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SEVERE DIABETIC NEUROPATHY RESULTS IN POOR SLEEP QUALITY IN TYPE-2 DIABETES MELLITUS PATIENTS

Neuropati Diabetik yang Parah Mengakibatkan Kualitas Tidur Pasien Diabetes Mellitus Tipe 2 yang Buruk

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ABSTRAK

Diabetes mellitus merupakan kelainan metabolisme kronis yang dapat menyebabkan komplikasi seperti neuropati diabetik. Neuropati diabetik dapat berimbas pada penurunan kualitas hidup secara substansial akibat gangguan tidur yang disebabkannya. Penelitian dilakukan untuk mengetahui hubungan keparahan neuropati diabetik dengan kualitas tidur pasien diabetes mellitus tipe 2. Penelitian analitik obervasional dengan desain cross-sectional. Subjek penelitian diambil berdasarkan teknik consecutive sampling pada pasien neuropati diabetik yang dirawat jalan di RSUD dr. Zainoel Abidin Banda Aceh pada September–November 2024. 69 responden terpilih sebagai sampel penelitian. Penilaian derajat keparahan neuropati diabetik dilakukan menggunakan Total Neuropathy Score (TNS) dan Neuropathy Symptom Score (NSS). Kualitas tidur dinilai menggunakan Pittsburgh Sleep Quality Index (PSQI). Hasil menunjukkan adanya korelasi antara keparahan neuropati diabetik berdasarkan TNS (r=0,492; p-value=0,000) dan NSS (r=0,721; p-value=0,000) dengan kualitas tidur pasien. Skor TNS menunjukkan hubungan yang kuat, dan skor NSS menunjukkan hubungan yang sangat kuat, dengan arah positif terhadap kualitas tidur pasien dengan neuropati diabetik. Hal ini menunjukkan bahwa peningkatan keparahan neuropati menyebabkan peningkatan skor kualitas tidur, yang bermakna sebagai penurunan kualitas tidur pasien dengan neuropati diabetik.

***Kata kunci**: diabetes melitus, kualitas tidur, neuropati diabetik, neuropathy symptom score, total neuropathy score*

ABSTRACT

Diabetes mellitus is a chronic metabolic disorder which can cause a complications such as diabetic neuropathy. Diabetic neuropathy can lead to a substantial reduction in quality of life for the sleep disorders it causes. This research was conducted to determine the relationship between the severity of diabetic neuropathy and the sleep quality of patients with type 2 diabetes mellitus. An analytical observational research with a cross-sectional design. The research sample was taken based on a consecutive sampling technique from diabetic neuropathy patients who were treated as outpatients at dr. Zainoel Abidin Hospital, Banda Aceh, on September-October 2024. 69 respondents were chosen as samples. Assessment of the severity of diabetic neuropathy was carried out using the Total Neuropathy Score (TNS) and Neuropathy Symptom Score (NSS). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). The result showed that there was a correlation between the severity degree of diabetic neuropathy based on TNS (r=0.492; p-value=0.000) and NSS (r=0.721; p-value=0.000) on the patient's sleep quality. The TNS score shows a strong relationship, while the NSS score shows a very strong relationship, in a positive way, to the sleep quality in patients with diabetic

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neuropathy. This implies that the increase of the severity degree of neuropathy causes an increase in sleep quality scores, which means a decrease in sleep quality in patients with diabetic neuropathy.

Keywords: *diabetes mellitus, diabetic neuropathy, neuropathy symptom score, sleep quality, total neuropathy score*

INTRODUCTION

Diabetes mellitus (DM) is defined by persistent hyperglycemia due to impaired insulin secretion and/or resistance to peripheral insulin action [1],[2]. Referring to the International Diabetes Federation (IDF) 2025, about 589 million adults were suffering from DM, and it is expected to continue to increase to 853 million DM sufferers by 2050. In 2024, Indonesia had about 20.4 million adults (20-79 years) with diabetes, or around 11% of the population [3]. One of the top ten nations in the world for Type-2 DM prevalence is Indonesia, which has the sharpest increase in prevalence [4]. According to the 2023 Indonesian Health Survey conducted by the Indonesian Ministry of Health, the prevalence of DM in the population aged 15 years and older based on the measurement of blood sugar levels reached 11.7%[5]. Most people with DM suffer from Type 2 DM. Its risk factors include both controllable and non-controllable factors. Non-controllable factors include age (those over 45 are more likely to be diagnosed with DM than those under 45), gender, and hereditary factors. A person with a family history of DM is four times more likely to acquire Type 2 DM. Other risk factors that can be controlled include eating habits, smoking habits, obesity (which has been linked to an increase in blood glucose levels (BMI >23), hypertension, stress, lack of physical activity, alcohol consumption, and other lifestyle-related factors [6].

