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Frequency and risk factors of abnormal nerve conduction studies in accidentally diagnosed diabetes

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Abstract

Background Diabetic peripheral neuropathy (DPN) is one of the major diabetic complication and affects quality of life (QoL).This study aims at assessing the frequency of DPN among accidentally diagnosed diabetic patients, identifying risk factors linked to DPN in those patients, and determine the potential effect on QoL.

Results According to nerve conduction study (NCS), 32 patients (44.4%) had polyneuropathy. Polyneuropathy is significantly associated with older age, higher hip and waist measurements, higher weight, and body mass index (BMI).

About 53% of patients with polyneuropathy were current smokers versus 25% of non-smokers. Longer duration since the first diagnosis, higher fasting blood sugar (FBG), 2-h post-prandial (2-hPP) glucose, and HbA1c are also associated with peripheral neuropathy (PN) ($p < 0.001$). Being on insulin was associated with PN ($p = 0.002$). Increasing BMI, current smoking, and increased HbA1c significantly increase the risk of PN by 1.314, 19.963, and 3.302-folds, respectively. An unhealthy diet is also associated with PN.Hyperlipidemia was also associated with PN ($p = 0.028$). A significant positive association was found between DQoL scores and symptom scores.

Conclusion A significant proportion of type 2 diabetic patients had DPN at the time of diagnosis, which adversely affects QoL. At the time of diagnosis, it is highly suggested that proper screening. procedures be used for DPN. Obesity, smoking, and elevated HbA1c significantly increase the risk of DPN.

Keywords Diabetic peripheral neuropathy (DPN), Quality of life (QoL), Nerve conduction studies (NCS), Peripheral neuropathy (PN)

Background

Diabetic peripheral neuropathy (DPN), a major diabetic complication, affects QoL. About 30 to 50% of diabetic patients develop DPN [1, 2].

DPN leads to foot ulceration with lower extremity amputations, functional limitations, and frequent hospitalizations [2–4]. The lower limb or part is lost worldwide as a result of diabetes every 30 s [5]. Foot ulceration annual incidence has increased roughly tenfold in the presence of neuropathy [6].

DPN is considered a significant cause of mortality and morbidity due to two crucial clinical effects, diabetic foot ulcer and neuropathic pain [7, 8]. One-fourth of individuals with type 2 diabetes are already complex at first diagnosis [9]. Half of the DPN cases are asymptomatic [10]. In the same line, about 8% of newly diagnosed cases as well as 50% of cases with the longstanding disease, have DPN [11]. DPN's major frequent risk factors include increasing

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patients' age, longer disease duration, smoking, as well as poor glycemic control [12, 13].

Diabetic peripheral neuropathic pain is regarded as one of the most psychologically burdensome diabetic symptoms and might substantially impact QoL, notably social and psychological well-being and physical illness [2]. Hence, early screening for DPN is critical. DPN screening successfully identifies patients more prone to developing diabetic foot ulcers [14]. There are many clinical scores, including the score of diabetic neuropathy symptom (DNS), neuropathy disabilities, as well as diabetic neuropathy examination scores, to assess DPN. The NCS is considered the gold standard diagnostic DPN test [15]. NCS assesses motor functions (conduction velocity, onset latency, and amplitude) of the median tibial, ulnar, and perineal nerves as well as sensory functions of the median sural and ulnar nerves (onset latency). The other motor response is the F waves evoked by the activation of the antidromic of motor neurons due to peripheral stimulation of motor axons [16].

Methods

Aim of the study

This study aims at assessing the frequency of DPN among accidentally diagnosed diabetic patients, identifying risk factors linked to DPN in those patients, and determine the potential effect on QoL.

Study design and setting

This was a cross-sectional study that performed at the outpatient clinics of Ain Shams University Hospitals. It included convenience sample from an accidentally diagnosed diabetic patients that recruited from the outpatient clinics along 4 months (from June 2022.to September 2022).

