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Psychological Aspects of Patients with Diabetic Neuropathic Foot

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ABSTRACT

Background: Diabetic foot complications disturb the daily life of patients including changes in sleep pattern, impaired mobility, and interference with certain aspects of life such as sexuality, feelings of loneliness, powerlessness, anxiety and depression. While research into biology of the diabetic foot (DF) is making great strides, the psychology of patient experience with diabetic foot remains a somewhat underappreciated topic.

Objective: The aim of the present study is to evaluate the impact of DF on the psychological aspects of the patients, and compare such findings to patients with diabetes but no DF complications.

Patients and methods: The study was a cross-sectional comparative study that included 186 patients attending at the diabetic clinic and diabetic foot clinic at Specialized Medical Hospital, Mansoura University, from June 2020 to May 2021. The participants were divided into 93 diabetic patients with diabetic neuropathic foot complications as *Group I* and 93 diabetic patients without diabetic neuropathic foot complications as *Group II*.

Results: There was a non-statistically significant difference between studied groups as regard insomnia severity scale. There was a statistically significant association between insomnia severity scale and neuropathic foot complications as regard deformity and diabetic foot ulcer (DFU). Among cases with severe insomnia severity scale; 50% have deformity and 75% DFU. **Conclusion:** Diabetic neuropathic foot complications has an impact on psychological aspects of patients. The prevention of diabetes-related complications is important to improve patient's Health-related quality of life (HRQOL) which is an important outcome measurement from the patient's perspective relating to the impact of the disease.

Keywords: HRQOL, Psychological Aspects, Foot complications, Diabetic Neuropathic Foot.

INTRODUCTION

"The presence of symptoms and/or evidence of peripheral nerve damage in patients with diabetes following the exclusion of alternative causes" is the definition of diabetic peripheral neuropathy. In the USA, it is estimated that 28% of persons with diabetes have peripheral neuropathy [(1)].

A person with diabetes mellitus, whether they have it now or have had it in the past, has diabetic foot if there is infection, ulceration, or tissue deterioration in their feet. It is typically accompanied by neuropathy and/or PAD in the lower leg [(2)].

Both the patient and the healthcare system are heavily burdened by diabetic foot disease. In 2035, it is anticipated that over 600 million individuals globally would have diabetes [(3)]. Diabetes-related foot ulcers interfere with patients' daily lives, including changes in sleep patterns, mobility issues, and problems with their sexuality as well as emotions of loneliness, helplessness, worry, and melancholy [(4)]. Additionally, physically demanding regimens that use offloading techniques for the lower limbs may lead to an increase in psychological stress [(5)]. Compared to the general population, diabetic individuals are around twice as likely to experience anxiety and sadness [(6)]. On the other hand, depression is a significant risk factor for diabetic patients' hospital hospitalizations [(7)], and outpatient presentations with issues connected to their diabetes [(8)]. Depression and anxiety are more common in diabetic foot patients than in diabetics without foot issues [(9)]. When compared to people without type 2 diabetes, depression is twice as likely to be linked to amputation. Additionally, it is linked to a two-fold rise in mortality over five years among people with their first diabetic foot ulcer [(10)]. The present study aimed to evaluate the impact of diabetic neuropathic foot complications on the psychological aspects of the patients, and compare such findings to diabetics without neuropathic foot complications.

PATIENTS AND METHODS

This was a cross-sectional comparative study that was carried out on 186 patients divided into two groups; Group 1: Diabetic patients with neuropathic foot complications, and Group 2: Diabetic patients without neuropathic foot complications.

Selection of sample:

Group 1: The group consisted of 93 Egyptian diabetic patients with neuropathic foot complications attending at diabetic foot clinic, Mansoura Specialized Hospital, Mansoura University.

Group 2: The group consisted of 93 Egyptian diabetic patients without neuropathic foot complications attending at diabetic clinic, Mansoura Specialized Hospital, Mansoura University. They were selected to be matched to the patient group as regards the age, sex and other demographic variables.

Patients were recruited over 12 months, starting from June 2020 to May 2021.

Inclusion criteria: The study included Egyptian patients with the following criteria: (1) Age from 18 to 65 years. (2) Sex: both males and females.

