



# Dietary non-adherence and circadian rhythm in diabetic patients: A case report

Lily Nur Indahsari<sup>1</sup>  
Nur Chayati<sup>2\*</sup> 

<sup>1</sup> Ners Profession Education Program, Faculty of medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia.

<sup>2</sup> Nursing Department, Faculty of medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia.

**\*Correspondence:**

Nur Chayati

Nursing Department, Faculty of medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia. Brawijaya street, Tamantirto, Kasihan, Bantul, Yogyakarta, 55183  
Email: [nur.chayati@umy.ac.id](mailto:nur.chayati@umy.ac.id)

## ABSTRACT

**Background:** Non-compliance with both medical and non-medical therapy regimens, such as dietary management, can lead to elevated blood glucose levels in patients with diabetes mellitus. Additionally, disturbances in circadian rhythms can impact glucose metabolism. The combination of these factors requires further investigation to understand their role in increasing glucose levels. Understanding how dietary non-adherence and circadian rhythm disturbances affect glucose metabolism may help improve glycemic control.

**Objective:** This study aims to assess dietary non-adherence and circadian rhythm disturbances in a patient with type 2 diabetes mellitus and uncontrolled blood sugar.

**Case:** A 65-year-old male patient was admitted to the inpatient unit from the emergency department. He had been diagnosed with type 2 diabetes mellitus since 2002. Blood sugar monitoring was performed every 12 hours using a sliding scale. Despite receiving a hospital-prescribed diet, the patient consumed additional foods such as bread, donuts, biscuits, and milk from outside sources. The patient also exhibited an irregular sleep pattern, sleeping only about 5 hours per night, going to bed after 9 p.m., waking up frequently during the night, and eating snacks (e.g., small bread) before sleep. On the first day, the morning glucose level (GDS) was 313 mg/dL and 140 mg/dL in the evening. On the second day, the morning GDS was 228 mg/dL, and 138 mg/dL in the evening. On the third day, the morning GDS was 145 mg/dL. The patient was discharged in the afternoon with an increased insulin dose from 6 to 8 units.

**Conclusion:** Dietary non-adherence and circadian rhythm disturbances are potential risk factors for elevated blood glucose levels in patients with type 2 diabetes mellitus. Providing health education, continuous monitoring, and support to both the patient and family can encourage adherence to medical regimens and improve health outcomes.

**Keywords:** diabetes mellitus; dietary non-adherence; insulin; cortisol

Volume 3(3), 142-146

© The Author(s) 2024

<http://dx.doi.org/10.55048/jpns130>

e-ISSN 2827-8100

p-ISSN 2827-8496

Received : January 14, 2024

Revised : April 28, 2024

Accepted : May 30, 2024

Published : September 7, 2024



This is an **Open Access** article distributed under the terms of the [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/).

## INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a significant public health concern worldwide. It is associated with high morbidity and mortality, as it is a leading cause of renal insufficiency, blindness, and non-traumatic amputations. T2DM is also a

## Nursing and Healthcare Practices

- *Continuously consuming additional food beside hospital food serving can cause an increase in plasma glucose and triglyceride levels, which will affect the circadian cycle, causing blood sugar to rise in the morning.*
- *Fundamentally, sleep patterns influence hormonal changes, such as increasing cortisol and decreasing melatonin, but sleep duration is not affected by increasing blood sugar.*
- *Patients suffering from type 2 diabetes mellitus should maintain good sleep and eating patterns to prevent complications and decrease requirement of insulin dose.*

major risk factor for cardiovascular disease. Furthermore, it negatively impacts both quality of life and life expectancy, which is, on average, eight years shorter than in the non-diabetic population (García-Molina et al., 2020). T2DM is a common metabolic disorder characterized by blood glucose levels exceeding 140 mg/dL. This condition is largely attributed to lifestyle and environmental factors, including poor nutrition and physical inactivity. In addition to these factors, the circadian rhythm has also been shown to influence blood glucose regulation. The circadian rhythm is a fundamental biological and metabolic process in humans. Alterations in circadian rhythms have been found to disrupt metabolic pathways and impact treatment outcomes for diseases such as T2DM (Hariri et al., 2023).

Circadian rhythm plays a crucial role in human glucose tolerance. Plasma glucose concentrations tend to rise more slowly in the evening than in the morning following oral or intravenous glucose intake. Patients with T2DM frequently experience morning hyperglycemia, which may be linked to the diurnal pattern of hepatic glucose production (HGP). The increase in HGP before breakfast is believed to be modulated by circadian mechanisms. Research has shown that in healthy individuals, insulin sensitivity and  $\beta$ -cell responsiveness to glucose are lower after dinner than before breakfast.

