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Constellation of Neurological Signs in Patients with Diabetes Mellitus of more than 5 Years

Zakia Kanwal, Abdul Khalid Awan, Syeda Aiman Naqvi, Shaista Imtiaz, Zainab Shahab, Tayyaba Haroon

Abstract

Objective: To identify the prevalence and related characteristics of peripheral neuropathy among diabetes mellitus patients with over five years of duration.

Study Design and Setting: A cross-sectional study at the Abbas Institute of Medical Sciences in Muzaffarabad, Azad Jammu and Kashmir.

Methodology: Non-probability consecutive sampling was used to select 266 patients with a diagnosis of either type 1 or type 2 diabetes mellitus of a duration of greater than five years. Patients with a history of vitamin B12 deficiency, cerebrovascular accident, or motor neuron disease were excluded. Sociodemographic data, clinical history, smoking, family history of diabetes, and comorbidities data were obtained. The data analysis was conducted using SPSS version 22. Post-stratification Chi-square test was used, and p= 0.05 was regarded as significant.

Results: The mean age of participants was 52.6 ± 10.8 years, with a mean diabetes duration of 9.4 ± 3.2 years and a mean HbA1c of 8.6 ± 1.4%. Peripheral neuropathy was detected in 53.4% of patients. Significant associations were observed with age =50 years ($p = 0.012$), rural residence ($p = 0.042$), illiteracy ($p = 0.021$), smoking ($p = 0.011$), hypertension ($p = 0.034$), diabetes duration =10 years ($p < 0.001$), and HbA1c =8% ($p < 0.001$). Gender and family history were not significantly associated.

Conclusion: Long-term diabetes patients are very susceptible to peripheral neuropathy. Its burden should be mitigated by implementing early screening and managing all risk factors, particularly those that are modifiable, i.e., glycaemic control, hypertension, and smoking.

Keywords: Diabetes Mellitus, Diabetic Neuropathies, Glycated Hemoglobin

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INTRODUCTION

Diabetes mellitus (DM) is a non-contagious metabolic disease that is hyperglycemic and is associated with a defect in insulin secretion, insulin activity, or both.[1] It is among the most urgent health issues worldwide, as the prevalence is steadily increasing, and the associated systemic complications are very numerous.[2] In Pakistan, diabetes has become a major burden causing serious morbidity, diminished quality of life, and elevated healthcare expenditure because of lifestyle changes, urbanization, and genetic susceptibility, according to the recent statistics which show that the number of adult affected individuals is estimated to be almost 33 million and this figure is projected to grow to 643 million by 2030 and 783 million by 2045.[2] South Asia, in particular, Pakistan, is experiencing a rapid surge in diabetes-related morbidity due to lifestyle changes, urbanization, and genetic predisposition.[3] Beyond its metabolic derangements, the insidious complications of diabetes, especially those involving the nervous system, pose significant morbidity, reduce quality of life, and increase healthcare costs.

Diabetes's neurological manifestations cover a wide variety of clinical signs and symptoms.[4] These may arise from a

direct metabolic impact due to chronic hyperglycemia, the development of microvascular complications, or through an immunologic mechanism. The most well-known complication is diabetic peripheral neuropathy (DPN), which affects upwards of 50% of patients with chronic diabetes.[5] DPN can present as distal symmetrical sensorimotor neuropathy with accompanying features of numbness, tingling, burning, and in severe cases, neuropathic pain and/or ulcerations of the skin. Nonetheless, the neurological manifestations of diabetes extend well beyond the peripheral nervous system. Neurological involvement can also include autonomic neuropathy, cranial nerve palsies, radiculoplexopathies, and even central nervous system (CNS) involvement with clinical signs ranging from postural hypotension and gastroparesis to visual deficits, seizures, or cognitive decline.[6]

The pathophysiological processes related to these neurological manifestations are not singular but multifactorial. The long-term hyperglycemia results in the flux through the polyol pathway, build-up of advanced glycation end products (AGEs), oxidative stress, and the activation of protein kinase C, which result in microvascular injury, demyelination, and axonal degeneration of the peripheral and autonomic nerves.[3] Ischemic injury to neural tissues is further worsened by dysfunction of vascular endothelial cells. Key processes, including impaired insulin signaling in the brain, can be a contributive factor to the development of cognitive impairment and increased risk of developing dementia in diabetic patients. Noteworthy, patient duration of diabetes continues to remain a significant predictor of neuropathological complications, with patients over five years of disease showing a sharp upward trend in incidence and severity of neuropathy.

