Original Article

# Sensory Neuropathy of the Foot among Asymptomatic Patients of Type II Diabetes Mellitus

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## ABSTRACT

**OBJECTIVE: This Study aimed to determine the frequency of sensory neuropathy in the feet of asymptomatic people with type II diabetes mellitus.**

**METHODOLOGY: This cross-sectional Study was conducted at the medical department of MTI/Lady Reading Hospital, Peshawar, between April - October 2022. A total of 133 patients were observed using a non-probability consecutive sampling technique. Patients aged 25-60 years who had type II diabetes mellitus for more than one year were included, while patients with vitamin B12 deficiency who used multivitamins were excluded from the study. SPSS version 20 was used for statistical analysis.**

**RESULTS: Age-wise distribution 25-30 Years (4.5%), 31-40 Years (21.8%), 41-50 Years (45.9%), and 51-60 Years (27.8%) (mean 45.56±3.3). Gender-wise, 104 (78.2%) were male and 29 (21.8%) were female. Regarding education level, 57 (42.9%) were illiterate, 46 (34.6%) had secondary education, and 30 (22.6%) had higher education. Residency status indicated 105 (78.9%) from urban areas and 28 (21.1%) from rural areas. Socioeconomic status was distributed as follows: 53 (39.8%) with a monthly income >100,000 Rs, 46 (34.6%) with an income range of 50,000 to 100,000 Rs, and 34 (25.6%) with an income range <50,000 Rs. Sensory neuropathy was found in 60 (45.1%) patients and absent in 73 (54.9%).**

**CONCLUSION: The Study revealed a notably high prevalence of sensory neuropathy. Prompt identification and focused treatment are essential, especially for patients over 40, sedentary lifestyles, and those with diabetes for more than two years.**

**KEYWORDS: Asymptomatic Patients, Foot, Peripheral Neuropathy, Sedentary Lifestyles, Sensory Neuropathy, Type II Diabetes Mellitus.**

## INTRODUCTION

Diabetes mellitus has become a worldwide health emergency, posing a complex challenge that is made worse by the current spike in obesity rates[1]. Due to its widespread effects, diabetes is currently the seventh most common cause of death globally[2]. The toll is particularly noticeable in the US, where it was responsible for an astounding 252,806 fatalities in 2015 alone[3]. Beyond its immediate consequences, diabetes dramatically increases the risk of cardiovascular diseases (CVD), which eventually emerges as the leading cause of death for those with the diagnosis[4]. Peripheral neuropathy, specifically, sensory neuropathy of the foot—is one of the many problems closely associated with diabetes[5,6].

Diabetes mellitus is a group of metabolic diseases typified by prolonged increases in blood sugar levels[7]. These elevated blood sugar levels can lead to several unfavourable health consequences, including peripheral neuropathy, renal failure, and cardiovascular problems[8]. It is noteworthy that the number of people affected by diabetes has increased to an alarming 382 million globally[9]. This worry is highlighted by projections, which indicate that by 2035, there will be an increase to 592 million instances[10].

Although weight loss, increased thirst, increased appetite, and frequent urination are the classic symptoms of diabetes, this study focuses on the complex field of peripheral neuropathy, specifically sensory neuropathy affecting the lower extremities[11]. Diabetic neuropathy is common; about 30–40% of people with diabetes have this condition. It can cause symptoms such as tingling, numbness, and excruciating pain[12]. The increasing prevalence of diabetes worldwide predicts a worsening of neuropathy-related costs. Hence, its frequency and consequences should be thoroughly studied[13].

