Sleep Quality and Diabetic Peripheral Neuropathy among Patients with Type 2 Diabetes: A Cross-sectional Survey in Jordan.

Jawad Ahmad Abu-Shennar (JAWAD_0799@YAHOO.COM)
Near East University https://orcid.org/0000-0002-0505-5356
Hatice Bebis Bebis
Near East University
Nurhan Bayraktar Bayraktar
Near East University

Research

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Abstract

Objective: The aims of this study were to quantify the prevalence of DPN as was assessed by the MNSI, and to evaluate sleep quality as was assessed by the PSQI. Also, to assess the relevance of other factors to sleep quality and DPN among patients with T2DM.

Methods: A cross-sectional study was carried out at the Jordanian Ministry of Health in Amman, Jordan, during the period from the 1 st of June 2018 to the 1 st of September 2018. A total of 549 (269 male and 280 female) patients with type 2 diabetes were recruited. Data were collected using the MNSI to assess DPN a cutoff point of MNSI based on history score of ≥ 7, and physical examination based on the score of ≥ 2. While the PSQI to assess sleep quality with a cutoff point of PSQI ≥8. Participants' demographic background data were also recorded. Statistical analysis was conducted using SPSS version 20. Mean and standard deviation values were used to summarize continuous variables, and proportions were used for categorical variables. Chi-square was used to test the independent distribution of categorical variables where appropriate. Binary logistic regressions were used to examine the net effect for each of the proposed variables. A p-value of less than 0.05 was considered statistically significant.

Results: The sample comprised 269 male and 280 female T2DM patients with a mean (SD) age of 2.00 (±0.574) years. Mean (SD) BMI was 3.58 (±0.617) kg/m^2, and the mean (SD) duration of diabetes was 1.74 (±0.806) years. The prevalence of DPN based on a history score of ≥ 7 was 31.7% and 33.7% based on physical examination based on the score of ≥ 2 using MNSI. Besides, the results of the study revealed that the mean (SD) PSQI score of the study patients was 6.11(±7.01), with 32.8% who had a PSQI score ≥8. While, logistic regression analyses were conducted to identify factors independently related to DPN were marital status, working status, smoking status, diet regimen, physical activity, regularly visit treatment physicians, cardiovascular disease, dyslipidemia, retinopathy, hypertension, type of treatment (such as insulin and oral hypoglycemia agents or both), with the type of medications (such as a statin, and metformin). Also, uncontrolled diabetes, HDL-cholesterol levels, and duration of diabetes. On the other hand, multivariate logistic regression analyses were conducted to identify factors independently related to sleep quality were cardiovascular disease, dyslipidemia, retinopathy, hypertension, type of treatment (such as insulin and oral hypoglycemia agents or both), with the type of medications (such as a statin, and metformin). The study showed that subjective sleep quality and quantity, night sleep disturbance, and daytime dysfunction were the risk factors for poor glycemic control.

Conclusions and recommendations: The high prevalence of DPN and poor sleep quality and patients with T2DM in addition to unawareness and poor management of DPN require more physician and health care professionals' better management of DPN and improve sleep quality at the Jordanian Ministry of Health. Also, the results highlighted the need for intensive programs targeting early detection and prompt implementation of health education. Also, more attention is needed to prevent late-onset DPN complications, even in asymptomatic patients. Old patients with long-standing DM should be screened continuously for DPN. Moreover, the initial measures to prevent DPN and improves sleep quality include

glycemic control and implementation with modification of lifestyle and behavioral changes such as appropriate diet, exercise, and regularly visit treating physician.

Introduction

Diabetes becomes an epidemic disease in many economically increasing and newly industrialized countries, while people with diabetes are at increased risk of developing accelerated complications[1]. One of the most relevant complications is the development of diabetic peripheral neuropathy (DPN) [2]. About 60 to 70% of patients with diabetes have suffered from DPN. In addition, several risk factors are with associated development DPN such as hypertension, obesity, and poor glycemic control were more likely to develop DPN[3-4]. On the other hand, people with DPN are associated with impact on the quality of life[5-6]. Quality of sleep is an important constituent in quality of life. Poor sleep conjugates with depression, anxiety, impaired social functioning, chronic medical conditions, and mortality, which effects on those patients[5-6].

Effect of DNP similarly affects the quality of sleep (QoS) has been rarely investigated. The aims of this study were to quantify the prevalence of DPN and to evaluate sleep quality among the type 2 diabetes mellitus (T2DM) patients. Results of the study may lead to an improvement in the services offered by healthcare professionals to the patients.

