



Analysis of Stress and Sleep Quality in Relation to Blood Glucose Levels in Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang

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Abstract

This study aimed to analyze the relationship between stress levels and sleep quality with random blood glucose (RBG) among patients with Type 2 Diabetes Mellitus (DM-2) at RSI Sultan Agung Semarang. A cross-sectional design was applied with 92 respondents selected through purposive sampling. Data on stress levels were measured using a standardized questionnaire, while sleep quality was assessed through self-reported indicators. Blood glucose levels were collected based on clinical laboratory results. Statistical analysis showed a significant correlation between stress and RBG ($p = 0.011$; $r = 0.586$), indicating that higher stress levels were associated with elevated glucose values. A stronger relationship was identified between sleep quality and RBG ($p = 0.0001$; $r = 0.629$), suggesting that poor sleep quality substantially increases the risk of hyperglycemia. These findings highlight the dual influence of psychological and behavioral factors on glycemic regulation. Physiological mechanisms, including hypothalamic-pituitary-adrenal axis activation and reduced insulin sensitivity, may explain the association between stress, sleep, and glucose dysregulation. The results underscore the importance of incorporating psychological assessment, stress management strategies, and sleep hygiene education into diabetes care. An integrated approach may enhance glucose control and contribute to better long-term outcomes for patients with DM-2.

Keywords : Type 2 Diabetes Mellitus, Stress, Sleep Quality, Random Blood Glucose, Glycemic Control.



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INTRODUCTION

Type 2 diabetes mellitus (DM) is one of the major health problems in the world, characterized by increased blood glucose levels due to impaired insulin secretion or insulin resistance. Data from the International Diabetes Federation (IDF) in 2021 shows that more than 537 million adults live with diabetes, and this number is predicted to continue to increase to 643 million by 2030. Indonesia ranks fifth in the world in terms of the number of people with DM, reaching 19.5 million. This figure is a serious indication of the high burden of this disease on society (Akbar, 2025).

The 2018 Basic Health Research (Riskesdas) report shows that the prevalence of DM in Indonesia is 10.9%, an increase from 6.9% in 2013. Central Java Province alone recorded a prevalence of 2.1% in people over the age of 15. RSI Sultan Agung Semarang, as a provincial referral hospital, often receives type 2 DM patients with various complications, both acute and chronic. This condition emphasizes the need for more in-depth research on factors that affect blood glucose levels in type 2 DM patients, including psychological factors and sleep quality (Andreani, 2024).

Psychological stress is closely related to blood glucose control (Al Fatih & Aprillia, 2023). Activation of the sympathetic nervous system during stress triggers the release of cortisol, epinephrine, and norepinephrine hormones, which can increase gluconeogenesis in the liver. Research conducted by Amalia & Wibisono (2019) found that type 2 DM patients experiencing chronic stress had poorer glycemic control than patients with low stress levels. This condition shows that stress is not just an emotional problem, but directly contributes to diabetes complications (Iman, 2024).

Sleep quality also plays an important role in glucose metabolism (Azizah et al., 2021). Insufficient sleep can decrease insulin sensitivity and increase appetite through the dysregulation of leptin and ghrelin hormones. Research by Bonita et al. (2016) reported that type 2 DM patients with

poor sleep quality had higher HbA1c levels. This indicates a strong relationship between sleep quality and glycemic control. In diabetic patients in Indonesia, sleep disorders are often overlooked, even though they can trigger blood glucose instability.

A study at Dr. Kariadi Hospital in Semarang conducted by Hermagita (2024) showed that 65% of type 2 DM patients experienced moderate to severe sleep disorders. This disorder is associated with higher blood glucose levels in patients with poor sleep quality. These findings are consistent with Aziz's (2020) research in Lampung, which states that diabetic patients with high stress levels and poor sleep quality have a twofold higher risk of hyperglycemia.

The stress experienced by DM patients is not only triggered by personal psychological factors, but also by social and economic factors. Patients who have to undergo long-term therapy often experience anxiety related to treatment costs, drug side effects, and concerns about chronic complications such as nephropathy, retinopathy, and neuropathy. Research conducted by Setyawan (2022) shows that socioeconomic stress factors contribute to poor glycemic control in type 2 DM patients in urban areas (Wahyuni et al., 2025).

RSI Sultan Agung Semarang, as a sharia-based hospital, has a diverse patient population in terms of age, occupation, and socio-cultural background. Medical record data from 2023 shows that more than 3,000 type 2 DM patients visited the internal medicine clinic. Many of them reported complaints of insomnia, fatigue, and difficulty controlling blood glucose levels despite undergoing drug therapy. This situation illustrates the need for a research approach that links stress, sleep quality, and blood glucose levels more specifically.