Up to 25% of people with diabetes have painful diabetic peripheral neuropathy (painful-dpn), which can significantly reduce the quality of life[14]. People with painful-dpn can present with varying degrees of persistent burning, aching, and "electric shock" pains in their legs and feet[15]. Nighttime exacerbations and contact hypersensitivity to bedclothes cause sleeplessness, and painful-dpn can be

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incapacitating[16]. The primary stay of treatment for painful-dpn is symptom control with pharmacotherapy, which has limited efficacy and frequently dose-limiting side effects[8]. The symptoms of painful-dpn include loss of sensation, weakness, and pain[17]. The pathophysiology of painful DPN is poorly understood, and no disease-modifying treatments exist for DPN[18]. About 30–40% of people with diabetes also have DPN, and as the global incidence of diabetes continues to rise, so too will the burden of this condition[19]. DPN is a crippling complication that has a significant influence on healthcare services in addition to the patient's quality of life[20]. Patients with type II diabetes mellitus have reported DPN prevalence rates of 39.5% [21].

The frequency and effects of sensory neuropathy of the foot in asymptomatic people with type II diabetes mellitus are still largely unknown, especially when it comes to local populations, despite the abundance of research on diabetic sequelae[22]. By offering thorough insights into the prevalence of this crippling issue, this study aims to close this critical gap and provide the foundation for future research projects and preventive measures. Formulating targeted therapies to reduce the morbidity and mortality associated with sensory neuropathy requires a sophisticated understanding of the local prevalence rates and related risk factors.

## METHODOLOGY

This descriptive cross-sectional design study was conducted in the General Medical Department of Lady Reading Hospital in Peshawar from April - October 2022 after ethical acceptance from the institute. With a 5.2% margin of error and a 10.4% prevalence of diabetic peripheral neuropathy (DPN) among patients with type II diabetes mellitus, 133 individuals were chosen using the WHO criteria. Non-probability sequential sampling was used.

Participants in the Study were required to meet specified inclusion criteria, which included being between the ages of 25 and 60, having a diagnosis of type II diabetes mellitus for more than one year, being gender-neutral, and having no glycaemic control status. Patients who met the exclusion criteria included those who, based on their medical history and records, had been diagnosed with vitamin B12 insufficiency, had pre-existing neuropathy, or took multivitamin supplements.

Patients who fit the criteria were sourced from the general medical department and outpatients with ethical permission from the hospital's research committee. After outlining the goals and advantages of the study, informed consent was obtained. A thorough history was taken, along with clinical exams, baseline investigations, and measurement of HbA1C. Semmes-Weinstein (SW) monofilament testing was performed on foot locations to identify sensory neuropathy. The test was deemed successful if the patient did not feel the touch of the monofilament at any of the predetermined locations.

Data were collected on a predefined proforma that included a variety of factors, including demographics, medical history, and socioeconomic status, to ensure adherence to the exclusion criteria and reduce bias. SPSS version 20 was used to enter the recorded data and perform statistical analysis. For numerical variables, descriptive statistics calculated the mean ± SD; categorical variables calculated frequencies/ percentages. Stratification of sensory neuropathy with modifiers such as age, gender, and other variables was examined to assess any effect modifications ($p < 0.05$) using chi-square tests. Tables and graphs were used to show the results and provide a thorough understanding of the correlation between different variables and the prevalence of sensory neuropathy.

## RESULTS

**Table I** illustrates the demographic distribution and salient features of the research participants. It shows how people are distributed across the various age groups, with the 41–50-year-old age group having the highest percentage (45.9%), followed by the 51–60-year-old group (27.8%). Male participants comprised 78.2% of the sample, while female participants comprised 21.8%. When compared to individuals whose disease had been diagnosed for more than two years (21.1%), a more significant percentage of

