RESEARCH ARTICLE

Diabetic neuropathy prevalence, progression and effects

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Abstract

Aim: To determine the prevalence of diabetic neuropathy, its progression and major effects among the patients visiting Nishtar Hospital, Multan. **Methods:** A cross-sectional survey was conducted using a structured questionnaire as a google form at Department of Community Medicine, Nishtar Medical University, Multan, from May, 2025 to September 2025. After informed consent data was collected from the patients with diagnosed diabetes mellitus type 2 either males or females visiting Nishtar Hospital OPD. **Results:** This study had 228 diabetic patients including 148 males and 80 females with mean age being 54.44 years +-13.43 years. Peripheral sensory neuropathy was observed as numbness in 67.5%, tingling in 64%, and pain in 57.9%, foot ulcers in 32.5%. Autonomic neuropathy presented as cardiovascular problems in 50%, urinary urgency/incontinency in 56.1%, and gastrointestinal symptoms in 36.8%. All PSN manifestations were more prevalent in females while all AN symptoms were more prevalent in males ($p<0.05$). Neuropathy symptoms increase beyond 10 years of disease ($p<0.001$). Physically inactive patients had higher rates of numbness (92.3%), tingling (87.2%), and pain (87.2%), foot ulcers(28.4%), CVD's (48.7%), urine urgency/incontinency (50.7%) and gastrointestinal issues (48.7%) than physically active ones ($p<0.001$). A positive family history, particularly paternal, had a significant association ($p < 0.05$) with higher rates of CVDs (65%) and Foot ulcers (47.5%). Regular medication routine also reduced diabetic neuropathy occurrence ($p<0.05$). Diet control reduced CVDs occurrence from 71.4% with no diet control and 45.2% with diet control. Low socioeconomic status patients had higher occurrence of neuropathy as numbness (100%), tingling (100%), pain (75%), foot ulcers (16.7%), CVDs (41.7%), urine urgency/incontinency (50%), and GI issues (33.3%) ($p<0.05$). Smokers had higher incidence of CVDs (53.4%), Urine urgency/incontinency (76.7%) and GI issues (44.1%). **Conclusion:** Peripheral sensory neuropathy is the most common, and autonomic neuropathy the most severe form of diabetic neuropathy. Numbness is the commonest symptom of PSN while urinary incontinence is that of AN. PSN is more prevalent in females while AN is more prevalent in males. Longer diabetes duration is the strongest factor contributing to diabetic neuropathy followed by physical inactivity, low socioeconomic status, poor medication routine, poor diet control and family history of diabetes particularly paternal.

Keywords: Diabetic neuropathy • Autonomic neuropathy • Peripheral neuropathy

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Introduction

Diabetic neuropathy (DN) is one of the most prevalent chronic complications of diabetes mellitus, significantly impairing quality of life and increasing healthcare burdens. It affects approximately 50% of patients with both type 1 and type 2 diabetes over their lifetime [1,2]. Currently it is affecting half a billion people worldwide. Its global prevalence is rising at an alarming rate forecasting that it will affect 700 million people by 2045 [2]. It is a heterogenous group of clinical or sub-clinical symptoms which affect the peripheral nervous system as complications of diabetes mellitus [3].

The pathophysiology of DN is multifactorial, involving chronic hyperglycemia-induced oxidative stress, inflammation, BMI, female sex, advanced age, genetics, mitochondrial dysfunction, and impaired insulin signaling etc leading to several disturbances at cellular level which affect the neuronal cells. [4–6]. This progression is not linear; instead, it is influenced by glycemic control, duration of diabetes, age, and comorbid metabolic conditions and their medications like tuberculosis, hypertension etc. Hyperglycemia triggers a cascade of metabolic changes including accumulation of advanced glycation end products (AGEs) and activation of the polyol and hexosamine pathways, further damaging peripheral nerves [5,7]. Despite these advancements, exact mechanism of pathophysiology of Diabetic neuropathy is still unknown [8].

There are several clinical subtypes of diabetic neuropathy. The most common Diffuse sensory peripheral neuropathy which primarily affects sensory fibers. Second serious type is Autonomic neuropathy which can effect either cardiovascular, gastrointestinal, genitourinary, and sudomotor functions. Other types include Focal and multifocal neuropathies such as cranial or truncal neuropathies, and diabetic amyotrophy, though less common, can cause acute and often severe deficits [6,9].