Participants

This study included 72 accidentally diagnosed diabetic patients attended to our hospitals' outpatient clinics. Before enrollment, all participants were instructed about study objectives, in addition to providing written consent. An ethical approval was obtained from the Research Ethical Committee. Diagnosis of diabetes was made according to the American Diabetes Association (2022) criteria [17].

Subjects were enrolled to do an NCS two to thirty weeks after diagnosis was confirmed and after obtaining informed consent. The patients were sent to the NCS unit at the same hospital, where they underwent nerve conduction studies.

The inclusion criteria in this study were any accidentally diagnosed type 2 DM older than 25 years.

Exclusion criteria included known diabetes, known peripheral neuropathy, autoimmune diseases, history of malignancy, active infection, severe uncontrolled medical illness, and patients on alcohol or drug abuse, patient who used drugs may cause PN as antiepileptic drugs, colchicine, some antihypertensive drugs, or using hormonal therapy were excluded from the study.

All patients underwent the following:

1 Full medical history taking with particular concern about onset and disease duration and drug history, level of education and type of profession, any chronic disease as hypertension, liver, or kidney disease.
2 Clinical assessment including general and neurological examination, BMI, and waist and hip circumference.
3 Arabic version of the Diabetes Quality of Life questionnaire (DQoL) questionnaire to assess Quality of Life (QoL): this was used to measure QoL among studied patients. It comprised 29-items categorized into three factors: worries (Cronbach's $\alpha = 0.88$), impact (Cronbach's $\alpha = 0.94$) and satisfaction (Cronbach's $\alpha = 0.97$). Different variables were linked with DQoL scores: diabetic complications, low-income status, marital status, and insulin administration. Pearson's correlation test was utilized for testing test–retest reliability, and all the items demonstrated a correlation > 0.8, denoting good test–retest reliability, whereas higher scores meant lower QoL [18].
4 DNS was used to assess the presence of DPN: it is a simplified scoring system and specific scoring for DPN investigating the presence of tingling, numbness, pain, and ataxia. The maximum score of DNS is four points. A score of one or more points denotes neurological issues [19] (Table 1).
5 Laboratory investigation: 3-cm blood sample was withdrawn to assess (fasting blood sugar), 2-h postprandial blood glucose, HbA1C, and lipid profile.
6 NCS.

Table 1 DNS score items

	Score
Unsteadiness in walking	0 = absent, 1 = present
Numbness	0 = absent, 1 = present
Burning, aching pain or tenderness in legs or feet	0 = absent, 1 = present
Prickling sensations	0 = absent, 1 = present
DNS ≥ 1 defines PN.	

DNS Diabetic neuropathy symptom score, *PN* Peripheral neuropathy

Nerve conduction studies

This was conducted using electromyography instrument (Natus Neurology-Schwarze Dantec™ DELTAMED, The Schwarzer topas Trolly EMG system; EMG/NCV/EP system topas 230/240 V, Natus Europ GmbH, Germany): NCS involves the stimulation of nerves of both upper and lower limbs.

Surface electrodes were used to deliver and detect electric responses. Most subjects described its electric impulse as a tapping or tingling sensation. Subjects should avoid the application of topical creams prior to the NCS. No fasting is required, and the subject can return to his normal activities after the study. The test is well tolerated as well as safe, inducing slight discomfort and having no long-term negative effects. The NCS was done in an outpatient room setting. It took between 40 min and an hour. NCS is often utilized for evaluating sensory and motor nerve functions in both limbs. The study included the evaluation of the motor and sensory fibers of upper extremity ulnar and median nerves as well as the tibial and peroneal nerves' motor and *sensory* fibers in lower extremities (including sural and superficial peroneal sensory nerves). The recording was obtained from the muscle supplied by the nerve distal to the stimulation site with two surface electrodes: an active electrode over the muscle belly as well as a reference electrode over the muscle tendon. Compound muscle action potential for motor nerves was created due to activated muscle fiber summation. Similarly, a propagated sensory nerve action potential was also obtained using antidromic method.