**Table I: Demographic details of the participants**

| Variable | Detail | Frequency | Percentage |
|---|---|---|---|
| Age of the participants (years) | 25- 30 | 6 | 4.5 |
| | 31-40 | 29 | 21.8 |
| | 41-50 | 61 | 45.9 |
| | 51-60 | 37 | 27.8 |
| Gender wise distribution | Male | 104 | 78.2 |
| | Female | 29 | 21.8 |
| Duration of disease-wise distribution | 1 to 2 Years | 105 | 78.9 |
| | More than 2 Years | 28 | 21.1 |
| Bmi classification | Underweight range | 5 | 3.8 |
| | Normal range | 27 | 20.3 |
| | Overweight range | 61 | 45.9 |
| | Obese range | 40 | 30.1 |
| Residency status | Urban | 105 | 78.9 |
| | Rural | 28 | 21.1 |
| Education level | Illiterate | 57 | 42.9 |
| | Secondary education | 46 | 34.6 |
| | Higher education | 30 | 22.6 |
| Distribution of residency status | Urban | 105 | 78.9 |
| | Rural | 28 | 21.1 |
| Distribution of socioeconomic status | Rich (monthly income >100,000 Rs) | 53 | 39.8 |
| | Middle Class (monthly income range 50,000 – 100,000 Rs) | 46 | 34.6 |

people with diabetes had just been diagnosed for one to two years (78.9%). Furthermore, the distribution of the participant's Body Mass Index (BMI) revealed a prevalence of those falling into the obese range (30.1%) and the overweight range (45.9%). According to residency status, more people lived in cities (78.9%) than in rural areas (21.1%). The distribution of educational attainment showed that a significant number had completed secondary school (34.6%), closely followed by those classified as illiterate (42.9%) and those with a higher degree of education (22.6%). Furthermore, there was an excellent representation of the socioeconomic category in the rich income group (>100,000 Rs) at 39.8%, with the middle-income range coming in second (34.6%).

Important information about the study participants' hypertension, sensory neuropathy, and family history of diabetes mellitus is shown in **Table II**. Of the participants, 45.1% showed evidence of sensory neuropathy, whereas the majority, 54.9%, showed no signs of the condition. Concerning hypertension, a sizeable fraction of participants - 60.2% of the sample were found to have it, although 39.8% did not exhibit any symptoms. With 46.6% of participants having a family history of diabetes and 53.4% having no family history of diabetes (non-diabetic), the distribution of family history of diabetes mellitus showed a virtually balanced representation. These numbers highlight how common it is for study participants to have a familial predisposition for diabetes, suggesting that genetic variables play a significant role in this cohort.

**Table III** presents the significant statistical connections shown by the p-values between several variables and the occurrence of sensory neuropathy in the study subjects. Age distribution showed that 31 people between 41 and 50 had sensory neuropathy, while only three were unaffected, demonstrating a significant correlation (p = 0.000). On the other hand, the age range of 51 to 60 years old showed the opposite pattern, with most of the 37 afflicted and unaffected. There was also a noteworthy correlation between gender and sensory neuropathy, with men showing a higher incidence of the condition than women (p = 0.0334). A statistically significant correlation was found in the distribution of sensory neuropathy across different BMI categories. The effects on individuals were significantly more significant in the overweight and obese categories than in the normal and underweight ranges (p = 0.000). There was a statistically significant correlation (p = 0.000) between the prevalence of sensory neuropathy in illiterate persons and those who had completed secondary or higher education. Socioeconomic status also showed a significant correlation, with a higher prevalence of sensory neuropathy in those from richer and middle-class backgrounds than in those from lower-class backgrounds (p = 0.000). Additionally, there were significant correlations between sensory neuropathy and family histories of diabetes mellitus and hypertension. Specifically, people with a history of diabetes or hypertension had a higher prevalence of sensory neuropathy than people without such a history (p = 0.000).

