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Research Article

PREVALENCE AND RISK FACTORS OF DIABETIC NEUROPATHY IN TYPE II DIABETES PATIENTS A CROSS-SECTIONAL STUDY

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ABSTRACT

Objective: Diabetic neuropathy (DN) is often underdiagnosed and undertreated, underscoring the importance of identifying risk factors in high-risk groups. This study examines the prevalence and risk factors of this condition in type II diabetes patients to enhance prevention and management strategies.

Methods: This cross-sectional study, conducted in Bhubaneswar, evaluated a total of 450 patients with type 2 diabetes mellitus (T2DM). The research gathered comprehensive data on demographics, clinical conditions, and lifestyle factors of the participants. The findings revealed that DN was present in 180 patients, accounting for 40% of the sample, whereas 270 patients, or 60%, did not exhibit any signs of the condition.

Results: This study of 450 T2DM patients revealed that 40% had DN, particularly among those with poor glycemic control (HbA1c >7.5%: 64.7%) and diabetes duration over 5 years (OR 2.75, p<0.001). Key risk factors included smoking (OR 3.55, p<0.001), alcohol use (OR 2.89, p<0.001), and hypertension (OR 2.45, p=0.002). Common symptoms were tingling (77.8%), numbness (66.7%), shooting pain (55.6%), and muscle weakness (44.4%), highlighting the need for improved glycemic control and lifestyle changes.

Conclusions: The research highlights the link between DN and factors like poor blood sugar control, long-term diabetes, and unhealthy habits. Timely screening, effective management, and lifestyle changes are crucial to mitigating its effects.

Keywords: Diabetic neuropathy, type II diabetes, prevalence, risk factors of diabetic neuropathy

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INTRODUCTION

Diabetes mellitus (DM) is a long-term illness marked by high blood sugar levels brought on by problems with the function or synthesis of insulin [1-3]. 90–95% of cases of diabetes worldwide are type II diabetes mellitus (T2DM), the most prevalent kind. The prevalence of type 2 diabetes is quickly increasing, particularly in emerging nations like India, primarily as a result of aging populations, urbanization, and changes in lifestyle [4-6]. A significant side effect of diabetes that harms nerves as a result of persistently elevated blood sugar levels is diabetic neuropathy (DN). Loss of feeling, discomfort, tingling, muscle weakness, and autonomic problems are some of the symptoms [7]. It can cause serious issues such as infections, amputations, and foot ulcers if left untreated, placing a burden on healthcare systems. The body is affected by DN due to a variety of intricate elements, such as inflammation, oxidative stress, advanced glycation end products (AGEs), and problems with small blood vessels [8,9].

One of the most prevalent complications among people with diabetes, especially those with type 2 diabetes mellitus (T2DM), is DN. According to research, between 30 and 50% of those with type 2 diabetes may get this illness. People who have diabetes for an extended period, have trouble controlling their blood sugar levels, or have other health issues such as high blood pressure or high cholesterol are more likely to develop DN [10-12]. DN can develop and develop due to a variety of circumstances. Long-term high blood sugar is a major cause of neuropathy and can harm nerves [13]. A person's risk rises considerably if they have had diabetes for more than 10 years. By impairing the function of the small blood arteries and their ability to nourish the neurons, poor blood sugar regulation (high HbA1c), high cholesterol and lipids (high LDL and triglycerides, low HDL), and high blood pressure can also cause nerve injury and neuropathy problems [14]. Because obesity and a metabolic disorder lead to insulin resistance and complications with body fat, they raise the risk of DN. Lifestyle choices like smoking and excessive alcohol consumption can exacerbate nerve degeneration and blood vessel problems [15,16]. Furthermore, a deficiency in vitamin B12, which frequently occurs in long-term metformin users, might impair nerve function and exacerbate neuropathy.

This study aims to evaluate the prevalence and risk factors of DN in individuals with Type II diabetes. For prompt intervention, it is essential to identify risk factors in high-risk populations.

METHODOLOGY

Study design and setting

This research is an observational study with a cross-sectional design performed in a clinical environment involving patients with Type II diabetes mellitus (T2DM). The research took place in hospitals and diabetic care facilities in Bhubaneswar, Odisha, which serves a substantial population of diabetes patients who receive ongoing treatment.