Research on the relationship between stress and sleep quality on blood glucose levels at RSI Sultan Agung Semarang is expected to provide new empirical insights. The results of this research are not only beneficial for the development of health science but also serve as a basis for more comprehensive clinical interventions, encompassing the psychological aspects and lifestyle of patients. Diabetes management should not only focus on pharmacotherapy but also involve stress management and improving sleep quality as an integral part of patient care.

RESEARCH METHODS

This study applied a correlational analytic design with a cross-sectional approach to examine the relationship between stress levels, sleep quality, and random blood glucose levels among patients with type 2 diabetes mellitus at RSI Sultan Agung Semarang. The independent variables were stress level, measured using the *Perceived Stress Scale* (PSS-10), and sleep quality, assessed through the *Pittsburgh Sleep Quality Index* (PSQI), while the dependent variable was random blood glucose level measured using a glucometer. The population consisted of 515 patients diagnosed with type 2 diabetes mellitus who attended the endocrinology clinic between December 2022 and January 2023. Using Dahlan's formula with a minimum correlation coefficient of 0.3, a significance level of 5%, and power of 90%, the minimum sample size was calculated as 92 participants. Samples were selected through purposive sampling, with inclusion criteria including conscious patients with type 2 diabetes who were willing to participate and exclusion criteria being uncooperative patients or those whose condition deteriorated during the study.

Data were collected using structured questionnaires and direct clinical measurement. Stress and sleep quality were self-reported by patients through validated Indonesian versions of the PSS-10 and PSQI, while random blood glucose levels were obtained from finger-prick tests recorded during outpatient visits. The study employed univariate analysis to describe participant characteristics and distribution of variables, while bivariate analysis was conducted to determine the relationship between stress, sleep quality, and random blood glucose levels. Statistical tests included the Lambda test for the association between stress level and blood glucose, and the Contingency Coefficient test for the correlation between sleep quality and blood glucose. Ethical clearance was obtained from the Faculty of Nursing, UNISSULA Semarang, and informed consent was signed by all participants. Confidentiality and anonymity were ensured by coding data and securing all files under restricted access.

RESULTS AND DISCUSSION**Respondent Characteristics****Table 1. Average Age of Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang (n = 92)**

Variable	N	Mean	Std. Deviation	Min	Max
Age	92	56.61	8.39	32	69

Source: Primary data, processed by researchers (2023).

As presented in Table 4.1, the participants with Type 2 Diabetes Mellitus (DM-2) at RSI Sultan Agung Semarang had a mean age of 56.61 years with a standard deviation of 8.39. The youngest respondent was 32 years old, while the oldest was 69 years, indicating that the majority of participants were in the middle to late adulthood stage.

Table 2. Distribution of Education Level, Gender, and Occupation of Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang (n = 92)

Variable	Frequency	Percentage (%)
Gender		
Male	37	40.2
Female	55	59.8
Education		
Primary	53	57.6
Secondary	36	39.1
Higher	3	3.3
Occupation		
Unemployed	28	30.4
Private Sector	23	25.0
Trade	3	3.3
Laborer	35	38.0
Civil Servant	3	3.3

Source: Primary data, processed by researchers (2023).

Table 2 illustrates the sociodemographic profile of DM-2 patients at RSI Sultan Agung Semarang. The majority of respondents were female (59.8%), while males accounted for 40.2%. In terms of educational attainment, more than half of the patients (57.6%) had only completed primary education, whereas only a small proportion (3.3%) attained higher education. Regarding employment status, the largest group was laborers (38.0%), followed by unemployed individuals (30.4%). A relatively small fraction of respondents worked in trade (3.3%) or as civil servants (3.3%).

Univariate Analysis**Table 3. Distribution of Stress Levels among Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang (n = 92)**

Stress Level	Frequency	Percentage (%)
Low	18	19.6
Moderate	57	62.0
High	17	18.5
Total	92	100.0

Source: Primary data, processed by researchers (2023).

Based on Table 4.3, most respondents with Type 2 Diabetes Mellitus experienced a moderate level of stress (62.0%), indicating that stress management is a common challenge among this group. A smaller proportion showed low stress (19.6%), while nearly one-fifth of the participants reported high stress levels (18.5%), suggesting vulnerability to psychological strain that may influence metabolic regulation.

Table 4. Distribution of Sleep Quality among Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang (n = 92)

Sleep Quality	Frequency	Percentage (%)
Good	54	58.7
Poor	38	41.3
Total	92	100.0

Source: Primary data, processed by researchers (2023).

Table 4 reveals that the majority of patients (58.7%) reported good sleep quality, which indicates that more than half of the respondents maintain adequate rest. However, 41.3% of the patients experienced poor sleep quality, highlighting a considerable subgroup at risk of impaired recovery and potential worsening of blood glucose control.