**Table II: Frequencies and percentages of different diseases of the participants**

| Variable | Detail | Frequency | Percentage |
|---|---|---|---|
| Sensory neuropathy | Yes | 60 | 45.1 |
| | No | 73 | 54.9 |
| Distribution of hypertension | Yes | 80 | 60.2 |
| | No | 53 | 39.8 |
| Distribution of family history of diabetes mellitus | Non Diabetic | 71 | 53.4 |
| | Diabetic | 62 | 46.6 |

**Table III: Association of sensory neuropathy with different variables**

| Variable | Detail | Sensory Neuropathy | | P-value |
|---|---|---|---|---|
| | | Yes | No | |
| Age of the participants (years) | 25- 30 | 5 | 1 | 0.000 |
| | 31-40 | 24 | 5 | |
| | 41-50 | 31 | 3 | |
| | 51-60 | 0 | 37 | |
| Gender of the participants | Male | 58 | 46 | 0.0334 |
| | Female | 2 | 27 | |
| Duration of disease (years) | 1-2 | 60 | 45 | 0.672 |
| | 2 | 0 | 28 | |
| BMI classification | Underweight range | 5 | 0 | 0.000 |
| | Normal range | 24 | 3 | |
| | Overweight range | 31 | 30 | |
| | Obese range | 0 | 40 | |
| Residency status | Urban | 60 | 45 | 0.00 |
| | Rural | 0 | 28 | |
| Education level | Illiterate | 44 | 13 | 0.000 |
| | Secondary education | 0 | 46 | |
| | Higher education | 16 | 14 | |
| Socioeconomic status | Rich (monthly income > 100, 000 Rs) | 44 | 9 | 0.000 |
| | Middle Class (monthly 50,000 - 100,000 Rs) | 0 | 46 | |
| | Low income (< 50,000 Rs) | 16 | 18 | |

| | | | | |
|---|---|---|---|---|
| Family history of diabetes mellitus | Yes | 60 | 11 | 0.000 |
| | No | 0 | 62 | |
| Hypertension | Yes | 60 | 20 | 0.000 |
| | No | 0 | 53 | |

## DISCUSSION

The age distribution of the 133 patients in the current study was examined, yielding n = 25-30 Years 6 (4.5%). 31-40 Years: 29(21.8%), 41-50 Years: 61 (45.9%), 51-60 Years: 37(27.8%), 45.56 years was the mean age, with a standard deviation of ±3.357. The analysis of the 133 patients' gender distribution revealed that 104(78.2%) were male and 29(21.8%) were female. Analysis of 133 patients' educational levels showed that 57(42.9%) were illiterate. 46 (34.6%) secondary education Higher learning 30 (22.6%), 133 patients residency status distribution was analyzed, and the results showed that n = Urban 105(78.9%), rural areas 28(21.1%). The socioeconomic status distribution of 133 patients was examined, and it was found that n= Rich (monthly income >100,000 Rs). 53(39.8%) Class C: Middle (monthly income between 50,000 and 100,000 rupees) 46(34.6%) Low income (monthly income < 50,000 Rs.) 34(25.6%). 133 patients with sensory neuropathy were analyzed, with 60(45.1%) with Yes and 73(54.9%) with No findings. The results of our investigation show that the prevalence of DPN, as reported by the MNSI history version, was 18.9%, significantly less than the 51.1% prevalence obtained by the MNSI examination of the same study. This discrepancy highlights the limitations of how patients perceive their own DPN symptoms and advocates for using the examination version of the MNSI. Based on MNSI, 196(53.6%) of the 366 patients in the study had an overall DPN prevalence (95% CI 48.9, 59). Our findings were consistent with a 52.2% study conducted in Bahirdar, Ethiopia[23]. The current study's prevalence also agreed with reports from other nations, such as Yemen, the USA, Ghana, and Malaysia, where it was determined to be 56.2%, 51%, 50.7%, and 50.7% [24]. The similarity in research design between the studies conducted in Yemen and Malaysia and the results obtained in Bahirdar, the USA, and Ghana may have resulted from using the same instrument[25].

