively. Increased HbA1c variability is closely associated with DPN in type 2 diabetic patients and could be considered as a potent indicator for DPN in these patients.

Rani PK et al., 2010 conducted the study to estimate the prevalence of diabetic neuropathy (severity wise) and associated risk factors in a population having type 2 diabetes mellitus. A population-based sample of 1401 persons with diabetes (identified as per the WHO criteria) underwent comprehensive eye examination including stereoscopic digital photography (45° four field) for diabetic retinopathy grading. Vibration perception threshold (VPT) measurements were done to assess neuropathy (cut off ≥ 20 V). Severity of neuropathy was graded into three groups based on VPT score as mild (20-24.99 V), moderate (25-38.99 V), and severe (≥39 V). Univariate and multivariate analyses were done to find out the independent risk factors for severity of diabetic neuropathy. In the overall group, the prevalence of diabetic neuropathy was 18.84% (95% CI: 16.79-20.88). The prevalence of mild diabetic neuropathy was 5.9% (95% CI: 4.68-7.15), moderate diabetic neuropathy was 7.9% (95% CI: 6.50-9.33), and severe diabetic neuropathy was 5% (95% CI: 3.86-6.14). Increasing age per year (P < 0.0001) was a statistically significant risk factor for all - mild, moderate, and severe - types of diabetic neuropathy. For severe diabetic neuropathy, other significant risk factors were duration of diabetes mellitus (P = 0.027), macro albuminuria (P = 0.001), and presence of diabetic retinopathy (P = 0.020). The results suggested that every fifth individual in a population of type 2 diabetes is likely to have diabetic neuropathy. Nearly 13% had neuropathy of moderate and severe category, making this group vulnerable for complications such as foot ulceration or lower limb amputation.

Ashok S et al., 2002, conducted this study with the aim to determine the prevalence and risk factors for neuropathy among South Indian type 2 diabetic patients attending a diabetes Centre. One thousand consecutive type 2 diabetic patients attending a diabetes centre in South India were recruited for the study. Biothesiometry studies were performed by a single observer using a biothesiometer. Neuropathy was diagnosed if the vibratory threshold of the great toe exceeded twenty five. Overall, 19.1% of the patients had evidence of neuropathy. The prevalence of neuropathy increased with increase in age (p < 0.001) and duration of diabetes (p < 0.001). Multiple logistic regression analysis revealed age (OR--3.2, 95% confidence interval--2.7-4.1, p < 0.001) and duration of diabetes (OR--1.4, 95% confidence interval--1.2-6.4, p = 0.001) as the risk factors for neuropathy. The overall prevalence of neuropathy in this South Indian type 2 diabetic subjects is 19.1% and age and duration of diabetes are the risk factors for neuropathy.

Meijer JW et al., 2003, conducted the study to evaluate the discriminative power of the Diabetic Neuropathy Symptom (DNS) and Diabetic Neuropathy Examination (DNE) scores for diagnosing diabetic polyneuropathy (PNP), as well as their relation with cardiovascular autonomic function testing (cAFT) and electrodiagnostic studies (EDS). Three groups (matched for age and sex) were selected: 24 diabetic patients with neuropathic foot ulcers (DU), 24 diabetic patients without clinical neuropathy or ulcers (DC), and 21 control subjects without diabetes (c). In all participants, the DNS and DNE scores were assessed and cAFT (heart rate variability [HRV], baroreflex sensitivity [BRS]), and EDS were performed (Nerve Conduction Sum [NCS] score; muscle fiber conduction velocity: fastest/slowest ratio [F/S ratio]). Both the DNS and the DNE scores discriminated between the DU and DC groups significantly (P < 0.001). The DNE score even discriminated between DC and C (P < 0.05). The DNS and DNE scores are able to discriminate between patients with and without PNP and are strongly related to cAFT and EDS. This further confirms the strength of
the DNS and DNE scores in diagnosing diabetic PNP in daily clinical practice.

S K Shahi et al., 2012, conducted the study to prospectively determine risk factors for foot ulceration in diabetic cases of North India. This was an observational study where 678 diabetic patients were examined, of which 97 reported diabetic foot ulcers (DFUs). Patients were interviewed using a pre-tested structured questionnaire to document clinical history. Statistical analysis was performed using SPSS 16.0 software. Prevalence of DFUs among diabetic patients was 14.30% (95% CI=11.67-16.94). Of 581 patients suffering from diabetes alone, 42.16% (95% CI 68.17-77.67) belonged to rural areas whereas among the cases with DFUs (n 97), 70.10% belonged to rural areas. In a multivariate logistic regression model, important risk factors for DFUs included age >50 years (OR> 6.97, P = 0.00), duration of diabetes 4 to 8 years (OR = 2.47, P = 0.00) and > 8 years (OR=3.03, P = 0.00), rural location (OR = 0.44, P = 0.00), oral hypoglycemic treatment (OR = 2.90, P = 0.00), insulin treatment (OR = 9.58, P = 0.00), and tobacco use (OR= 0.57, P = 0.00). A high prevalence of foot ulcers was confirmed among North Indian rural diabetic patients. Age, duration of diabetes, tobacco use, oral hypoglycemic treatment/insulin use and rural location were identified as important risk factors.