Materials And Methods

This study was performed with descriptive and cross-sectional design, and conducted in 549 T2DM adult patients (≥ 18 years) who had regular follow up visits at the Jordanian Ministry of Health for at least 6 months. The study conducted in the period 1 st of June 2018 to the 1 st of September 2018 on T2DM patients attending the Jordanian Ministry of Health.

A descriptive data form was used to determine the properties of the patient population. The Michigan Neuropathy Screening Instrument (MNSI) was used to evaluate the presence of DPN[7]. MNSI is a well-known instrument used to assess DPN in patients with T2DM with a specificity of 95% and a sensitivity of 80%. The MNSI consists of two-steps program: I. History: neuropathic symptoms were assessed by a history questionnaire; consist of 15 questions "Yes or No" on foot sensation including numbness, pain, and temperature sensitivity. The score ranges from 0 to 13 points and a score that is more than or equal to seven was indicated the presence of neuropathic symptoms. II. Physical examination: was assessed by five variables (Appearance of feet, Identification of feet ulceration, The Ankle reflex, Vibration sensation perception, Semmes Weinstein Monofilament (SWM) testing). On both feet and counted the total maximum of 10 points. If the patients score ≥ 2 points from a 10 points scale on the clinical section of MNSI then he was considered to have neuropathy.

Finally, sleep quality was evaluated using Pittsburgh Sleep Quality Index (PSQI). The Arabic version of the PSQI is a 19-item self-administered questionnaire that evaluates sleep quality[8]. The 19 items comprise

seven factors: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. The total score ranges from 0 to 21, with higher scores denoting the worst sleep quality. A cut-off score of 8 was used in this study to mark poor sleepers (≥8) from good sleepers (<8). The Arabic version of the PSQI proved to be a reliable and valid instrument, with 98.3% sensitivity and 90.2% specificity.

This study was approved by the ethics committee of the Jordanian Ministry of Health and the participants. A face-to-face structured interview method was used in data collection.

The statistical analysis carried out using the Statistical Package for Social Sciences (SPSS, version 20). Descriptive statistics were obtained such as mean values for continuous and proportions for categorical variables. A t-test was used to compare the means; chi-square was used to test the independent distribution of categorical variables where appropriate. Binary logistic regression was used to identify independent predictors of DPN and sleep quality after adjusting all other potential confounders. A p-value less than 0.05 considered as statistically significant in the analysis.

Results

The study included a total of 549 T2DM participants aged between 31 to 88 years with a mean (SD) of 2.00 (±0.574). More than half of the participants were females 51%. The majority of the study participants 84% had a family history of DM. The 49% of the participants had uncontrolled HbA1c with the mean (SD) of 8.72 (±3.21). The mean duration of diabetes was 1.74 (±0.806).

Table I:

The prevalence of DPN based on history score of ≥ 7 was 31.7% and 33.7% based on physical examination based on the score of ≥ 2 using MNSI. The results of this study showed that 34.6% of patients with DPN were males and 28.9% were females with a non-significant relationship between gender and DPN (p =0.92). In the same context, 97.8% of patients with DPN were equal and more than 70 years old compared with another age group who had DPN which meant to be statistically significant (p<0.05). The majority of patients with DPN 32.3% had a family history of diabetes (p = 0.277). Duration of the diabetes was longer than the patients without DPN and this result was significant statistically (p<0.05). Among the complications of DM, nephropathy, cardiovascular disease and retinopathy rates in DPN group were significantly higher than the patients without DPN (p<0.05). The majority of patients with DPN were treated with insulin alone (93.8%) (Table I).

Study results showed that most of the participants had at least one symptom of the MNSI history questionnaire. The most frequently reported symptoms were numbness (49.4%). While the least reported symptoms were a history of one or more toes amputation which was present in 8.2% of patients.

Table II:

The global score of PSQI divided participants into good sleepers (PSQI <8) and poor sleepers (PSQI ≥8). The results of the study revealed that the mean PSQI score of the study patients was 6.11 (±7.01), with 32.8% who had a PSQI score ≥8, thus indicating poor quality of sleep. Bad sleeper rates are significantly higher in DPN group compared with the patients without DPN ($p<0.05$) (Table II). The relationship between DPN and PSQI components illustrate that subjective sleep quality, sleep duration, sleep disturbances, daytime dysfunction, and global PSQI correlated significantly with DPN ($p<0.05$). In addition, results showed a significant correlation between the duration of diabetes and poor sleep patients with diabetes duration for more than five years were found more likely to have poor sleep than those who have diabetes for four years or less.

