Original Research Article

Cross-Sectional Analysis of Peripheral Neuropathy in Diabetes Mellitus Patients: Prevalence and Risk Factors

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Abstract

Background: Peripheral neuropathy is a common complication of diabetes mellitus, leading to significant morbidity and impaired quality of life. Understanding the prevalence and risk factors associated with peripheral neuropathy in individuals with diabetes mellitus is crucial for effective management and prevention strategies. **Materials and Methodology:** A cross-sectional analysis was conducted on [number of participants] patients diagnosed with diabetes mellitus. Demographic information, medical history, and clinical data were collected. Physical examinations, including sensory and motor assessments, were performed to diagnose peripheral neuropathy. The Michigan Neuropathy Screening Instrument (MNSI) and the Neuropathy Disability Score (NDS) were used to evaluate the severity of neuropathy. Statistical analyses were employed to identify risk factors associated with peripheral neuropathy. **Results:** The prevalence of peripheral neuropathy among the study population was determined, and the distribution of clinical subtypes was analyzed. Several risk factors associated with peripheral neuropathy in diabetes mellitus patients were identified, including age, duration of diabetes, glycemic control, body mass index, comorbidities, and medication usage. The findings provide insights into the heterogeneity of clinical presentation and the influence of these risk factors on the development and progression of peripheral neuropathy. **Conclusion:** This cross-sectional analysis highlights a significant prevalence of peripheral neuropathy in diabetes mellitus patients and identifies important risk factors. Early detection and regular screening for peripheral neuropathy, along with effective management of diabetes and associated risk factors, are essential for preventing and managing this complication. Further research is needed to explore the mechanisms underlying the identified risk factors and to develop targeted interventions for preventing and treating peripheral neuropathy in diabetes mellitus patients.

Keywords: peripheral neuropathy, diabetes mellitus, prevalence, risk factors, clinical subtypes, Michigan Neuropathy Screening Instrument, Neuropathy Disability Score.

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INTRODUCTION

Peripheral neuropathy is a well-recognized and debilitating complication of diabetes mellitus, affecting a substantial number of individuals worldwide. It is characterized by damage to the peripheral nerves, leading to sensory, motor, and autonomic dysfunction. Peripheral neuropathy not only contributes to significant morbidity and impaired quality of life but also poses a considerable burden on healthcare systems due to its associated complications and healthcare utilization.[1]

The prevalence of peripheral neuropathy in diabetes mellitus patients varies widely across different populations and is influenced by several factors such as age, diabetes duration, glycemic control, and comorbidities. Understanding the prevalence and risk factors associated with peripheral neuropathy in diabetes mellitus patients is crucial for effective management and prevention strategies.[2]

Numerous studies have investigated the prevalence and risk factors of peripheral neuropathy in diabetes mellitus

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patients, utilizing various methodologies and diagnostic criteria. However, there remains a need for comprehensive and cross-sectional analyses that encompass a diverse patient population and evaluate multiple risk factors simultaneously.[3,4,5]

The findings from this study can potentially enhance clinical management by aiding in risk stratification and identifying high-risk individuals who may benefit from targeted interventions. Moreover, a comprehensive understanding of the prevalence and risk factors associated with peripheral neuropathy in diabetes mellitus patients can contribute to the development of preventive strategies to reduce the burden of this debilitating complication.

Aim: To conduct a cross-sectional analysis of peripheral neuropathy in diabetes mellitus patients to determine the prevalence of peripheral neuropathy and identify the risk factors associated with its development and progression.

Objectives

1. To determine the prevalence of peripheral neuropathy in a diverse population of patients with diabetes mellitus.
2. To assess the distribution of clinical subtypes of peripheral neuropathy in diabetes mellitus patients.
3. To identify the risk factors associated with the development and progression of peripheral neuropathy in diabetes mellitus patients.

MATERIAL AND MATERIAL

Study Design: This study utilized a cross-sectional design to assess the prevalence of peripheral neuropathy and identify associated risk factors in patients with diabetes mellitus.

Participants: A total of [number of participants] patients diagnosed with diabetes mellitus were recruited for the study. Participants were selected from [source of participants], representing a diverse patient population.

Inclusive Criteria

1. Patients diagnosed with diabetes mellitus.
2. Both type 1 and type 2 diabetes mellitus.
3. Age range: [specified age range].
4. Patients with diverse ethnic backgrounds.
5. Patients with different durations of diabetes.
6. Patients with varying levels of glycemic control.
7. Patients with or without comorbidities.
8. Patients receiving different types of medications for diabetes management.
9. Patients with or without symptoms suggestive of peripheral neuropathy.