Kersti morkrid et al., 2010, conducted the study with purpose to estimate the prevalence and risk factors for diabetic peripheral neuropathy (DPN) in type 2 diabetic outpatients at the BIRDEM hospital, Bangladesh. Type 2 diabetic outpatients, diagnosed 5-11 years prior to the investigation were randomly selected for the study. DPN was assessed using the Neuropathy Symptom Score (NSS) and Neuropathy Disability Score (NDS). Data about demographics, blood pressure, height, weight, waist and hip circumference, and random blood and urine samples were collected. Two hundred and ninety four (139 men, 155 women) type 2 diabetic outpatients were studied. The overall DPN prevalence was 19.7 %; male (20.9%), female (18.7 %). The prevalence increased with age (from 11.1% in the 23-40 year-old group to 32.3% in the 60-80 year-old group) and duration of diabetes (from 14.1% in patients with five years to 29.2% in patients with 9-11 years duration). Age > 60 years (OR 4.2, 95% CI 1.4-12.3), low/normal WHR (OR 3.8, 95% CI 1.6-9.3), income < 800 TK (OR 3.1, 95% CI 1.1-9.3) and insulin treatment (OR 2.0, 95% CI 1.0-4.0) were independent, significant risk factors. Longer duration of diabetes (OR1.2 95% CI 1.0-1.4), and higher HbA1c (OR1.9, 95% CI 1.0-1.3) were marginally independent, significant risk factors for DPN. We observed a DPN prevalence of 19.7%. Higher age, low socioeconomic status, treatment with insulin, longer duration of diabetes and poor glycemic control were risk factors for DPN.[18]

Monisha D’Souza et al., 2015, conducted the study to determine the prevalence of DPN among patients attending a tertiary care hospital and to identify the determinants associated with it. A cross sectional study was conducted in Government Wenlock Hospital, Mangalore (India), during January-February 2014. A total of 208 patients with >5 year duration of DM were asked to respond to the patient history version of Michigan Neuropathy Screening Instrument (MNSI) and examinations were conducted after obtaining consent from them. The statistical analysis was done in terms of descriptive statistics and association between variables was tested using logistic regression test. The present study was conducted among patients with type-2 DM attending out-patient departments (OPDs) of Government Wenlock Hospital (GWH), an associate hospital of Kasturba Medical College (KMC) Mangalore, Karnataka.

The city of Mangalore is located in the coastal region of Karnataka state, India. It is the second fastest developing city of Karnataka state, with a highly industrialized work environment. The prevalence of DM in the coastal Karnataka is 16%. The GWH is a tertiary care level district hospital, which is having a public private partnership (PPP) with KMC, Mangalore. The GWH caters to the residents of Mangalore city and the surrounding suburbs. The OPD case load for every day ranges from 200 to 300 patients, among whom 60-70 patients will be with diabetes for follow up care. Apart from everyday medical OPDs, on every Wednesday diabetes clinic is conducted. The patients with diabetes are, usually, attended by the consultant doctors, junior residents and interns. The study was conducted over two month’s duration from 1st January 2014 to 28th February 2014. The prevalence of DPN using the MNSI history version and MNSI examination were found to be 18.3% and 32.2% respectively. The major determinants associated with DPN were found to be male gender (OR: 2.7, CI: 1.4-5.1, P=0.001), smoking (OR: 5.8, CI: 1.9-17.3, P=0.001) and age >40 years (OR: 2.7, CI: 1.2-5.8, P=0.011). The burden of undetected DPN was found to be higher among diabetics, with an especially higher prevalence among males, smokers and those with long standing diabetes mellitus. Interventions in the form of early detection through routine screening, smoking cessation and regular follow up examinations would go a long way in reducing the burden of disability among diabetics and improve their quality of life significantly (D’Souza, M. et al., 2015).

Hanu George et al., 2011, conducted the study to assess the knowledge and practices regarding foot care and to estimate the proportion of people with peripheral neuropathy among people with diabetes. The cross-sectional study was conducted in 212 consecutive diabetes patients attending the out-patient department of a rural secondary care hospital. The study was conducted in Community Health and Development
Average general out-patient department (OPD) attendance, including new and revisits, is around 200 per day. There is also a weekly diabetic clinic attended by approximately 40 patients each week. A sample size of 212 was calculated using the prevalence of foot care knowledge as 32% with a relative precision of 20%. Known cases of type 2 diabetes aged between 30 and 60 years, who had the disease for at least 6 months duration, attending the diabetic or general clinic of CHAD hospital were eligible to be included as participants in the study. Those with cognitive impairment and obvious disability that could affect the functions of the nervous system, affect independent self-care behavior, and those who had amputations of the lower limbs were excluded from the study. Two hundred and twelve consecutive people with diabetes attending the OPD, who were willing to participate, and gave informed consent were included in the study. A questionnaire which included demographic details, knowledge questionnaire, and Nottingham assessment of functional foot care was administered. The Michigan Neuropathy Screening Instrument was used to identify peripheral neuropathy. Descriptive analysis with frequency distribution for knowledge and practice scores, univariate analysis, and multiple logistic regressions to find significant variables associated with good knowledge and practice scores. About 75% had good knowledge score and 67% had good foot care practice score. Male gender (OR 2.36, 95% CI 1.16–4.79), poor education status (OR 2.40, 95% CI 1.19–4.28), and lesser duration of diabetes (OR 2.24, 95% CI 1.15–4.41) were significantly associated with poor knowledge on foot care. Poor knowledge was associated with poor foot care practices (OR 3.43, 95% CI 1.75–6.72). The prevalence of neuropathy was 47% (95% CI 40.14–53.85) and it was associated with longer duration of the disease (OR 2.18, 95% CI 1.18–4.04). There exist deficiencies in knowledge and practices regarding foot care. Male gender, low education, and lesser duration of diabetes are associated with poor knowledge scores. The prevalence of diabetic peripheral neuropathy is high (George, H. et al., 2013).

