



# Diabetic Neuropathy as the Commonest Diabetic Complication in Patients Attending the Diabetes Center in Arar, Northern Saudi Arabia

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## ABSTRACT

**Background:** Previous literature estimates that 50 to 66 percent of DM patients would ultimately experience PN at some points in their lifespan. **Objectives:** To evaluate the prevalence of diabetic neuropathy and its associated risk factors in patients with diabetes mellitus attending the diabetes center in Arar, Saudi Arabia. **Methods:** A hospital-based cross-sectional study was carried out in the diabetes center in Arar, Saudi Arabia. Data were collected by personal interviews with the diabetic patients attending the diabetes center, and filling a predesigned questionnaire that included the following items; patient's code, department of residency, sex, age, marital status, educational level, occupation, compliance to DM treatment, fasting blood glucose level, diagnosis of diabetic neuropathy, type of received treatment, manifestations of DNP if found, and vital status. **Results:** DNP was reported in 26.4% of the studied DM patients. The most common DNP manifestations reported by the patients were inability to feel the feet while walking in 85.5%, pain in legs or feet in 78.2%, and weakness of the limbs in 70.9%, numbness and tingling in the legs or feet in 69.1% and 65.5%. More than half the patients (58.2%) had muscle spasms in the legs or feet, 52.7% suffered from dryness and cracking of the skin of the feet, 61.8% reported that symptoms worsen at night. Leg amputation was reported in 6 (10.9%) of patients. **Conclusion:** In our study, DNP was reported in 26.4% of the studied DM patients. DNP showed a statistically significant relation with BMI group, chronic hypertension, the period of DM, compliance with DM treatment, type of DM treatment, physical exercise, and fasting blood glucose level. On the other hand, DNP showed a statistically insignificant relation with gender, age group, and smoking.

**Key Words:** diabetic neuropathy, associated risk factors, diabetic patients, diabetes center, Arar, Saudi Arabia.

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## INTRODUCTION

Diabetes has been increasing in recent years [1]. Diabetic neuropathy (DNP) is the most troublesome and common complication in patients with diabetes mellitus and is defined as peripheral nerve dysfunction in diabetics in whom other causes of peripheral nerve dysfunction have been excluded [2]. DNP may be the reason for the highest mortality rate and lead to a heavy economic burden on diabetes care [3, 4]. It is the most common reason for hospitalization in diabetics than all the other diabetic

complications and is responsible for 50-75% of non-traumatic amputations [4, 5].

The commonest clinical form of diabetic neuropathy is the distal symmetrical polyneuropathy, affecting more than 90% of the patients [6]. It generally affects the distal foot and toes, but gradually progresses proximally and involves the legs and feet in a stocking distribution. In addition, it is characterized by a gradual loss of nerve fibers that affect both the somatic and autonomic divisions, resulting in diabetic nephropathy and retinopathy [6, 7]. The main clinical consequences are painful neuropathy and foot

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ulceration with higher mortality and morbidity [8]. Neuropathic pain is a major disabling symptom of patients with diabetic neuropathy. It is a difficult condition to treat and therefore causes significant patient suffering and societal burden. Diabetic neuropathic pain is usually moderate to severe and often worsens at night, causing sleeping disturbances. The pain is characterized by lancinating, shooting, sharp, burning, tingling, and even electric shock sensations [6, 9]. It not only causes pain but also is associated with a high degree of functional impairment in health-related quality of life and activities of daily living [10, 11]. Although DNP may be asymptomatic, the symptomatic form affects 10% to 26% of the diabetic population [12, 13]. Frequently, patients look for medical help only when pain appears [14].

The exact mechanisms involved in different pain sensations are still unknown, however, some evidence points to abnormal discharges from diseased peripheral neurons as the main cause of this pain [15, 16]. Others point to the role of spontaneous activity in the peripheral nociceptor system in stimulating the central nervous system leading to hyperalgesia and allodynia [15, 16].

The risk of DNP was found to be associated with age, duration of DM, glycemic control (high level of HbA1c), gender, and smoking [17]. This study aimed to evaluate the prevalence of DNP and its risk factors in patients with diabetes mellitus attending primary healthcare (PHC) in Arar city, KSA.

### Rationale

According to the changes in the quality of life and the health hazards of patients who suffer from diabetic neuropathy, it is important to address the current burden in Arar, KSA.

### Aim of the Study

To study the prevalence, risk factors, and treatment outcomes of the DNP in the diabetic center in Arar, KSA.