Study population and sample size

The study focused on adults aged 30 and above who have been diagnosed with type II diabetes mellitus and who had undergone

treatment for a minimum of 1 year. Individuals with type I diabetes, gestational diabetes, or those experiencing neuropathy due to secondary causes—such as chronic alcohol abuse, kidney disease, or autoimmune disorders—were not included in the study. The sample size was determined based on the expected prevalence of DN, ensuring adequate representation through appropriate statistical methods.

Data collection and clinical assessment
Patients were assessed using a structured questionnaire that collected demographic details, medical history, diabetes duration, glycemic control status, medication history, lifestyle habits, and comorbid conditions such as hypertension and dyslipidemia.

Statistical analysis
The data were analyzed using SPSS version 20 to gain insights into the demographic and clinical characteristics of the participants.

Ethical considerations
All research protocols adhered to ethical standards. Participants were made aware of the study's aims, and their written informed consent was collected. The confidentiality of patient information was rigorously upheld.

RESULT

In this study, 450 patients with T2DM were assessed for DN. Among them, 180 patients (40%) were found to have DN, whereas 270 patients (60%) showed no symptoms.

Table 1 shows that 450 people with T2DM to find out how common DN is and what factors might increase the risk. The average age of the participants was 47.4 years. Those with neuropathy were older, averaging 51.2 years, while those without neuropathy averaged 49.6 years.

In the study, the participant demographic consisted of 260 males (57.8%) and 190 females (42.2%). Among those in the neuropathy group, 110 men (61.1%) were affected, whereas 70 women (38.9%) were impacted. In contrast, the non-neuropathy group included 150 males (55.6%) and 120 females (44.4%). This distribution illustrates the gender differences in the prevalence of neuropathy among the participants.

The mean duration of diabetes among all subjects was 4.3±3.7 years. Nonetheless, individuals with neuropathy exhibited a notably longer disease duration of 2.1±1.2 years, in contrast to 3.3±1.4 years in those without neuropathy.

The average body mass index (BMI) of the entire study population was 25.7±3.8 kg/m^2. Patients with neuropathy had a slightly higher BMI of 26.1±4.2 kg/m^2, compared to 26.4±2.3 kg/m^2 for those without neuropathy.

Lifestyle factors like smoking and alcohol consumption were more common in the neuropathy group. Of the 140 smokers (31.1%), 90 (50.0%) were in the neuropathy group, while only 50 (18.5%) were in the non-neuropathy group. Alcohol consumption was reported by 120 patients (26.7%), with 44.4% in the neuropathy group compared to 14.8% in the non-neuropathy group. These findings suggest that smoking and alcohol use may be modifiable risk factors for DN.

The research also noted that individuals who did not smoke or consume alcohol were more prevalent among those without neuropathy, supporting the notion that a healthier lifestyle may help reduce the risk of developing neuropathic issues. Among the entire study population, 310 participants (68.9%) identified as non-smokers, showing an equal split of 50.0% for both those with and without neuropathy. Similarly, 330 participants (73.3%) reported not drinking alcohol, with 55.6% in the neuropathy group and 85.2% in the non-neuropathy group.

Table 2 focuses that a high prevalence of DN has been noted among individuals with T2DM. This study included 450 participants, 180 were identified as having DN, representing 40% of the entire population studied. In contrast, the other 270 participants, making up 60%, did not exhibit any symptoms or clinical evidence of neuropathy. This underscores the necessity of monitoring for DN in patients with T2DM.

The examination of risk factors for DN revealed several important associations that contribute to its onset. Ineffective glycemic control, indicated by HbA1c levels exceeding 7%, was identified as a strong predictor of neuropathy, with an odds ratio of 3.21 (95% CI: 2.12–4.85, p<0.001) (Table 3).

A longer duration of diabetes, particularly beyond 5 years, also showed a significant correlation with the development of neuropathy, evidenced by an odds ratio of 2.75 (95% CI: 1.88–4.02, p<0.001). This suggests that extended exposure to high blood sugar levels and metabolic abnormalities increases the risk of nerve damage over time.

Hypertension emerged as another significant risk factor, with an odds ratio of 2.45 (95% CI: 1.67–3.62, p=0.002), indicating that patients with high blood pressure have a notably increased likelihood of developing neuropathy.

Dyslipidemia, or abnormal lipid levels, was also identified as a critical risk factor, presenting an odds ratio of 1.98 (95% CI: 1.31–2.98, p=0.005), highlighting its role in the development of neuropathy.