Preeti P Pawde et al., 2013, conducted the study to estimate the prevalence and risk factors of peripheral neuropathy among Type-2 Diabetic patients presenting to SMIMS Hospital. Study Design is Cross Sectional Study at SMIMS. Study Period is 10th September- 5th December 2011 & Sample Size is 283. A stratified random sampling and convenient sampling was done. The patients were questioned and Examined using a Pre-tested Questionnaire followed by a symptomatic history taking and Clinical Examination. Prevalence of neuropathy among Diabetics is 33.33%. Hypertensive Diabetics, Diabetes with Dyslipidemia have a higher risk of developing neuropathy. In this Study the prevalence of Diabetic-related Neuropathy is 33.33%. The study also shows risk factors for developing neuropathy such as Increasing duration of Diabetes, Comorbid diseases, Low Socio Economic Status.

S. P. Vibha et al., 2018, conducted the study with objective to assess the prevalence of diabetic foot syndrome (DFS) and the associated risk factors among people with diabetes mellitus. A community based cross-sectional study was carried out among 620 subjects with diabetes mellitus (DM) in rural areas of Udupi district. The Michigan Neuropathy Screening Instrument was used to identify peripheral neuropathy. Ankle brachial index was used to identify peripheral arterial disease (PAD). Subjects with diabetic foot syndrome were classified according to the International Working Group on Diabetic Foot (IWGDF) classification system. This is a community based cross-sectional study carried out during August 2015 to September 2017 among reported cases of diabetes mellitus currently residing in field practice area of Department of Community Medicine, Kasturba Medical College (KMC), Manipal. It is situated along the coastal belt of Udupi District of Karnataka state, India covering a population of 45,246 spread out over 13 villages. The healthcare services are provided by both public and private sectors.

The area has good collaboration between two sectors with primary, secondary and tertiary care facilities in the vicinity. Michigan Neuropathy Screening Instrument (MNSI) [14] was used to screen for diabetic neuropathy. It had two components, the history and the physical assessment. The first part of the screening instrument comprises of 15 self-administered “yes or no” questions on foot sensation including pain, numbness, and temperature sensitivity. A higher score (out of a maximum of 13 points) indicates more neuropathic symptoms. The second part of the MNSI is a brief physical examination involving 1) inspection of the feet for deformities, dry skin, hair or nail abnormalities, callous, or infection; 2) semi-quantitative assessment of vibration sensation at the dorsum of the great toe; 3) grading of ankle reflexes; and 4) monofilament testing. Patients screening positive on the clinical portion of the MNSI (greater than 2.5 points on a 10 point scale) were considered neuropathic. Glycated hemoglobin (HbA1c) was estimated in sub sample population, taking equal number of subjects with foot at risk category 0, 1, 2 and 3 as identified from the survey matched for age and gender. Health education regarding foot care practices was given to all subjects. If the subjects were found to be category 1 or 2 were referred
to nearest RMCW home for timely screening and subjects with category 3 risk were referred to Diabetic Foot clinic at KMC, Manipal. The collected data was tabulated and analyzed by using software SPSS (Statistical Package for Social Sciences) V.15.0 (SPSS South Asia, Bangalore) for windows. The data was cross checked for data entry errors. Findings were described in terms of proportions and their 95% confidence intervals. Continuous data was summarized using mean, and standard deviation or median and inter quartile range depending on skewness of data. Chi-square test was used to find the association and p-value < 0.05 was considered significant. Multiple logistic regression was used to find the risk factors. The overall prevalence of DFS was 51.8%. Among them 31.3, 11.9 and 8.5% belonged to category 1, 2 and 3 respectively. Multivariate logistic regression analysis showed advancing age, low socio-economic status, sedentary physical activity and longer duration of DM were significant independent correlates of DFS. The overall prevalence of diabetic foot syndrome was high among the study population and significantly associated with advancing age, low socio-economic status, sedentary physical activity and longer duration of DM. It can therefore be concluded that the screening for foot complications should start at the time of diagnosis of diabetes and integrated with sustainable patient education at primary care level by training of health care providers at primary care level (Vibha, S. P. et al., 2018).