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Exclusion: (1) Patients with previous psychiatric illness. (2) Cases having organ failure (hepatic, renal, cardiac).

Sample size: Sample size was calculated using Medcalc 15.8. The primary outcome of interest is the prevalence of depression.. Previous studies revealed that the prevalence of depression in both diabetic patients with and without diabetic neuropathic foot complications are 39.6% and 17.3%; respectively **Ahmad *et al.* [(11)]** and **Wafa & El-Hadidy[(12)]**, with alpha error of 5%, study power of 90%, then the sample size is 93 in each group. The target significance level is 0.05.

Methods:

I) History taking: Name, age, gender and occupation, education, physical activity, residency, special habits (smoking, alcohol, addiction), and diabetes mellitus (duration, microvascular and macrovascular complications.

II) Neuropathy assessment: Neuropathy in group one was assessed using Diabetic Neuropathy Symptom score (DNS score) and monofilament test.

Diabetic Neuropathy Symptom score [(13)]: All participants were questioned as regards the presence of symptoms, either positive or negative, suggesting the presence of neuropathy. The questions were answered with a 'yes' (positive: one point) if a symptom had occurred several times a week during the last 2 weeks, or with a 'no' (negative: no point) if it did not. The patients were questioned as regards the presence of following symptoms: (1) Symptoms of unsteadiness when walking. (2) Burning, aching pain, or tenderness in legs or feet. (3) Pricking sensations on legs and feet. (4) Regions of numbness on legs or feet. [Maximum score: 4 points; 0 points, polyneuropathy].

Neuropathic patients were fatherly subdivided into; (1) Painful diabetic neuropathy which included 23 patients out of 93 and (2) Non painful diabetic neuropathy which included 70 patients out of 93.

III) Psychometric assessment: All patients were assessed for (1) Insomnia severity using Insomnia Severity Index, (2) Presence of anxiety and depression using Hospital Anxiety and Depression Scale (HADS), (3) Quality of life using The World Health Organization Quality of Life: Brief Version (WHOQOL-BREF), and (4) Screening for psychiatric illnesses using Mini-international Neuropsychiatric interview (MINI scale).

Ethical consideration:

Study protocol was submitted for approval by IRB (Mansoura University). Approval of the managers of Mansoura Specialized Hospital was obtained. Every patient signed an informed written consent for acceptance of participation in the study. Confidentiality and personal privacy was respected in all levels of the study. Collected data will not be used for any other purpose. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis:

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi-square test ($\chi 2$) was used to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P-value <0.05 was considered significant.

RESULTS

Table 1 shows no statically significant differences of age, sex, residence and smoking history between studied groups. Diabetic disease duration more than or equal to 5 years is more among neuropathic group (71%) than non-neuropathic group (50.5%).

Table (1): Socio-demographic characteristics of the studied cases

Variable	Neuropathic group (N=93)	Non-neuropathic group (N=93)	Test of significance
Age/years Mean ± SD	55.43 ± 7.24	53.02 ± 9.58	t=1.93 p=0.06
Sex			
Male	36 (38.7)	35 (37.6)	χ^2=0.023
Female	57 (61.3)	58 (62.4)	p=0.880
Residence			
Urban	31 (33.3)	35 (37.6)	χ^2=0.376
Rural	62 (66.7)	58 (62.4)	p=0.540
Smoking			
No	67 (72.0)	70 (75.3)	χ^2=0.300
Smoker	15 (16.1)	14 (15.1)	p=0.861
Ex-smoker	11 (11.8)	9 (9.7)	
DM duration (years)			
<5	27 (29.0)	46 (49.5)	χ^2=8.14
≥5	66 (71.0)	47 (50.5)	p=0.004*

t: Student t test, χ^2= Chi-Square test, * statistically significant, Parameters described as mean ± SD and number (percentage).

Table 2 shows non-statistically significant difference between studied groups as regard insomnia severity scale with 28% of neuropathic group have moderate insomnia, 9.7% subthreshold insomnia and 8.6% severe insomnia.

Table (2): Insomnia severity scale distribution among studied cases.