One of the most prevalent microvascular side effects of diabetes mellitus is diabetic neuropathy [7]. About 50% of the 425 million DM patients worldwide are affected by it. DM complications can cause severe morbidity and reduce patients' quality of life as a result of diabetic neuropathy [8], [9]. Until now, no data have been found on the severity of diabetic neuropathy in Indonesia (in general) or in Aceh (in particular). so it is estimated that the condition of diabetic neuropathy can be higher or lower than the data in the world. However, complaints of diabetic neuropathy are often found in daily practice. Diabetic neuropathy can cause symptoms such as burning, stabbing, or pain that gets worse at night. This can lead to sleep disturbances, anxiety, and depression [9]. Elevated blood glucose levels and poor glycemic control can also exacerbate the development of diabetic neuropathy with pain. In patients with diabetes, frequent drops and rapid fluctuations in glucose via insulin or oral hypoglycemic agents cause microvascular changes in the epineurium, including neovascularization, vascular twists, and arteriovenous shunt formation, resulting in hypoxia of nerve fibers. These structural and functional changes in the peripheral nerves trigger excessive electrical impulses, causing neuropathic pain [10].

Humans require sleep as a basic physiological necessity, and it has been demonstrated that sleep affects learning, emotions, and memory. Sleep disturbances lead to poorer quality of life [7]. Diabetic neuropathy patients with pain are reported to tend to have sleep disturbances [11]. Sleep-disordered breathing patterns, which include excessive daytime sleepiness, morning headaches, morning dizziness, mood swings, and cognitive deterioration, are linked to sleep abnormalities in people with diabetic neuropathy [12]. Research by Choi et al. [13] shows that diabetic neuropathy without pain can also cause poor sleep quality. This is linked to oxidative stress and inflammation in painless diabetic neuropathy, which may be the reason for poor sleep. Diabetic neuropathy is one of the causes of decreased quality of life in patients with DM.

The introduction above shows the importance of detection and appropriate therapy for diabetic neuropathy and the prevention of sleep disorders to maximize the quality of

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life of patients with DM. According to this issue, the authors were interested to understand more about the relationship between the severity of diabetic neuropathy and the sleep quality of patients with type 2 diabetes mellitus in Banda Aceh.

METHODS

Observational analytic research with a cross-sectional design. This study was conducted on diabetes mellitus patients who underwent treatment at the endocrine and metabolic disease polyclinic at dr. Zainoel Abidin Regional Public Hospital, Banda Aceh during the period of September-October 2024, with a total of approximately 1336 patients. Then, patients who experienced diabetic neuropathy and met the inclusion criteria and had no exclusion criteria were chosen as the study population, a many as 69 patients, by a total sampling method. Inclusion criteria were patients diagnosed with Type-2 DM for more than 5 years, being older than 18 years, cooperative, and able to communicate well. The exclusion criteria included Type-2 DM patients with comorbid chronic renal failure, chronic infection (HIV), autoimmune diseases (e.g., lupus, rheumatoid arthritis), hypothyroidism, patients with malignancies undergoing chemotherapy, and Type-2 DM patients diagnosed with neurological disorders in the central nervous system, including stroke, parkinson disease, dementia, and epilepsy. Ethical approval was obtained with letter number: 266/ETIK-RSUDZA/2024, authorized by the health research ethics committee of RSUD dr. Zainoel Abidin. Before the research was conducted, the respondents had given their consent.

The dependent variable was the sleep quality of DM patients on a ratio scale, while the independent variable was the diabetic neuropathy severity of DM patients, which was measured on an ordinal scale. Data were collected through the Pittsburgh Sleep Quality Index (PSQI) questionnaire after the respondents provided informed consent. The data was obtained through assessment of diabetic neuropathy in patients with Type-2 DM based on the anamnesis, physical examination, TNS, and NSS assessment. Secondary data includes demographic data such as full name, age, gender, occupation, and education. Univariate analysis was done to explain the frequency distribution and proportion of the dependent and independent variables. Variables that were analyzed univariately were age, gender, education, and occupation. Bivariate analysis was done to analyze the relationship between the severity of diabetic neuropathy and sleep quality. The hypothesis test used is the Pearson correlation test if the data is normally distributed and the Spearman correlation test if the data is not normally distributed. The severity of diabetic neuropathy was assessed using an ordinal scale, and the quality of sleep was assessed by the PSQI questionnaire using a ratio scale. The hypothesis test used was the Spearman correlation test because the data were not normally distributed. The strength of the relationship is seen from the r value as follows: 0.01-0.19 (no relationship), 0.20-0.39 (weak relationship), 0.30-0.39 (moderate relationship), 0.40-0.69 (strong relationship), and 0.70-1.00 (very strong relationship).

