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Relationship Between Sleep Quality and Blood Glucose Levels on Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: Poor sleep quality has been identified as a contributing factor to insulin resistance and metabolic dysfunction, which may negatively impact glycemic control in individuals with type 2 diabetes mellitus (T2DM). Sleep disturbances can exacerbate glucose dysregulation, increasing the risk of diabetes-related complications and impairing overall health outcomes. Therefore, maintaining good sleep quality is essential as part of a comprehensive strategy to manage T2DM and reduce its associated morbidity and mortality.
Objective: This study aims to examine the relationship between sleep quality and random blood glucose levels in patients with T2DM at the Cempaka Putih District Health Center.
Methods: A cross-sectional observational study was conducted involving 92 respondents selected using a purposive sampling technique. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), and random blood glucose levels were obtained from patient medical records. Data were analyzed using the chi-square test with a significance level of 0.05.
Results: The results revealed a significant association between sleep quality and random blood glucose levels ($p < 0.001$). Patients with poor sleep quality exhibited higher random blood glucose levels compared to those with good sleep quality.
Conclusion: These findings suggest that inadequate sleep may contribute to impaired glycemic regulation in individuals with T2DM.
Recommendations: Future research with a larger sample size and a more detailed examination of sleep parameters, including sleep duration and sleep disturbances, is recommended to provide deeper insights into the mechanisms underlying this relationship. Healthcare professionals should integrate sleep quality assessments into routine diabetes management to optimize patient care and improve health outcomes.

Keywords : random blood sugar, sleep quality, type 2 diabetes mellitus.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease characterized by elevated blood glucose (or blood sugar) levels, which over time can lead to serious complications affecting the heart, blood vessels, eyes, kidneys, and nerves. The most prevalent form is type 2 diabetes mellitus (T2DM), primarily occurring in adults, which results from insulin resistance or inadequate insulin production. Diabetes mellitus is classified based on the underlying factors contributing to hyperglycemia, including Type 1 Diabetes Mellitus, Type 2 Diabetes Mellitus, and Gestational Diabetes Mellitus (World Health Organization [WHO], 2024).

Random blood glucose levels reflect an individual's metabolic status and are influenced by multiple physiological and behavioral factors. In patients with T2DM, various domains are associated with random blood glucose levels, including role limitations due to physical health, physical functioning, general health perception, treatment satisfaction, symptom frequency, financial concerns, mental health, and dietary satisfaction (Yuswar et al., 2022).

Patients with T2DM often experience classic symptoms such as polyuria (frequent urination), polydipsia (excessive thirst), and polyphagia (increased hunger), along with other physical discomforts. These symptoms frequently occur at night, leading to sleep disturbances, including nocturia (frequent nighttime urination) and pain-related sleep disruption (Ministry of Health, Republic of Indonesia, 2022). Sleep disturbances have bidirectional implications: poor sleep quality increases the risk of developing T2DM, while diabetes itself negatively affects sleep quality. Physical, psychosocial, and environmental factors further contribute to sleep disorders in individuals with T2DM (Aliffia Bingga, 2021).

Sleep quality is a crucial determinant of overall health and well-being. It is commonly defined as an individual's satisfaction with their sleep experience, which is influenced by sleep duration, efficiency, and disturbances. Poor sleep quality has been linked to metabolic dysregulation, including insulin resistance, which can impair glucose metabolism and hinder daily functioning (Umam et al., 2020).

The Pittsburgh Sleep Quality Index **(**PSQI**)** is a widely used instrument to assess sleep quality, categorizing individuals into good or poor sleep quality based on a composite score. Poor sleep quality is associated with hormonal imbalances, particularly increased activity of the hypothalamic-pituitary-adrenal **(**HPA**)** axis and the sympathetic nervous system, leading to elevated secretion of catecholamines and cortisol. These hormonal changes contribute to impaired glucose tolerance and insulin resistance, which ultimately exacerbate diabetes mellitus. Cortisol plays a key role in gluconeogenesis—the process of glucose production from carbohydrates, proteins, and fats—thereby influencing glucose homeostasis during rest periods (Sumah, 2019).

Given the interplay between sleep quality and glucose metabolism, improving sleep patterns may serve as a preventive strategy to mitigate the morbidity and mortality associated with T2DM.

MATERIALS AND METHODS

This study employed a quantitative research design using observational analytical methods with a cross-sectional approach. The study was conducted at the Cempaka Putih Sub-District Health Center from July 3 to July 17, 2024. The study population consisted of patients diagnosed with type 2 diabetes mellitus (T2DM) at the Cempaka Putih District Health Center. A purposive sampling technique was used to select 92 respondents who met the inclusion criteria. Two main variables were analyzed in this study. First, sleep quality, assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire, developed by Buysse et al. (1989). The PSQI consists of seven components, with a total score of ≤5 indicating good sleep quality and >5 indicating poor sleep quality. Second, random blood glucose levels, measured using standard blood glucose examination procedures. Data collection was conducted

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through a structured, closed-ended questionnaire and blood glucose test results. Univariate analysis was performed to describe the distribution of variables using frequency and percentage calculations. Meanwhile, bivariate analysis was carried out using the chi-square test to examine the relationship between sleep quality and random blood glucose levels. A significance level (α) of 0.05 was applied to determine statistical significance. This study was funded by the PGI Cikini College of Health Sciences under Hibah LPPM 2024 (SK No. 019/sk/STIKes.Cik/III/2025)

RESULTS

This study examined the relationship between sleep quality and random blood glucose levels in patients with type 2 diabetes mellitus (T2DM) at the Cempaka Putih District Health Center. The results are presented in four sections:

a. Demographic characteristics of respondents

Table 1 presents the demographic characteristics of the respondents, including age, gender, education level, and occupation.