Diabetic neuropathy exerts profound effects on patient outcomes.Peripheral sensory neuropathy leads to pain and paraesthesia like tingling sensations, numbness etc ultimately causing discomfort. It is major risk factor of lower limb ulcers especially foot ulcers and other deformities leading to the amputation of lower limbs. [3,10]. Autonomic neuropathy leads to cardiovascular derangements mainly by damaging the microvasculature. It can also lead to heart and vascular diseases including hypertension and myocardial infarction due to loss of autonomic control on the vessels resulting from nerve damage[11]. It also causes bladder dysfunction and affects the GIT motility. Other subtypes may also have serious effects. These complications not only increase morbidity and mortality but also contribute to a significant economic burden.

Regarding the prevention, management and treatment of diabetic neuropathy, glycemic control is of much significance [12]. It is more useful in type 1 diabetes. It also reduces the risk in type 2 diabetes but its significance did not reach the statistical level [13]. Diet modifications and exercise is also useful in diabetic neuropathy [14–16]. Despite these consequences, DN often remains under-diagnosed and undertreated, highlighting the urgent need for improved screening, preventive strategies, and disease-modifying therapies.

The rationale of this study is to determine the prevalence of different types of diabetic neuropathy and the association of their association and progression with various factors. This study results will highlight the causative factors of diabetic neuropathy, its preventive measures and also the neuropathic effects of diabetes mellitus thus helping the clinicians in properly managing the diabetic patients.

Materials & methods

It was a cross-sectional survey was conducted using a structured questionnaire as a google form at Department of Community Medicine, Nishtar Medical University, Multan, from May 2025 to September 2025.

Before actual data collection procedure, an application was submitted to the office of Ethical Review Board of the institution. After taking ethical approval actual data collection procedure was started.

The sample size was assessed by using WHO sample size calculation criteria keeping confidence level 85% ,margin of error 5% and population proportion 50%. A non-probability random sampling technique was used. Data were collected on the google form the diabetic patients visiting the Nishtar Hopsital, Multan OPD. 165 subjects were included in the study after an informed consent.

Type 2 diabetic patients of all ages and both genders who visited Nishtar Hospital OPD on Thursday, Friday and Saturday during May-Sep 2025 are included in the study.

Type 1 diabetic patients and those with other hyperglycemia due to other diseases are excluded. The patients visiting the OPD on other days of week are also exluded. Type 2 diabetics not willing to cooperate are also excluded.

After the collection of data, it was analyzed using Statistical Package for Social Sciences (SPSS) version 27. Frequency and percentages were calculated for each variable. Chi-square test was used to study the association between the predisposing factors and symptoms of DN. A p-value of ≤ 0.05 was taken as significant. Mean and standard deviation values were calculated using Microsoft excel 2010.

Results

This study had 228 diabetic patients including 148 (64.9%) males and 80 (35.1%) females with the mean age being 54.44 years +-13.43 years. 185 were non-smokers and 43 were smokers. The manifestations of Peripheral sensory neuropathy were observed as numbness in 67.5%, tingling in 64%, and pain in 57.9%, while foot ulcers were found in 32.5%. Autonomic neuropathy presented as cardiovascular problems in 50%, urinary urgency/incontinency in 56.1%, and gastrointestinal symptoms in 36.8%. There was a significant association between gender and diabetic neuropathy symptoms with peripheral sensory neuropathy occurring more in females and autonomic neuropathy occurring more in males as evident in Table 1. A signification realtionship ($p<0.001$) was found between the duration of diabetes and diabetic neuropathy manifestations, as occurrence of all the symptoms increased after more than 10 years of disease. This association is demonstrated in Table 2.

Table 1. Association between gender and diabetic neuropathy

Variables	Female (n=80)	Male (n=148)	Chi Square	P-value
Peripheral Sensory Neuropathy				
Numbness	68 (85.0%)	86 (58.1%)	17.13	0.000
Tingling	72 (90.0%)	74 (50.0%)	36.08	0.000
Pain	52 (65.0%)	80 (54.1%)	2.55	0.110

Foot Ulcers/Infection	28 (35.0%)	46 (31.1%)	0.36	0.546
Autonomic Neuropathy				
CVDs	38 (47.5%)	76 (51.4%)	0.31	0.579
Urine Urgency	30 (37.5%)	98 (66.2%)	17.39	0.000
Constipation/Diarrhea	40 (50.0%)	44 (29.7%)	9.17	0.002