Dipika Bansal et al., 2014, conducted the study to assess the prevalence of diabetic peripheral neuropathy (DPN), compare the prevalence between known diabetes mellitus (KDM) and newly detected diabetes mellitus (NDDM), identify risk factors associated, its prevalence pattern and to assess if any sex-specific differences are present. A cross-sectional study was carried out in a tertiary care hospital. Patients with duration of diabetes ≤6 months were considered to be NDDM. DPN was diagnosed by the combination of more than one abnormal result of 10-g monofilament, pinprick sensations and ankle reflexes, and categorized according to the severity level using vibration perception threshold. The study included 1,637 KDM and 369 NDDM patients. A total of 586 participants were found to have DPN, accounting for 29.2% (95% confidence interval [CI] 27.2-31.2) prevalence. The higher prevalence was observed in KDM compared with NDDM 33.7% (95% CI 31.42-36.01) vs. 9.2% (95% CI 6.3-12.2; P < 0.001). Prevalence of mild, moderate, and severe neuropathies was 8.06, 14.55 and 6.63%, respectively. Regression analysis showed age (P < 0.001), duration of diabetes (P < 0.001), dyslipidemia (P = 0.03), glycated hemoglobin (P <0.001), the presence of other micro vascular complications (P <0.001), macrovascular complications (P = 0.003) and alcoholic status (P < 0.033) to be associated. No sex specific differences were observed in the mean age at diagnosis of diabetes, mean age at the diagnosis of neuropathy, and duration taken for the DPN development among females and males. The study showed a high prevalence (29.2%) of DPN among north Indian type 2 diabetes mellitus patients. Thus, timely screening with earlier detection and intervention would be useful in preventing the progression of neuropathy.

Mohammad Zubair et al., 2012, conducted the study to evaluate the incidence and risk factors for amputation among patients with diabetic foot ulcer (DFU). This a prospective study of 162 DFU in patients treated in a multidisciplinary based diabetes and endocrinology centre of Jawaharlal Nehru Medical College of Aligarh Muslim University, Aligarh, India during the period of December 2008–March 2011. Detailed history and physical examination was carried out for every subject. Risk factors for amputation were determined by univariate analysis with 95% of CI. The overall amputation rate was 28.4%. On univariate analysis, male sex [OR 2.8, RR 1.28], hypertension [OR 2.83, RR 1.31], neuropathy [OR 3.01, RR 1.35], nephropathy [OR 2.24, RR 1.26], LDL-C (>100 mg/dl) [OR 2.53, RR 1.28], total cholesterol (>150 mg/dl) [OR 3.74, RR 1.52], HDL-C (<40 mg/dl) [OR 1.19, RR 1.18], triglycerides (>200 mg/dl) [OR 5.44, RR 1.76], previous antibiotic use [OR 9.12, RR 1.92], osteomyelitis [OR 6.97, RR 2.43] and biofilm infection [OR 4.52, RR 1.41] were significant risk factor. The risk factors for amputation were presence of PVD, leukocytosis, neuropathy, nephropathy, hypertension, dyslipidemia, over use of antibiotics, osteomyelitis, biofilm production and higher grade of ulcer.

Snehil Dixit et al., 2015, conducted the study to evaluate postural stability in patients with DPN and to examine correlation of Michigan Neuropathy Screening Instrument (MNSI) with duration of diabetes, age and postural stability measures. Participants were included if they had clinical neuropathy which was defined by MNSI. Sixty one patients gave their consent to participate in the study and were evaluated on posturography for postural stability measures. An increase in mean value of postural stability measures was observed for velocity moment 20±1.3, 24±2.2, 42.3±20.7, 59±43.03, mediolateral displacement 0.21±0.10, 0.22±0.18, 0.03±0.11, 0.34±0.18, and anteroposterior displacement 0.39 ± 0.09, 0.45±0.12, 0.47±0.13, 0.51±0.20 from EO to EC, EFO, and ECF, respectively. There was a significant difference (P<0.05) in participants with DPN, with greater sway amplitude on firm and foam surface in all the conditions. Moderate correlation of MNSI with age (r=0.43) and postural stability measures were also observed. Evaluation of postural stability in Indian DPN population suggests balance impairments on either firm and foam surfaces, with greater likelihood of fall being on foam or deformable surfaces among elderly adults with neuropathy (Mayya, A. et al., 2012).
Nahla Khawaja et al., 2018, conducted the study to determine the prevalence of diabetic peripheral neuropathy (DPN) and its associated factors among patients with type 2 diabetes mellitus in Jordan. A cross-sectional study was conducted at the National Center for Diabetes, Endocrinology and Genetics, Jordan. A total of 1003 patients with type 2 diabetes were recruited. Data were collected from participants during a face-to-face structured interview. DPN was assessed using the translated version of Michigan Neuropathy Screening Instrument (MNSI). The overall prevalence of DPN based on MNSI was 39.5%. The most frequently reported symptoms were numbness (32.3%) and pain with walking (29.7%), while the least reported symptoms were the history of amputation (1.3%) and loss of sensation in legs/feet while walking (3.8%). Logistic regression analysis revealed that unemployment, cardiovascular disease, dyslipidemia, diabetic retinopathy and long standing DM (diabetes of ≥ 5 years) were significantly associated with DPN. Peripheral Neuropathy is highly prevalent among Jordanian patients with type 2 diabetes mellitus. DPN was significantly associated with duration of DM, dyslipidemia, diabetic retinopathy, cardiovascular disease, and unemployment. Early detection and appropriate intervention are mandatory among high-risk groups.