Table 1: Demographic and clinical characteristics of study participants

Variable	Total (n=450)	With neuropathy (n=180)	Without neuropathy (n=270)
Age (years, Mean±SD)	47.4±7.9	51.2±6.4	49.6±11.3
Gender			
Male (%)	260 (57.8)	110 (61.1)	150 (55.6)
Female (%)	190 (42.2)	70 (38.9)	120 (44.4)
Duration of Diabetes (years)	4.3±3.7	2.1±1.2	3.3±1.4
BMI (kg/m^2, Mean±SD)	25.7±3.8	26.1±4.2	26.4±2.3
Smoking Status			
Smokers (%)	140 (31.1)	90 (50.0)	50 (18.5)
Non-smokers (%)	310 (68.9)	90 (50.0)	220 (81.5)
Alcohol Consumption			
Alcohol Users (%)	120 (26.7)	80 (44.4)	40 (14.8)
Non-Alcohol Users (%)	330 (73.3)	100 (55.6)	230 (85.2)

Table 2: Prevalence of diabetic neuropathy

Neuropathy status	Number of patients (n=450)	Percentage
Present	180	40.0
Absent	270	60.0

Table 3: Risk factor analysis for diabetic neuropathy

Risk factor	Odds ratio (95% CI)	p-value
Poor glycemic control (HbA1c>7%)	3.21 (2.12–4.85)	<0.001
Longer duration of diabetes (>5 years)	2.75 (1.88–4.02)	<0.001
Hypertension	2.45 (1.67–3.62)	0.002
Dyslipidemia	1.98 (1.31–2.98)	0.005
Smoking	3.55 (2.23–5.64)	<0.001
Alcohol consumption	2.89 (1.79–4.69)	<0.001
Physical inactivity	2.14 (1.45–3.16)	0.008

Lifestyle factors, such as smoking and alcohol consumption, demonstrated strong associations with DN. Smoking had the highest odds ratio among all the risk factors, reaching 3.55 (95% CI: 2.23–5.64, p<0.001), suggesting that smokers are more than three times as likely to experience neuropathy. Smoking can induce vasoconstriction, reduce oxygen supply, and increase oxidative stress, all of which can harm nerve health. Similarly, alcohol consumption was significantly related to neuropathy, with an odds ratio of 2.89 (95% CI: 1.79–4.69, p<0.001). Furthermore, physical inactivity was recognized as a risk factor, with an odds ratio of 2.14 (95% CI: 1.45–3.16, p=0.008).

A study on glycemic control and its association with neuropathy found a significant link between elevated HbA1c levels and DN. Among 450 patients, 120 with well-controlled blood glucose (HbA1c ≤6.5%) had a low neuropathy prevalence of 16.7%. This suggests that optimal glycemic control protects against neuropathic development by reducing oxidative stress and inflammation.

In contrast, of the 160 patients with moderate glycemic control (HbA1c 6.6–7.5%), 31.2% experienced neuropathy, indicating even slightly elevated blood glucose levels can lead to nerve damage over time. This reinforces the importance of maintaining HbA1c within target ranges to minimize complications.

The highest neuropathy rates were found in the 170 patients with poor glycemic control (HbA1c>7.5%), where 64.7% reported neuropathy. This starkly highlights the connection between chronic hyperglycemia and nerve damage, leading to severe symptoms that significantly impact quality of life (Table 4).

The Result depicted in Table 5 shows that 180 patients with DN assessed the severity of neuropathic symptoms, showing variations across mild, moderate, and severe categories. The most common symptoms reported were tingling and burning sensations, affecting 140 patients: 35.7% mild, 42.9% moderate, and 21.4% severe. Numbness was reported by 120 patients, with 33.3% mild, 41.7% moderate, and 25.0% severe. Shooting pain was observed in 100 patients, with 30.0% mild, 40.0% moderate, and 30.0% severe. Finally, muscle weakness was noted by 80 patients: 31.2% mild, 37.5% moderate, and 31.2% severe.

DISCUSSION

Multiple studies indicate that older age is a notable risk factor for DN in people with T2DM. Research indicates that the likelihood of developing DN rises with age. In particular, individuals who are 40, 50, 60, and 70 years old have logarithmic odds ratios (LnOR) of 1.22, 1.79, 2.29, and 2.67, respectively, when compared to those who are 19 years old. This clearly illustrates an increasing trend in the risk of DN with advancing age [17]. A study found that 7% of young people with Type 1 Diabetes have diabetic nephropathy, while the rate is 22% for those with Type 2 diabetes [18]. In our study, we found DN was more common in older individuals, averaging 51.2 years, compared to 49.6 years without neuropathy.