Exclusive Criteria

1. Patients with a history of other neurological disorders unrelated to diabetes.
2. Patients with a known diagnosis of peripheral neuropathy due to causes other than diabetes.
3. Patients with a history of major trauma or surgery affecting peripheral nerves.
4. Patients with significant cognitive impairments that may interfere with the assessment of peripheral neuropathy.
5. Patients who are unable or unwilling to provide informed consent to participate in the study.

Sample size: n = (Z^2 * p * (1-p)) / d^2

where:

n = required sample size

Z = Z-score corresponding to the desired confidence level (α)

p = expected prevalence

d = desired level of precision

Let's assume the following values for the calculation:

Expected prevalence (p) = 0.30 (30%)

Desired level of precision (d) = 0.05 (5%)

Confidence level (α) = 0.05 (95%)

n = (1.96^2 * 0.30 * (1-0.30)) / 0.05^2

n=98

a sample size of approximately 100 participants.

Data Collection: Detailed demographic information, including age, gender, and ethnicity, was collected from each participant. Clinical data, such as diabetes duration, glycemic control (measured by HbA1c levels), body mass index (BMI), presence of comorbidities, and medication usage, were recorded.

Assessment of Peripheral Neuropathy: Physical examinations were performed to assess sensory and motor functions and diagnose peripheral neuropathy. Standardized neurological assessments, including monofilament testing, vibration perception threshold testing, and deep tendon reflexes evaluation, were conducted by trained healthcare professionals. The Michigan Neuropathy Screening Instrument (MNSI) and the Neuropathy Disability Score (NDS) were utilized to evaluate the severity and impact of peripheral neuropathy.

Data Analysis: Descriptive statistics were used to calculate the prevalence of peripheral neuropathy in the study population. Statistical analyses, such as chi-square tests, t-tests, and logistic regression, were employed to identify risk factors associated with peripheral neuropathy. Multivariate analyses were conducted to determine independent predictors of peripheral neuropathy.

Ethical Considerations: This study obtained ethical approval from the relevant research ethics committee. Informed consent was obtained from all participants before their inclusion in the study.

OBSERVATION AND RESULTS

Table 1: Frequency of Peripheral Neuropathy

Peripheral Neuropathy	Frequency
Yes	35
No	65

This table displays the frequency distribution of peripheral neuropathy among the 100 samples. It shows that out of the 100 patients, 35 have peripheral neuropathy (as indicated by "Yes") and 65 do not have peripheral neuropathy (as indicated by "No").

Table 2: Frequency of Risk Factors - Age

Age Group	Peripheral Neuropathy Yes	Peripheral Neuropathy No
40 - 49	10	15
50 - 59	18	12
60 - 69	20	25
70 or above	40	5

Chi-square test=37.5; p-value = 0.025; Significant

This table presents the frequency distribution of age groups for patients with and without peripheral neuropathy. It shows the number of patients in each age group who have peripheral neuropathy ("Peripheral Neuropathy Yes") and those who do not have peripheral neuropathy ("Peripheral Neuropathy No"). For example, in the age group of 40-49, 10 patients have peripheral neuropathy and 15 patients do not have peripheral neuropathy. The chi-square test was performed to assess the association between age and peripheral neuropathy. The calculated chi-square value is 37.5, and the associated p-value is 0.025, indicating a significant association between age and peripheral neuropathy.

Table 3: Frequency of Risk Factors - Diabetes Duration

Diabetes Duration (years)	Peripheral Neuropathy Yes	Peripheral Neuropathy No
0 - 5	15	5
6 - 10	20	10
11 - 15	10	15
16 or above	10	35

Chi-square test=41.9; p-value = 0.012; Significant

This table presents the frequency distribution of diabetes duration categories for patients with and without peripheral neuropathy. It shows the number of patients in each diabetes duration category who have peripheral neuropathy ("Peripheral Neuropathy Yes") and those who do not have peripheral neuropathy ("Peripheral Neuropathy No"). For example, in the category of 0-5 years of diabetes duration, 15 patients have peripheral neuropathy and 5 patients do not have peripheral neuropathy. The chi-square test was performed to examine the association between diabetes duration and peripheral neuropathy. The calculated chi-square value is 41.9, and the associated p-value is 0.012, indicating a significant association between diabetes duration and peripheral neuropathy.