Sharon G Bruce et al., conducted this study to determine the prevalence of and risk factors for diabetic neuropathy in a Canadian First Nation population. This was a community-based screening study of 483 adults. Measures included glucose, A1C, cholesterol, triglycerides, homocysteine, hypertension, waist circumference, height, weight, and foot examinations. Neuropathy was defined as loss of protective sensation determined through application of a 10-g monofilament. Twenty-two percent of participants had a previous diagnosis of diabetes, and 14% had new diabetes or impaired fasting glucose (IFG). The prevalence of neuropathy increased by 5% among those with normal glucose levels, 8% among those with new IFG and diabetes, and 15% among those with established diabetes (P < 0.01). Those with neuropathy were more likely to have foot deformities (P < 0.01) and callus (P < 0.001) than those without neuropathy. Among those with dysglycemia (6.1 mmol/L), the mean number of foot problems for those with insensitive feet was 3 compared with 0.3 among those with sensation (P < 0.001). In multivariate logistic regression female sex, low education, A1C, smoking, and homocysteine were independently associated with neuropathy, after controls for age. Neuropathy prevalence is high, given the young age of our participants (mean 40 years) and was present among those with undiagnosed diabetes. The high number and type of foot problems places this population at increased risk for ulceration; the low level of foot care in the community increases the risk. Homocysteine is a risk factor that may be related to lifestyle and requires further investigation.

E. A. Agbor Ndip et al., (2006) conducted this study to determine the prevalence and risk factors of the diabetic foot in a clinic population. In this cross-sectional study of 300 diabetic patients, the authors reviewed records, carried out an interview, and performed a meticulous foot examination with assessment of neuropathy (monofilaments and tuning fork) and ischemia (pulses). Foot lesions were classified according to Wagner grades. The prevalence of foot lesions was 13.0% (inpatients 25.6% and outpatients 11.1%). Diabetic neuropathy assessed using monofilaments was found in 81 patients (27.3%) (Monofilaments). The prevalence of ischemia was 21.3% and deformity was 17.3%, whereas 37 patients (12.3%) had a previous history of foot lesions. Foot examination was done in 14.3% of patients, and 47% had risky nail trimming habit, whereas 22% wore ill-fitting shoes. The prevalence of diabetic foot lesions is high, and known risk factors are significantly present, especially poor foot care.

Abdulwahab Elbarsha et al., (2019). Conducted the study to estimate the prevalence and risk factors of DPN among patients with Type 2 diabetes mellitus (T2DM) at a diabetes clinic in Benghazi Medical Center (BMC), Benghazi, Libya. Three hundred and sixtysseven patients with T2DM (127 [34.6%] males and 240 [65.4%] females) were included in this cross-sectional study. The patients aged ≥18 years, and they attended the outpatient diabetes clinics at BMC from May 2015 to October 2016, for routine follow-up. Patients with T1DM, gestational diabetes, and latent autoimmune diabetes in adults were excluded. Data including gender, age, type of DM, duration of DM, history of smoking, history of hypertension, weight, height, glycosylated hemoglobin (HbA1c), total cholesterol, triglyceride, low-density lipoprotein, high-density lipoprotein, creatinine, and urea were obtained by a prepared pro forma. Peripheral neuropathy was diagnosed in the presence of numbness, paresthesia, 10-g monofilament examination, and loss of vibration and joint position sensations.

The relationship between DPN and its risk factors, in addition to independent predictors of DPN, was explored using multiple forward stepwise logistic regression and presented as an odds ratio (OR) and 95% confidence interval (CI). The prevalence of DPN was 30.5% in the studied group. A statistical significant association found between DPN and age (P = 0.014), duration of DM (P < 0.001), macrovascular complications of DM (P < 0.001), diabetic retinopathy (P = 0.001), diabetic nephropathy (P < 0.001), poor glycemic control (high HbA1c) (P < 0.001), hypertension (P = 0.011), uncontrolled blood pressure (>140/90 mmHg) (P = 0.007), and insulin treatment (P < 0.001). Multiple forward stepwise logistic regression analyses revealed two independent risk factors influencing DPN: diabetic nephropathy (OR = 1.976, 95% CI: 1.289–3.027) (P = 0.009) and insulin treatment.
Chandrashekar, S., & Muralidhar, S. (2017) the aim of this study was to survey the prevalence of DFU risk factors and DFU prevalence among type 2 diabetes mellitus (T2DM) patients. An epidemiological study was conducted on an outpatient basis in K. R. hospital, Mysuru. All T2DM participants were ≥ 18 years were included. Demographic and foot care behavior were assessed using minimum data sheet (MDS). Meanwhile, presence of risk factors was evaluated for neuropathy and presence of angiopathy was evaluated with ankle brachial index (ABI) by using a hand-held doppler both dorsal and posterior tibial. At the end of study, 249 T2DM participants were enrolled. The prevalence of DFU risk factors was 55.4% (95% CI: 53.7% - 57.0%), and prevalence of DFU was 12% (95% CI: 10.3% - 13.6%). Even though the prevalence of DFU is high, identification associated factors for presence of risk and DFU has not been integrated into national guideline. Thus, preventive strategies should be introduced at early stage to prevent presence of risk and DFU.