Table 2. Effect of duration of diabetes on diabetic neuropathy

Variables	<5 Years (n=60)	5-10 Years (n=56)	10-15 Years (n=58)	15-20 Years (n=34)	>20 Years (n=20)	Chi Square	P-value
Peripheral Sensory Neuropathy							
Numbness	34 (56.7%)	28 (50.0%)	48 (82.8%)	24 (70.6%)	20 (100%)	26.97	0.000
Tingling	34 (56.7%)	26 (46.4%)	40 (69.0%)	26 (76.5%)	20 (100%)	23.08	0.000
Pain	28 (46.7%)	22 (39.3%)	38 (65.5%)	26 (76.5%)	18 (90.0%)	25.71	0.000
Foot Ulcers/Infection	4 (6.7%)	14 (25.0%)	30 (51.7%)	18 (52.9%)	8 (40.0%)	36.47	0.000
Autonomic Neuropathy							
CVDs	44 (73.4%)	22 (39.3%)	24 (41.4%)	16 (47.1%)	8 (40.0%)	18.28	0.001
Urine Urgency/Incontinence	30 (50.0%)	14 (25.0%)	36 (62.1%)	28 (82.4%)	20 (100%)	48.91	0.000
Constipation/Diarrhea	16 (26.7%)	20 (35.7%)	16 (27.6%)	16 (47.1%)	16 (80.0%)	22.37	0.000

Physical activity also showed a significant association ($p < 0.001$) with prevalence of diabetic neuropathy. Physically inactive patients had higher rates of numbness (92.3%), tingling (87.2%), and pain (87.2%), foot ulcers(28.4%), CVD's (48.7%), urine urgency/incontinency (50.7%) and gastrointestinal issues (48.7%), while those who were engaged in walking or heavy workout had lower rates of these manifestations. This association is demonstrated in Table 3.

Table 3. Effect of physical activity on diabetic neuropathy

Variables	Heavy Workout (n=16)	Walk (n=134)	No Activity (n=78)	Chi Square	P-value
Peripheral Sensory Neuropathy					
Numbness	6 (37.5%)	76 (56.7%)	72 (92.3%)	35.57	0.000
Tingling	6 (37.5%)	72 (53.7%)	68 (87.2%)	29.21	0.000
Pain	4 (25.0%)	60 (44.8%)	68 (87.2%)	44.00	0.000
Foot Ulcers/Infection	0 (0.0%)	36 (26.9%)	38 (48.7%)	15.39	0.000
Autonomic Neuropathy					
CVDs	10 (62.5%)	66 (49.3%)	38 (48.7%)	1.08	0.58
Urine Urgency/Incontinence	4 (25.0%)	56 (41.8%)	68 (87.2%)	15.65	0.000
Constipation/Diarrhea	0 (0.0%)	46 (34.3%)	38 (48.7%)	14.43	0.001

A positive family history of diabetes, particularly paternal, had a significant association ($p < 0.05$) with higher rates of CVDs (65%) and Foot ulcers (47.5%). Medication routine also significantly influenced diabetic neuropathy occurrence ($p<0.05$) as depicted in Table 4. Diet control has a significant effect just on CVDs occurrence being 71.4% with no diet control and 45.2% with diet control. Socioeconomic status also significantly influenced diabetic neuropathy occurrence ($p < 0.05$). The patients with low socioeconomic status had higher occurrence of neuropathy as numbness (100%), tingling (100%), pain (75%), foot ulcers (16.7%), CVDs (41.7%), urine urgency/incontinency (50%), and GI issues (33.3%). Details of this association are demonstrated in Table 5. Smoking didn't showed a significant association with neuropathy ($p<0.05$) in our study but smokers had higher incidence of autonomic neuropathic manifestations being CVDs (53.4%), Urine urgency/incontinency (76.7%) and GI issues (44.1%).

Table 4. Effect of medication routine on diabetic neuropathy

Variables	Regular (n=194)	Random (n=26)	Rare (n=8)	Chi Square	P-value
Peripheral Sensory Neuropathy					
Numbness	132 (68.0%)	20 (76.9%)	2 (25.0%)	7.67	0.02
Tingling	122 (62.9%)	22 (84.6%)	2 (25.0%)	10.18	0.006

Pain	114 (58.8%)	18 (69.2%)	0 (0.0%)	12.43	0.002
Foot Ulcers/Infection	66 (34.0%)	8 (30.8%)	0 (0.0%)	4.09	0.12
Autonomic Neuropathy					
CVDs	92 (47.4%)	16 (61.5%)	6 (75.0%)	3.90	0.14
Urine Urgency/Incontinence	110 (56.7%)	18 (69.2%)	0 (0.0%)	12.07	0.002
Constipation/Diarrhea	72 (37.1%)	12 (46.2%)	0 (0.0%)	5.64	0.06