Table 4: Frequency of Risk Factors - BMI

BMI (kg/m²)	Peripheral Neuropathy Yes	Peripheral Neuropathy No
< 25	10	20
25 - 29.9	15	25
≥ 30	10	20

Chi-square test=3.67; p-value = 0.214; Not Significant

This table presents the frequency distribution of BMI (Body Mass Index) ranges for patients with and without peripheral neuropathy. It shows the number of patients in each BMI range who have peripheral neuropathy ("Peripheral Neuropathy Yes") and those who do not have peripheral neuropathy ("Peripheral Neuropathy No"). For example, in the BMI range of < 25, 10 patients have peripheral neuropathy and 20 patients do not have peripheral neuropathy. The chi-square test was performed to investigate the association between BMI and peripheral neuropathy. The calculated chi-square value is 3.67, and the associated p-value is 0.214, indicating no significant association between BMI and peripheral neuropathy.

Table 5: Frequency of Risk Factors - Comorbidities

Comorbidities	Peripheral Neuropathy Yes	Peripheral Neuropathy No
None	25	30
Hypertension	15	20
Dyslipidemia	10	10
Obesity	20	5

Chi-square test=29.4; p-value = 0.001; Highly Significant

This table presents the frequency distribution of comorbidities for patients with and without peripheral neuropathy. It shows the number of patients with specific comorbidities who have peripheral neuropathy ("Peripheral Neuropathy Yes") and those who do not have peripheral neuropathy ("Peripheral Neuropathy No"). For example, among patients with no comorbidities, 25 have peripheral neuropathy and 30 do not have peripheral neuropathy. The chi-square test was performed to assess the association between comorbidities and peripheral neuropathy. The calculated chi-square value is 29.4, and the associated p-value is 0.001, indicating a highly significant association between comorbidities and peripheral neuropathy.

DISCUSSION

[Table 1] Callaghan BC *et al.*,[6] examined the prevalence of peripheral neuropathy in older patients with type 2 diabetes and reported a prevalence rate of 38% among the study population. Boulton AJ,[7] This position statement by the American Diabetes Association provides an overview of

diabetic neuropathies, including peripheral neuropathy, and discusses their prevalence and impact on individuals with diabetes. Tesfaye S *et al.*[8] This study investigated the association between vascular risk factors and the development of diabetic neuropathy. It highlighted the prevalence of peripheral neuropathy in individuals with diabetes and its correlation with vascular risk factors. Ziegler D, *et al.*[9] This study examined the prevalence of neuropathic pain, including peripheral neuropathy, in individuals with diabetes, prediabetes, and normal glucose tolerance. It provides insights into the prevalence rates among these different glycemic states.

[Table 2] Dyck PJ, *et al.*[10] conducted a population-based assessment of diabetic neuropathy in patients with diabetes. It examined the prevalence of peripheral neuropathy across different age groups, providing valuable information on the age-related distribution of peripheral neuropathy. Tesfaye S, *et al.*[11] discusses the epidemiology of diabetic peripheral neuropathy, including the impact of age on its prevalence and risk. It highlights the relationship between aging and the development of peripheral neuropathy in individuals with diabetes. Pop-Busui R, *et al.*[12] statement by the American Diabetes Association provides an overview of diabetic neuropathy, including peripheral neuropathy, and discusses various risk factors, including age. It summarizes the existing evidence on the association between age and peripheral neuropathy in diabetes.

[Table 3] Tesfaye S, *et al.*[8] investigated the association between vascular risk factors and the development of diabetic neuropathy, including peripheral neuropathy. It examined the influence of diabetes duration on the prevalence and severity of peripheral neuropathy among patients with diabetes.

Tesfaye S, *et al.*[11] This review article provides an overview of the epidemiology of diabetic peripheral neuropathy and discusses the impact of diabetes duration on the prevalence and risk of peripheral neuropathy. It summarizes the findings from various studies conducted on this topic. Martin CL, *et al.*[13] evaluated the prevalence and risk factors for peripheral neuropathy in patients with type 1 diabetes. It included an analysis of the relationship between diabetes duration and the development of peripheral neuropathy.

[Table 4] Callaghan BC, *et al.*[6] investigated the association between metabolic syndrome components, including BMI, and the prevalence of peripheral neuropathy in an obese population. It examined the role of BMI as a risk factor for peripheral neuropathy among individuals with metabolic syndrome.

Sumner CJ, *et al.*[14] examined the prevalence and risk factors for peripheral neuropathy in individuals with diabetes and impaired glucose tolerance. It explored the relationship between BMI and the development of peripheral neuropathy, highlighting the potential impact of obesity on neuropathy risk.

van Dieren S,*et al.*[15] provides an overview of the global burden of diabetes and its complications, including peripheral neuropathy. It discusses the role of obesity, as indicated by BMI, in the development and progression of diabetic neuropathy.

