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SLEEP QUALITY PREDICTORS IN PATIENTS WITH DIABETIC PERIPHERAL NEUROPATHY: SYSTEMATIC REVIEW

Prediktor Kualitas Tidur pada Penderita Diabetic Peripheral Neuropathy: Systematic Review

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ABSTRAK

Diabetic Peripheral Neuropathy (DPN) merupakan salah satu komplikasi kronis diabetes mellitus tipe 2 yang berdampak besar terhadap kualitas tidur. Kualitas tidur yang buruk pada pasien DPN berkaitan erat dengan peningkatan nyeri neuropatik, disfungsi saraf otonom, serta gangguan metabolik. Penelitian ini bertujuan untuk mengidentifikasi faktor prediktor yang memengaruhi kualitas tidur pada pasien dengan DPN melalui pendekatan systematic review. Penelusuran literatur dilakukan menggunakan tiga database PubMed, Google Scholar, dan ProQuest menggunakan kata kunci "diabetic peripheral neuropathy", "sleep quality", "sleep disorder", dan "peripheral neuropathy" dengan batasan publikasi tahun 2020–2025, bahasa Inggris dan Indonesia, serta status open access. Dari 18.558 artikel yang diidentifikasi, sebanyak 11 artikel memenuhi kriteria inklusi dan dianalisis secara naratif. Hasil menunjukkan bahwa nyeri neuropatik merupakan prediktor utama kualitas tidur yang buruk. Faktor lain yang turut berpengaruh adalah durasi diabetes, depresi, kecemasan, kontrol glikemik buruk, serta komorbiditas seperti penyakit kardiovaskular dan gaya hidup tidak sehat. Kualitas tidur pada pasien DPN dipengaruhi oleh interaksi kompleks antara faktor biologis, psikologis, dan gaya hidup. Hasil penelitian ini memberikan implikasi penting bagi praktik klinis, yaitu perlunya skrining nyeri dan gangguan tidur serta intervensi multidimensi untuk meningkatkan kualitas hidup pasien.

***Kata kunci**: diabetic peripheral neuropathy, nyeri, kualitas tidur*

ABSTRACT

Diabetic Peripheral Neuropathy (DPN) is one of the chronic complications of type 2 diabetes mellitus that significantly impacts sleep quality. Poor sleep quality in DPN patients is closely associated with increased neuropathic pain, autonomic nerve dysfunction, and metabolic disorders. This study aims to identify predictive factors influencing sleep quality in patients with DPN through a systematic review approach. Literature search was conducted using three databases PubMed, Google Scholar, and ProQuest using the keywords "diabetic peripheral neuropathy," "sleep quality," "sleep disorder," and "peripheral neuropathy" with the following criteria publications from 2020 to 2025, English and Indonesian languages, and open access status. Out of 18.558 identified articles, 11 met the inclusion criteria and were analyzed narratively. The results showed that neuropathic pain is the primary predictor of poor sleep quality. Other influencing factors include diabetes duration, depression, anxiety, poor glycemic control, and comorbidities such as cardiovascular disease and unhealthy lifestyle. Sleep quality in DPN patients is influenced by the complex interaction between biological, psychological, and lifestyle factors. The findings of this study have important implications

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for clinical practice, emphasizing the need for screening for pain and sleep disorders, as well as multidimensional interventions to improve patients quality of life.

Keywords: *diabetic peripheral neuropathy, pain, sleep quality*

INTRODUCTION

Diabetic Peripheral Neuropathy (DPN) is one of the most common chronic complications in type 2 diabetes mellitus sufferers[1], with prevalence increasing with the duration of the disease[2]. DPN not only causes sensory and motor disorders, but also has a significant impact on the quality of life of sufferers[3]. Sleep disorders in DPN patients are often not detected early, DPN has long-term consequences on glycemic control, mental health, and individual productivity[4]. DPN is characterized by peripheral nerve damage that can cause symptoms such as numbness, tingling, pain, and burning sensations, especially in the lower extremities[5]. Poor sleep quality in DPN sufferers is closely related to increased pain perception, metabolic disorders, and changes in autonomic nervous system activity[6]. Recent studies have shown that short sleep duration (<6 hours) and chronic sleep disturbances can worsen diabetes complications, accelerate the progression of neuropathy, and reduce the effectiveness of therapy[7]. Therefore, identifying factors that act as predictors of sleep quality in DPN patients is a very important aspect[8].

