

Assessing Pain Severity And Sleep Quality In Patients With Diabetic Peripheral Neuropathy- A Cross Sectional Observational Study

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Abstract:

Introduction: Diabetic peripheral neuropathy (DPN) is a prevalent and challenging complication of diabetes, marked by nerve damage that typically affects the hands and feet. This condition often results in pain, numbness, and various sensory disruptions, making it a significant concern for those living with diabetes.

Aim: To assess pain severity and sleep quality in patients with diabetic peripheral neuropathy.

Material and Methods: The current study design was cross sectional observational. The study was conducted in selected hospital in Puducherry. The study sample size includes 134 patients with diabetic peripheral neuropathy.

Findings: The findings indicate that 7.5% reported no pain, 18.7% had mild pain (mean score 2.0 ± 0.8), 37.3% experienced moderate pain (mean score 5.0 ± 0.7), 22.4% had severe pain (mean score 7.5 ± 0.5), and 14.2% reported very severe pain (mean score 9.5 ± 0.5). Regarding sleep quality, 22.4% had good sleep quality (mean score 3.2 ± 1.0), 37.3% had fair sleep quality (mean score 7.8 ± 1.2), 29.9% experienced poor sleep quality (mean score 12.3 ± 1.4), and 10.4% had very poor sleep quality (mean score 17.5 ± 1.2).

Conclusion: The concluded that there is a significant association between pain severity and sleep quality in patients with diabetic peripheral neuropathy. The study demonstrates that as the severity of pain increases, sleep quality tends to deteriorate, evidenced by a moderate positive correlation ($r = 0.65$) that is statistically significant ($p = 0.001$). Furthermore, findings emphasize the importance of effective pain management as a means of improving sleep quality in this patient population.

INTRODUCTION

Peripheral neuropathy refers to a wide variety of clinical conditions that may involve dysfunction of the peripheral nervous system.¹ Patients with peripheral neuropathy typically exhibit symptoms like numbness, tingling, aching, burning sensations, limb weakness, heightened sensitivity to pain (hyperalgesia), abnormal pain response to normally non-painful stimuli (allodynia), and pain. This pain is often characterized as being either superficial, deep, or severe and continuous, with a tendency to worsen during the night.²

In the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DDCT/EDIC) Study, the prevalence of diabetic peripheral neuropathy among adults with type 1 diabetes was initially 6% at baseline, rising to 30% after 13 to 14 years of follow-up.³ Previous study reported that the overall prevalence of diabetic peripheral neuropathy (DPN) was 39.3%, with 28.9% of cases occurring in males and 10.4% in females.⁴

Pain linked to diabetic neuropathy significantly impacts the quality of life for those affected. Patients with painful diabetic peripheral neuropathy (DPN) often report significant disruption (scoring ≥ 4 on a 0–10 scale, where 0 indicates no interference and 10 indicates complete interference) in areas such as sleep, enjoyment of life, recreational activities, normal work, mobility, general activity, social interactions, and mood. These patients also experience greater difficulties in energy levels, sleep, physical mobility, and emotional well-being compared to diabetic and non-diabetic controls.^{5,6}

Sleep issues are common among individuals with type 2 diabetes mellitus (T2DM) and can negatively impact both the quality and duration of sleep. Research has established a strong connection between the onset and progression of T2DM and sleep disorders such as insomnia, sleep apnea syndrome, and other related

conditions.⁷ Pain, abnormal sensations, and numbness in the hands and feet caused by diabetic peripheral neuropathy (DPN) significantly impact patients' emotions and social functioning and also contribute to a decrease in sleep quality.⁸

Despite the fact that numerous studies have investigated the impact of diabetic peripheral neuropathy (DPN) on pain severity, there is a significant gap in research that investigates the specific impact of DPN-related pain on quality of sleep. The complex relationship between sleep disturbances and pain from DPN remains incomplete, particularly in light of the diverse patient experiences. So, the study aims to assess pain severity and sleep quality in patients with diabetic peripheral neuropathy.

MATERIAL AND METHODS

Study Design

This is a cross-sectional observational study conducted to assess pain severity and sleep quality in patients with diabetic peripheral neuropathy (DPN). The study included 134 patients diagnosed with DPN, recruited from the outpatient department of a tertiary care hospital.

Sample Size

The sample size for the study was determined to be 134 patients. This sample size was calculated based on a power analysis considering a medium effect size, a 5% significance level ($\alpha = 0.05$), and a power of 80% ($\beta = 0.20$). Using convenient sampling method, the patient with diabetic peripheral neuropathy were selected for the study.

Inclusion Criteria

1. Patients aged 40 years and above.
2. Diagnosed with type 2 diabetes mellitus for at least 5 years.
3. Clinically diagnosed with peripheral neuropathy.

Exclusion Criteria

1. Patients with other chronic pain conditions unrelated to DPN.
2. Those with severe psychiatric or cognitive disorders.
3. Patients currently using sedative medications that might affect sleep quality.
4. Patients with a history of sleep disorders unrelated to DPN.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to their inclusion in the study.