The research instruments were medical records, anamnesis, and physical examination. Total Neuropathy Score (TNS) and Neuropathy Symptom Score (NSS) examinations were conducted to diagnose diabetic neuropathy and determine the severity of diabetic neuropathy. In addition, the PSQI assessment was performed to assess the sleep quality. The TNS and its modified forms have been validated as a clinical tool to assess the severity of systemic neuropathies such as diabetic neuropathy and chemotherapy-induced peripheral neuropathy [14]. TNS was the only assessment tool that effectively integrates both objective and subjective methods. It encompasses a comprehensive range of components, including sensory and motor functions, autonomic symptoms, pin-prick sensation, muscle strength, deep tendon reflexes, nerve conduction studies, vibration sense, as well as sural and peroneal nerve conduction studies [15].

In Zamroni's study [16] the reability study result of NSS were excellent. NSS is a validated tool designed to assess the symptoms and signs of diabetic neuropathy. It is

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not only quick and easy to administer in clinical settings but also demonstrates a high predictive value for screening this condition. The NSS assessment involves observing negative symptoms of neuropathy, such as burning sensations, thickness, tingling (paresthesias), and weakness, as well as positive symptoms like pain and cramping. Additionally, it evaluates the location and characteristics of these complaints. The PSQI instrument is a reliable and standardized tool designed to evaluate sleep quality and patterns in adults [17]. It consists of seven components, which assess subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction [18].

RESULTS

This research obtained 69 respondents whose characteristics can be seen in Table 1.

Table 1. Research Samples Characteristics

Characteristics		Frequency (n)	Percentage (%)
Gender	Male	30	43.5
	Female	39	56.5
	Total	69	100.0
Age	Adults (18–64 Years)	53	76.8
	Elderly (>64 Years)	16	23.2
	Total	69	100.0
Education	Not in School	5	7.2
	Elementary School	1	1.4
	Middle School	5	7.2
	High School	16	23.2
	DI-DIV	10	14.5
	Bachelor	27	39.1
	Master	5	7.2
	Total	69	100.0
Marital Status	Married	66	95.7
	Not Married/Divorced	3	4.3
	Total	69	100.0
BMI	Underweight	2	2.9
	Normal	24	34.8
	Excessive	25	36.2
	Obesity class I	12	17.4
	Obesity class II	6	8.7
	Total	69	100.0
Duration of DM	Under 5 years	9	13
	5–10 years	13	18.8
	More than 10 years	47	68.1
	Total	69	100.0
HbA1c	<7%	6	8.7
	7–8%	14	20.3
	8–9%	14	20.3
	> 9 %	35	50.7
	Total	69	100.0
Type of Therapy	Oral hypoglycemic drug monotherapy	11	15.8
	Combination of 2 oral hypoglycemic drugs	9	13.0
	Combination of 3 oral hypoglycemic drugs	1	1.4

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Characteristics		Frequency (n)	Percentage (%)
	Basal insulin	8	11.6
	Prandial insulin	9	13.0
	Combination of 1 oral hypoglycemic drug and basal insulin	7	10.1
	Combination of 1 oral hypoglycemic drug and prandial insulin	2	2.9
	Combination of basal insulin and prandial insulin	19	27.5
	Combination of 1 oral hypoglycemic drug, basal insulin and prandial insulin	2	2.9
	Combination of 2 oral hypoglycemic drugs and prandial insulin	1	1.4
	Combination of 2 oral hypoglycemic drugs, basal insulin and prandial insulin	1	1.4
	Total	69	100.0
Comorbidity	Hypertension	22	31.9
	Hypertension and Dyslipidemia	14	20.3
	Dyslipidemia	13	18.8
	None	20	29.0
	Total	69	100.0

Based on Table 1, it is known that the majority of patients with diabetic neuropathy treated at dr. Zainoel Abidin Hospital were female with a female percentage of 56.5% (39 respondents), had a bachelor's degree (27 respondents; 39.1%), and were married (66 respondents; 95.7%). Generally, respondents showed an overweight body mass index (43 respondents; 62.3%), which included those with excessive, obesity class 1, and obesity class 2 categories. Among various types of therapy, long-acting insulin combined with rapid-acting is the most common (27.5%). The dominant comorbidity was hypertension (31.97%), while the second most common group was actually those with no comorbidity, rather than any other possible concomitant diseases.