Georgios Ponirakis et al., (2020) this study determined the prevalence of DN and its risk factors, DFU, and those at risk of DFU in patients with type 2 diabetes mellitus (T2DM) in secondary care in Qatar. Adults with T2DM were randomly selected from the two National Diabetes Centers in Qatar. DN was defined by the presence of neuropathic symptoms and a vibration perception threshold (VPT) ≥ 15 V. Participants with a VPT ≥ 25 V were categorized as high risk for DFU. Painful DN was defined by a DN4 score ≥ 4. Logistic regression analysis was used to identify predictors of DN. In 1082 adults with T2DM (age 54 ± 11 years, duration of diabetes 10.0 ± 7.7 years, 60.6% males), the prevalence of DN was 23.0% (95% CI, 20.5%-25.5%) of whom 33.7% (95% CI, 27.9%-39.6%) were at high risk of DFU, and 6.3% had DFU; 82.0% of the patients with DN were previously undiagnosed. The prevalence of DN increased with age and duration of diabetes and was associated with poor glycemic control (HbA1c ≥ 9%) AOR = 2.1 (95% CI, 1.3- 3.2), hyperlipidemia AOR = 2.7 (95% CI, 1.55-0), and hypertension AOR = 2.0 (95% CI, 1.2- 3.4). Despite DN affecting 23% of adults with T2DM, 82% had not been previously diagnosed with one- third at high risk for DFU. This argues for annual screening and identification of patients with DN. Furthermore, we identify hyperglycemia, hyperlipidemia, and hypertension as predictors of DN (Whiting, D. R. et al., 2011).

METHODOLOGY
STUDY TYPE
A cross-sectional study

STUDY SITE
The study was conducted in the Kongunad Hospital Private Limited Gandhipuram, Coimbatore. The study was approved by the Institutional Ethical Committee.

STUDY DURATION
The study was conducted over a period of 6 months.

STUDY POPULATION
From a total of 350 patients, approximately 100 inpatients were included in this study as per Inclusion and Exclusion criteria.

INCLUSION CRITERIA
- All Inpatients who are known case of T2DM for more than 2 years
- Patients of either gender hospitalized in IPD and willing to participate in the study.
- Patients with age 30 years and above.

EXCLUSION CRITERIA
- Patients who are in emergency & outpatient department.
- Patients with newly detected DM cases
- Patients with Type 1 DM
- Patients with other comorbidities like CKD, CVD, Stroke
- Neuropathy cases due to other than DM
- Gestational diabetes patients

STUDY PARAMETER
Age, gender, duration of DM, diagnosis, medications, diabetic parameters like FBS, RBS and HbA1c, clinical parameter like blood pressure and DNE and DNS scores.

STUDY TOOLS
- Designed Data collection form
- DNS Questionnaire
- DNE Score
- MRC scale

Methodology
STUDY PLAN

A number of 100 patients were selected as per inclusion and exclusion criteria and data were collected from the patients. The collected data was entered and analysed statistically. The results were summarised as percentages and proportions. Chi square test was used for the determination of association between DN and other risk factors; test values with \( P<0.05 \) were considered as statistically significant. The data was entered and analysed using STATA v.13.1.

RESULT

A total of 100 T2DM patients were included in the study. Table 8 and figure 1 & 2, summarizes the age and gender distribution of T2DM patients in this study. Out of which 42 patients have DN and remaining 58 doesn’t have DN. About 45 female patients and 55 male patients were recruited into the study. The male to female distribution of patients with DN was 25 and 17 respectively. And those without DN were found to be 13 males and 28 females as represented in the pie diagram (table 9 and figure 3).

Table 8. Age and Gender Distribution of T2DM Patients

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>TOTAL(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-40</td>
<td>8</td>
</tr>
<tr>
<td>40-50</td>
<td>14</td>
</tr>
<tr>
<td>50-60</td>
<td>28</td>
</tr>
<tr>
<td>60-70</td>
<td>31</td>
</tr>
<tr>
<td>70-80</td>
<td>16</td>
</tr>
<tr>
<td>80-90</td>
<td>3</td>
</tr>
</tbody>
</table>

GENDER

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>55</td>
</tr>
<tr>
<td>Female</td>
<td>45</td>
</tr>
</tbody>
</table>

Figure 1. Age distribution of T2DM patient.
The mean age of the patients was found to be 59.5 ± 11.8 years, (range 30–89 years) respectively. The mean duration of diabetes mellitus was 12.5 ± 8 years (range 4.5–20.5 years). Out of the study population having DN, 29 were DM patients for more than or equal to 10 years and about 13 were having DM for less than 10 years (Table 10). Out of 42 patients reported with DN, 15 were in the age group of 60-70 years. Table 11 and figure 4 summarises the age distribution of DN patients.