Epidemiological reports note that close to two-thirds of individuals diagnosed with type 2 diabetes develop one or another form of neuropathy within their first 10 years of diagnosis, and many adults are already experiencing deficits of a subclinical nature even sooner. In type 1 diabetes, neuropathy risk increases substantially after 5–10 years of duration of illness.[8] This risk is predominantly observed, except for acute neuropathy, among individuals with suboptimal glycemic control, especially when hemoglobin A1C levels are <10%–12%.[8] All of these complications add substantial morbidities: diabetic foot ulcerations and amputations, urinary and fecal incontinence, erectile dysfunction, cardiovascular autonomic neuropathy resulting in sudden cardiac death, and impaired cognitive and motor function that disrupts activities of daily living. All of these individual patient impacts result not only in human suffering but also instigate significant economic upstream burden. Studies from the United States and Europe approximate nearly 25% of healthcare costs supporting diabetes are for neuropathic complications, and likely higher in low- and middle-income countries where prevention is hindered [9, 10]

Though neurological manifestations are common and can impact diabetic patients significantly, they often remain under-recognized or not fully evaluated. Clinical attention has typically been placed on glycemic targets and macrovascular end points like myocardial infarction and stroke, while subtle or progressive neurological changes may not be observed until the late stages of the disease. Furthermore, the constellation of signs is highly variable, ranging from quietly observed absent sensory loss to obvious motor deficits, autonomic dysfunction, and cognitive decline. This reinforces the importance of characterizing and documenting full clinical presentation in longer-standing cases of diabetes, especially when 5 years or longer.

The combination of signs representing neurological involvement (e.g., loss of sensation, autonomic dysfunction, etc.) in patients with diabetes represents a major but under-appreciated burden of disease. To address this burden of disease, increased understanding of the frequency, distribution, and characteristics of neurological manifestations should lead to earlier diagnoses, which can improve patient care and quality of life. The purpose of the study herein was to determine the frequency of peripheral neuropathy incidence in diabetic patients over a period of 5 years or more.

METHODOLOGY

This cross-sectional study was conducted in the Department of Medicine at Abbas Institute of Medical Sciences (AIMS), Muzaffarabad, Azad Jammu and Kashmir. The total duration of the study was six months from 1st January 2025 to 30th June 2025, following the approval of the study by the ethical committee certificate (ECC) of AIMS, Approval No: MED/AIMS/24176, Dated: 28th November 2024.

The sample size was calculated using the WHO population proportion sample size calculator, with an assumed prevalence of 51% for peripheral neuropathy in patients with diabetes mellitus, a margin of error of 6%, and a 95% confidence interval.[11] Based on these parameters, a total of 266 patients with diabetes mellitus were recruited. A non-probability consecutive sampling technique was used to enroll participants.

Patients were eligible for inclusion if they had a diagnosis of diabetes mellitus, either type 1 or type 2, for a duration exceeding five years. The age range was set between 14 and 70 years, as patients below the age of 14 were managed in the pediatric department, and the median life expectancy in the region was estimated to be between 60 and 70 years. Exclusion criteria included patients with a known history of vitamin B12 deficiency, confirmed either clinically or by laboratory evidence of serum B12 levels below 220 mg/dl. Similarly, patients with a documented history of cerebrovascular accident or motor neuron disease, ascertained clinically and by history, were excluded from the study.

Diabetes mellitus was defined as the presence of classical symptoms, including increased thirst beyond routine, polyuria exceeding 3 liters per day (measured at home by a urine

collection pot), or excessive hunger compared to normal, with fasting plasma glucose (FPG) >126 mg/dl. Fasting was defined as no caloric intake for at least eight hours. In addition, patients who were already diagnosed cases of diabetes for more than five years were also included.

Peripheral neuropathy was deemed positive when diabetic individuals noted bilateral leg and or foot symptoms, including pain, numbness, or restlessness. A formal neurological examination was conducted to confirm and characterize neuropathy. Clinical findings included a formal evaluation of pinprick sensation, light touch, temperature, vibration, proprioception, and monofilament testing, in addition to examining knee and ankle reflexes. Each of the aforementioned modalities was first assessed at the forehead, to ensure patient understanding of the examination, and then subsequently examined in order from distal (big toe) to proximal (knee) regions. Pinprick sensation was assessed with a disposable toothpick, which was discarded after each use. Light touch sensation was assessed with cotton wool lightly applied to the skin. Temperature was assessed with a cold metallic object placed on the skin surface.