Table 1 Frequency distribution of respondent characteristics

Variable	Categorize	Frequency (n)	Percentage (%)
Age	Early Adulthood (26 – 35 Years)	3	3.3
	Late Adulthood (36 – 45 Years)	7	7.6
	Early Elderly (46 – 55 Years)	16	17.4
	Late Elderly (56 – 65 Years)	37	40.2
	Seniors (> 65 Years)	29	31.5
Gender	Male	29	31.5
	Female	63	68.5
Education	Elementary School	2	2.2
	Junior High School	35	38.0
	High School	33	35.9
	College	22	23.9
Job	Unemployment	66	71.7
	Government employee	2	2.2
	Private sector employee	18	19.6
	Businessperson	5	5.4
	Farmer / Farm Laborer / Fisher	1	1.1
Total		92	100.0

The results indicate that 40.2% of respondents were in the late elderly category (56–65 years old), with the majority being female (68.5%). In terms of education level, junior high school was the most common level (38%). Regarding employment status, 71.7% of respondents were unemployed.

b. Distribution of respondents based on sleep quality

Table 2 presents the distribution of respondents based on their sleep quality, assessed using the Pittsburgh Sleep Quality Index **(**PSQI**)**.

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Table 2 Frequency Distribution of Respondent Characteristics Based on Sleep Quality

Sleep Quality	Frequency (n)	Percentage (%)
Good	20	21,7
Poor	72	78,3
Total	92	100

The results show that the majority of respondents (78.3%) had poor sleep quality, while only 21.7% had good sleep quality.

c. Distribution of respondents based on random blood glucose levels

Table 3 presents the distribution of respondents based on random blood glucose levels, categorized as normal or abnormal.

Table 3. Frequency Distribution Based on Random Blood Sugar

Blood Glucose Category	Frequency (n)	Percentage (%)
Normal (70 – 139)	26	28,3
Abnormal (<70- ≥140)	66	71,7
Total	92	100

Table 3 shows that the majority of respondents are in the abnormal category for random blood sugar, with a total of 71.7% of respondents.

d. Relationship between sleep quality and random blood glucose levels

Table 4 presents the relationship between sleep quality and random blood glucose levels using the chi-square test.

Table 4 Relationship between Sleep Quality and Random Blood Sugar Random Blood Sugar Levels

Sleep Quality	Normal		Abnormal		Total		*p-value*
	f	%	f	%	f	%	
Good Sleep Quality	12	60,0%	8	40,0%	20	100%	
Poor Sleep Quality	14	19,4%	58	80,6	72	100%	<0,001
Total	26	28,3	66	71,7	92	100	

The statistical analysis using the chi-square test yielded a p-value <0.001, indicating a significant relationship between sleep quality and random blood glucose levels. The findings suggest that respondents with poor sleep quality were more likely to have abnormal blood glucose levels compared to those with good sleep quality.

DISCUSSION

Sleep quality is a crucial determinant of overall health, particularly in individuals with type 2 diabetes mellitus (T2DM). It encompasses various aspects such as psychological comfort, physical relaxation before sleep, and the depth of sleep (Nashor & Wulandari, 2017). In this study, a significant proportion of respondents (78.3%) reported poor sleep quality, with the sleep duration component being the most affected. These findings align with previous research indicating that both short and long sleep durations are associated with an increased risk of developing T2DM (Cappuccio et al., 2010; Shan et

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al., 2015). Specifically, individuals sleeping less than 5–6 hours per night have nearly twice the risk of developing prediabetes and T2DM compared to those sleeping 7–8 hours per night (Antza et al., 2022).

Physiological sleep disturbances contribute to poor glycemic control by affecting the endocrine system. Sleep deprivation has been shown to reduce insulin sensitivity by 29% and alter glucose metabolism, leading to hyperglycemia (Kolb & Martin, 2017; Spiegel et al., 1999). Moreover, excessive sleep duration has been linked to a 60% higher risk of developing metabolic syndrome (Shan et al., 2015). In this study, 71.7% of respondents had abnormal random blood glucose (RBG) levels, supporting prior evidence that sleep disorders contribute to impaired glucose homeostasis (Reutrakul & Van Cauter, 2018).

The relationship between sleep quality and blood glucose levels is bidirectional. Poor sleep can disrupt metabolic regulation, while hyperglycemia itself may lead to frequent nocturnal awakenings due to polyuria, restless legs syndrome, or autonomic dysfunction (Setianingsih & Diani, 2022). Studies have further demonstrated that individuals with sleep-disordered breathing or fragmented sleep have significantly higher fasting glucose levels and an increased risk of developing diabetes (Stamatakis & Punjabi, 2010; Tentero, Pangemanan, & Polii, 2016).

Addressing sleep disturbances in T2DM patients is critical. Evidence suggests that improving sleep hygiene can enhance glycemic control and overall quality of life (Reutrakul & Van Cauter, 2018). Therefore, healthcare professionals should incorporate sleep assessments into diabetes management protocols and consider behavioral interventions to improve sleep quality. Future research should focus on longitudinal studies to establish causality and evaluate targeted sleep interventions in T2DM management.

CONCLUSIONS

The worse the respondent's sleep quality, the higher the results of the random blood sugar test. Recommendations for further research are to conduct research with a larger number of respondents and more specifically use the sleep duration variable as part of sleep quality.

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Availability of Data and Materials

The datasets generated and analyzed during this study are available from the corresponding author upon reasonable request.

Authors' Contributions

L.Y and S.M.P conceptualized the study and designed the methodology. S.F.D and L.Y collected and analyzed the data. H.K.S and S.M.P wrote the original draft, and all authors contributed to reviewing and editing the manuscript. All authors have read and approved the final version of the manuscript.

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Conflict of Interest

There is no conflict of interest in this researches.

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