Table 2. The Identification of the Severity Degree of Neuropathy and Sleep Quality

	Category	Frequency (n)	Percentage (%)
Severity of diabetic neuropathy	NSS		
	Mild	11	15.9
	Moderate	31	44.9
	Severe	27	39.1
	Total	69	100.0
	TNS		
	Mild	18	26.1
	Moderate	39	56.5
	Severe	12	17.4
	Total	69	100.0
Sleep Quality	Good	9	13.0
	Poor	60	87.0
	Total	69	100.0

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According to Table 2, based on NSS assessment, the majority of DM patients with diabetic neuropathy generally showed a moderate degree (31 respondents; 44.9%), followed by a severe degree (27 respondents; 39.1%). Mild diabetic neuropathy occurred in 11 respondents (15.9%). According to the TNS assessment, the majority of respondents showed moderate diabetic neuropathy (39 respondents; 56.5%), followed by mild (18 respondents; 26.1%). Severe diabetic neuropathy was only found in 12 respondents (17.4%). The majority of respondents showed poor sleep quality (60 respondents; 87.0%). Good sleep quality was only obtained in 9 respondents (13.0%).

Table 3. Cross-Tabulation of Diabetic Neuropathy Severity with Sleep Quality Based on NSS and TNS

Category		Sleep Quality					
		Good		Poor		Total	
		N	%	N	%	N	%
NSS	Mild	7	63.6	4	36.4	11	100.0
	Moderate	2	6.5	29	93.5	31	100.0
	Severe	0	0.0	27	100.0	27	100.0
TNS	Mild	9	50.0	9	50.0	18	100.0
	Moderate	0	0.0	39	100.0	39	100.0
	Severe	0	0.0	12	100.0	12	100.0

Based on Table 3, the results of cross-tabulation assessment using the NSS instrument showed that most respondents had moderate diabetic neuropathy with poor sleep quality (29 respondents; 93.5%). All patients with severe diabetic neuropathy experienced poor sleep quality. The results of cross-tabulation assessment using the TNS instrument in patients with mild diabetic neuropathy showed the same proportion of good and poor sleep quality. All respondents with moderate and severe diabetic neuropathy showed poor sleep quality (100.0%).

Table 4. Diabetic Neuropathy Severity Correlation with Sleep Quality

Severity of Diabetic Neuropathy		r	*p-value*
NSS	Sleep Quality	0.721	0.000
TNS		0.492	0.000

* Spearman correlation test

Table 4 shows the result of the Spearman correlation test. It implies that the NSS score was very strongly and positively associated with sleep quality in diabetic neuropathy patients. This indicates that an increase in the severity of neuropathy can lead to an increase in the sleep quality score, which means a decrease in the sleep quality of patients. The TNS score was strongly and positively associated with the sleep quality of diabetic neuropathy patients. This indicates that an increase in neuropathy severity can lead to an increase in sleep quality score, which means a decrease in sleep quality of patients.

DISCUSSION

This research found that the majority of DM patients with diabetic neuropathy were female, with a percentage of 56.5%. Research by Elliot et al. [19] showed that females, as a gender, are a risk factor for diabetic neuropathy (p=0.03). Several studies have shown a higher incidence of peripheral neuropathy in postmenopausal women. This is related to the female sex hormone, estrogen. Estrogen has neuroprotective effects that can regenerate damaged nerves and increase nerve velocity and vascularity. Women also have a higher risk of diabetic neuropathy with pain compared to men. It is unclear what mechanisms underlie the disparities in chronic pain between the sexes. Sex hormones are thought to play a role in pain regulation and are known to support sexual

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differentiation of the nervous system [20]. While testosterone in men may intensify the pain-relieving effect, fluctuations in estrogen levels may increase pain sensitivity in women. Probably, biological factors alone do not account for all of the disparities in pain between the sexes. Psychosocial and cultural factors, including socio-cultural differences in gender roles and different coping strategies, could also take a part in it.

In this research, the majority of respondents had a bachelor's degree, as many as 27 respondents (39.1%), and were classified as adults, aged around 18–64 years (53 respondents; 76.8%). Research by Azmiardi et al. [21] shows that higher education is a protective factor against the incidence of diabetic neuropathy in patients with DM. A person with a high level of education has better self-efficacy. They also tend to have better awareness about their glycemic control, DM complications such as neuropathy, better lifestyle management, and compliance in using oral antidiabetics and insulin treatment. The same study also found an increased risk of diabetic neuropathy in DM patients with age ≥ 55 years. Diabetic neuropathy is a long-term consequence of diabetes that typically affects older diabetic people since it takes years to develop. Aging is associated with metabolic stress and natural degenerative processes of nerve cells [22].

Generally, the research respondents showed an overweight body mass index (25 respondents; 36.2%). This is in line with the opinion of Wu et al [23]. That a higher body mass index (BMI) is linked to a higher incidence of diabetic neuropathy. In obesity, there is an accumulation of visceral fat that causes adipose tissue dysfunction. This can trigger systemic inflammation, oxidative stress, and contribute to insulin resistance. Metabolic inflammation in patients with Type-2 DM can result in peripheral tissue and nerve dysfunction.