The parameters which were obtained as well as utilized for interpretation include (A) latency (ms) from stimulus to the onset of the evoked response, (B) amplitude (mv) from baseline to peak denotes the number of conducting fibers, decreasing axonal loss, (C) conduction velocity (m/s) determined by dividing the distance between stimulation and recording endpoints by delay. It indicates myelin sheath required integrity for impulse transmission and inhibits demyelination of nerves, (D) late responses were made to evaluate the peripheral nervous system's proximal segments, including the nerve as well as plexus roots, and this includes (F) wave for median, ulnar, and tibial nerves as well as the soleus H reflex [20, 21].

Electrophysiologic criteria for chronic polyneuropathy

Demonstrate at least three of the following in motor nerves:

Prolonged distal latency (DL) (two or more nerves, not at entrapment sites), DL > 130% upper limit of normal (ULN).

Conduction velocity slowing (CV) (two or more nerves, not across entrapment sites), CV < 75% lower limit of normal.

Prolonged late responses: F response and H reflexes (one or more nerves), > 130% ULN (Note: If distal compound muscle action potential (CMAP) amplitude is very low, absent F waves may not beabnormal).

Conduction block/temporal dispersion (one ormore nerves). Unequivocal conduction block: Proximal/distal CMAP area ratio< 0.50. Possible conduction block: proximal/distal CMAP amplitude ratio< 0.70. Temporal dispersion: proximal/distal CMAP duration ratio > 1.15 [22].

Statistical analysis

The collected data were analyzed using the 28th version of the SPSS software IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp. Standard deviations, as well as means, were utilized for describing quantitative variables, whereas categorical variables were described using their absolute frequencies and compared utilizing the chi-square test. The chi-square for trend test was utilized for ordinal binary data. Levene (homogeneity of variances), as well as Kolmogorov–Smirnov (distribution-type) tests, were utilized for verifying assumptions for parametric tests. In order to compare quantitative data between two groups, the independent sample *t* test (for normally distributed data) and Mann–Whitney test (for not normally distributed data) were utilized. The Spearman rank correlation coefficient was utilized to measure the association strength between two continuous, not normally distributed variables. Binary logistic regression analysis was performed to calculate the odds that certain risk factors can produce particular health problems. The level of statistical significance was set at $p \leq 0.05$. A highly significant difference was present if $P \leq 0.001$.

Results

This study was applied on 72 patients who had been accidentally diagnosed as having type 2 diabetes during routine screening with time passed since diagnosis ranged from 2 to 30 weeks.

According to NCS, 32 patients (44.4%) had polyneuropathy. Concerning types, about 41% of them had sensory, motor, and demyelinating neuropathy. Sensory, motor, axonal, and demyelinating PN prevailed in 15.3% of patients. While 21.9% had sensory, demyelinating type (Fig. 1 and Table 2).

Concerning lifestyles, 37.5% stated they are current smokers, and 80.6% stick to an unhealthy diet. Of the