A 128 Hz tuning fork that was placed over a bony prominence, namely the medial aspect of the first metatarsophalangeal joint, was used to test vibration sense. The monofilament test was determined by applying a 10-gram monofilament to the plantar part of the foot in standard locations. Proprioception was assessed by placing the joint between the feet (interphalangeal) of the big toe in an upright or downward position with the eyes of the patient closed, and requesting that he should determine the direction of movement. Deep tendon reflexes were evaluated in the knee (quadriceps tendon) and ankle (Achilles tendon) with a common rubber reflex hammer, and reinforcing measures were taken in case of necessity to obtain the reflexes.

The research was initiated on the basis of the institutional ethical review committee. All the participants were recruited with informed written consent. The patients who came to the Medicine Department with the problem of diabetes mellitus, as per the operational definition, were approached sequentially. On a structured pro forma, data were gathered on demographic variables, which included age, sex, place of residence (urban or rural), and education level (illiterate, primary, intermediate, or graduate and above). Clinical information, such as the length of diabetes, the history of diabetes in the family, smoking habits, and comorbid conditions, hypertension, etc., was also noted.

Each participant had blood samples (venous) collected under aseptic conditions and forwarded to the institutional laboratory to assess the level of glycated hemoglobin (HbA1c). The clinical examination was then conducted to determine the presence of the neurological manifestations with specific attention to the peripheral neuropathy. Peripheral neuropathy diagnosis was developed on the clinical level, according to the symptoms of the patient and the observed neurological alterations when examining the patient. All the information was recorded on a pro forma that was approved and designed.

This study did not include randomization or a control group because it was designed as a cross-sectional observational study aimed at assessing the prevalence and associated factors of peripheral neuropathy at a single point in time. As the objective was to measure existing neurological outcomes among patients already diagnosed with diabetes mellitus of more than five years' duration, random allocation or comparison with a separate control population was neither feasible nor required for this type of epidemiological design.

The use of SPSS version 22 was used to manage and analyze the data and provide statistical analysis. The age, period of diabetes, and HbA1c levels were the quantitative variables that were represented in terms of means and standard deviations. The qualitative variables, such as gender, residence, educational status, family history of diabetes, smoking, hypertension, and peripheral neuropathy, were given in the form of frequencies and percentages. Stratification with respect to age, gender, place of residence, educational status, and duration of diabetes, HbA1c levels, family history, and smoking status was done to take care of the possible effect modifiers. After stratification, the chi-square test was used to test the relationship between categorical variables. A p-value of =0.05 was statistically significant.

RESULTS

The study involved 266 diabetes mellitus. The average age of the participants was 52.6±10.8 years. The study population was composed of males (55.6%) and females (44.4%). Most of the patients (61.7%) were found in the urban areas as compared to 38.3% in rural environments. As far as the education level is concerned, 32.3% of the patients were illiterate, 27.1% completed primary education, and 20.3% had at least graduated or higher. The majority of the subjects (66.2%) had a positive family history of diabetes mellitus. The prevalence of smoking was 33.1% and that of non-smokers was 66.9% with 53.4% of the study population being hypertensive. The average HbA1c level and the mean diabetes duration measured 8.6 ± 1.4 and 9.4 ± 3.2, respectively. (Table 1) Peripheral neuropathy was identified in 53.4% of the study population, accounting for 142 out of 266 patients. The remaining 124 patients (46.6%) did not exhibit clinical evidence of neuropathy. (Figure 1) There was a significant association between age group and peripheral neuropathy, with 62% of patients aged =50 years affected compared to 40.7% in those <50 years (p = 0.012). Residence was also significantly associated, as neuropathy was more common in patients living in rural areas (60.8%) than those living in urban areas (48.8%) (p = 0.042). Educational status showed that illiterate patients had a greater prevalence of neuropathy (67.4%) than those who had

primary education or higher (46.7%) (p = 0.021). Smoking was significantly associated, as 63.6% of smokers had neuropathy compared to 48.3% of non-smokers (p = 0.011). Similarly, hypertension was linked to neuropathy, affecting 59.2% of hypertensive patients compared to 46.8% of non-hypertensive patients (p = 0.034). Duration of diabetes showed a strong relationship, with 66.7% of patients having diabetes for =10 years developing neuropathy versus 43.4% with <10 years duration (p < 0.001). HbA1c was also highly significant, as 61.4% of patients with HbA1c =8% had neuropathy compared to 37.8% with HbA1c <8% (p < 0.001). In contrast, no statistically significant associations were found with gender (p = 0.723) or family history of diabetes (p = 0.192). (Table 2)