Several studies have examined the relationship between neuropathic pain, glycemic control, Body Mass Index (BMI), and psychological status with the sleep quality of DPN sufferers[9]. Research from various countries has begun to adopt a biopsychosocial approach and uses measurement tools such as the Pittsburgh Sleep Quality Index (PSQI), the Insomnia Severity Index (ISI), and the Epworth Sleepiness Scale (ESS) to comprehensively assess sleep quality[10]. However, the results of these studies are still varied, and there is no agreement regarding the main predictors of sleep quality in the DPN population[11]. Although various studies have been conducted, there are still limitations in terms of population variation, assessment methods, and selection of predictor variables[12]. Many studies only involve small samples from a single health care center, making it difficult to generalize the research[13]. In addition, there are not many studies that integrate clinical factors (such as diabetes duration and DPN severity) with psychosocial factors (such as depression, anxiety, and quality of life) in one complete prediction model[14].

With the increasing number of related studies, systematic reviews have become an essential approach to objectively summarize the current evidence[15]. Through a systematic review, existing methodological gaps can be identified[16]. It is important to develop a more solid framework for identifying predictors of sleep quality in patients with DPN[17]. Therefore, this study aims to conduct a systematic review of the literature discussing predictive factors of sleep quality in DPN patients[18]. With this approach, it is hoped that the most consistent and meaningful key variables that influence sleep quality can be found[19]. The results of this review are expected to not only fill the scientific gap, but also provide guidance for clinicians and researchers in developing relevant and effective predictor-based interventions[20].

METHODS

This study used a systematic review design to identify various predictors that influence sleep quality in patients with DPN. The review process was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which included a literature search through PubMed, Google Scholar, and ProQuest databases using the keywords "diabetic peripheral neuropathy," "sleep quality," "sleep disorder," and "peripheral neuropathy" combined using the Boolean operator "AND." The search was limited to articles in Indonesian and English, open access, and published between 2020 and 2025.

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Inclusion criteria included patients with DPN, original research articles with observational designs or Randomized Controlled Trials (RCTs), articles in Indonesian and English, open access, and the use of sleep quality measurement instruments such as the PSQI and MOS-SS. Exclusion criteria included patients with other chronic diseases such as kidney failure, heart failure, gangrenous ulcers, diabetic non-neuropathic pain, stroke, and cancer, which may confound the relationship between DPN and sleep quality. Articles published before 2020, editorials, opinion pieces, cohort studies, articles in languages other than Indonesian and English, and non-open access articles were also excluded. Each selected article was analyzed based on its study design, sample characteristics, pain and sleep quality measurement methods, and risk of bias.

The analysis was conducted narratively, categorizing psychological, clinical, and lifestyle factors that influence sleep quality. Study quality assessment influenced the interpretation of the results and emphasized the importance of further research with more robust designs. The entire selection process is depicted in the PRISMA flowchart in Figure 1, and the data analyzed were sourced from previous studies, not primary data. Of the 71,975 articles identified, after filtering by year, 18,558 relevant articles were identified within the last five years. After a rigorous selection process, 11 articles met all inclusion criteria and were eligible for further analysis in this systematic review.