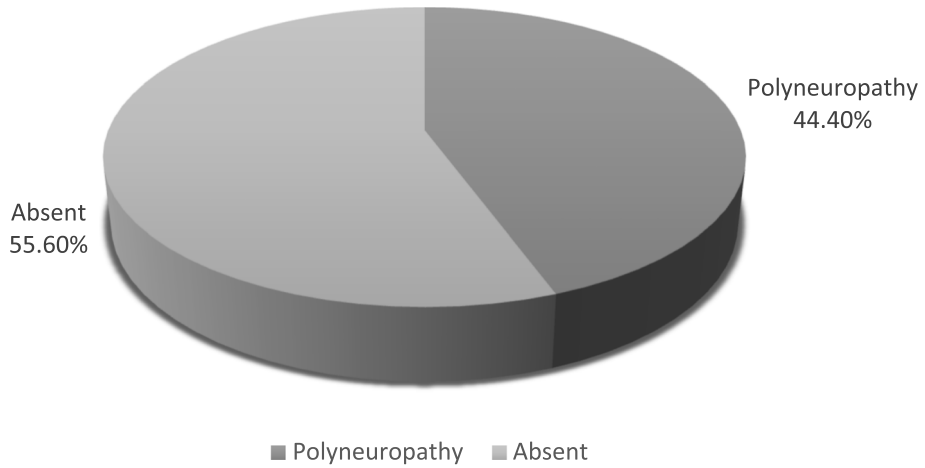

Fig. 1 Distribution of patients according to presence of polyneuropathy

studied patients, one-third had comorbid hypertension, and 25% were dyslipidemic. More significant percentages of patients were on oral hypoglycemic drugs. When the patients were asked torate their symptoms, 47.2% were asymptomatic, while 2.8% reported their symptoms to have a score of 4 (Table 3). On examination, mean BMI, waist, and hip circumferences are 30.8 kg/m^2, 107.99 cm, and 104.76 cm, respectively. Mean fasting, 2-h post-prandial blood glucose and HbA1c are 140.14 mg/dl, 248.6 mg/dl, and 7.64% (Table 3).

About 63% were males aged from 34 to 69, with a mean of 51.13. About 21% of them received high education, and 15% of them worked as professional or semi-professional (Table 3).

There is a statistically remarkable association between the presence of polyneuropathy and all of age, smoking, weight, BMI, waist circumference, hip circumference, type of diet, drug used, time since diagnosis, 2-h post-prandial glucose, HbA1c, fasting blood glucose, hyperlipidemia, and score.

Polyneuropathy is significantly associated with older age, higher weight, body mass index, and waist and hip circumferences. About 53% of patients with polyneuropathy are current smokers versus 25% are non-smokers. An unhealthy diet is also associated with PN (93.8% versus 70% among those with and without PN, respectively). Hyperlipidemia is also associated with PN ($p=0.028$) (Table 4). Longer duration since the first diagnosis, higher FBG, 2-hPP glucose, and HbA1c is also associated with PN ($p<0.001$). Concerning the type of therapy, being on insulin is associated with PN ($p=0.002$) (Table 4).

There is a statistically marked association between symptoms scores and the presence of PN (those with no symptoms represented 80% of patients without PN). All those who reported scores of 3 to 4 had already been diagnosed with PN (Table 4). There is a statistically insignificant correlation between polyneuropathy and either gender, height, education, occupation, or presence of comorbid hypertension (Table 4).

Multivariate analysis of risk factors of PN showed that increasing BMI, current smoking, and increased HbA1c significantly increase the risk of PN by 1.314, 19.963, and 3.302 folds, respectively (Table 5).

Patients with DPN had non-significantly higher scores for impact on QoL and worries about DM domains ($p=0.221$ and 0.728, respectively) and significantly higher satisfaction and total scores ($p=0.01$ and 0.039, respectively) (Fig. 2). Satisfaction scores in those with DPN ranged from 14 to 65, with a median of 24.5 versus 21 (14–48) in subjects with no DPN. Median and range impact scores in those with DPN were 32.5 (5–55) versus 20.5 (5–51) in subjects without DPN. Median and range worry scores in those with DPN were 12 (6–20) versus 12 (5–20) in subjects without DPN. Median and range total scores in those with DPN were 69 (27–130) versus 55 (33–98) in subjects without DPN. There is a statistically marked positive association between DQoL scores and symptom scores (Fig. 2). There is a statistically significant positive correlation between DQoL scores and symptom scores (Table 6).

Discussion

The American Association of Diabetes recommends DPN screening in diabetic cases at the time of diagnosis and annually due to its impact on patient health, QoL, and health care costs [23]. Our study assessed the frequency and risk factors associated with PN in accidentally discovered DM.