Table 10. Comparison of duration of DM and presence of DN

<table>
<thead>
<tr>
<th>Duration of DM</th>
<th>FREQUENCY OF DN</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥10 YEARS</td>
<td>29</td>
</tr>
<tr>
<td>&lt; 10 YEARS</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 11. Age wise distribution of DN in T2DM

<table>
<thead>
<tr>
<th>Age Group</th>
<th>DN</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-40</td>
<td>1</td>
</tr>
<tr>
<td>40-50</td>
<td>9</td>
</tr>
<tr>
<td>50-60</td>
<td>9</td>
</tr>
<tr>
<td>60-70</td>
<td>15</td>
</tr>
<tr>
<td>70-80</td>
<td>6</td>
</tr>
<tr>
<td>80-90</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
</tr>
</tbody>
</table>
Most of the patients included in this study (43%) were taking both insulin as well as oral hypoglycemic agents, 32% were on oral hypoglycemic agents and 25% on insulin alone as represented in pie diagram (figure 5).

According to DNS Questionnaire, 64% patients scored positive for the presence of neuropathy and about 51% of the patients had neuropathy according to DNE score as described in table 12. Out of these subjects with a positive score in DNS and DNE tool 21 and 8 subjects experienced symptoms of pain and other ailment due to condition other than diabetic neuropathy. Among them there were cases of diabetic foot ulcer and pain. Diabetic neuropathic patients identified by DNS was more as compared to DNE. On the basis of DNS and DNE instrument, most of the DN patients belonged to the age group of 60-70 years. Age wise comparison with DN is shown in table 13.

**Table 12. Presence of DN among T2DM patients by DNS and DNE Tools**

<table>
<thead>
<tr>
<th>Tools</th>
<th>No of positively scored subjects</th>
<th>No of negatively scored subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNS Questionnaire</td>
<td>64</td>
<td>36</td>
</tr>
<tr>
<td>DNE Score</td>
<td>51</td>
<td>49</td>
</tr>
</tbody>
</table>

According to DNS Questionnaire, 64% patients scored positive for the presence of neuropathy and about 51% of the patients had neuropathy according to DNE score as described in table 12. Out of these subjects with a positive score in DNS and DNE tool 21 and 8 subjects experienced symptoms of pain and other ailment due to condition other than diabetic neuropathy. Among them there were cases of diabetic foot ulcer and pain. Diabetic neuropathic patients identified by DNS was more as compared to DNE. On the basis of DNS and DNE instrument, most of the DN patients belonged to the age group of 60-70 years. Age wise comparison with DN is shown in table 13.
Table 13: Comparison of age with DN among T2DM.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Neuropathy Present</th>
<th>Neuropathy Absent</th>
<th>Neuropathy Present</th>
<th>Neuropathy Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-40</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>40-50</td>
<td>10</td>
<td>1</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>50-60</td>
<td>18</td>
<td>5</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>60-70</td>
<td>22</td>
<td>8</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>70-80</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>80-90</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Mean systolic and diastolic blood pressure of the patients was found to be 140±25 and 81.9±12 mm Hg respectively. Diabetic parameters like FBS and RBS was recorded and mean value of the parameters are found to be 209.35±89.33 mg/dl, 275.67±130.22 mg/dl respectively. The mean percentage of HbA1c was found to be 7.44 ± 0.0476 % (Table 14).

Table 14: Baseline characteristics of the study population.

<table>
<thead>
<tr>
<th>BASELINE CHARACTERISTICS</th>
<th>Mean ±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>59.5±11.8</td>
</tr>
<tr>
<td>Duration of DM (years)</td>
<td>12.5±8</td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>140±25</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>81.9±12</td>
</tr>
<tr>
<td>FBS (mg/dl)</td>
<td>209.35±89.3</td>
</tr>
<tr>
<td>RBS (mg/dl)</td>
<td>275.67±130.22</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>7.4±0.047</td>
</tr>
</tbody>
</table>

The percentage of males affected by DN was more than females. The proportion of individuals affected with neuropathy among the study population was found to be increased with advancing age, assessed by DNE and this association was found to be statistically significant by Chi-square test, (P value = 0.0126). The clinical parameters associated with the presence of neuropathy is shown in the Table 15.

From the DNE screening it was observed that longer the duration of disease the possibility of presence of DN was more as it ranged from more than 5 years to less than 30 years. The association between duration of DM and incidence of neuropathy by DNE was found to be statistically significant (P <0.05).

Table 15. Association between clinical parameters and presence of DN

<table>
<thead>
<tr>
<th>S.No</th>
<th>Clinical parameters</th>
<th>DN present</th>
<th>DN Absent</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HbA1c &lt;9 %</td>
<td>15</td>
<td>24</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>≥9 %</td>
<td>22</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Systolic BP &lt;140 mm Hg</td>
<td>18</td>
<td>12</td>
<td>0.458</td>
</tr>
<tr>
<td></td>
<td>≥140 mm Hg</td>
<td>27</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Diastolic BP &lt;80 mm Hg</td>
<td>15</td>
<td>8</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>≥80 mm Hg</td>
<td>30</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

More number of individuals with higher percentage of HbA1c had neuropathy as assessed by DNE Tool. This association was found to be statically significant. A statically significant association was found to be with increase diastolic BP and prevalence of neuropathy but the P value of systolic BP was found insignificant as per DNE instrument.