Table 4: Glycemic control and neuropathy prevalence

HbA1c (%) range	Total patients (n=450)	With neuropathy (%)	Without neuropathy (%)
≤6.5% (Well controlled)	120	20 (16.7)	100 (83.3)
6.6-7.5% (Moderate control)	160	50 (31.2)	110 (68.8)
>7.5% (Poor control)	170	110 (64.7)	60 (35.3)

Table 5: Neuropathic symptom score distribution

Symptom	Total patients (n=180)	Mild (%)	Moderate (%)	Severe (%)
Tingling/Burning sensation	140	50 (35.7)	60 (42.9)	30 (21.4)
Numbness	120	40 (33.3)	50 (41.7)	30 (25.0)
Shooting pain	100	30 (30.0)	40 (40.0)	30 (30.0)
Muscle weakness	80	25 (31.2)	30 (37.5)	25 (31.2)

Our findings indicate that DN is more commonly observed in males (61.1%) than in females (38.9%), which aligns with previous research. Specifically, men with type 2 diabetes are at a greater risk of developing sensory neuropathy, whereas women often experience more intense neuropathic pain and nerve damage. This suggests that although DN is more prevalent in men, women may suffer from a higher level of pain. This highlights the gender-related differences in the prevalence and severity of the condition across various populations [19,20].

The research findings indicate that individuals with neuropathy experienced a shorter duration of diabetes (2.1 years) compared to those without neuropathy (3.3 years). This contradicts the common belief that a longer duration of diabetes increases the risk of neuropathy. Previous studies show that the prevalence of DN typically rises with the length of diabetes, with significant nerve issues emerging within the first decade after diagnosis [21,22].

Our research indicates a notable connection between smoking and alcohol consumption and the prevalence of DN. These behaviors may serve as modifiable risk factors for the condition. Studies show that smoking correlates with microvascular complications, including diabetic peripheral neuropathy (DPN). For instance, a specific study revealed that individuals with insulin-dependent diabetes mellitus (IDDM) who smoke have an increased odds ratio of 2.46 for developing neuropathy (p=0.02) [23,24]. Excessive alcohol consumption is associated with an increased risk of neuropathy, particularly symptomatic peripheral neuropathy in men. High alcohol intake, along with diabetes, is a key contributor to distal symmetrical polyneuropathy (DSP). Addressing smoking and alcohol use is important for managing and reducing the risk of DN [25].

Elevated HbA1c levels are linked to a higher incidence of DN. Research indicates that achieving normal HbA1c levels in those with a short history of type 2 diabetes significantly improves microvascular complications, including neuropathy. Keeping HbA1c levels between 6.5 and 7.0% may help prevent or mitigate diabetic peripheral neuropathy. In addition, higher HbA1c levels and older age are strong predictors of polyneuropathy in diabetic patients, underscoring the importance of maintaining optimal blood glucose levels to reduce the risk of developing DN [26-28].

DN often shows symptoms such as tingling, burning, numbness, sharp pain, and muscle weakness, varying in severity among individuals. Research suggests these symptoms typically affect the legs, feet, and hands, depending on the nerves involved. Patients may experience paresthesia, numbness, and neuropathic pain, described as burning or shooting. These findings emphasize the commonality of such symptoms in DN [29,30].

CONCLUSION

This study looks at how common DN is among patients with Type II diabetes. It found a strong link between DN and factors like poor blood sugar control, long-term diabetes, and lifestyle habits such as smoking and drinking alcohol. High blood pressure and abnormal cholesterol levels are also major risks. People with DN often experience symptoms such as tingling, numbness, sharp pain, and muscle weakness, which can greatly lower their quality of life. These findings highlight the need for early detection, good blood sugar management, and healthy lifestyle changes to reduce the effects of DN in patients. Future studies should focus on longitudinal research to uncover causal relationships between risk factors and the advancement of DN in Type II diabetes.

Implementing early screening initiatives for individuals at high risk is essential for prompt interventions.

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AUTHOR'S CONTRIBUTIONS

Conceptualization, Design, Data collection, Manuscript Preparation, Manuscript Editing, and Data interpretation: Durga Madhab Kar, Karmajeet Rath, Prabhudatta Mohapatra, Rudra Narayan Dash; Statistical analysis, Manuscript Editing: N. Saroj Kumar Choudhury, Rudra Narayan Dash.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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