Elevated blood glucose levels require prompt conservative interventions, such as dietary modifications or adjustments to medications that may contribute to hyperglycemia (American Diabetes Association, 2020). Studies have shown that beyond pharmacological therapy, dietary interventions are among the most effective methods to improve glycemic control in patients with T2DM. However, diet education is often underutilized and not consistently integrated into clinical management protocols for T2DM (García-Molina et al., 2020).

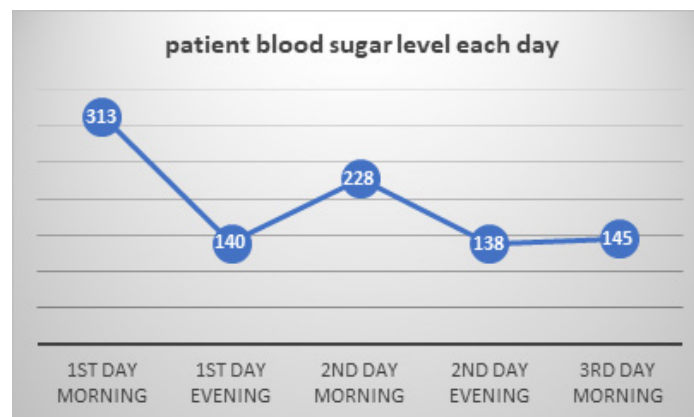
Additionally, reduced glucose absorption in the brain may impair the satiating effects of a carbohydrate-rich diet. Consequently, limiting carbohydrate intake can support weight management and improve metabolic function (Magkos et al., 2020). A recommended diet for individuals with type 2 diabetes mellitus should be balanced and nutrient-dense, including a variety of vegetables, fruits, nuts, legumes, moderate amounts of fish and lean meats, and low-fat dairy products.

Studies have shown that dietary scheduling significantly influences eating behavior (Maay et al., 2022). For individuals with type 2 diabetes mellitus, establishing a structured meal schedule is essential. Dividing daily intake into smaller, more frequent meals helps slow and stabilize carbohydrate digestion and absorption. Eating habits, in addition to nutritional content, play a critical role in determining health outcomes. Consuming large quantities of food in one sitting can negatively impact blood glucose levels, as elevated fasting glucose is a known risk factor for metabolic syndrome (Alkhulaifi & Darkoh, 2022). Therefore, proper meal scheduling and food frequency are necessary to promote better control of eating behavior.

To enhance dietary adherence in patients with diabetes mellitus, mobile health technologies—such as smartphone applications—can be employed for managing diet and daily routines. These tools allow users to monitor food intake, body weight, and nutritional content, making it easier to select appropriate foods and maintain dietary compliance for individuals with type 2 diabetes mellitus (Joshua et al., 2023).

## CASE

A 65-year-old male patient was admitted to the medical ward from the emergency department at 20:15 WIB on September 30, 2022, with complaints of coughing, nausea, vomiting, fatigue, and abdominal pain while coughing



**Figure 1.** Blood sugar level

(pain scale 3). These symptoms had persisted since September 28, 2022. Upon admission, his vital signs and physical parameters were as follows: height 160 cm, weight 55 kg, BMI 21.5 kg/m<sup>2</sup>, blood pressure 114/74 mmHg, pulse 64 bpm, temperature 36.2°C, and respiratory rate 20 breaths/min. He was conscious and alert (*compos mentis*). Clinical diagnosis included type 2 diabetes mellitus (T2DM) and hypertension. Physical examination showed pink conjunctiva, no throat inflammation, and bowel sounds at 6x/minute. The patient was observed coughing forcefully and holding his abdomen, reporting that the pain would subside after 5–10 minutes of rest. Laboratory tests revealed hyponatremia (Na: 131 mmol/L), hypochloremia (Cl: 97 mmol/L), elevated urea (57.7 mg/dL), and creatinine (1.35 mg/dL).

The hospital provided a T2DM-specific diet that included porridge, a variety of vegetables (e.g., carrots, spinach, green beans), protein sources (tempeh, eggs, chicken, fish), and fruits (bananas, watermelon, oranges), along with plain diabetes tea. The patient regularly finished each meal but also consumed food from outside the hospital, including bread, donuts, biscuits, and milk. This additional intake influenced fluctuations in his blood glucose levels. Blood glucose was monitored every 12 hours via a sliding scale. On Day 1, after consuming sweet tea and high-carbohydrate meals, the patient's morning glucose (GDS) was 313 mg/dL. Ezelin insulin was administered at 12:30 PM (12 units), and his evening GDS decreased to 140 mg/dL.