However, the current study's findings exceeded those of a 39.5% study done in Jordan[26]. This variation may result from variations in healthcare attributes and genetic predisposition. Similarly, a study in China revealed a 33.1% frequency of DPN[27]. The community under investigation, genetic predisposition, and varied medical care availability could all contribute to the greater DPN prevalence rate that we found in our study. Furthermore, research from Mulago, Uganda, 29.5% [28] and Libya, 30.5% [29] indicate a lower prevalence of DPN. These disparities in prevalence are probably due to variations in the study population, the diagnostic standards applied, and the participant selection procedures.

According to reports, Jimma, Ethiopia, had a prevalence of 25.4% and Mekelle, Ethiopia, 41%, respectively, of diabetic peripheral neuropathy[30]. The difference in DPN prevalence between our Study and Mekelle may be due to the later use of a prospective cohort study with a six-week period that only records new cases. Type 1 and type 2 diabetes were included in the previous study that Jimma published; the sample size was small, and the data on DPN came from a review of patient charts. DPN may not have been frequently documented on the patient chart during follow-up, which might be why the preceding study lacks DPN cases. This study evaluated DPN using the MNSI history and examination versions, which can find more cases[30]. There was a decreased prevalence of DPN when the current study was compared to studies from Iran, Nigeria, and Italy, which found DPN prevalence of 75.1%, 75%, and 82%, respectively[31]. The greater frequency of those studies may result from different research designs, settings, and tools utilized. While the Nigerian study utilized a vibration perception threshold instrument of greater than 15 volts, which may have inflated the prevalence of DPN, the Iranian Study used nerve conduction velocity, the gold standard test, and a large sample size[32]. Lastly, the disparity between the present study's findings and an Italian study might be explained by variations in study design, genetic predisposition, and instrumentation[33].

The present results showed that the patient's age over 40 was a reliable indicator of DPN. Studies from the past provided support for this report[34]. Potential explanations for this correlation could be supported by the fact that peripheral neuropathy is a chronic diabetes consequence that develops gradually, making older diabetic individuals more likely to have it. Furthermore, as people age, their neural systems become more susceptible to ongoing metabolic stress and the deteriorating effects of aging on their bodies[35]. Our research revealed a substantial correlation between DPN and DM, lasting more than five years. A similar conclusion was also stated in several study findings[26]. The prolonged duration of diabetes is associated with chronic hyperglycemia, which triggers many metabolic pathways in diabetic neurons, leading to oxidative stress and subsequent neuronal ischemia and nerve damage, which explains the linkage[35]. The possibility of a delayed diagnosis can also explain it.

Consistent with previous findings, our data demonstrated that lack of physical activity was identified as a separate factor predicting diabetic peripheral neuropathy (DPN)[36]. One possible explanation for this correlation could be that engaging in physical activity can enhance the circulation of small blood vessels, promote the production of neurotrophic factors, reduce oxidative stress, and contribute to the overall physiological well-being of the body[37].

Ultimately, the current investigation established a noteworthy correlation between the act of smoking and the occurrence of diabetic peripheral neuropathy (DPN). Other investigations have also reported similar findings[35]. The relationship between DPN and smoking can be explained by the fact that smoking causes neuropathy using endothelial damage, increased inflammation, oxidative stress, alteration of glucose metabolism, and direct neurotoxic effects that cause neuronal ischemia.

## CONCLUSION

The high frequency of DPN in our study was quite considerable. For individuals who are older than 40, are not physically active, and have had diabetes for more than two years, early detection and suitable therapies are crucial.

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**Conflict of Interest:** No conflicts of interest, as stated by authors.

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**Data Sharing Statement:** The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

## AUTHOR'S CONTRIBUTION

Shah SMA: Study design and conceptualization, data collection, approval of manuscript

Bilal M: Study design and conceptualization, data analysis, manuscript revising and drafting, approval of manuscript

Khattak S: Data analysis, manuscript revising and drafting, approval of manuscript

Fareezuddin M: Data collection, manuscript drafting and revising, approval of manuscript

Khan Y: Data analysis, data collection, approval of manuscript

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