In this study, the frequency of PN in our patients was 44.4%. In addition, the percentage of DPN prevalence

Table 2 Baseline data of the studied patients

	Mean ± SD/*n* = 72	Range %
Male gender	45	62.5%
Education:		
Illiterate	5	6.9%
Primary	8	11.1%
Preparatory	6	8.3%
Secondary	28	38.9%
Intermediate	10	13.9%
High education	15	20.8%
Occupation		
Housewife/non-working	6	8.3%
Unskilled worker	6	8.3%
Skilled worker	20	27.8%
Employee/free business	29	40.3%
Professional/semi	11	15.3%
Current smokers	27	37.5%
Unhealthy diet	58	80.6%
Hypertensive	24	33.3%
Hyperlipidemic	18	25%
Drug:		
Insulin	10	13.9%
Oral drugs	62	86.1%
Score:		
0	34	47.2%
1	16	22.2%
2	6	8.3%
3	14	19.4%
4	2	2.8%
Age (year)	51.13 ± 7.23	34–69
Height (cm)	169.08 ± 6.41	150–182
Weight (kg)	87.96 ± 12.37	63–115
BMI (kg/m^2)	30.8 ± 4.24	21.8–40.58
Hip circumference (cm)	107.99 ± 13.29	70–145
Waist circumference (cm)	104.76 ± 14.99	75–150
Fasting blood glucose (mg/dL)	140.14 ± 53.93	85–366
2-h postprandial glucose (mg/dL)	248.6 ± 69.57	110–450
HbA1c	7.64 ± 1.52	5.7–13.3
< 6.5%	7	9.7%
≥ 6.5%	65	90.3%
Time since first diagnosis (week)	11.71 ± 7.9	2–30

Quantitative data is represented as frequency and percentage while quantitative data is represented as mean ± SD

n number, *SD* standard of deviation, *BMI* body mass index, *cm* centimeter, *kg* kilogram, *kg/m^2* kilogram per meter square, *mg/dL* milligram per deciliter, *HbA1c* hemoglobin A1c

was 9.6, 10.7, 23.1, and 14.1 for Spain, France, Italy, and the UK [24]. In recent Egyptian research, DPN prevalence was 45% by symptoms and 54% by NCS [25]. In another study conducted in Alexandria, peripheral neuropathy was determined in twenty percent of the studied cases, 29.4% of known diabetic cases, and 3.3% of newly diagnosed cases ($p < 0.001$) [26]. Pan and colleagues estimated that prevalence rates were 21.92 and 35.34% in type 1 as well as type 2 diabetic cases [27].

Table 3 Distribution of the studied patients according to presence and type of polyneuropathy

	n = 72	%
Polyneuropathy	32	44.4%
Type:		
Sensory, motor, demyelinating	13	40.6%
Sensory, motor, axonal	1	3.1%
Sensory, motor, axonal, demyelinating		
Sensory demyelinating	11	15.3%
	7	21.9%

n Number

The current research reveals a substantial relationship between the presence of DPN and all of age, smoking, weight, BMI, waist circumference, hip circumference, type of diet, insulin therapy, time since diagnosis, fasting blood glucose, HbA1c, hyperlipidemia, 2-h postprandial glucose and symptom score.

Multivariate analysis revealed that higher BMI, current smoking, and higher HbA1c significantly increase the risk of DPN by 1.314, 19.963, and 3.302 folds, respectively. In multicenter studies of 12 sites in Chinese, DPN prevalence was 18.28% among known diabetic cases as well as 6.35% among newly diagnosed diabetic cases [28]. The prior study revealed that patients over 60 years, with longer diabetes duration (> 10 years), hypertension, family history of diabetes, higher triglycerides (TGs), and uncontrolled glycemic status were at risk of developing DPN [29]. DPN prevalence according to DNS was 60.5%. Multivariate analysis conveyed that dyslipidemia, longstanding diabetes, and abdominal obesity were significantly associated with DPN [30, 31]. In this research, the glycemic status substantially affected the development of DPN. Intense glycemic control must be achieved to decrease DPN risk. Patients who received insulin were more likely to experience marked impairment of glycemic control, making it crucial to prescribing insulin. Consistent with our results, Kostev and colleagues revealed that using insulin was one of the most significant DPN risk factors among newly diagnosed diabetic cases in the UK and Germany [32].