On Day 2, the morning GDS was 228 mg/dL. He consumed similar food quantities, including sweet tea, fried chicken, biscuits, eggs, and donuts. Insulin was given at a reduced dose of

6 units, and the evening GDS was 138 mg/dL. On Day 3, the morning GDS dropped further to 145 mg/dL. The patient was discharged in the afternoon with subcutaneous insulin therapy prescribed at an increased dose of 8 units. The patient's blood sugar trends during hospitalization are summarized in Figure 1. These findings suggest that both dietary non-adherence and circadian rhythm disturbances may have contributed to the instability in his glucose levels.

## DISCUSSION

Diabetes mellitus can result from both age-related factors and genetic predispositions (Cole & Florez, 2020). In this case, the patient was an elderly individual with a known family history of diabetes mellitus. Lifestyle choices, particularly those involving physical activity and dietary habits, also play a crucial role in the onset of type 2 diabetes mellitus (T2DM). An unhealthy diet—such as frequent consumption of high-fat or fast foods—can lead to obesity, a significant risk factor for T2DM (Uloko et al., 2018). Although the patient maintained an ideal body weight, he regularly consumed various types of bread and sweetened tea (approximately 500 ml every morning and evening). This behavior aligns with previous research indicating that patients with poor dietary adherence have a significantly higher risk—up to 44.7 times—of uncontrolled blood glucose (Nursihhah, 2021), with dietary non-adherence affecting 69.2% of 143 respondents.

Uncontrolled blood glucose due to inconsistent dietary intake necessitates frequent adjustments in insulin dosing. Although clinical guidelines offer recommendations for initiating

and titrating insulin, real-world application often varies significantly based on individual circumstances, including glycemic control, comorbidities, concomitant medications, side effects, patient preferences, and affordability (Forst et al., 2021). Typically, insulin therapy is initiated when lifestyle and dietary interventions fail to adequately control blood glucose levels. Additionally, hormonal imbalances, particularly involving leptin and ghrelin, also play a role in diabetes. Leptin, an adipokine secreted by fat cells, regulates energy balance and is associated with insulin resistance. Ghrelin, on the other hand, influences satiety and indirectly affects insulin and leptin signaling. Increased serum leptin levels have been significantly correlated with reduced insulin sensitivity (Mehriya, 2023).

The patient also exhibited elevated morning blood glucose levels, a common phenomenon linked to circadian rhythm disturbances (Parameswaran & Ray, 2022). Circadian misalignment may arise from altered behavioral cycles, such as disrupted sleep or irregular eating patterns. Sleep deprivation or shifted sleep schedules influence hormonal fluctuations, including increased cortisol and decreased melatonin levels, both of which regulate insulin secretion and sensitivity (Sumbarwoto et al., 2022). Cortisol, in particular, plays a vital role in metabolism, adipocyte differentiation, and insulin signaling pathways. It promotes visceral fat accumulation and modulates insulin action. The suprachiasmatic nucleus (SCN) of the hypothalamus governs these rhythms by responding to environmental light-dark cycles, which influence hormonal release and anticipate behavioral patterns. However, modern lifestyles and exposure to artificial light often override these natural cues, disrupting physiological synchronization.

Experimental studies using forced desynchronization protocols have shown that circadian misalignment alone—independent of sleep duration—can contribute to insulin resistance. These effects are primarily mediated by peripheral clocks synchronized through the SCN, which prepares the body for metabolic demands in anticipation of behavior. On average, most people eat over a span of 15 hours daily, consuming more than 75% of their calories after midday (Parameswaran & Ray, 2022). In older adults with declining glucose tolerance, this prolonged feeding window and late eating pattern impair metabolic efficiency. Repeated nutrient intake triggers cortisol

release and other anticipatory processes that, if not aligned with natural circadian cycles, may exacerbate glucose intolerance and insulin resistance. Since all peripheral clocks are synchronized with the SCN and influenced by environmental light cues, any disruption in this system can negatively impact insulin sensitivity, emphasizing the importance of maintaining regular sleep and eating patterns in managing T2DM.

## CONCLUSION

Dietary non-adherence and circadian rhythm disturbances are potential risk factors for elevated blood glucose levels in patients with type 2 diabetes mellitus. Habits such as frequently consuming additional food outside the prescribed diet can lead to poor eating patterns and stimulate hormonal changes that disrupt peripheral clock rhythms, thereby worsening glycemic control. Providing ongoing health education, regular monitoring, and emotional and practical support to both the patient and their family can help improve adherence to medical treatment and promote better health outcomes.