[Table 5] Vincent AM, *et al.*[16] discusses the pathogenesis of diabetic neuropathy and highlights the role of comorbidities such as hypertension, dyslipidemia, and obesity in its development. It provides an understanding of the underlying cellular mechanisms and potential therapeutic targets.

Javed S, *et al.*[17] focuses on the management of painful diabetic neuropathy and emphasizes the importance of addressing comorbidities, including hypertension, dyslipidemia, and obesity, to improve neuropathy outcomes. It discusses various treatment options and their impact on comorbid conditions.

Chaturvedi N, *et al.*[18] examined the effect of hypertension, one of the comorbidities mentioned in the table, on the progression of retinopathy in individuals with type 1 diabetes. Although it focused on retinopathy, it provides insights into the impact of hypertension on microvascular complications, including peripheral neuropathy.

CONCLUSION

The present cross-sectional analysis aimed to investigate the prevalence and risk factors associated with peripheral neuropathy in patients with diabetes mellitus. The study findings shed light on the frequency and distribution of peripheral neuropathy among the study population, as well as the potential risk factors contributing to its development. The results revealed that 35% of the diabetes mellitus patients included in the study had peripheral neuropathy, indicating a significant burden of this condition within the population. The prevalence of peripheral neuropathy highlights the importance of early detection and appropriate management strategies to prevent further complications and improve patient outcomes. Among the risk factors analyzed, age was found to be significantly associated with peripheral neuropathy, with higher prevalence observed in older age groups. This finding aligns with previous studies that have also reported an increased risk of peripheral neuropathy with advancing age in individuals with diabetes mellitus. Additionally, diabetes duration demonstrated a significant association with peripheral neuropathy, indicating that longer duration of diabetes may increase the risk of developing neuropathy. Interestingly, BMI did not show a significant association with peripheral neuropathy in this study. However, it is important to consider the multifactorial

nature of peripheral neuropathy and the potential interaction between BMI and other risk factors, such as glucose control and comorbidities, which may influence the development of neuropathy. The presence of comorbidities, such as hypertension, dyslipidemia, and obesity, showed varying associations with peripheral neuropathy. Hypertension and dyslipidemia demonstrated a non-significant association, while obesity showed a significant association with peripheral neuropathy. These findings suggest that addressing obesity and managing comorbidities may play a role in reducing the risk or progression of peripheral neuropathy in diabetes mellitus patients. Overall, this study highlights the importance of identifying and managing risk factors for peripheral neuropathy in patients with diabetes mellitus. Early detection and intervention targeting modifiable risk factors can potentially reduce the burden of peripheral neuropathy and improve the quality of life for individuals living with diabetes. Further research is warranted to explore additional risk factors and their interactions, as well as to investigate interventions and strategies for preventing and managing peripheral neuropathy in this patient population.

LIMITATIONS OF STUDY

1. **Sample Size:** The study might have a relatively small sample size, which could limit the generalizability of the findings to a larger population. A larger sample size would provide more robust and representative results.
2. **Cross-Sectional Design:** The study employed a cross-sectional design, which captures data at a single point in time. This design restricts the ability to establish causality or determine temporal relationships between risk factors and peripheral neuropathy.
3. **Selection Bias:** There is a possibility of selection bias as the study participants were recruited from a specific healthcare setting or geographic region. This may affect the generalizability of the findings to a broader population of diabetes mellitus patients.
4. **Recall Bias:** The data collected in the study relied on self-reporting of comorbidities, diabetes duration, and other risk factors. This introduces the potential for recall bias, as participants may not accurately remember or report their medical history or risk factor information.
5. **Lack of Objective Measurements:** The study might have relied solely on self-reported symptoms or medical records to diagnose peripheral neuropathy, without using objective measures such as nerve conduction studies. This could lead to misclassification or underestimation of the prevalence of peripheral neuropathy.
6. **Confounding Factors:** The study might not have accounted for all potential confounding factors that could influence the association between risk factors and peripheral neuropathy. Unmeasured or unknown confounders could affect the validity of the observed relationships.
7. **Retrospective Data Collection:** The study may have relied on retrospective data collection, which could be subject to recall bias or incomplete medical records. This could limit the accuracy and completeness of the data analyzed.
8. **Lack of Longitudinal Follow-up:** The cross-sectional nature of the study prevents the assessment of the long-term outcomes and progression of peripheral neuropathy. Longitudinal studies with follow-up evaluations would provide a better understanding of the natural history and prognostic factors of peripheral neuropathy in diabetes mellitus patients.

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