Insulin resistance can be a link between DPN as well as obesity. In addition, the status of insulin-resistant is characterized by low-grade inflammation [33, 34], affecting endothelial dysfunction [35], in addition to microvascular disorders [36]. The KORA study

Table 4 Relation between polyneuropathy and baseline data of the studied patients

Parameter	Polyneuropathy		Test	
	Present	Absent	χ^2/t	*P*
	n = 32 (44.4%)	*n* = 40 (55.6%)		
Male gender	22 (68.8%)	23 (57.5%)	0.96	0.237
Age (year)	52.93 ± 6.44	48.88 ± 7.61	2.445	**0.017***
Weight (kg)	92.47 ± 13.12	84.35 ± 10.58	2.908	**0.005***
Height (cm)	169.47 ± 7.35	168.78 ± 5.62	0.454	0.651
BMI (kg/m^2)	32.27 ± 4.69	29.62 ± 3.48	2.763	**0.004***
Waist circumference (cm)	110.22 ± 14.55	100.4 ± 14.04	2.902	**0.005***
Hip circumference (cm)	112.81 ± 12.53	104.13 ± 12.75	2.896	**0.005***
Occupation:				
Housewife	2 (6.3%)	4 (10%)		
Non-skilled worker	4 (12.5%)	2 (5%)	0.385¥	0.535
Skilled worker	10 (31.3%)	10 (25%)		
Employee/free trade	12 (37.5%)	17 (42.5%)		
Semi/professional	4 (12.5%)	7 (17.5%)		
Education:				
Illiterate	3 (9.4%)	2 (5%)		
Basic education	5 (15.6%)	9 (22.5%)	0.314¥	0.575
Secondary education	14 (43.8%)	14 (35%)		
Middle education	6 (18.8%)	4 (10%)		
High education	4 (12.5%)	11 (27.5%)		
Current smokers	17 (53.1%)	10 (25%)	6	**0.014***
Unhealthy diet	30 (93.8%)	28 (70%)	6.402	**0.011***
Hypertension	13 (40.6%)	11 (27.5%)	1.378	0.24
Hyperlipidemia	12 (37.5%)	6 (15%)	4.8	**0.028***
Time since diagnosis (week)	14 (4–30)	8 (2–26)	− 3.854	**< 0.001****
Fasting blood glucose (mg/dL)	167.03 ± 51.18	118.63 ± 46.32	4.159	**< 0.001****
2-h postprandial (mg/dL)	286.75 ± 60.13	218.08 ± 61.54	4.753	**< 0.001****
HbA1c	8.47 ± 1.75	6.89 ± 0.87	4.379	**< 0.001****
Treatment:				
Insulin	9 (28.1%)	1 (2.5%)	9.761	**0.002***
Oral hypoglycemics	23 (71.9%)	39 (97.5%)		
Score:				
0	2 (6.3%)	22 (80%)		
1	9 (28.1%)	7 (17.5%)	41.478¥	< 0**.001****
2	5 (15.6%)	1 (2.5%)		
3	14 (43.8%)	0 (0%)		
4	2 (6.3%)	0 (0%)		

n number, χ^2 chi-square test, *t* independent sample *t* test, *P* probability value, *BMI* body mass index, *cm* centimeter, *kg* kilogram, kg/m^2 kilogram per meter square, *mg/dL* milligram per deciliter, *HbA1c* hemoglobin A1c

* $p \leq 0.05$ is statistically significant

** $p \leq 0.001$ is statistically highly significant

¥ Chi square for trend test

reported that subclinical inflammation biomarkers are linked with DPN progression [37].