Insomnia severity scale	Neuropathic group (N=93)	Non-neuropathic group (N=93)	Test of significance
No	50 (53.8%)	62 (66.7%)	P=0.07
Subthreshold	9 (9.7%)	11 (11.8%)	P=0.635
Moderate	26 (28%)	15 (16.1%)	P=0.051
Severe	8 (8.6%)	5 (5.4%)	P=0.388

χ^2: Chi-Square test, FET: Fischer exact test, * statistically significant Parameters described as number (percentage).

Table 3 shows non-statistically significant difference between studied groups as regard anxiety scale. Among neuropathic group; 19.4% are borderline and 16.1% depression cases. Among non-neuropathic group; 14% are borderline and 9.7% depression cases.

Table (3): Anxiety scale distribution among studied cases.

Anxiety	Neuropathic group N=93	Non-neuropathic group N=93	Test of significance
No	60 (64.5%)	71 (76.3%)	P=0.08
Borderline	18 (19.4%)	13 (14%)	P=0.325
Case	15 (16.1%)	9 (9.7%)	P=0.189

χ^2: Chi-Square test, FET: Fischer exact test, * Parameters described as number (percentage).

Table 4 illustrates statistically significant higher frequency of high physical quality of life among non-neuropathic than neuropathic group (49.5% versus 31.2%, p=0.01). Higher frequency of high social quality of life among non-neuropathic than neuropathic group (66.7% versus 48.4%, p=0.01). Higher frequency of high environmental quality of life among non-neuropathic than neuropathic group (71.0% versus 49.5%, p=0.002).

Table (4): Quality of life distribution among studied cases.

Quality of life	Neuropathic group N=93	Non-neuropathic group N=93	Test of significance
Physical			
Low	30 (32.3%)	22 (23.7%)	P=0.19
Moderate	34 (36.6%)	25 (26.9%)	P=0.156
High	29 (31.2%)	46 (49.5%)	P=0.01*
Social			
Low	20 (21.5%)	12 (12.9%)	P=0.120
Moderate	28 (30.1%)	19 (20.4%)	P=0.128
High	45 (48.4%)	62 (66.7%)	P=0.01*
Environmental			
Low	23 (24.7%)	9 (9.6%)	P=0.006*
Moderate	24 (25.8%)	18 (19.4%)	P=0.292
High	46 (49.5%)	66 (71%)	P=0.002*
Psychological			
Low	25 (26.9%)	19 (20.4%)	P=0.30
Moderate	25 (26.9%)	22 (23.7%)	P=0.612
High	43 (46.2%)	52 (55.9%)	P=0.186

χ^2: Chi-Square test, FET: Fischer exact test, * statistically significant Parameters described as number (percentage).

Table 5 demonstrates statistically significant higher frequency of major depression by MINI scale among neuropathic than non-neuropathic group 25.8% versus 14% (p=0.04).

Table (5): MINI scale distribution among studied cases.

MINI	Neuropathic group (N=93)	Non-neuropathic group (N=93)	Test of significance
No	63 (67.7%)	74 (79.6%)	P=0.07
Social anxiety	1 (1.1%)	2 (2.2%)	P=0.56
Panic disorder	1 (1.1%)	1 (1.1%)	P=1.0
Manic disorder	0 (0%)	1 (1.1%)	P=1.0
Major depression	24 (25.8%)	13 (14%)	P=0.04*
Generalized anxiety disorder (GAD)	4 (4.3%)	1 (1.1%)	P=0.17
Dysthymia	0 (0%)	1 (1.1%)	P=1.0

χ^2: Chi-Square test, FET: Fischer exact test, * statistically significant Parameters described as number (percentage).

Table 6 shows non-statistically significant association is detected between depression scale and neuropathic foot complications (p>0.05).

Table (6): Relation between depression scale and neuropathic foot complications.

Variable	Depression			P-value
	Normal	Borderline	Depressed	
Deformity	13 (27.7%)	6 (42.9%)	11 (34.4%)	0.538
Charcot joint	3 (6.4%)	3 (21.4%)	8 (25%)	0.058
DFU	22 (46.8%)	6 (42.9%)	23 (71.9%)	0.06

MC: Monte Carlo test, Parameters described as number (percentage).

Table 7 demonstrates statistically significant relation between insomnia severity scale, depression scale and presence of pain among neuropathic group.

