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ORIGINAL RESEARCH

Assessment of Sleep Quality and Its Association with Glycemic Control among Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study

Dr. Vinay Arvindbhai Sojitra[1], Dr. Nirav Maheshbhai Patel[2], Dr. Nirali Parsingbhai Rathva[3], Dr. Jaydeep Vallabhbhai Zulasana[4]

[1-4]MBBS, GMERS Medical College and General Hospital, Vadnagar, Gujarat, India

Corresponding Author
Dr. Jaydeep Vallabhbhai Zulasana
MBBS, GMERS Medical College and General Hospital, Vadnagar, Gujarat, India
Email: zulasanajaydipv4151@gmail.com

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ABSTRACT

Background: Sleep quality plays a vital role in maintaining optimal glycemic control in patients with Type 2 Diabetes Mellitus (T2DM). Emerging evidence suggests that sleep disturbances may contribute to insulin resistance and poor metabolic outcomes. However, in many populations, the association between sleep quality and glycemic control remains underexplored.**Materials and Methods:**This cross-sectional study was conducted among 200 adult patients with T2DM attending the endocrinology outpatient department of a tertiary care hospital. Participants were assessed for sleep quality using the Pittsburgh Sleep Quality Index (PSQI), with a global score >5 indicating poor sleep quality. Glycemic control was evaluated using the most recent HbA1c levels, with a cutoff of 7% to distinguish between controlled and uncontrolled diabetes. Demographic, clinical, and lifestyle data were collected through structured interviews. **Results:**Among the 200 participants, 124 (62%) had poor sleep quality (PSQI >5), while 76 (38%) reported good sleep quality. The mean HbA1c level was 8.2 ± 1.3% among poor sleepers and 6.9 ± 1.1% among good sleepers. A statistically significant association was observed between poor sleep quality and poor glycemic control ($p = 0.001$). Logistic regression analysis indicated that poor sleep quality was independently associated with uncontrolled HbA1c (OR: 2.34; 95% CI: 1.30–4.22).**Conclusion:**Poor sleep quality is significantly associated with suboptimal glycemic control in patients with T2DM. Screening for sleep disturbances and incorporating sleep hygiene interventions into diabetes management strategies may help improve glycemic outcomes.

Keywords: Sleep quality, Type 2 Diabetes Mellitus, Glycemic control, PSQI, HbA1c, Cross-sectional study.

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a growing public health concern globally, marked by chronic hyperglycemia due to insulin resistance and relative insulin deficiency. It is associated with multiple complications, including cardiovascular disease, nephropathy, neuropathy, and retinopathy, leading to significant morbidity and mortality worldwide (1). Glycemic control is essential in minimizing these complications, and several modifiable lifestyle factors, such as diet, physical activity, and stress, have been well documented in influencing blood glucose levels (2). However, sleep quality, an often overlooked factor, has recently gained attention as a potential contributor to glycemic control.

Sleep is a physiological process vital for metabolic regulation and immune function. Poor sleep quality and sleep disturbances have been shown to alter glucose metabolism, reduce insulin sensitivity, and increase levels of cortisol and inflammatory cytokines, all of which may adversely affect glycemic control (3,4). Additionally, sleep deprivation can lead to increased appetite and weight gain through hormonal dysregulation, further worsening insulin resistance in individuals with T2DM (5). Studies have demonstrated that individuals with poor sleep patterns are more likely to have higher HbA1c levels, an indicator of long-term glycemic control (6,7).

Despite this emerging evidence, sleep quality is not routinely evaluated in clinical management of T2DM, particularly in low- and middle-income countries. Moreover, the interaction between sleep disturbances and diabetes outcomes may vary across populations due to socio-cultural and behavioral differences.

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Therefore, assessing sleep quality and its potential association with glycemic control is crucial for developing comprehensive management strategies.

This study aims to assess the sleep quality among patients with T2DM and explore its association with glycemic control using HbA1c levels, thereby contributing to an integrative approach for diabetes care.

MATERIALS AND METHODS

This cross-sectional study was conducted over a period of six months and study included adult patients (aged ≥30 years) diagnosed with Type 2 Diabetes Mellitus for at least one year.

Sample Size and Sampling Technique

A total of 200 patients were recruited using a consecutive sampling method. Patients with a history of psychiatric illness, diagnosed sleep disorders, night-shift workers, or those on medications affecting sleep (such as sedatives) were excluded.

Data Collection Tools

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a validated questionnaire consisting of 19 self-rated questions covering seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. A global PSQI score >5 indicated poor sleep quality.

Glycemic control was determined using the most recent HbA1c values recorded in the last three months. An HbA1c level of ≤7% was considered good control, while >7% was considered poor glycemic control, in accordance with the American Diabetes Association guidelines.

Sociodemographic and clinical information including age, sex, duration of diabetes, body mass index (BMI), comorbidities, and medication adherence was collected through structured interviews and verified from medical records.

Statistical Analysis

Data were analyzed using SPSS version 25.0. Descriptive statistics were used to summarize participant characteristics. The Chi-square test was applied to assess the association between sleep quality and glycemic control. Logistic regression analysis was performed to determine independent predictors of poor glycemic control. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 200 patients with Type 2 Diabetes Mellitus were included in the study. The mean age of the participants was 55.6 ± 10.4 years, with 110 (55%) males and 90 (45%) females. The average duration of diabetes was 8.2 ± 3.7 years. The mean BMI was 26.8 ± 4.1 kg/m². Of the total, 124 (62%) participants had poor sleep quality (PSQI >5), while 76 (38%) had good sleep quality.