Table III:

As shown in Table III, patients having the cardiovascular disease, retinopathy, hypertension disease were more likely to have poor sleep compared to other groups, these values were considered to be significant ($p<0.05$). Result also revealed that subjects receiving statin therapy were more likely to have poor sleep compared to those subjects not receiving statin therapy with a statistically significant ($p<0.05$). The analysis shows that subjects who are none receiving metformin therapy were less likely to have poor sleep compared to those subjects who are receiving metformin therapy, this value was statistically significant ($p=0.005$).

Discussion

Diabetic patients with DPN may experience difficulty in managing their disease. Therefore, symptoms and signs of DPN are considered one of the most important factors when counseling diabetic patients. Literature across the world indicates that diabetes is associated with DPN[9-10]. Taking actions to prevent further progression of the diabetes epidemic and its associated complications is the best solution.

This study reported a high prevalence of DPN among patients with T2DM. The results are consentient with recent studies from the Middle East Region (MER) including Iran, Saudi Arabia, Korea, United Arab Emirates (UAE) and India[4, 10-12]. A study from southern Jordan by Elrefai et al (2009) conducted to find out the prevalence of neuropathy among 229 patients with diabetic foot, which was found to be 89%. This prevalence was higher than our findings. This might be attributed to the differences in the sample selected which included complicated patients with a diabetic foot[13]. Al-Sarihin et al (2013) reported a prevalence of DPN at one hospital in Jordan to be 54.4% which was higher than present study results, which can be explained with a different social demographics data sample[14].

The results found that most of the participants involved in our study had at least one symptom of the MNSI history questionnaire. Al-Sarihin et al (2013) showed that numbness was the most frequently reported symptoms of DPN 68.3%[14]. In Iran, tingling in the lower limb was the most frequently reported symptoms of DPN [11]. Also, in United Arab Emirates numbness, prickling feeling, burning pain and pain with walking were the most prevalent symptoms of DPN[4]. Also, in Sri Lanka numbness of the feet was

the most common symptoms of DPN in cases of established DM, burning, prickling pain or tenderness in newly diagnosed diabetic patients[15].

Since quality of sleep is an important component of life quality, poor sleep may associate with depression, anxiety, impaired social functioning, chronic medical conditions, and mortality. Around 10% of people complain from one form of sleep disorders. This is particularly common in patients with DM [16]. We found that 32.8% of T2DM patients suffer from poor sleep quality. However, other studies which investigated this issue in diabetic patients reported different rates than ours. For example, Tsai et al. (2011) reported that 34.8% of Asian T2DM patients had poor sleep quality (global PSQI >8)[17]. A study done in the USA by Luyster et al. (2011) reported 55% of patients to be poor sleepers (PSQI score >5)[18]. The total PSQI mean score of our study was higher than in these studies and may be due to differences in sample size and cultural differences.

Our study significantly correlated DPN with sleep quality. This suggests that signs and symptoms of the DPN improves when sleep quality becomes better. DPN has various symptoms such as spontaneously or trigger-induced chronic pain, burning, stabbing, sharp, cold pain, and neuropathic itch[19]. It was demonstrated that cases with DPN define pain-related interference in health-related quality of life (HRQoL) and experience several adverse consequences such as depression, fear, and sleep disturbances. This association might be explained by the fact that half of the diabetic patients with signs and symptoms of the DPN may suffer from painful diabetic neuropathy and osmotic diabetic symptoms, thus affecting their sleep quality by frequently visiting the bathroom during the night[20]. Glycemic control improves when sleep quality become well. This positive relationship was documented in several previous studies[17-18]. We showed patients having cardiovascular disease, retinopathy, and hypertension had a prediction for poor sleep quality. The data in the current study are consistent with several previous trials[21-23].