Based on the HbA1c results, the majority of respondents showed values above 9% (50.7%). Research by Casadei et al. found that the increase of variability of HbA1c is closely related and even considered as a powerful indicator for diabetic neuropathy in patients with Type-2 DM [12]. HbA1c is the main indicator to measure long-term blood sugar control. Uncontrolled HbA1c levels indicate that blood sugar levels are chronically high. In patients with DM, chronic hyperglycemia can exacerbate damage to body tissues, especially to nerves and blood vessels, which contributes to diabetic neuropathy. Elevated blood sugar levels and poor glycemic control can also aggravate the development of diabetic neuropathy with pain [10]. DM patients with diabetic neuropathy have generally been diagnosed with DM for more than 10 years (47 respondents; 68.1%). Prolonged hyperglycemia can lead to decreased glycolysis in cells, increased oxidative stress and stimulate other pathways leading to nerve and endothelial dysfunction to blood vessels [21]. Progression of diabetic neuropathy is also influenced by diabetes control [24].

The main comorbidity in this research sample was hypertension (22 respondents, 31.9%). Hypertension can cause vascular endothelial dysfunction and decreased nitric oxide production through increased oxidative stress and endothelial damage, leading to poor blood circulation to the nerves. In addition, in patients with hypertension unstable blood pressure can stimulate excessive collagen formation and fibrosis in small blood vessels. This fibrosis can reduce the elasticity of blood vessels and affect blood circulation, which in turn leads to insufficient oxygen supply to the nerves, exacerbating neuropathy. Research by Wang et al. [25] showed that diabetic patients with hypertension are more likely to develop diabetic neuropathy.

In this research, patients with diabetic neuropathy generally experienced poor sleep quality. Diabetic neuropathy can be symptomatic or asymptomatic. Type-2 DM patients with peripheral neuropathy are more likely to experience recurrent nocturnal hypoxia, reduced sleep efficiency, fragmentation, and obstructive sleep apnea (OSA), among other sleep disorders. The patient's daily activities are severely disrupted by these sleep

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disorders, which result in excessive daytime sleepiness, poor glycemic control, decreased productivity, mood swings, impaired cognition, increased accident rates, and increased insulin resistance. Thus, early diagnosis and management of sleep disorders in diabetic neuropathy patients is essential for holistic patient management, increased productivity, reduced rates of diabetic complications, and improved quality of life [26].

Poor sleep quality increases susceptibility to pain, and neuropathic pain is linked to sleep problems, making it important to assess sleep quality in conjunction with neuropathic pain. In individuals with chronic pain, sleep disruptions are 50% to 80% common, and their severity is correlated with the degree of the pain [27]. What mechanisms underlie the interaction between sleep and pain have not been fully answered. Fu et al. explored the major central pathways associated with sleep and pain modulation and found that there is a reciprocal relationship between pain and sleep quality. An exploratory meta-analysis conducted by Fu et al. investigated the temporal relationship between sleep and pain, showing that sleep problems were prospectively associated with pain outcomes [28].

The primary symptoms of diabetic neuropathy are sensory and autonomic, and it progresses gradually and symmetrically. Along with sleep apnea syndrome, decreased sleep efficiency and increased sleep fragmentation trigger the hypothalamic-pituitary-adrenal axis, which raises sympathetic overactivity, oxidative stress, and systemic inflammation, all of which can lead to metabolic dysfunction and increased insulin resistance [26].

In this research at dr. Zainoel Abidin Hospital, the majority of respondents showed diabetic neuropathy with moderate severity. This is in line with the results of research by Karmilayanti et al. which assessed the severity of diabetic neuropathy based on DNS in Type-2 DM patients [26]. The severity of diabetic neuropathy is influenced by the duration of diabetes diagnosis [24]. This is supported by the results of research by Lai, et al. [29]. Other studies have shown that the incidence of diabetic neuropathy in patients who have been diagnosed with DM for longer than 5 years is not always progressive and can be reversible to a certain degree depending on the patient's initial condition.

In this research, the severity of diabetic neuropathy using TNS and NSS was strongly associated with the sleep quality of DM patients. An increase in the severity of diabetic neuropathy will increase the PSQI score and indicate a decrease in patient sleep quality. Research by Abu-Shennar et al. [30] examined the relationship of diabetic neuropathy to sleep quality assessed using the Michigan Neuropathy Screening Instrument (MNSI). The majority of patients with diabetic neuropathy showed poor sleep quality.

The result of this research corroborate the research by Karmilayanti et al. who found that there was a statistically significant relationship between the severity of peripheral diabetic neuropathy and sleep quality (global PSQI score). The more severe the degree of diabetic neuropathy, the worse the sleep quality is [26]. This is also in line with a study result by Prahardini et al. who found that the more severe the severity of diabetic neuropathy, the worse the quality of sleep, in line with the high prevalence of poor quality sleep of the patients. The higher the sleep quality scores is indicating more acute sleep disturbances and poorer sleep quality [31]. The PSQI cut-off value for the poor sleep quality indicator was five points (89.6% sensitivity and 86.5% specificity, respectively). Most subjects (14 out of 18 or 77.8%) had PSQI scores greater than 5, which indicates poor sleep quality [32].