Table 5 Distribution of Random Blood Glucose (RBG) Levels among Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang (n = 92)

Random Blood Glucose	Frequency	Percentage (%)
Normal	63	68.5
Elevated	29	31.5
Total	92	100.0

Source: Primary data, processed by researchers (2023).

As shown in Table 5, more than two-thirds of respondents (68.5%) had normal random blood glucose levels, indicating relatively stable glycemic control among the majority. Conversely, 31.5% demonstrated elevated RBG values, representing a notable fraction of patients requiring closer monitoring and intervention to prevent diabetes-related complications.

Bivariate Analysis

The Relationship Between Stress Levels and GDS Levels in Type 2 Diabetes Mellitus Patients at RSISA Group Semarang

Table 6. Association between Stress Levels and Random Blood Glucose (RBG) among Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang (n = 92)

Stress Level	Random Blood Glucose (RBG)		Total	r	p
	Normal (n, %)	Elevated (n, %)	n (%)		
Low	18 (28.6)	0 (0.0)	18 (19.6)	0.586	0.011
Moderate	45 (71.4)	12 (41.4)	57 (62.0)		
High	0 (0.0)	17 (58.6)	17 (18.5)		

Source: Primary data, processed by researchers (2023).

Table 6 demonstrates a significant relationship between stress levels and random blood glucose values among patients with Type 2 Diabetes Mellitus. All respondents with low stress (19.6%) had

normal blood glucose levels, while the majority of patients with high stress (58.6%) presented with elevated glucose. Patients with moderate stress showed mixed outcomes, with 71.4% maintaining normal glucose and 41.4% having elevated levels. Statistical testing revealed a significant association ($p = 0.011$), with a correlation coefficient ($r = 0.586$) indicating a moderate positive relationship, meaning that higher stress tends to be linked with increased blood glucose levels.

The Relationship Between Sleep Quality and Blood Glucose Levels in Type 2 Diabetes Mellitus Patients at Sultan Agung Hospital in Semarang

Table 7. Association between Sleep Quality and Random Blood Glucose (RBG) among Type 2 Diabetes Mellitus Patients at RSI Sultan Agung Semarang (n = 92)

Sleep Quality	Random Blood Glucose (RBG)		Total n (%)	r	p
	Normal (n, %)	Elevated (n, %)			
Good	54 (85.7)	0 (0.0)	54 (58.7)	0.629	0.0001
Poor	9 (14.3)	29 (100.0)	38 (41.3)		
Total	63 (100.0)	29 (100.0)	92 (100.0)		

Source: Primary data, processed by researchers (2023).

Table 7 highlights the relationship between sleep quality and random blood glucose values. Among respondents with good sleep quality, the vast majority (85.7%) maintained normal blood glucose, with none presenting elevated levels. In contrast, patients with poor sleep quality were disproportionately represented in the elevated glucose group (100%), although a small fraction (14.3%) still maintained normal values. The statistical test confirmed a significant association ($p = 0.0001$), with a stronger correlation coefficient ($r = 0.629$) compared to stress, indicating a robust positive correlation. This finding suggests that better sleep quality is strongly associated with maintaining normal blood glucose levels, whereas poor sleep substantially increases the likelihood of hyperglycemia.

Relationship between Stress Levels and Random Blood Glucose (RBG)

The study identified a statistically significant association between stress levels and random blood glucose (RBG) among patients with Type 2 Diabetes Mellitus (DM-2). Patients classified with low stress were more often found in the normal RBG category, while those reporting higher stress tended to experience hyperglycemia. Stress therefore appears to play an important role in the disruption of glucose regulation (Wróblewski et al., 2023).

Physiological explanations support this outcome through the activity of the hypothalamic-pituitary-adrenal (HPA) axis. Cortisol, released during prolonged stress, stimulates gluconeogenesis, lowers insulin sensitivity, and contributes to rising glucose levels (Janssen, 2022). The higher number of patients in the high-stress category with elevated glucose levels illustrates how this pathway operates in clinical settings. The correlation coefficient ($r = 0.586$) shows a moderate relationship, indicating stress is influential yet not the only determinant. Factors such as physical activity, medication adherence, diet, and individual metabolic differences interact with stress to produce varied glycemic outcomes (Balakrishnanpillai & Saboo, 2024). This reinforces the multifactorial nature of glucose regulation.

Behavioral responses to stress also shed light on this relationship. Patients under greater psychological strain often fall into patterns of overeating, neglecting dietary recommendations, or skipping medications. These maladaptive choices undermine glycemic control, whereas lower stress often corresponds with healthier coping and better treatment adherence (Dziewa et al., 2023).