## METHODS AND PARTICIPANTS

### Study design and setting

A hospital-based cross-sectional study was carried out in the diabetic center in Arar, Saudi Arabia. The study was during the period from April 1, 2020 to June 31, 2020.

All consenting diabetic patients attending the center were interviewed.

Inclusions criteria included Saudi patients diagnosed with DM.

Exclusion criteria included non-Saudi patients, patients with neurological disorders, and refusing patients.

### Sample Size

The sample size was calculated using the following formula:

$$N = Z^2 \times P(1-P)/E^2$$

Where:

N = sample size

Z<sup>2</sup> = 1.96 (The critical value that divides the central 95% of the Z distribution from the 5% in the tail)

P=Prevalence of diabetic neuropathy among Saudi diabetics attending the diabetes center in Arar, Northern KSA.

E<sup>2</sup> = the margin of error (=width of confidence interval)

So, by calculation, the sample size is equal to 184 cases with a 10% drop-out rate, so the total sample size will be 208 cases.

### Sampling Technique

The cases were selected using a systematic random sampling technique. First, one case was chosen randomly from the attendees of the center. Second, every 2<sup>nd</sup> case was included until the end of the sample (208 cases).

### Data collection

Data were collected by a personal interview with the diabetic patients attending the diabetes center, and filling a predesigned questionnaire that included the following items; patient code, department of residency, sex, age, marital status, educational level, occupation, compliance to DM treatment, fasting blood glucose level, diagnosis of diabetic neuropathy, type of received treatment, manifestations of DNP if found, and vital status.

### Ethical considerations

Approval to carry out the study was obtained from the Research Ethics Committee of the Northern Border University. Data was anonymous for patient confidentiality and the data was kept safely.

### Data management and Statistical analysis

The collected data was entered and analyzed using the SPSS software (SPSS Inc. Chicago, IL, USA) version 23. Descriptive statistics were performed. Percentages were given for qualitative variables. The determinant factors were determined using the Chi-square test. P-value was considered significant if P <0.05.

## RESULTS

The Socio-demographic characteristics of the included DM patients are shown in Table 1. 60.6% of participants were females, 37.5% were between 41 and 60 years old, and 26.9% were elderly. Regards body mass index (BMI) group, 36.1% were overweight and 33.2% suffered

obesity. Most of the participants were married (80.3%). 40.4% had a university degree, however, 63.0% were non-employed. Among the participants, 12% were smokers, and 21.2% suffered from chronic hypertension.

Table 2 shows DNP and its possible risk factors in the participants. DNP was reported in 26.4% of the studied DM patients. The period of DM was from 5 to 10 years in 39.9%, and more than 10 years in 33.7% of the participants. 76% reported that they are compliant with their DM treatment. DM treatment was only oral pills at 61.5%. Fasting blood glucose level was normal in 71.2% of the participants, and 66.8% do not perform physical exercise.

Table 3 shows the DNP manifestations among DNP patients. The most common DNP manifestations reported by the patients were inability to feel the feet while walking (85.5%), pain in legs or feet (78.2%), and weakness of the limbs (70.9%). Tingling and numbness in the legs or feet were reported in 69.1% and 65.5%, respectively. More than half of the patients (58.2%) had muscle spasms in the legs or feet, and 52.7% suffered from dryness and cracking of the skin of the feet. 61.8% said that symptoms were worse at night. Leg amputation was reported in 6 patients (10.9%).

Table 4 illustrates the relation between DNP and other factors. DNP showed a statistically significant relation with BMI group, chronic hypertension, period of DM, compliance with DM treatment, type of DM treatment, physical exercise, and fasting blood glucose level. On the other hand, DNP showed a statistically insignificant relation with gender, age group, and smoking.

**Table 1. Socio-demographic characteristics of the participants, 2020 (N=208).**

Variables	Frequency (N=208)	Percent (%)
<b>Sex</b>		
Male	82	39.4
Female	126	60.6
<b>Age group</b>		
18 years or younger	5	2.4
19 – 40 years	69	33.2
41 – 60 years	78	37.5
61 years or older	56	26.9
<b>BMI group</b>		
Low	7	3.4
Normal	57	27.4
Overweight	75	36.1
Obese	69	33.2
<b>Marital status</b>		
Married	167	80.3
Unmarried	41	19.7
<b>Educational level</b>		
Introductory	29	13.9

Secondary	45	21.6
University degree	84	40.4
Illiterate	50	24.0
<b>Employment</b>		
Employed	77	37.0
Non-employed	131	63.0
<b>Smoking status</b>		
Current smoker	25	12.0
Non-smoker	183	88
<b>Chronic hypertension</b>		
Yes	44	21.2
No	164	78.8