Most patients have positive sensory symptoms, such as paresthesia and pain. Symptoms can include numbness, tingling, imbalance and falls, prickling, and burning sensations which are usually worse at night. In general, these symptoms are mild but can also be severe. Negative sensory symptoms are like the loss of sensitivity in the affected part. There is severe neuropathic pain, in the form of hyperesthesia, hyperalgesia, hyperpathia or even allodynia. This may progress to hypo or deep

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anesthetic sensitivities, such as tactile, vibration, and proprioceptive. More severe diabetic neuropathy symptoms at night cause sleep disturbances that can worsen the sleep quality of the sufferer [33]. Neuropathy symptoms, especially burning, stabbing, electric shock sensations and tingling, can disturb sleep. The pain can be persistent and accompanied by allodynia, which often worsens at night, causing sleep disturbances [13].

Sleep quality is one component of the quality of life. Sleep quality affects various aspects of life, including health, physical and cognitive function, and psychological effects [34]. Patients with diabetic neuropathy may experience severe pain, leading to dissatisfaction, fatigue, and distress, which ultimately reduces the quality of life of patients with DM. It is important to detect and undergo appropriate therapy of diabetic neuropathy and prevention of sleep disturbances to maximize the quality of life of patients with Type-2 DM.

This research found that diabetic neuropathy is strongly associated with the sleep quality of DM patients, so appropriate treatment strategies must be made. As far as the authors know, in Banda Aceh, there was no research that has juxtaposed the two tools for neuropathy severity, as this research assessed neuropathy severity subjectively and objectively. In addition, during the conduction of this research, the authors did not find significant weaknesses and obstacles. The author hopes that, on another opportunity, this topic can be developed with a wider selection of research instruments and more complex research variables, so there can be an expansion in knowledge regarding diabetic neuropathy and sleep quality of DM patients.

CONCLUSION

There was a significant relationship between the severity of diabetic neuropathy and sleep quality in patients with type 2 diabetes mellitus at dr. Zainoel Abidin Hospital in the last quarter of 2024. The correlation test showed a strong relationship from the TNS examinations and a very strong relationship from the NSS examinations. Most Type-2 DM patients with diabetic neuropathy had poor sleep quality, with a percentage of 87%. Most Type-2 diabetes mellitus patients had moderate neuropathy severity with a percentage of 44.9% on the NSS examination and 56.5% on the TNS examination. The results of this research can be taken into consideration in planning appropriate treatment strategies in patients with diabetic neuropathy, so that the quality of life of patients with diabetic neuropathy can be improved. This research can be developed by assessing other factors that contribute to increasing the risk of disruption of sleep quality in patients with diabetic neuropathy, so an assessment modality can be developed in hope that it can assess what factors are involved in sleep quality disorders. Identification of risk factors is expected to be identified and intervened as soon as possible and as optimally as possible.

REFERENCES

[1] U. Galicia-Garcia *et al.*, "Pathophysiology of Type 2 Diabetes Mellitus.," *Int. J. Mol. Sci.*, vol. 21, no. 17, Aug. 2020, doi: 10.3390/ijms21176275.

[2] A. Azriful, Y. Adnan, E. Bujawati, S. Alam, and N. Nildawati, "Mengungkap Fakta Faktor Risiko Diabetes Melitus Di Indonesia," *Media Penelit. dan Pengemb. Kesehat.*, vol. 34, no. 4, pp. 814–823, 2024, doi: 10.34011/jmp2k.v34i4.1988.

[3] International Diabetes Federation, "IDF Diabetes Atlas," Brussels, 2025.

[4] D. W. Soeatmadji, R. Rosandi, M. R. Saraswati, R. P. Sibarani, and W. O. Tarigan, "Clinicodemographic Profile and Outcomes of Type 2 Diabetes Mellitus in the Indonesian Cohort of DISCOVER: A 3-Year Prospective Cohort Study," *J. ASEAN Fed. Endocr. Soc.*, vol. 38, no. 1, pp. 68–74, May 2023, doi: 10.15605/jafes.038.01.10.