Various studies stated that weight loss reduced the incidence of DPN [38]. Also, some studies showed a beneficial effect of bariatric on DPN [39]. In this study, glycemic control affects the development of DPN. Controlled patients showed a decrease in DPN. The type of treatment also influenced DPN occurrence. In agreement, several studies reported that FPG and HbA1c

Table 5 Multivariate analysis of factors significantly associated with PN among the studied patients

	β	AOR	95% CI	*P*	β
BMI	**0.273**	**1.314**	**1.085**	**1.591**	**0.005***
Current smoking	2.994	19.963	3.526	113.034	< 0.001**
HbA1c	1.194	3.302	1.452	7.508	0.004*

PN peripheral neuropathy, *B* beta coefficient, *AOR* adjusted odds ratio, *CI* confidence interval, *P* probability value, *BMI* body mass index, *HbA1c* hemoglobin A1c

* $p \leq 0.05$ is statistically significant

** $p \leq 0.001$ is statistically highly significant

variability are markedly associated with diabetic neuropathy in type 2 diabetes [40].

Increased HbA1c levels are linked to deteriorated wound healing. In addition, HbA1c is a good indicator for healing foot ulcers in diabetic cases [41, 42]. Also, HbA1c, < 7%, is linked to a 60% decline in the occurrence of DPN [43]. Uncontrolled DM is a significant factor that leads to axonal degeneration in diabetes patients [44]. Dyslipidemia is another DPN risk factor. Furthermore, studies have revealed that increased TGs levels and low/high levels of density lipoprotein cholesterol (HDL-C) are linked to DPN in diabetic patients [45, 46].

Studies reported a positive correlation between increased serum TC levels and DPN [47, 48]. Statins and fibrate were associated with a decline in the incidence of DPN [49, 50]. On the contrary, the US reported that peripheral neuropathy was significantly higher among statin users than non-users [51].

Elevated glycated lipoproteins, as well as serum-free fatty acids, contribute to the DPN development as well as progression [47]. Smoking is accompanied by systemic inflammation, endothelial dysfunction, and oxidative stress [52, 53], which elevate the risk of nerve damage. Smoking may directly induce DPN via hypoxia and microvascular affection.

DPN cases had significantly higher scores for the satisfaction domain and overall scores of QoL and non-significantly higher impact and worries scores, indicating that the presence of DPN impairs satisfaction domains which in turn derives patients from abandoning compliance to lifestyle, exercise, and management plans, impairing glycemic control and elevates DPN-related risks. Patients with DPN had significantly higher scores (impaired QoL), which is consistent with the findings of prior studies [54].

Limitation of the study

The study had some limitations such as being cross sectional study provides only association not precise casual relationship, relatively small sample size and that we included accidentally diagnosed patients so we can not

Table 6 Correlation between DQoL scores and symptoms score among patients with DPN

	R	*P*
Satisfaction score	**0.527**	**0.002***
Impact score	0.384	0.03*
Worries score	0.438	0.012*
Total score	0.611	< 0.001**

DQoL Diabetic Quality of Life, *DPN* Diabetic peripheral neuropathy, *r* Spearman rank correlation coefficient, *P* Probability value