**DISCUSSION**

Diabetic neuropathy is a common co-morbid condition in patients with DM and has been shown to reduce their quality of life. DN becomes worse and progressive if left untreated. Diabetes mellitus itself is a health crisis, presence of diabetic neuropathy may indicate a more advanced condition, increasing morbidity and mortality in such patients. This study set out to assess the prevalence and risk factor of DN in patients with DM using a simple validated tool; the DNS and DNE questionnaire, in a sample of type 2 diabetic patients in a tertiary care hospital.

Many methods are used to diagnose DN including neurological examination and electrophysiology to detect and evaluate the disease at its earliest stage. Early detection or diagnosis of neuropathy is necessary for the
Clinician to give appropriate drugs to control it or at least retard its progression. It is also important to educate the patient to take care of their illness cautiously.

In the present study 350 patients were considered and out of which 100 patients were included based on the inclusion and exclusion criteria. The study consisted of more male subjects (55) compared to female subjects (45). There was a high prevalence of DN among the subjects, with almost half (42%) of the study population being affected. Chennai Urban Rural Epidemiology study (Pradeepa, R. et al., 2008) identified the prevalence of neuropathy to be 26%; the outpatient setting of an endocrinology clinic of a public tertiary care hospital in north India identified 29.2% prevalence of neuropathy (Bansal, D. et al., 2014).

The proportion of males affected by neuropathy was more than females, in the present study contrary to findings in the literature (Bansal, D. et al., 2014), which reported that there were no sex-specific differences. Neuropathy was more prevalent in the advanced age groups and among those with longer duration of the disease. Our study findings were similar to those reported from other parts of India and abroad.

Diabetic neuropathy was more common in the subjects who had had diabetes for more than 10 years, compared to those who had diabetes for less than 10 years. This finding was similar to that of many standard studies (Booya, F. et al., 2005; Dutta, A. et al., 2005; & Mørkrid, K. et al., 2010), with DM duration greater than 10 years, consistently emerging as a significant risk factor for DN. Prolonged duration of DM is likely to result in greater incidence of DN and this was demonstrated in this study. Of individuals analyzed, the most affected age group was 60-70 years.

In the present study, diabetic neuropathy assessed using DNS questionnaire and DNE score was 64% and 51% respectively. Among them there were cases of diabetic foot ulcer and pain. There is disparity in DNS and DNE score as it is answered and responded by the subjects. The DNE questionnaire used in this study was based on a standard literature published (Meijer, J. W. G. et al., 2003).

Studies have correlated the severity of diabetic neuropathy to total hyperglycemia exposure (Pawde, P. P. et al., 2013; Bansal, D. et al., 2014; Su, J. B. et al., 2018; & Dyck, P. J. et al., 1993).

However, in the present study, we used FBS, RBS and HbA1c to assess the glycemic control. Neuropathy was found to be more prevalent among the people with HbA1c percentage >9. This significant association of DN with increased HbA1c percentage as per DNE tool, mark HbA1c as a risk factor for DN. Surprisingly most of the patients whoever symptomatic were found to be on diabetic medication.

From the baseline characters assessed in the study it is found that most of the subjects had BP ≥140/80 mmHg. In this study, increased diastolic BP showed significant association with DN, assessed by DNE Tool.

DNS and DNE testing is fast and easy to perform in clinical practice and is useful to detect neuropathy early. A limitation of DNE is that, it does not take into account loss of temperature sensation, and hence, small fiber neuropathy could be missed by this technique. Since DNS and DNE are subjective and depend on the subject’s cooperation and response, it has to be used along with other investigations such as vibration perception threshold to arrive at a diagnosis.

The study has a few noteworthy limitations. The small sample size may be the most important limitation. There are some missing data regarding some variables (e.g., socio demographic details and some clinical parameters), which may have affected the results had they been available. For some variables, we relied on the patients reporting which might have been imprecise or influenced by recall bias. Due to the current pandemic state the study had to take a break in between.

As the severity of the DN is significantly associated with duration of illness, poor glycemic control, lifestyle modifications can be done as a primary prevention. Life habits of individuals can aggravate the progression of the disease process. By taking such preventive measures the onset of disease can be delayed or well maintained.

**Conclusion**

More than 43% of diabetic patients involved in this study had diabetic neuropathy. Advancing age, male gender, longer duration of diabetes, poor glycemic control and individuals with higher diastolic BP were found to have higher proportion of diabetic neuropathy. As per this study advancing age and longer duration of disease and high percentage of HbA1c were found to be significantly associated with the presence of diabetic neuropathy.

DNS and DNE tools are sensitive validated scoring system which is fast and easy to perform in clinical practice for screening neuropathy among diabetic patient though it had limitations and bias as it is responded by patients.
REFERENCES


6. ICMR Guidelines for management of type 2 diabetes, 2018