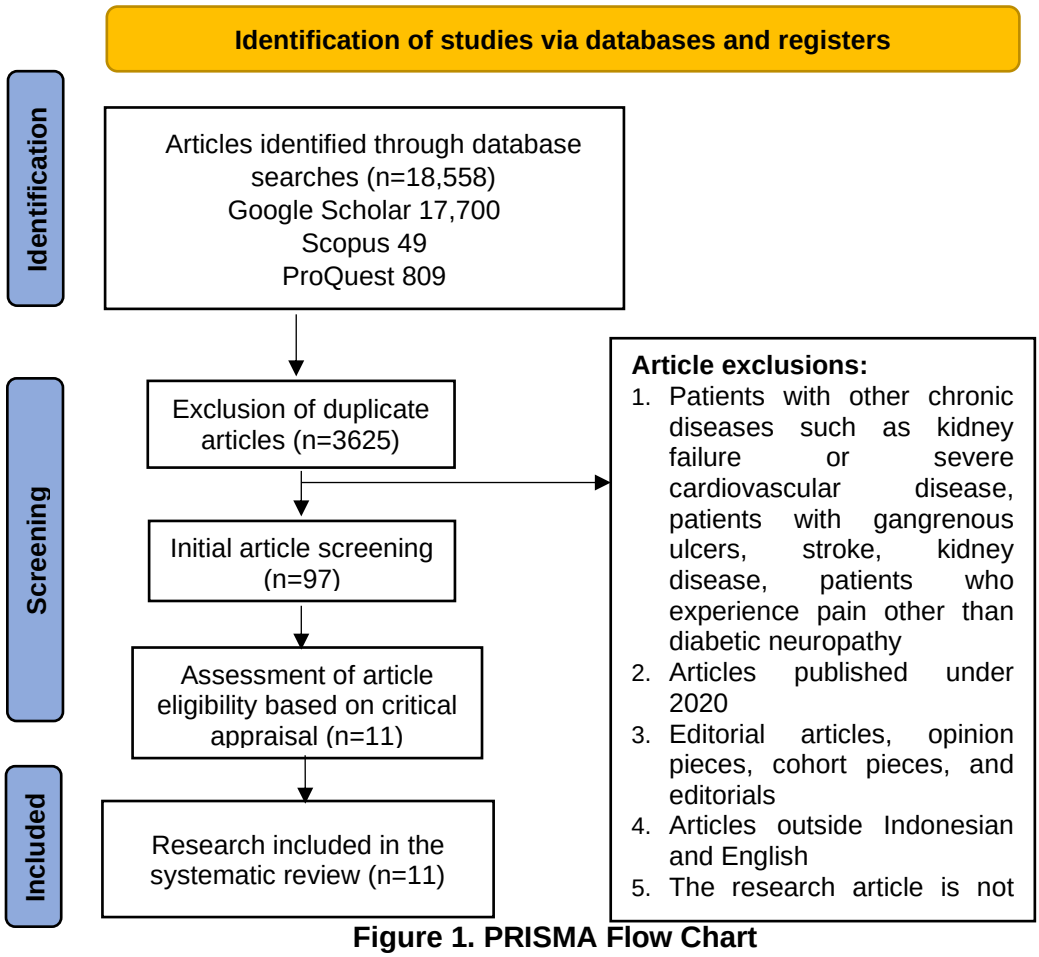

Figure 1. PRISMA Flow Chart

Risk of Bias Assessment

Assessing the potential for systematic error in research is crucial to ensure the validity and reliability of results. Inaccuracies can arise from various sources, including data collection and reporting. One crucial aspect that needs to be evaluated is the clarity of

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inclusion and exclusion criteria. Methodical and transparent risk assessment is essential in evaluating systematic reviews. In this case, the accuracy of the results regarding sleep quality in patients with DPN depends heavily on assessing the potential for deviation.

In the research conducted, the main potential bias lies in the use of subjective measurement tools such as the PSQI and MOSS-SS, which rely on individual perceptions and are influenced by psychological factors, thus potentially reducing measurement accuracy. Furthermore, the majority of studies analyzed used cross-sectional designs without randomization or blinding, which opens up the possibility of errors in data selection and recording.

RESULTS

Table 1. Study Characteristics

No	Title, Researcher, Year	Method	Instrument	Results
1	*Predicting the Quality of Life in Patients With Painful Diabetic Neuropathy (PDN) Based on Pain Severity, Pain Catastrophizing, Pain Acceptance, Depression, Anxiety, and Sleep Disturbance: Assessing the Prevalence of Psychiatric Symptoms in Iranian Patients With PDN*[21]	**Design**: cross-sectional study. **Technique:** *Convenience sampling* **Amount :** There were 1500 participants in this study.	*NeuroQoL, Back Depression Inventory-II (BDI-II), Beck Anxiety Inventory (BAI), Visual Analog Scale (VAS), Pain Catastrophizing Scale (PCS), Chronic Pain Acceptance Questionnaire (CPAQ), Pittsburgh Sleep Quality Index (PSQI)*	Depression is one predictor of sleep quality. Patients with high levels of pain catastrophizing tend to experience more severe sleep disturbances. Conversely, patients who are better able to accept their chronic pain tend to have better sleep quality.
2	*The Prevalence and Risk Factors of Diabetic Peripheral Neuropathy and its Impact on Sleep Quality among Adult Patients with Type 2 Diabetes Mellitus* [22]	**Design :** *cross-sectional study.* **Technique:** *Probability sampling and non-probability sampling* **Amount :** There were 549 participants in this study.	*Pittsburgh Sleep Quality Index (PSQI), Michigan Neuropathy Screening Instrument*(MNSI)	Diabetes duration of more than 5 years, the presence of cardiovascular disease, diabetic retinopathy, hypertension, and not using metformin are factors that can worsen the patient's condition.
3	*Sleep Quality and Diabetic Peripheral Neuropathy among Patients with Type 2 Diabetes: A Cross-sectional Survey in Jordan [23]*	**Design :** *Cross-sectional study.* **Technique:** *Non-random consecutive sampling* **Amount :** There were 549 participants in this study.	*Michigan Neuropathy Screening Instrument (MNSI), Pittsburgh Sleep Quality Index (PSQI)*	In patients with DPN, the presence of comorbidities such as cardiovascular disease, retinopathy, and hypertension correlates with decreased sleep quality. Long-term diabetes and suboptimal glycemic control also worsen sleep quality. Furthermore, dyslipidemia plays a role as a contributing factor to sleep disturbances in DPN patients.