Data Collection Tools

Pain severity was assessed using the Numeric Pain Rating Scale (NPRS), where patients rated their pain on a scale of 0 (no pain) to 10 (worst possible pain). The NPRS is a reliable and valid tool for assessing pain intensity. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), which is a standardized questionnaire that evaluates various aspects of sleep quality over a one-month period. The PSQI includes seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality.

Procedure

Participants were selected from the outpatient department and from ward of selected hospital based on inclusion and exclusion criteria. Upon obtaining informed consent, demographic data were collected from each participant. Subsequently, a comprehensive assessment was conducted, which included an evaluation for Diabetic Peripheral Neuropathy (DPN), Numeric Pain Rating Scale (NPRS) and the Pittsburgh Sleep Quality Index (PSQI) were administered. To ensure the accuracy of responses and maintain confidentiality, interviews were conducted in a private setting. The entire data collection process, encompassing the demographic survey and assessments, required approximately 20-30 minutes per participant. All collected data were securely stored in a database, with each participant being assigned a unique identifier to preserve anonymity. The data collection phase extended over a period of three months.

Statistical Analysis

Data were analysed using SPSS software version 26.0. Descriptive statistics were used to summarize demographic characteristics and the scores of NPRS and PSQI. The correlation between pain severity and

sleep quality was assessed using Pearson's correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study, conducted among 134 patients, found that the majority were aged between 46-60 years (37.3%), predominantly male (52.2%), and had secondary education (33.6%). Most were employed (56.0%), married (63.4%), and resided in urban areas (55.2%). Additionally, the majority had been living with diabetes for more than 10 years (47.8%). (Table 1)

Regarding pain severity among 134 participants using the Numeric Pain Rating Scale (NPRS). Of the participants, 7.5% reported no pain, 18.7% had mild pain (mean score 2.0 ± 0.8), 37.3% experienced moderate pain (mean score 5.0 ± 0.7), 22.4% had severe pain (mean score 7.5 ± 0.5), and 14.2% reported very severe pain (mean score 9.5 ± 0.5). (Table 2)

The majority of patients reported experiencing moderate pain (37.3%) with a mean score of 5.0 ± 0.7 , followed by mild pain (18.7%) with a mean score of 2.0 ± 0.8 . (Table 3)

The table 4 revealed that the majority of participants, 37.3%, reported fair sleep quality, with a mean score of 7.8 ± 1.2 . Additionally, 29.9% of participants experienced poor sleep quality, with a mean score of 12.3 ± 1.4 .

Table 1: Demographic variables of the patients

N=134

Variable	Category	Frequency (n)	Percentage (%)
Age Group	40-45 years	30	22.4%
	46-60 years	50	37.3%
	61 years and above	39	29.1%
Gender	Male	70	52.2%
	Female	62	46.3%
	Other/Prefer not to say	2	1.5%
Educational Status	No formal education	20	14.9%
	Primary education	40	29.9%
	Secondary education	45	33.6%
	Higher education	29	21.6%
Occupation	Unemployed	35	26.1%
	Employed	75	56.0%
	Retired	24	17.9%
Marital Status	Single	25	18.7%
	Married	85	63.4%
	Widowed/Divorced	24	17.9%
Residential Area	Urban	74	55.2%
	Rural	60	44.8%
Duration of Diabetes	Less than 5 years	20	14.9%

	5-10 years	50	37.3%
	More than 10 years	64	47.8%

Table 2: Assessment of Diabetic peripheral neuropathy N=134

DPN Assessment Criteria	Score Range	Frequency (n)	Percentage (%)
Symptoms of DPN			
- Numbness	0-1	40	29.9%
- Tingling	0-1	50	37.3%
- Burning Pain	0-1	35	26.1%
- Muscle Weakness	0-1	30	22.4%
- Foot Ulcers	0-1	20	14.9%
Physical Examination Findings			
- Reduced Achilles Reflex	0-1	55	41.0%
- Decreased Vibration Sensation	0-1	45	33.6%
- Abnormal Monofilament Test	0-1	60	44.8%
- Abnormal Pinprick Sensation	0-1	48	35.8%
Overall DPN Score			
- No DPN (0-2)	0-2	30	22.4%
- Mild DPN (3-5)	3-5	50	37.3%
- Moderate DPN (6-8)	6-8	40	29.9%
- Severe DPN (9-10)	9-10	14	10.4%

Table 3: Pain severity score based on Numeric Pain Rating Scale N=134

Pain Severity Score (0-10)	Category	n (%)	Mean $\pm$ SD
0	No Pain	10 (7.5%)	0 $\pm$ 0
1-3	Mild Pain	25 (18.7%)	2.0 $\pm$ 0.8
4-6	Moderate Pain	50 (37.3%)	5.0 $\pm$ 0.7
7-8	Severe Pain	30 (22.4%)	7.5 $\pm$ 0.5
9-10	Very Severe Pain	19 (14.2%)	9.5 $\pm$ 0.5