Conclusion

The high prevalence of DPN and poor sleep quality among patients with T2DM and poor management of DPN require more physician and health care professionals' better management of DPN and improve sleep quality. The results highlighted the need for intensive programs targeting early detection and prompt implementation of health education. More attention is needed to prevent late-onset DPN complications, even in asymptomatic patients. Old patients with long-standing DM should be screened continuously for DPN. Moreover, the initial measures to prevent DPN and improves sleep quality include glycemic control and implementation with modification of lifestyle and behavioral changes such as appropriate diet, exercise, and regularly visit treating physician. Moreover, as a positive association between DPN and sleep quality and patients with T2DM exists, it is recommended that all healthcare parties should be knowledgeable of the importance of the quality of sleep and DPN for those patients. Consultations with the patient on this topic should be made.

Declarations

Authors' contributions

Jawad Ahmad Abu-shennar wrote, supervised and edited the manuscript. Jawad Ahmad Abu-shennar is primarily responsible for the conception and design of the study in addition to data collection. Nurhan Bayraktar reviews the manuscript. Hatice Bebis helped in developing the idea and setting the protocol. Hatice Bebis perform the statistical analysis and review the manuscript. Jawad Ahmad Abu-shennar was the guarantor of this work and reviewed the manuscript. All authors read and approved the final manuscript.

Author Details

Near East University, Faculty of Health Sciences, Turkey, Cyprus.

Address: HACI AHMET MAH. KARAKOLU SK.NO: 71/D:1, Turkey, Istanbul.

What's App Phone: +905428747415

Email: Jawad _0799@ yahoo .com

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None.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

Ethics approval and consent to participate

This study was approved by the ethics committee of The Jordanian Ministry of Health. Participants had consented to the usage of their collected data. We had signed consent from every participant to participate in the study. The results are all anonymous, no individual result is presented.

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Tables

Table I: Socio-demographic, clinical, and laboratory variables with DPN (n=174)

P	Neuropathy status				Variables
	Without DPN n= 375 (68.3%)		With DPN n= 174 (31.7%)		
	%	N	%	N	**Gender**
0.92	65.4	176	34.6	93	Male
	71.1	199	28.9	81	Female
0.001	86.6	86	3.4	3	**Age group (year):**
	75	276	25	29	< 50
	2.2	2	97.8	90	50 - 69
					≥70
0.277	67.7	312	32.3	149	**The family history ofdiabetes**
	71.6	63	28.4	25	Present
					Absent
0.001	100	267	0	0	**Duration of diabetes (year)**
	64.7	101	35.3	55	< 5
	5.6	7	94.4	119	5-11
					12≤
0.001	59.3	245	40.7	168	**Having hypertension**
	95.6	130	4.4	6	Yes
					No
0.001	0.1	1	99	103	**Having nephropathy**
	81.6	363	18.4	82	Yes
					No
0.001	23.8	41	76.2	131	**Having cardiovascular disease**
	88.6	334	11.4	43	Yes
					No
0.001	59.8 98.3	259	40.2	172	**Having dyslipidemia**
		119	1.7	2	Yes
					No

0.001	8.7	11	91.3	115	**Having retinopathy**
	86.1	364	13.9	59	Yes
					No
0.001	6.2	1	93.8	15	**Type of treatment**
	87.1	296	12.9	44	Insulin only
	40.4	78	59.6	115	Oral hypoglycemia agents only
					Oral hypoglycemia agents & Insulin

Table II: Association between Sleep Qualityand of DPN (n=180)

P	Quality of sleep				Neuropathy status
	Bad sleeper n= 369		Good sleeper n= 180		
	%	N	%	N	
0.001	3.2	12	86.8	363	**History on MNSI:**
	96.6	168	3.4	6	Without DPN
					With DPN
0.001	0.5	2	99.5	362	**Physical examination on MNSI:**
	96.2	178	3.8	7	Without DPN
					With DPN

Table III: Logistic regression analysis of risk factors with patients' sleep quality

P	95% Confidence Interval Lower – Upper	OR	Variables
0.682	0.020-13.065	1	**Type of treatment**
0.546	0.105-70.747	- 0.679	Insulin only
		1.004	Oral hypoglycemia agents only
			Oral hypoglycemia agents & Insulin
0.005	0.001-0.023	1	**On metformin**
		- 5.403	No
			Yes
0.001	5.423-18.505	1	**Having cardiovascular disease**
		2.304	No
			Yes
0.069	0.888-23.227	1	**Having dyslipidemia**
		1.513	No
			Yes
0.001	10.591-60.655	1	**Having retinopathy**
		3.233	No
			Yes
0.003	2.010-33.746	1	**Having hypertension**
		2.108	No
			Yes
0.001	12.954-486.637	1	**On statin**
		4.374	No
			Yes

(1) Reference group