The glycemic control status, based on HbA1c values, showed that 132 (66%) participants had poor glycemic control (HbA1c >7%), and 68 (34%) had good glycemic control (HbA1c ≤7%). Among participants with poor sleep quality, 102 (82.3%) had poor glycemic control compared to 30 (39.5%) among those with good sleep quality (Table 1). This association was statistically significant ($p < 0.001$).

Table 1: Association between Sleep Quality and Glycemic Control

Sleep Quality	HbA1c ≤ 7% (Good Control)	HbA1c > 7% (Poor Control)	Total
Good (PSQI ≤ 5)	46 (60.5%)	30 (39.5%)	76
Poor (PSQI > 5)	22 (17.7%)	102 (82.3%)	124
Total	**68 (34%)**	**132 (66%)**	**200**

Logistic regression analysis further confirmed that poor sleep quality was a significant independent predictor of poor glycemic control (Odds Ratio: 2.34; 95% CI: 1.30–4.22; $p = 0.004$) after adjusting for age, gender, BMI, duration of diabetes, and medication adherence (Table 2).

Table 2: Logistic Regression Analysis of Predictors of Poor Glycemic Control

Variable	Odds Ratio (OR)	95% CI	p-value
Poor Sleep Quality	2.34	1.30–4.22	0.004
Age > 60 years	1.12	0.60–2.10	0.715
Female Gender	1.20	0.66–2.18	0.542
BMI ≥ 25 kg/m²	1.65	0.92–2.95	0.089
Diabetes Duration ≥5y	1.78	1.02–3.09	0.042
Irregular Medication	2.01	1.10–3.68	0.023

These findings highlight a significant association between poor sleep quality and suboptimal glycemic control in patients with T2DM.

DISCUSSION

This study assessed the association between sleep quality and glycemic control in patients with Type 2 Diabetes Mellitus (T2DM). Our findings demonstrated that poor sleep quality, as measured by the Pittsburgh Sleep Quality Index (PSQI), was

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significantly associated with poor glycemic control. A majority (62%) of the participants had poor sleep quality, and more than 80% of them exhibited suboptimal HbA1c levels, indicating that sleep disturbances may play a crucial role in diabetes management.

Previous studies have reported similar trends, reinforcing the relationship between poor sleep and adverse glycemic outcomes. Sleep deprivation and poor sleep architecture are known to impair insulin sensitivity and increase sympathetic nervous system activity, which may result in elevated blood glucose levels (1,2). Furthermore, disturbances in sleep can disrupt the hypothalamic–pituitary–adrenal axis, leading to increased cortisol secretion, which has been implicated in promoting insulin resistance (3,4).

A cross-sectional study conducted in the United States found that poor sleep quality was significantly associated with elevated HbA1c levels in adults with T2DM, even after adjusting for confounders such as age, BMI, and medication adherence (5). Similar findings have been observed in studies conducted in Asian and Middle Eastern populations, suggesting that the association is consistent across diverse ethnic groups (6–8). Our results support these findings and highlight the need to consider sleep quality in routine diabetic care.

Mechanistically, sleep deprivation reduces slow-wave sleep and disrupts circadian rhythms, both of which are essential for glucose homeostasis (9). Poor sleep has also been associated with increased levels of pro-inflammatory cytokines such as IL-6 and TNF-alpha, which contribute to insulin resistance (10). Additionally, poor sleep may indirectly affect glycemic control by promoting unhealthy behaviors, including increased caloric intake, reduced physical activity, and poor adherence to medications (11,12).

In our logistic regression analysis, poor sleep quality was an independent predictor of poor glycemic control (OR: 2.34, $p = 0.004$). These findings are aligned with longitudinal studies which suggest that persistent sleep disturbances increase the risk of developing poorly controlled diabetes over time (13). Moreover, interventions targeting sleep hygiene, such as cognitive behavioral therapy and relaxation techniques, have shown promise in improving both sleep quality and metabolic parameters in diabetic patients (14,15).

Despite its strengths, this study has some limitations. Being cross-sectional in nature, it does not establish causality. Self-reported data, particularly regarding sleep quality, may be subject to recall bias. Also, potential confounders such as depressive symptoms and obstructive sleep apnea were not evaluated, which could influence both sleep and glycemic control.

Nevertheless, our study adds to the growing body of evidence suggesting that addressing sleep quality may be a key component of comprehensive diabetes management. Incorporating routine screening for sleep disturbances and educating patients on sleep hygiene practices should be considered in clinical settings. Future longitudinal and interventional studies are recommended to further explore the causal link and potential therapeutic benefits of improving sleep in diabetic populations.

CONCLUSION

This study highlights a significant association between poor sleep quality and inadequate glycemic control in patients with Type 2 Diabetes Mellitus. Addressing sleep disturbances as part of routine diabetes management may contribute to better metabolic outcomes. Future interventional studies are warranted to evaluate the impact of sleep improvement strategies on long-term glycemic control.

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