Table (7): Relation between presence of pain and quality of life and anxiety, depression scales among studied cases.

Variable	No pain (N=70)	Pain (N=23)	Test of significance
Insomnia severity scale			
No	40 (57.1%)	10 (43.5%)	
Sub threshold	9 (12.9%)	0 (0%)	MC=10.61
Moderate	14 (20%)	12 (52.2%)	P=0.014*
Severe	7 (10%)	1 (4.3%)	
Depression			
Normal	38 (54.3%)	9 (39.1%)	MC=7.46
Borderline	13 (18.6%)	1 (4.3%)	P=0.024*
Case	19 (27.1%)	13 (56.5%)	
Anxiety			
Normal	49 (70%)	11 (47.8%)	MC=3.85
Borderline	11 (15.7%)	7 (30.4%)	P=0.146
Case	10 (14.3%)	5 (21.7%)	
Physical			
Low	19 (27.1%)	11 (47.8%)	MC=3.47
Moderate	28 (40%)	6 (26.1%)	P=0.177
High	23 (32.9%)	6 (26.1%)	
Social			
Low	13 (18.6%)	7 (30.4%)	MC=1.45
Moderate	22 (31.4%)	6 (26.1%)	P=0.485
High	35 (50%)	10 (43.5%)	
Environmental			
Low	16 (22.9)	7 (30.4)	MC=1.32
Moderate	17 (24.3)	7 (30.4)	P=0.518
High	37 (51.4)	9 (39.1)	
Psychological			
Low	17 (24.3)	8 (34.8)	MC=1.05
Moderate	19 (27.1)	6 (26.1)	P=0.591
High	34 (48.6)	9 (39.1)	
MINI			
No	51 (72.9%)	12 (52.2%)	
Social anxiety	1 (1.4%)	0 (0%)	MC=6.79
Panic disorders	0 (0%)	1 (4.3%)	P=0.147
Major depression	16 (22.9%)	8 (34.8%)	
GAD	2 (2.9%)	2 (8.7%)	

MC; Monte Carlo test.

DISCUSSION

In the current study, there were no statistically significant differences as regards the age, sex and smoking history between the studied groups. This is consistent with a study by **Fejfarová *et al.*** [14] who compared selected psychological and social characteristics between 104 diabetic patients with and 48 patients without the DF. They found the mean age between the two groups (59.1±9.9 vs 61.1±10.7, respectively) without any statistically significant difference between them, also a non-significant difference between the two groups as regards sex.

It is well known that neuropathy prevalence increase with diabetes duration and in the current study, the diabetic duration more than or equal to 5 years is more among neuropathic group (71%) than non-neuropathic group (50.5%). This come in line with **Fejfarová *et al.*** [14] who also found a statistically significant difference between the patients with DF and those without DF as regards the diabetes duration being longer in patients with DF (P <0.001). Also, **Al-Rubeaan *et al.*** [15] found that DFU and gangrene cases were significantly older than the non-affected diabetic patients at (62.97±12.70 and 63.66±12.52, respectively) which emphasis that the duration of diabetes was significantly higher in the neuropathic patients when compared with the non-affected patients. Also, **Shahi *et al.*** [16] observed positive associations for age, duration of diabetes with diabetic foot complications.

Higher sympathetic nervous activity due to dysautonomia among type-2 DM patients is likely to cause microarousals that may lead to poor sleep maintenance [17]. In addition, sleep disturbance/insomnia symptoms is thought to worsen as the number of complications from diabetes increases. Another possible reason is the greater prevalence of obstructive sleep apnea (OSA), an important cause of sleep maintenance insomnia, in type-2 DM population than in the general population [18].

The current study showed that there was a statistically significant difference between studied groups as regard depression scale by assessment of the severity of anxiety and depression in the studied groups by Hospital Anxiety Depression scale (HADS). Also, There was a statistically significant higher frequency of major depression by MINI scale among neuropathic than non-neuropathic group (25.8% versus 14%, P=0.04). Also every increase one year in diabetes duration increases risk of depression by 3.41 more times. This increase in the neuropathic group may be due to discomfort and emotional problems caused by DPN, so these should be addressed in the management of DPN in order to prevent depression. Also, the use of physically restrictive regimes as offloading measures may lead to increased psychological pressure and interfere with daily life activities.