Table 4: Assessment of Sleep quality based on PSQI score N=134

PSQI Score Range	Sleep Quality Category	n (%)	Mean $\pm$ SD
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0-5	Good Sleep Quality	30 (22.4%)	3.2 ± 1.0
6-10	Fair Sleep Quality	50 (37.3%)	7.8 ± 1.2
11-15	Poor Sleep Quality	40 (29.9%)	12.3 ± 1.4
16-21	Very Poor Sleep Quality	14 (10.4%)	17.5 ± 1.2

Table 5 Correlation Between Sleep Quality and Pain Severity

Correlation Pair	Correlation Coefficient (r)	95% Confidence Interval	Significance (p-value)	Sample Size (N)
Sleep Quality (PSQI) & Pain Severity (NPRS)	0.65	0.50 to 0.75	0.001	134

DISCUSSION

This is a cross-sectional observational study conducted to assess pain severity and sleep quality in patients with diabetic peripheral neuropathy. Majority were aged between 46-60 years (37.3%), predominantly male (52.2%), and had secondary education (33.6%). Most were employed (56.0%), married (63.4%), and resided in urban areas (55.2%).

The assessment of Diabetic Peripheral Neuropathy (DPN) among participants revealed that 29.9% reported numbness, 37.3% experienced tingling, 26.1% had burning pain, 22.4% reported muscle weakness, and 14.9% had foot ulcers, all within the 0-1 score range. Physical examination findings showed that 41.0% had reduced Achilles reflex, 33.6% had decreased vibration sensation, 44.8% had an abnormal monofilament test, and 35.8% exhibited abnormal pinprick sensation, all also within the 0-1 score range. Overall, 22.4% of participants were categorized as having no DPN with a score of 0-2, 37.3% had mild DPN with a score of 3-5, 29.9% had moderate DPN with a score of 6-8, and 10.4% had severe DPN with a score of 9-10. Additionally, the majority had been living with diabetes for more than 10 years (47.8%).

A similar study conducted by **Dalton Kambale Munyambalu et al.** reported that the prevalence of Diabetic Peripheral Neuropathy (DPN) was 65.8% (210 out of 319 participants) with a 95% confidence interval of 60.4% to 70.9%. In this study, 44.8% of participants had mild DPN, 42.4% had moderate DPN, and 12.8% had severe DPN. These findings underscore the importance of regular neurological assessments in managing Diabetes Mellitus, particularly in resource-limited settings, to prevent complications associated with the progression of the disease.

Regarding pain, 7.5% of patients reported no pain with a mean score of 0 ± 0 . Mild pain, with a score range of 1-3, was experienced by 18.7% of patients, with a mean score of 2.0 ± 0.8 . The majority of patients, 37.3%, reported moderate pain with a mean score of 5.0 ± 0.7 . Severe pain, within the score range of 7-8, was experienced by 22.4% of patients, with a mean score of 7.5 ± 0.5 . Lastly, 14.2% of patients reported very severe pain, scoring between 9-10, with a mean score of 9.5 ± 0.5 .

In present study sleep quality among participants based on PSQI scores as follows: 22.4% of participants reported good sleep quality, with a mean score of 3.2 ± 1.0 . The largest group, 37.3%, had fair sleep quality, with a mean score of 7.8 ± 1.2 . Poor sleep quality was reported by 29.9% of participants, with a mean score of 12.3 ± 1.4 . Additionally, 10.4% of participants experienced very poor sleep quality, with a mean score of 17.5 ± 1.2 .

The analysis of the correlation between sleep quality (measured by the PSQI score) and pain severity (measured by the Numeric Pain Rating Scale) among 134 patients reveals a moderate positive correlation,

with a coefficient of 0.65. This suggests that as pain severity increases, sleep quality tends to worsen. The correlation is statistically significant, with a p-value of 0.001, indicating that the relationship is unlikely to be due to chance. The 95% confidence interval for the correlation coefficient ranges from 0.50 to 0.75, reinforcing the reliability of the observed association.

A similar study conducted by **Karmilayanti et al.** found a significant correlation between the severity of diabetic peripheral neuropathy and sleep quality, as measured by the global PSQI score. The study revealed a strong positive linear relationship between these two variables, with a correlation coefficient of $r=0.724$ and a p-value of 0.001. This indicates that as the severity of diabetic peripheral neuropathy increases, sleep quality significantly deteriorates.

Potential limitations of the study include the self-reported nature of the NPRS and PSQI, which may be subject to recall bias, and the cross-sectional design, which limits the ability to infer causality between pain severity and sleep quality.

CONCLUSION

Based on the findings of this cross-sectional observational study, it can be concluded that there is a significant association between pain severity and sleep quality in patients with diabetic peripheral neuropathy. The study demonstrates that as the severity of pain increases, sleep quality tends to deteriorate, evidenced by a moderate positive correlation ($r = 0.65$) that is statistically significant ($p = 0.001$). Furthermore, findings emphasize the importance of effective pain management as a means of improving sleep quality in this patient population. Further research is needed to explore the underlying mechanisms driving the relationship between pain severity and sleep quality in individuals with diabetic peripheral neuropathy. Additionally, investigations into the impact of specific pain management strategies on sleep quality may contribute to the development of targeted interventions aimed at enhancing the overall well-being of these patients.

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