### Declaration of Interest

*The authors declare no conflict of interest.*

### Acknowledgment

*The author would like to thank the patient who was permitted to report his condition as a means of learning.*

### Funding

*This study did not receive any funding.*

### Data Availability

*All data generated or analyzed during this study are included in this published article.*

## REFERENCES

- Alkhulaifi, F., & Darkoh, C. (2022). Meal timing, meal frequency and metabolic syndrome. *Nutrients*, *14*(9), 1719. <https://doi.org/10.3390/nu14091719>
- American Diabetes Association. (2020). Diabetes care in the hospital: Standards of medical care in diabetes—2020. *Diabetes Care*, *43*(Supplement\_1), S193–S202. <https://doi.org/10.2337/dc20-S015>
- Cole, J. B., & Florez, J. C. (2020). Genetics of diabetes mellitus and diabetes

- complications. *Nature Reviews Nephrology*, 16(7), 377–390. <https://doi.org/10.1038/s41581-020-0278-5>
- Forst, T., Choudhary, P., Schneider, D., Linetzky, B., & Pozzilli, P. (2021). A practical approach to the clinical challenges in initiation of basal insulin therapy in people with type 2 diabetes. *Diabetes/Metabolism Research and Reviews*, 37(6). <https://doi.org/10.1002/dmrr.3418>
- García-Molina, L., Lewis-Mikhael, A.-M., Riquelme-Gallego, B., Cano-Ibáñez, N., Oliveras-López, M.-J., & Bueno-Cavanillas, A. (2020). Improving type 2 diabetes mellitus glycaemic control through lifestyle modification implementing diet intervention: A systematic review and meta-analysis. *European Journal of Nutrition*, 59(4), 1313–1328. <https://doi.org/10.1007/s00394-019-02147-6>
- Hariri, A., Mirian, M., Zarrabi, A., Kohandel, M., Amini-Pozveh, M., Aref, A. R., Tabatabaee, A., Prabhakar, P. K., & Sivakumar, P. M. (2023). The circadian rhythm: an influential soundtrack in the diabetes story. *Frontiers in Endocrinology*, 14(1156757), 01–17. <https://doi.org/10.3389/fendo.2023.1156757>
- Joshua, S. R., Shin, S., Lee, J.-H., & Kim, S. K. (2023). Health to eat: A smart plate with food recognition, classification, and weight measurement for type-2 diabetic mellitus patients' nutrition control. *Sensors*, 23(3), 1656. <https://doi.org/10.3390/s23031656>
- Maay, J. K., Blestina, M., Nasrah, Kismiyati, Utami, T. F., Jarona, M., & Suweni, K. (2022). Description of dietary compliance of type 2 diabetes mellitus patients at the sorendiwari health center, supiori regency. *Fitness, Performance and Health Journal*, 1(1), 52–58. <https://doi.org/https://doi.org/10.53797/fphj.v1i1.8.2022>
- Magkos, F., Hjorth, M. F., & Astrup, A. (2020). Diet and exercise in the prevention and treatment of type 2 diabetes mellitus. *Nature Reviews Endocrinology*, 16(10), 545–555. <https://doi.org/10.1038/s41574-020-0381-5>
- Mehriva, D. (2023). Analisis asupan makronutrient dan kadar leptin. *Jurnal Pendidikan Dan Konseling (JPDK)*, 5(1), 755–762. <https://doi.org/https://doi.org/10.31004/jpdk.v5i1.11034>
- Nursihhah, M. (2021). Hubungan kepatuhan diet terhadap pengendalian kadar gula darah pada pasien diabetes melitus tipe 2. *Jurnal Medika Utama*, 2(3), 1002–1010.
- Parameswaran, G., & Ray, D. W. (2022). Sleep, circadian rhythms, and type 2 diabetes mellitus. *Clinical Endocrinology*, 96(1), 12–20. <https://doi.org/10.1111/cen.14607>
- Sumbarwoto, A., Isbandiyah, I., Nelasari, H., & Rarung, G. (2022). Pengaruh gangguan ritme sirkadian dengan kejadian diabetes melitus tipe 2. *CoMPHI Journal: Community Medicine and Public Health of Indonesia Journal*, 3(2), 58–63. <https://doi.org/10.37148/comphijournal.v3i2.103>
- Uloko, A. E., Musa, B. M., Ramalan, M. A., Gezawa, I. D., Puepet, F. H., Uloko, A. T., Borodo, M. M., & Sada, K. B. (2018). Prevalence and risk factors for diabetes mellitus in nigeria: A systematic review and meta-analysis. *Diabetes Therapy*, 9(3), 1307–1316. <https://doi.org/10.1007/s13300-018-0441-1>