DISCUSSION

In this cross-sectional cohort of 266 patients with diabetes for >5 years, peripheral neuropathy was present in 53.4% of participants. This prevalence is within the broad range reported in recent literature, but towards the higher end of estimates from multinational and regional studies. A 2023 meta-analysis of studies performed in Pakistan reported a pooled prevalence of diabetic peripheral neuropathy (DPN) of 43.2% (95% CI 32.9–53.7%), with important heterogeneity between provinces and a particularly high pooled prevalence in Khyber Pakhtunkhwa (˜55%). The pooled estimate and the regional variation reported in that meta-analysis help explain why our estimate (53.4%) is comparable to some Pakistani subgroups and higher than many single-site reports.[12]

Multinational observational data from the INTERPRET-DD

Table 1. Baseline Characteristics of Patients (n = 266)

Variable	Categories	Mean ± SD / n (%)
Age (years)		52.6 ± 10.8
Gender	**Male**	148 (55.6)
	Female	118 (44.4)
Place of Residence	**Urban**	164 (61.7)
	Rural	102 (38.3)
Educational Status	**Illiterate**	86 (32.3)
	Primary	72 (27.1)
	Intermediate	54 (20.3)
	Graduate or above	54 (20.3)
Family History of DM	**Yes**	176 (66.2)
	No	90 (33.8)
Smoking	**Yes**	88 (33.1)
	No	178 (66.9)
Hypertension	**Yes**	142 (53.4)
	No	124 (46.6)
Duration of Diabetes (years)		9.4 ± 3.2
HbA1c		8.6 ± 1.4

Figure 1: A pie chart showing the frequency of peripheral neuropathy among study participants

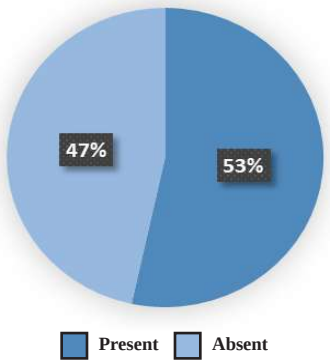

Table 2. Association of Peripheral Neuropathy with Various Factors (n = 266)

Variable	Categories	Neuropathy		p-value
		Present	Absent	
Age Group (years)	<50	44 (40.7)	64 (59.3)	0.012*
	=50	98 (62.0)	60 (38.0)	
Gender	Male	80 (54.1)	68 (45.9)	0.723
	Female	62 (52.5)	56 (47.5)	
Residence	Urban	80 (48.8)	84 (51.2)	0.042*
	Rural	62 (60.8)	40 (39.2)	
Education	Illiterate	58 (67.4)	28 (32.6)	0.021*
	Primary/Above	84 (46.7)	96 (53.3)	
Family History of DM	Yes	100 (56.8)	76 (43.2)	0.192
	No	42 (46.7)	48 (53.3)	
Smoking	Yes	56 (63.6)	32 (36.4)	0.011*
	No	86 (48.3)	92 (51.7)	
Hypertension	Yes	84 (59.2)	58 (40.8)	0.034*
	No	58 (46.8)	66 (53.2)	
Duration of DM (years)	<10 years (n=152)	66 (43.4)	86 (56.6)	<0.001*
	=10 years (n=114)	76 (66.7)	38 (33.3)	
HbA1c	<8% (n=90)	34 (37.8)	56 (62.2)	<0.001*
	=8% (n=176)	108 (61.4)	68 (38.6)	

consortium (data from 14 countries; n = 2,733) and other large cohorts have repeatedly shown that advancing age and longer diabetes duration are among the strongest and most consistent risk factors for DPN. In our study, the prevalence increased markedly in those =50 years (62.0% vs 40.7% in <50; p = 0.012) and with diabetes duration =10 years (66.7% vs 43.4%; p < 0.001). These patterns mirror findings from INTERPRET-DD and other large cohorts in which age and duration of diabetes are independent predictors of neuropathy, reflecting the cumulative metabolic and microvascular injury that accrues with time.[13, 14]