* $p \leq 0.05$ is statistically significant

** $p \leq 0.001$ is statistically highly significant

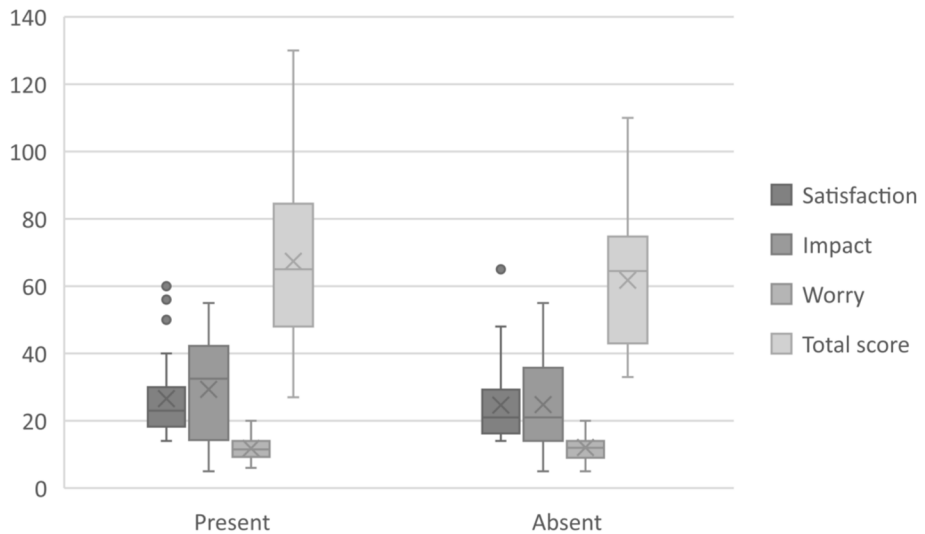

Fig. 2 Relation between polyneuropathy and HRQoL of the studied patients

accurately assess disease duration. So, we recommend doing large-scale prospective multi-center studies including pre-diabetic patients which can be followed up till development of disease so we can establish relationship.

Conclusion

This study reveals that a large proportion of type 2 DM patients with DPN at the time of diagnosis adversely impact health-related QoL. Good glycemic control, normal lipid profile, normal BMI, and smoking cessation can decrease such risk. In addition, proper screening strategies are recommended for patients with diabetes at the time of diagnosis, starting with diabetic DNS, which can be applied in primary health care units and Family health units. Those with higher scores can be referred for further NCS to confirm the diagnosis. Strict adherence to therapy and lifestyle modifications should be evaluated at each visit to the Family Health Unit to prevent further complications.

Abbreviations

BMI	Body mass index
CMAP	Compound muscle action potential
CV	Conduction velocity
DL	Distal latency
DM	Diabetes mellitus
DNS	Diabetic neuropathy symptom
DQoL	Diabetic quality of life
DPN	Diabetic peripheral neuropathy
FBS	Fasting blood sugar
LLN	Lower limit of normal
NCS	Nerve conduction studies
2-hpp	Two hour post-prandial
HbA1c	Hemoglobin A1c
HDL-C	High levels of density lipoprotein cholesterol
PN	Peripheral neuropathy
QoL	Quality of life
TG	Triglycerides
ULN	Upper limit of normal

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Authors' contributions

MM recruited patients, performed nerve conduction studies, and generated the result sheets. AM underwent data tabulation and statistical analysis, and interpreted the patient's data and wrote the final results. MMM recruited patients, carried out clinical examination and assessment, and revised data interpretation and manuscript. AR was the major contributor in writing and editing the manuscript and shared in patient's recruitment and clinical assessment. SM designed the protocol, carried out the ethical approval, and data collection. All authors have agreed to conditions noted on the Authorship Agreement Form and have read and approved the final version submitted. The content of the manuscript has not been published or submitted for publication elsewhere. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analyzed during this study are not publicly available due to patients' privacy, but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

All procedures performed in the study were in accordance with the ethical standards of the faculty of medicine, Ain Shams university research and ethical committee. We obtained approval from Research Ethics Committee (REC) No. FWA 000017585. FMASU R 83/2022, On 26/5/2022. Written informed consent was obtained from participants for participation in this study.
The FMASU REC is organized and operated according to guidelines of the International Council on Harmonization (ICH) and the Islamic Organization of Medical Sciences (IOMS), the United States Office for Human research Protections and the United States Code of Feral Regulations and operates under Federal Wide Assurance No. FWA 000017585.

Consent for publication

All patients included in this research gave written informed consent to publish the data contained within this study**.**

Competing interests

The authors declare that they have no competing interests concerning this article.

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