[5] Kementerian Kesehatan Republik Indonesia, "Penyakit Tidak Menular," in *Survei Kesehatan Indonesia (SKI)*, Jakarta: Kementerian Kesehatan Republik Indonesia, 2023,

https://doi.org/10.34011/jmp2k.v35i3.3102

e-ISSN: 2338-3445
p-ISSN: 0853-9987

pp. 223–279.
[6] F. Nasution, A. Andilala, and A. A. Siregar, "Faktor Risiko Kejadian Diabetes Mellitus," *J. Ilmu Kesehat.*, vol. 9, no. 2, pp. 94–102, 2021, doi: 10.32831/jik.v9i2.304.
[7] R. Galiero *et al.*, "Peripheral Neuropathy in Diabetes Mellitus: Pathogenetic Mechanisms and Diagnostic Options," *Int. J. Mol. Sci.*, vol. 24, no. 4, p. 3554, Feb. 2023, doi: 10.3390/ijms24043554.
[8] E. Gómez-Pimienta *et al.*, "Decreased Quality of Life in Individuals with Type 2 Diabetes Mellitus Is Associated with Emotional Distress," *Int. J. Environ. Res. Public Health*, vol. 16, no. 15, p. 2652, Jul. 2019, doi: 10.3390/ijerph16152652.
[9] H. Degu, A. Wondimagegnehu, Y. M. Yifru, and A. Belachew, "Is health related quality of life influenced by diabetic neuropathic pain among type II diabetes mellitus patients in Ethiopia?," *PLoS One*, vol. 14, no. 2, p. e0211449, Feb. 2019, doi: 10.1371/journal.pone.0211449.
[10] K. C. Chang, Y. W. Pai, C. H. Lin, I. Te Lee, and M. H. Chang, "Glycemic variability's impact on painful diabetic peripheral neuropathy in type 2 diabetes patients," *Sci. Rep.*, vol. 14, no. 1, p. 22276, 2024, doi: 10.1038/s41598-024-73472-y.
[11] C. Naranjo, M. Dueñas, C. Barrera, G. Moratalla, and I. Failde, "Sleep Characteristics in Diabetic Patients Depending on the Occurrence of Neuropathic Pain and Related Factors," *Int. J. Environ. Res. Public Health*, vol. 17, no. 21, p. 8125, Nov. 2020, doi: 10.3390/ijerph17218125.
[12] G. Casadei, M. Filippini, and L. Brognara, "Glycated Hemoglobin (HbA1c) as a Biomarker for Diabetic Foot Peripheral Neuropathy," *Diseases*, vol. 9, no. 1, 2021, doi: 10.3390/diseases9010016.
[13] D. Choi, B.-Y. Kim, C.-H. Jung, C.-H. Kim, and J.-O. Mok, "Association between Sleep Quality and Painless Diabetic Peripheral Neuropathy Assessed by Current Perception Threshold in Type 2 Diabetes Mellitus," *Diabetes Metab. J.*, vol. 45, no. 3, pp. 358–367, May 2021, doi: 10.4093/dmj.2019.0219.
[14] T. Issar *et al.*, "The utility of the Total Neuropathy Score as an instrument to assess neuropathy severity in chronic kidney disease: A validation study," *Clin. Neurophysiol.*, vol. 129, no. 5, pp. 889–894, 2018, doi: 10.1016/j.clinph.2018.02.120.
[15] A. Abulhaija, "The Relationship Between Total Neuropathy Score-reduced, Neuropathy Symptoms and Function," University of South Florida, 2017.
[16] Zamroni, A. Asmedi, and D. Nuradyo, "Neuropathy Symptom Score dan Neuropathy Deficit Score sebagai Skor Diagnostik Neuropati Diabetik," *Berk. Neurosains*, vol. 15, no. 1, pp. 46–53, 2016, doi: 10.22146/bns.v15i1.55726.
[17] A. Almalki *et al.*, "Sleep Quality Among a Sample of Medical Students and the Association with Academic Performance: An Updated Data," *J. Epidemiol. Glob. Health*, vol. 15, no. 8, 2025, doi: 10.1007/s44197-025-00345-6.
[18] A. Shahid, K. Wilkinson, S. Marcu, and C. M. Saphiro, "Pittsburgh Sleep Quality Index (PSQI)," in *STOP, THAT and One Hundred Other Sleep Scales*, New York: Springer US, 2011, pp. 279–283.
[19] J. Elliot *et al.*, "Female sex is a risk factor for painful diabetic peripheral neuropathy: the EURODIAB prospective diabetes complications study," *Diabetologia*, vol. 67, no. 1, pp. 190–198, 2024, doi: 10.1007/s00125-023-06025.
[20] M. E. Lenert, A. Avona, K. M. Garner, L. R. Barron, and M. D. Burton, "Sensory Neurons, Neuroimmunity, and Pain Modulation by Sex Hormones," *Endocrinology*, vol. 162, no. 8, Aug. 2021, doi: 10.1210/endocr/bqab109.
[21] A. Azmiardi, D. Tamtomo, and B. Murti, "Factors Associated with Diabetic Peripheral Neuropathy among Patients with Type 2 Diabetes Mellitus in Surakarta, Central Java," *Indones. J. Med.*, vol. 4, no. 4, pp. 300–312, 2019, doi: 10.26911/theijmed.2019.04.04.02.
[22] D. Abdissa *et al.*, "Prevalence and Determinants of Peripheral Neuropathy among Type 2 Adult Diabetes Patients Attending Jimma University Medical Center, Southwest Ethiopia,

https://doi.org/10.34011/jmp2k.v35i3.3102

e-ISSN: 2338-3445
p-ISSN: 0853-9987

2019, an Institutional-Based Cross-Sectional Study," *J. Diabetes Res.*, vol. 2020, 2020, doi: 10.1155/2020/9562920.