**Table 2. Diabetic neuropathy and its risk factors.**

Variables	Frequency (N=208)	Percent (%)
<b>Diabetic neuropathy</b>		
Yes	55	26.4
No	153	73.6
<b>Period of DM</b>		
Less than 5 years	55	26.4
5 – 10 years	83	39.9
More than 10 years	70	33.7
<b>Compliance to DM treatment</b>		
Yes	158	76.0
No	50	24.0
<b>Type of DM treatment</b>		
Oral pills	128	61.5
Insulin injection	42	20.2
Both	15	7.2
Only dietary changes	23	11.1
<b>Fasting blood glucose level</b>		
High	60	28.8
Normal	148	71.2
<b>Physical exercise</b>		
Regularly	14	6.7
Not regularly	55	26.4
No physical exercise	139	66.8

**Table 3. Manifestations of DNP among DNP patients. (N=55)**

Manifestation	Frequency (N=55)	Percentage (%)
Numbness in the legs or	36	65.5
Pain in the legs or feet	43	78.2
Higher touch sensitivity in legs	23	41.8
Muscle spasms in the legs or feet	32	58.2
Tingling in the legs or feet	38	69.1
Pain on touching the bed sheets	11	20.0
Undifferentiation between hot and cold-water bathroom	8	14.5

Open ulcer on the feet	15	27.3
Weakness of the limbs	39	70.9
Symptoms are worse at night	34	61.8
Inability to feel the feet while walking	47	85.5
Dryness and cracking of the skin of the feet	29	52.7
Leg amputation	6	10.9

Fasting blood glucose level	Irregularly	21	34	55	0.001
		38.2%	22.2%	26.4%	
	No physical exercise	28	111	139	
		50.9%	72.5%	66.8%	
	High	26	34	60	
		47.3%	22.2%	28.8%	
Normal	29	119	148		
		52.7%	77.8%	71.2%	

**Table 4. Relation between DNP and other factors**

		Diabetic neuropathy		Total (N=208)	P-value
		Yes (N=55)	No (N=153)		
Gender	Male	21	61	82	0.479
		38.2%	39.9%	39.4%	
	Female	34	92	126	
		61.8%	60.1%	60.6%	
Age group	18 years or younger	1	4	5	0.790
		1.8%	2.6%	2.4%	
	19 – 40 years	19	50	69	
		34.5%	32.7%	33.2%	
	41 – 60 years	18	60	78	
	32.7%	39.2%	37.5%		
	More than 60 years	17	39	56	
		30.9%	25.5%	26.9%	
BMI group	Low weight	1	6	7	0.001
		1.8%	3.9%	3.4%	
	Normal	30	27	57	
		54.5%	17.6%	27.4%	
	Overweight	11	64	75	
	20.0%	41.8%	36.1%		
	Obese	13	56	69	
		23.6%	36.6%	33.2%	
Smoking status	Current smoker	7	18	25	0.509
		12.7%	11.8%	12.0%	
	Non-smoker	48	135	183	
		87.3%	88.2%	88.0%	
Chronic hypertension	Yes	17	27	44	0.033
		30.9%	17.6%	21.2%	
	No	38	126	164	
		69.1%	82.4%	78.8%	
Period of DM	Less than 5 years	13	42	55	0.038
		23.6%	27.5%	26.4%	
	5 – 10 years	16	67	83	
		29.1%	43.8%	39.9%	
More than 10 years	26	44	70		
	47.3%	28.8%	33.7%		
Compliance to treatment	Yes	35	123	158	0.012
		63.6%	80.4%	76.0%	
	No	20	30	50	
		36.4%	19.6%	24.0%	
Type of DM treatment	Oral pills	29	99	128	0.012
		52.7%	64.7%	61.5%	
	Insulin injection	13	29	42	
		23.6%	19.0%	20.2%	
	Both	9	6	15	
	16.4%	3.9%	7.2%		
Only dietary changes	4	19	23		
		7.3%	12.4%	11.1%	
Physical exercise	Regularly	6	8	14	0.013
		10.9%	5.2%	6.7%	

**DISCUSSION**

Owing to dramatic shifts in lifestyle and diet in recent decades, Saudi Arabia (SA) ranked 7th-largest adult diabetes (24.0 percent) in the world by 2011[18]. Previous literature estimates that 50 to 66 percent of DM patients would ultimately experience PN at some points in their lifespan. This cross-sectional study assessed the prevalence of diabetic neuropathy and its associated risk factors in patients with diabetes mellitus attending the diabetes center in Arar, Saudi Arabia.