Table 5. Effect of socioeconomic status on diabetic neuropathy

Variables	Upper Class (n=32)	Middle Class (n=172)	Lower Class (n=24)	Chi Square	P-value
Peripheral Sensory Neuropathy					
Numbness	20 (62.5%)	110 (64.0%)	24 (100%)	12.91	0.002
Tingling	18 (56.3%)	104 (60.5%)	24 (100%)	15.27	0.000
Pain	12 (37.5%)	102 (59.3%)	18 (75.0%)	8.48	0.01
Foot Ulcers/Infection	8 (25.0%)	62 (36.0%)	4 (16.7%)	4.55	0.10
Autonomic Neuropathy					
CVDs	18 (56.3%)	86 (50.0%)	10 (41.7%)	1.16	0.55
Urine Urgency/Incontinence	10 (31.3%)	106 (61.6%)	12 (50.0%)	10.52	0.005
Constipation/Diarrhea	12 (37.5%)	64 (37.2%)	8 (33.3%)	0.14	0.93

Discussion

The peripheral sensory neuropathy is the most common type of diabetic neuropathy while autonomic neuropathy is the most serious one [4,6]. Among the PSN, numbness is the most common manifestation followed by tingling and pain. Foot ulcers and infections are the most serious complications of PSN although there is also a great role of impaired wound healing due to poor glycemic control [6,10,15]. Among autonomic neuropathy, urine urgency or incontinency is predominant manifestation followed by constipation/diarrhea and then CVDs. The reason is that autonomic control of urinary bladder, GIT, heart and vessels is affected due to nerve damage [6,11]. Other types of DN like focal and truncal neuropathies are rare [6]. Longer duration of diabetes is the most significant risk factor of DN with almost all patients with >20 years diabetes having DN. It happens because biochemical mechanisms mainly oxidative stress damage the nerves and their microvasculature with the passage of time [6,11,17]. Physical activity is the second most significant factor which determines the incidence of DN. Physically active patients are on significantly lower risk of DN than those having no physical activity; glucose consumption being the reason [2,14–16]. Socioeconomic status is also among the factors affecting the incidence of DN; Lower socioeconomic status patients are at higher risk of DN than high socioeconomic status patients. It may be due to the medication routine difference between the different classes. So, medication routine is another factor for DN incidence. Patients with regular medication routine have low incidence of DN due to glycemic control [18–20]. Diet control is also significant in preventing DN. Patients who take low carbohydrate and high protein diet are at lower risk of developing DN than those who take high carbohydrate and low protein diet [13,16]. Smoking is also a risk factor for DN. It causes hypoxemia and microvasculature insufficiencies which affect the nerve terminals and thus potentiates the effect of poor glucose metabolism on the nerve terminals, ultimately leading to the neuropathy [21,22]. Patients with family history of diabetes especially paternal have more incidence of CVDs and diabetic foot of than those with no family history. Regarding gender there is high incidence of PSN in females than males while AN is more prevalent in males than females [23,24]. Diabetic neuropathy incidence also has significant association with age groups and weight but this association is random among different groups.

This study provides readers information about prevalence, progression and effects of diabetic neuropathy. Firstly, the sample size was small. Secondly, all the results are based on the data provided by the patients so there are chances of recall bias. Thirdly, results are based on only a few symptoms of diabetic neuropathy though there are certain others. Fourthly, data were collected from only those patients visiting Nishtar Hospital OPD on specific days during specific period of time, so, there may be difference in results in different regions and different time frames. Moreover, there is space for nerve conduction studies to get the more accurate results. Future researchers need to perform case control studies on each aspect of this topic for better understanding of this vast topic.

Conclusion

Peripheral sensory neuropathy is the most common, and autonomic neuropathy is the most severe form of diabetic neuropathy. Numbness is the commonest symptom of PSN while urinary incontinence is that of AN. PSN is more

prevalent in females while AN is more prevalent in males. Longer diabetes duration is the strongest factor contributing to diabetic neuropathy followed by physical inactivity, low socioeconomic status, poor medication routine, poor diet control and family history of diabetes particularly paternal.

Data availability statement

The raw data supporting the conclusions can't be made publically available due to ethical restrictions and respondents' privacy concerns as the dataset contains personal information of the respondents.

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Ethical considerations

This study was approved by Institutional Ethical Review Board (IERB) of Nishtar Medical University, Multan with the Reference no. (13024/NMU).

Consent to participate

All the participants gave informed consent to participate in study.

Consent for publication

All the participants gave consent to publish the results of this study.

Disclaimer

None

Conflict of interest

None

Source of funding

None

Authors' contributions

ALI RAZA: Study concept and design, Data acquisition, Analysis and interpretation of data, Drafting the manuscript

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