[23] R. L. Wu, N. Chen, Y. Chen, X. Wu, C. Y. Ko, and X. Y. Chen, "Visceral Adiposity as an Independent Risk Factor for Diabetic Peripheral Neuropathy in Type 2 Diabetes Mellitus: A Retrospective Study," *J. Diabetes Res.*, vol. 2024, p. 9912907, 2024, doi: 10.1155/2024/9912907.

[24] A. P. Picon, N. R. S. Ortega, R. Watari, C. Sartor, and I. C. N. Sacco, "Classification of the severity of diabetic neuropathy: a new approach taking uncertainties into account using fuzzy logic," *Clinics*, vol. 67, no. 2, pp. 151–156, Feb. 2012, doi: 10.6061/clinics/2012(02)10.

[25] W. Wang *et al.*, "Prevalence and risk factors of diabetic peripheral neuropathy: A population-based cross-sectional study in China," *Diabetes Metab. Res. Rev.*, vol. 39, no. 8, 2023, doi: 10.1002/dmrr.3702.

[26] Karmilayanti, Y. Goysal, M. I. Basri, S. Aulina, and A. K. Bintang, "The relationship between the severity of peripheral diabetic neuropathy and sleep quality in type 2 diabetic mellitus patients," *Med. Clínica Práctica*, vol. 4, p. 100210, Apr. 2021, doi: 10.1016/j.mcpsp.2021.100210.

[27] L. Ferini-Strambi, "Neuropathic Pain and Sleep: A Review," *Pain Ther.*, vol. 6, no. S1, pp. 19–23, Dec. 2017, doi: 10.1007/s40122-017-0089-y.

[28] L. Fu *et al.*, "Deteriorated sleep quality and associate factors in patients with type 2 diabetes mellitus complicated with diabetic peripheral neuropathy," *PeerJ*, vol. 12, p. e16789, Jan. 2024, doi: 10.7717/peerj.16789.

[29] Y. R. Lai *et al.*, "HbA1c Variability is Strongly Associated with the Severity of Peripheral Neuropathy in Patients with Type 2 Diabetes," *Front. Neurosci.*, vol. 13, no. FEB, pp. 1–9, 2019, doi: 10.3389/fnins.2019.00090.

[30] J. A. Abu-Shennar, I. Alenezi, N. Bayraktar, H. Bebis, H. Şahin, and Q. R. S. Qassar, "The Prevalence and Risk Factors of Diabetic Peripheral Neuropathy and its Impact on Sleep Quality Among Adult Patients with Type 2 Diabetes Mellitus," *Stechnolock Brain Neurol. Disord.*, vol. 1, no. 1, pp. 1–12, 2024.

[31] Y. T. A. Prahardini, S. Sasmiyanto, and S. A. Ginanjar, "Hubungan Neuropati Diabetikum dengan Kualitas Tidur Pada Pengidap DM Tipe 2 di Rumah Sakit Baladhika Husada Jember," *Protein J. Ilmu Keperawatan dan Kebidanan.*, vol. 2, no. 3, pp. 150–158, 2024, doi: 10.61132/protein.v2i3.579.

[32] M. Alshehri, "The Relationship Between Pain, Daily Function, and Sleep Quality in Diabetic Neuropathy," *Majmaah J. Heal. Sci.*, vol. 12, no. 1, p. 78, 2024, doi: 10.5455/mjhs.2024.01.008.

[33] R. Pop-Busui *et al.*, "Diabetic Neuropathy: A Position Statement by the American Diabetes Association," *Diabetes Care*, vol. 40, no. 1, pp. 136–154, Jan. 2017, doi: 10.2337/dc16-2042.

[34] M. Badri, M. Alkhaili, H. Aldhaheri, G. Yang, M. Albahar, and A. Alrashdi, "From good sleep to health and to quality of life – a path analysis of determinants of sleep quality of working adults in Abu Dhabi," *Sleep Sci. Pract.*, vol. 7, no. 1, p. 1, Feb. 2023, doi: 10.1186/s41606-023-00083-3.

https://doi.org/10.34011/jmp2k.v35i3.3102