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4	*Impact of Pain Severity on Functioning Domains, Sleep, and Cognition in Painful Diabetic Peripheral Polyneuropathy Patients* [24]	**Design :** *Cross-sectional study.* **Technique:** *Purposive sampling* **Amount :** There were 100 participants in this study.	*Visual Analog Scale (VAS), Brief Pain Inventory (BPI), Pittsburgh Sleep Quality Index (PSQI), Montreal Cognitive Assessment (MOCA)*	Several factors that influence the decline in sleep quality in diabetes mellitus patients include pain severity, poor glycemic control, disease duration of more than six years, low social status and education level, and pain experienced during sleep.
5	*A Higher Incidence of Diabetic Peripheral Neuropathy May Be Associated with Decreased Sleep and Increased Depression in Older Adults* (Selvi Öztorun Et Al., 2022)	**Design :***Retrospective cross-sectional study* **Technique:** *Purposive sampling* **Amount :** There were 125 participants in this study.	*Katz ADL, Lawton-Brody IADL, Geriatric Depression Scale (GDS), Mini Mental State Examination (MMSE), MNA-SF, Sleep duration*	Sleep duration of less than six hours, a depression score of more than 5, a history of heart failure, use of multiple medications (polypharmacy) or side effects from the medications consumed, and uncontrolled blood glucose levels are factors that can influence the decline in sleep quality in patients.
6	*The relationship between the severity of peripheral diabetic neuropathy and sleep quality in type 2 diabetes mellitus patients* [26]	**Design :** *Cross-sectional study.* **Technique:** *Consecutive sampling* **Amount :** There were 18 participants in this study.	*Diabetic Neuropathy Symptom (DNS), Pittsburgh Sleep Quality Index (PSQI)*	Higher levels of neuropathy severity, especially in patients with Diabetic Peripheral Neuropathy (DPN), are associated with increasingly significant declines in sleep quality.
7	*Association between sleep quality and painless diabetic peripheral neuropathy assessed by current perception threshold in type 2 diabetes mellitus* [11]	**Design :** *Observational, retrospective.* **Technique:** *Purposive sampling* **Amount :** There were 146 participants in this study.	*Current Perception Threshold Test (CPT), Pittsburgh Sleep Quality Index (PSQI)*	Factors such as painless DPN, insulin resistance, high BMI, and accumulation of visceral fat (VFT) and subcutaneous fat are known to contribute to decreased sleep quality in diabetic patients.
8	*Factors related to cognitive function in type-2 diabetes and neuropathic pain patients, the role of mood and sleep disorders in this relationship* [27]	**Design :** *Cross-sectional study.* **Technique:** *Consecutive non-random sampling* **Amount :** There were 149 participants in this study.	Cognitive function (TYM), neuropathy (DN4), pain (VAS), depression (HADS), sleep quality (MOS-Sleep), quality of life (SF-12), neuropathic pain symptoms (NPSI), questionnaires, and records	Depression, duration of diabetes, obesity with BMI>30, older age are associated with poorer sleep quality, insulin use, history of use of sleeping pills.