Real prevalence is not documented, and estimates range from 10% to 90% in diabetic patients, based on the parameters and methods used to describe neuropathy[19]. In our study; the reported prevalence of DNP was 26.4%.

In a previous study; 25% of patients attending a diabetes clinic volunteered symptoms (50% of them have neuropathy) [20]. This was higher than the findings of a Saudi study, which reported a prevalence of 19.9% [21] and was higher than a worldwide estimate of DPN prevalence among diabetics (8.1% – 12.2%) [22]. In Saudi Arabia, a prevalence of 65.3% has been previously reported for painful DPN in a nationally representative diabetic population [23]. Another study in KSA showed a prevalence of only 2.5% [24]. This was much lower than another study in KSA that reported an overall prevalence of 29.1% [25]. A higher prevalence rate was reported in KSA with the overall prevalence of PDPN among the study participants being 34.71% [26]. A study in Qassim, KSA reported a prevalence of diabetic neuropathy to be 38.2% [27]. Our population had a higher compliance level of 76% than lower compliance (2.9%) reported in another region in KSA [27]. The prevalence rates of painful DPN in Middle East were 61.3%, 57.5%, 53.9%, and 37.1% for Egyptian, Jordanian, Lebanese, and Gulf States populations, respectively [28]. In the USA, the reported prevalence was 28.5% [29].

Regarding the symptoms of DNP, the most common symptoms were 65.5% numbness in the legs or feet, 78.2% pain in feet or legs, 58.2% muscles spasm in legs or feet, 69.1% tingling sensation in the legs or feet, 78.2% leg pain while walking, 85.5% inability to feel the feet while walking and 621.8% reported symptoms worsening at night. This was higher than that of another Saudi study, which reported symptoms as tingling (26.7%), hypoaesthesia to touch (23.3%), and pins and needles (23%)



[25]. Common symptoms reported in the prevalence sample in another previous Saudi study were “burning pain in legs and/or feet” (91.7%), “prickling feelings in legs or feet,” (79.8%), and “symptoms worsening at night” (63.1%) [26].

In our study, there was a significant and positive association between DNP and duration of diabetes, fasting blood glucose level, compliance with treatment, hypertension, and BMI index group. There was no correlation between DNP and age, sex, muscular exercise, and smoking status. This was on the line with results of another study reported that; participants with a diabetes duration of >20 years presented a 12.19-fold odds of DPN when compared with those with a diabetes duration of 2–5 years but they suggested that abdominal obesity had a significant and independent correlation with DPN, whereas general obesity (BMI  $\geq 30$  kg/m<sup>2</sup>) was not significant after multivariate adjustment [21]. Another study found that the prevalence of DPN significantly increased with increased in the age and all the age groups had a higher prevalence of DPN compared to the age group of 18–25 years ( $P < 0.05$ ) and the prevalence of DPN significantly increased with increase in the duration of DM ( $P < 0.05$ ). They also found that patients with uncontrolled A1C had a higher prevalence of DPN (39.4%) compared to patients with controlled A1C (14.9%) [13]. In a study conducted in the KSA, the prevalence of PDPN was significantly associated with glycemic control, as we observed that a higher level of HbA1c and poor compliance with treatments was significantly associated with higher odds of PDPN. They also observed no significant association between PDPN and gender, BMI, and smoking status, which supported the results of some studies [21].

In the results of another study, the odds ratio of PDN significantly increased in patients who had diabetes for more than 10 years, hypertension, and cardiovascular disease; it significantly decreases with glycemic control. HbA1c was positively associated with PDN; better glycemic control, hypertension as a co-existing disease was prevalent in this study population, but more significantly prevalent in PDN (73.7%) than in non-PDN patients (50.55) [30]. Another study of 136 diabetes patients, found that duration, insulin use, and glycemic control were the most important risk factors associated with diabetic neuropathy [31].

## CONCLUSION AND RECOMMENDATIONS

In our study, DNP was reported in 26.4% of the studied DM patients. DNP showed a statistically significant relation with BMI group, chronic hypertension, the period of DM, compliance with DM treatment, type of DM treatment, physical exercise, and fasting blood glucose level. On the other hand, DNP showed a statistically

insignificant relation with gender, age group, and smoking. So, health education for diabetic patients is necessary to guard against non-adherence to diabetes treatment and the necessity of muscular exercise. Large-scale national researches are needed to include all diabetic patients in Saudi Arabia.

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