Glycaemic control emerged as a strong correlate in our sample: neuropathy affected 61.4% of patients with HbA1c =8% versus 37.8% with HbA1c <8% (p < 0.001). This relationship between sustained hyperglycemia and neuropathy is consistent with longitudinal and case-control evidence. For example, a claims-based case–control study reported that higher multi-year mean HbA1c was significantly associated with DPN, and other large clinical cohorts (including long-term follow-up studies of intensive vs standard glycaemic control) have demonstrated that better long-term glucose control reduces the risk and progression of neuropathy. These data collectively support the biological plausibility that chronic hyperglycemia mediates axonal and microvascular injury in peripheral nerves.[14, 15]

Recent work has also emphasized not only the mean HbA1c but the pattern of glycaemia: glycaemic variability has been linked to the severity of painful DPN and to neuropathy outcomes. A 2024 study found associations between HbA1c variability and neuropathy severity, suggesting that both chronic hyperglycemia and fluctuations in glucose contribute to neural injury, an observation that supports the idea that interventions should target both average control and stability of glycemia. Our finding that poor glycaemic control (HbA1c =8%) was associated with higher neuropathy prevalence aligns well with these newer lines of evidence.[16]

Lifestyle and cardiovascular risk factors matched previous studies of prediabetes and neuropathy. Smoking was also correlated with a greater rate of neuropathy in our cohort (63.6% for smokers vs. 48.3% for non-smokers; p = 0.011). Previous mechanistic and epidemiologic data have identified smoking as a modifiable risk factor for microvascular complications, including DPN, through the potential mechanisms of endothelial dysfunction, oxidative stress, and reduced perfusion to the nerves. Though the strength of associations varies across studies, the direction is consistent, supporting smoking cessation as a plausible preventive strategy [17, 18]

Hypertension likewise showed a significant relationship with neuropathy in our sample (59.2% with HTN vs 46.8% without; p = 0.034). Several recent analyses and reviews have highlighted hypertension as a contributor to nerve ischemia and an independent correlate of DPN; some authors have even described hypertension as a "missed" modifiable risk factor for DPN. Our results reinforce the importance of comprehensive cardiovascular risk management in diabetes to lower neuropathy risk.[19, 20]

Geographic and socioeconomic determinants surfaced in our data: neuropathy prevalence was higher in rural patients (60.8%) compared with urban patients (48.8%; p = 0.042), and patients classified as illiterate had higher neuropathy rates (67.4% vs 46.7% in those with primary education or higher; p = 0.021). These observations echo regional meta-analytic results showing province-level differences in Pakistan and multiple facility-based studies in low- and middle-income countries where rural residence, lower education, and limited access to preventive care contribute to delayed diagnosis and worse metabolic control. For instance, facility studies from Ethiopia (2024) and multiple single-site studies across South Asia document higher neuropathy prevalence where health-system access and education are limited—consistent with our findings that social determinants influence neuropathy burden [12, 21]

Methodological differences offer an important lens when comparing prevalence estimates. Studies that use questionnaire screens alone (e.g., MNSI questionnaire) or rely on self-reported symptoms often report lower or higher prevalence than studies using structured clinical examination with monofilament, vibration, pinprick, and reflex testing; some recent facility-based reports have shown prevalence ranges from about 16% to >60% depending on case definition and tools used. For example, a 2024 Indian study reported lower prevalence when using some screening instruments but higher rates when structured clinical assessment and nerve conduction tests were applied. These methodological differences likely account for part of the heterogeneity between our 53.4% estimate and other published values.[21]

Comparing with specific recent studies: a 2024 facility-based study in Ethiopia reported substantial DPN prevalence and identified age, duration, poor glycemic control, and comorbid hypertension as associated factors, findings that mirror ours. A 2020 multi-country INTERPRET-DD analysis and the DCCT/EDIC long-term evidence both emphasize the protective effect of sustained glycaemic control; Nozawa et al. (2022) demonstrated the link between higher average HbA1c and neuropathy in claims data; and multiple 2022–2024 site studies from South Asia and Africa report associations with smoking, HTN, duration, and socioeconomic indicators, again concordant with our results [13, 21]

This study provides several important clinical insights. The finding that more than half of patients with diabetes of over five years' duration had peripheral neuropathy highlights the urgent need for systematic neuropathy screening in clinical practice. As neuropathy commonly progresses insidiously and may be asymptomatic for some time,

assessment and screening with simple, inexpensive bedside instruments should become a standard part of diabetes clinical care. This is especially true for diabetes patients who have had the disease for a longer time or have had poor glycaemic control. All of the substantial associations highlighted in this report with modifiable risk factors (glycaemic control, hypertension, tobacco abuse, etc.) underscore the importance of a comprehensive and multifactorial approach to diabetes treatment. Clinicians should not only focus on the optimization of blood glucose but also aggressively manage cardiovascular risk factors, such as treating hypertension and providing structured smoking cessation counseling. These therapies, if applied early, are thought to delay or even prevent the development of neuropathy.