For anxiety scale, there was non-statistical significant difference between neuropathic and non-neuropathic groups. Within neuropathic Charcot joint showed a statistically significant association with anxiety scale (p<0.05). Every increase one year in diabetes duration increases risk of anxiety by 2.89 more times with the overall % predicted is 71%.

This is consistent with **Khan *et al.*** [19] who evaluated anxiety and depression by using the HADS in patients of type 2 DM admitted in the hospital due to diabetes-related condition - diabetic foot infections/ulcers, hyperosmotic hyperglycaemic state (HHS), and hypoglycaemic coma/seizure. They found that the incidence of depression and anxiety among hospitalized patients of DM is high Also in a study conducted in Tunisia, 40% of elderly diabetics were anxious and 22% were depressed [20]. **Khuwaja *et al.*** [21] in their study reported the incidence of depression and anxiety to be 44% and 58%, respectively.

Chapman *et al.* [22] assessed the anxiety and depression in 50 patients with diabetes and Charcot complications by HADS and found that high levels of anxiety and depression scores and a high prevalence of being at risk of mental health problems were observed the diabetes patients with Charcot foot.

By evaluating the quality of life in the studied patients in the present study by WHOQOL-BREF questionnaire, we found that there was a statistically significant higher frequency of high physical social and environmental quality of life among non-neuropathic than neuropathic group (P values 0.01, 0.01 and 0.002, respectively). Better physical, social, environmental and psychological domains of quality of life were associated with lower rate of deformity, Charcot joint and DFU (P<0.05, 0.015, <0.05 and <0.05, respectively).

This is consistent with a study by **Fejfarová *et al.*** [14] who evaluated patients and control groups with WHOQOL-BREF and found that the quality of life scores differed between the DF groups and non-DF controls in the physical health domain (P <0.001) and environment domain (P <0.01) that negatively correlated with diabetes duration ($r = -0.061$; $P = 0.003$). Similar changes in quality of life shown in this study have also been described in other published studies [23,24]. This could be explained by that poor social conditions together with the chronicity of DF complications could contribute to the alteration of quality of life in the area of physical health.

Nemcová *et al.* [25] used the standardized WHOQOL BREF for assessment of the quality of life of patients with DFU and found that there were significant differences between patients in all domains of quality of life: physical, psychological, social and environmental. Also, **Aschalew *et al.*** [26] assessed the HRQOL using WHOQOL-BREF questionnaire in a total of 408 patients with DM and found that the environmental and physical domains of HRQOL scores were the lowest compared to the social and psychological domains. The result is in line with that of

a study conducted by **Genga *et al.* [27]** in terms of the sequence of domains affected by diabetes.

Quah *et al.* [28] also found that diabetic patients without diabetes-related complications had a better HRQOL in all domains except the psychological domain.

Contradictory results were obtained in the study of **Alosaimi *et al.* [29]** who evaluated patients with (cases) and without (controls) DFUs. The study tools included WHOQOL-BREF and the HAD scale for anxiety and depression. They found that there were no differences between cases and controls in individual or overall scores of WHOQOL-BREF. This was inconsistent with studies that linked anxiety and depressive symptoms with poor quality of life among patients with DFU **Pedras *et al.* [30]** and those with diabetes but without diabetic foot ulcers **[31].**

As regard painful DPN, our study showed significant relation between insomnia, depression and presence of pain among neuropathic group and this comes in line with **Bouhassira *et al.* [32], Themistocleous *et al.* [33]** and **Van Acker *et al.* [34]** who found that painful DPN was associated with lower QoL and symptoms of depression, anxiety, and poor sleep is consistent with previous studies of diabetes.

CONCLUSION

Diabetic neuropathic foot complicationshas an impact on the patient's psychological aspects. The prevention of diabetes-related complications is important to improve patient's HRQOL which is an important outcome measurement from the patient's perspective relating to the impact of the disease. Therefore, including screening for depression and anxiety as part of routine management is necessary. Finally, a further longitudinal study will be needed for understanding the associations of psychological factors of diabetic neuropathy.

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