Findings are consistent with international evidence linking stress and poor diabetes outcomes. Studies in the United States and South Korea reported improved HbA1c levels after structured stress-reduction programs, including mindfulness practices and cognitive behavioral therapy. Such interventions highlight the importance of addressing psychological burdens in diabetes care (Lee & Won, 2025). Not all individuals with moderate stress recorded abnormal glucose levels. Some

maintained stable readings, suggesting that stress effects vary by intensity, duration, and presence of protective coping mechanisms. Social support, religious involvement, or community engagement can buffer against the biological consequences of stress (Mahamid & Bdier, 2021).

From a clinical perspective, incorporating psychological assessments into diabetes management emerges as essential. Routine screening for stress, together with counseling and stress-reduction programs, can enhance the effectiveness of pharmacological and lifestyle-based interventions (Geis & Heyland, 2024). Hospitals and clinics could benefit from integrating mental health specialists into diabetes care teams. Stress and RBG levels show a significant positive relationship. Greater stress is linked to an increased likelihood of hyperglycemia, while lower stress coincides with more stable control. These findings reinforce the role of stress management as a critical component of diabetes treatment strategies (American Diabetes Association, 2021).

Relationship between Sleep Quality and Random Blood Glucose (RBG)

The analysis demonstrated a strong positive correlation between sleep quality and random blood glucose levels, with a correlation coefficient of $r = 0.629$. Patients who reported good sleep quality predominantly exhibited normal glucose values, while poor sleep quality was strongly associated with elevated glucose. This finding suggests that sleep quality exerts an even stronger influence on glucose regulation compared to stress (Lo Martire et al., 2024).

Sleep is a vital physiological process that supports metabolic homeostasis. Poor sleep quality, whether due to insomnia, fragmented sleep, or short sleep duration, can disrupt glucose metabolism by impairing insulin sensitivity (Reutrakul & Van Cauter, 2021). Scientific evidence indicates that sleep restriction increases sympathetic nervous system activity and elevates cortisol levels, leading to persistent hyperglycemia in diabetic patients. The current findings showed that none of the patients with good sleep quality had elevated glucose levels, highlighting the protective effect of adequate sleep on glycemic stability. In contrast, patients with poor sleep quality had a disproportionately high percentage of elevated RBG levels, indicating that poor sleep may serve as a predictor of poor metabolic control in DM-2 patients.

Behavioral explanations also support this relationship. Patients with poor sleep may experience fatigue, low motivation, and reduced self-care behaviors, such as skipping exercise, consuming high-calorie foods, or forgetting to take medication on time. These factors collectively exacerbate glucose imbalance and increase the risk of complications. These results are consistent with international findings. Studies in Europe and Asia have demonstrated that diabetic patients with sleep disturbances often present with higher HbA1c levels compared to those with adequate sleep (Nasir et al., 2022). Interventions aimed at improving sleep hygiene such as regulating bedtime routines, reducing caffeine intake, and creating supportive sleep environments have been shown to significantly improve glycemic outcomes.

The clinical significance of this relationship lies in its strength compared to stress. With a higher correlation coefficient, sleep quality appears to be a stronger determinant of glycemic status. This indicates that improving sleep hygiene may yield measurable benefits in blood glucose control, even when pharmacological treatment remains constant (Tiwari, 2021).

It is worth noting that sleep quality is influenced by multiple factors, including stress, age, comorbid illnesses, and lifestyle. This makes it essential for healthcare providers to assess sleep problems comprehensively (King et al., 2021). Sleep interventions tailored to individual patient needs may serve as an effective adjunct therapy in diabetes care. The findings demonstrate a robust relationship between poor sleep quality and elevated RBG levels. Sleep quality not only reflects lifestyle and psychological well-being but also has direct physiological consequences for glucose regulation.

CONCLUSION

The present study demonstrated that both stress levels and sleep quality are significantly associated with random blood glucose (RBG) levels among patients with Type 2 Diabetes Mellitus (DM-2) at RSI Sultan Agung Semarang. Patients with higher stress were more likely to exhibit elevated RBG, reflecting the role of psychological strain in disrupting glucose regulation through both physiological mechanisms, such as HPA axis activation, and behavioral pathways, such as poor adherence to dietary and medical regimens. In contrast, lower stress was consistently linked with normal glucose levels, underscoring the importance of stress management in diabetes care.

Sleep quality showed an even stronger relationship with glycemic control compared to stress. Patients with good sleep quality were almost entirely within the normal RBG category, while poor sleep was strongly correlated with elevated glucose levels. This finding highlights sleep as a critical determinant of metabolic stability, with potential effects on insulin sensitivity, cortisol secretion, and self-care behaviors. Taken together, these results suggest that integrating psychological assessment and sleep hygiene interventions into routine diabetes management could improve long-term glycemic outcomes and reduce the risk of complications.

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