The greater incidence of neuropathy seen in rural and less educated individuals points to a serious public health issue: inequality in diabetes education, screening, and management. This indicates that community-level approaches are warranted, including mobile health, local language campaigns, and primary care provider training on simple identification of neuropathy. Educational approaches tailored to patients with limited literacy may also improve self-care behaviors and lower the risks of complications.

The second implications from a research standpoint indicate that neuropathy screening should be endorsed at all levels of the healthcare system and incorporated into diabetes management guidelines in Pakistan, specifically in resource-poor contexts like AJK. Health policymakers may consider incorporating monofilament testing as the standard of care in diabetic clinics, and ensuring affordable HbA1c testing is available to help track glycaemic control. Lastly, for researchers, the findings highlight areas to discuss further implications, including the need for longitudinal studies to understand the progression of symptoms and trials evaluating multifactorial interventions aimed at lowering the incidence of neuropathy, as well as studies incorporating electrophysiological or histopathological confirmation to characterize neuropathy more accurately.

Although this research is important, it has limitations that should be considered. First, the study was limited to a single tertiary care center, which may limit the broader applicability of the findings to the larger diabetic population even within Azad Jammu and Kashmir. Patients who present to a tertiary hospital are often likely to have more severe disease or complications than those at primary or secondary healthcare levels; thus, this potentially leads to an overestimate of the prevalence of peripheral neuropathy. Second, the study was cross-sectional in nature, limiting our ability to determine causal relationships. Though correlations were noted between age, duration of diabetes, glycaemic control, hypertension, smoking, and neuropathy, we did not know the temporality or directionality of these predictors. Longitudinal studies will be needed to better delineate the cause-and-effect nature of diabetes, glycaemic control, hypertension, and neuropathy.

The third reason was that peripheral neuropathy was assessed through clinical examination with bedside modalities of monofilament testing, vibration perception, temperature sensation, proprioception, and reflex testing. These modalities are commonly used and are relatively inexpensive; however, they are not as sensitive as more advanced diagnostic testing, such as nerve conduction studies or quantitative sensory testing, and small-fiber neuropathy may have been under-detected. In addition, clinical diagnosis can vary between examiners even after trying to standardize the assessment process. The fourth reason was additional biochemical factors that can also contribute to neuropathy, including serum lipid profiles and renal function, as well as micronutrient levels (besides B12 exclusion), which were not examined in detail. This limits our ability to control for important contributors to neuropathic risk. Finally, nonprobability consecutive sampling was used in the study, which may have introduced selection bias. Although this type of sampling is feasible, it limits representativeness and may have skewed the findings if particular risk subgroups were over- or underrepresented.

CONCLUSION

Among patients with diabetes mellitus for more than five years, peripheral neuropathy was the most common complication affecting over half of the cohort. The associations observed with longer diabetes duration, poor glycaemic control, smoking, hypertension, and sociodemographic factors such as living in rural areas and possessing low educational status illustrate the many factors that played a role in this debilitating condition. Our data have shown that neuropathy is not simply the expected outcome of diabetes, but rather is a largely preventable complication when the appropriate actions are implemented regarding the unreasonable risk factors of diabetes, and generally, diabetes itself. By identifying neuropathy early through systematic clinical screening along with comprehensive management of glycaemia and cardiovascular risks, there could be a significant reduction in the burden of neuropathy as a complication of diabetes. At the same time, it is important to stress the need for systematic public health initiatives aimed at vulnerable groups to fill the gaps in awareness and access to care for peripheral neuropathy as a complication of diabetes. Overall, our study highlights the need to bridge the gap of putting simple and timely bedside measures and holistic management of type 2 diabetes into practice with the fundamental objective of maintaining quality of life and preventing long-term disability for individuals living with diabetes.

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Authors Contribution:
Zakia Kanwal: Intro, Literature review, deta collection, data analysis
Abdul Khalid Awan: Literature review, data collection, results
Syeda Aiman Naqvi: Literature review, data collection, data analysis
Shaista Imtiaz: Review the article, results and data analysis
Zainab Shahab: Literature review, data collection
Tayyaba Haroon: Data collection, Data analysis

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