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9	*Deteriorated sleep quality and associated factors in patients with type 2 diabetes mellitus complicated with diabetic peripheral neuropathy* [28]	**Design :** *Cross-sectional study*. **Technique:** *Purposive sampling* **Amount :** There were 200 participants in this study.	PSQI, demographic and lifestyle questionnaire	Low exercise frequency, poor dietary status, infrequent physical examinations, diabetes duration >5 years, and smoking. Patients with physical pain had worse PSQI scores than those without pain.
10	Evaluation of Complications, Peripheral Neuropathic Pain, and Sleep Quality in Patients With Diabetes Mellitus [29]	**Design:** *Cross-sectional study.* **Technique:** *Purposive sampling* **Amount :** There were 300 participants in this study.	*Descriptive Information Form, Self-Administered Leeds Assessment of Neuropathic Symptoms and Signs*(S-LANSS), Richards-Campbell Sleep Questionnaire (RSQ)	Patient sleep quality is affected by neuropathic pain, duration of diabetes, and age, the higher the pain intensity and age, the worse the sleep quality, HbA1C has not been shown to significantly affect sleep quality.
11	*Sleep Characteristics in diabetic patients depending on the occurrence of neuropathic pain and related factors* [30]	**Design :** *Cross-sectional study*. **Technique:** *Consecutive non-random sampling* **Amount :** There were 130 participants in this study.	*MOS-Sleep Scale, Neuropathic Pain Symptom Inventory (NPSI), Visual Analogue Scale (VAS), Hospital Anxiety and Depression Scale (HADS), SF-12v2*	High pain intensity, paroxysmal pain phenotype, anxiety and depression, duration of diabetes, lower HbA1C levels.

DISCUSSION

The results of this systematic review confirm that neuropathic pain is a major predictor of decreased sleep quality in patients with DPN. Of the 11 studies reviewed in Table 1, 9 reported that more than 70% of patients with neuropathic pain experienced poor sleep quality, particularly at night when pain intensity increases[21] [22] [23] [24] [26] [27] [28] [29] [30]. Paroxysmal, untreated pain can disrupt deep (non-REM) sleep, resulting in increased sleep latency and frequency of awakenings. The mechanism is thought to involve overactivation of the sympathetic nervous system and increased inflammatory cytokines that affect the brain's sleep-regulating centers[31].

Besides pain, several other significant predictive factors include diabetes duration >5 years, depression, anxiety, and poor glycemic control. For example, in a study by Abu-Shennar et al. (2024), patients with major depression (GDS score >5) had a 2.5-fold greater risk of experiencing sleep disturbances than those without depression[32]. Psychologically, depression and anxiety lower pain tolerance and increase nighttime alertness, which physiologically inhibits melatonin secretion. Meanwhile, high HbA1C contributes to autonomic nervous system disorders and systemic inflammation, which worsen sleep quality[33].

Comorbidities and lifestyle factors also contribute to worsening conditions. A study by Yildirim et al. (2025) showed that patients with a history of cardiovascular disease and hypertension experienced a 35% decrease in sleep quality compared to the group without comorbidities[29]. Unhealthy lifestyles such as smoking, lack of exercise, and poor diet are consistently found in populations with a high (poor) PSQI. These factors

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operate through metabolic disturbances, increased insulin resistance, and the chronic release of stress hormones such as cortisol, which disrupt the sleep cycle[34].

Most of the studies reviewed were cross-sectional in design, thus unable to demonstrate a causal relationship between predictor factors and sleep quality. Furthermore, most of the instruments used in the analyzed studies were subjective, such as the PSQI and pain scales, which are susceptible to individual perception bias[35]. The risk of selection bias and information bias is also increased because not all studies controlled for confounding variables such as other comorbidities, use of sleeping medication, or sleep environment factors. These limitations need to be considered when interpreting the results and indicate the need for further research with more robust longitudinal or interventional designs.

CONCLUSION

A systematic review showed that poor sleep quality in patients with DPN is significantly influenced by the severity of neuropathic pain, duration of diabetes, depression, anxiety, and poor glycemic control. Neuropathic pain is a key predictor consistently found to worsen sleep quality, particularly as pain intensity tends to increase at night. Furthermore, comorbidities such as cardiovascular disease and unhealthy lifestyle habits contribute to poor sleep quality in DPN patients. Therefore, sleep quality in DPN is the result of a complex interaction between biological, psychological, and lifestyle factors. These findings provide an important contribution to patient education, emphasizing the importance of increasing awareness of pain management.

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