International Journal of Community Medicine and Public Health
Chavalit T et al. Int J Community Med Public Health. 2026 Apr;13(4):1674-1680
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040
DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20260762

Original Research Article

Association between sleep quality and glycemic control among patients with type 2 diabetes mellitus: a cross-sectional study in a Thai primary care setting

Thanaboon Chavalit[1], Kod Phithakwongrojn[1], Tatree Bosittipichet[1], Thanakamon Leesri[2]*

[1]Department of Social Medicine, Phra Nakhon Si Ayutthaya Hospital, Phra Nakhon Si Ayutthaya, Thailand
[2]Nursing Institution, Suranaree University of Technology, Thailand

Received: 10 February 2026
Revised: 09 March 2026
Accepted: 11 March 2026

***Correspondence:**
Dr. Thanakamom Leesri,
E-mail: thanakamon@sut.ac.th

ABSTRACT

Background: Sleep is a vital homeostatic process linked to circadian rhythms. Sleep deprivation or misalignment can impair insulin sensitivity; however, while studies in urban Thai settings exist, data in primary care remains limited and inconclusive. This cross-sectional study investigated the association between sleep quality and glycemic control among patients with type 2 diabetes mellitus (T2DM) at a primary care unit in Phra Nakhon Si Ayutthaya Hospital.
Methods: A total of 109 patients with T2DM were enrolled. Sleep quality was assessed using the Thai version of the Pittsburgh sleep quality index (PSQI). Data were analyzed using descriptive statistics and multiple logistic regression to identify independent predictors of glycemic and blood pressure control.
Results: Multiple logistic regression revealed no significant association between sleep quality and glycemic control (Adjusted OR=0.77; 95% CI: 0.35-1.71; p=0.523) or blood pressure control. However, insulin therapy was significantly associated with poor glycemic control (Adjusted OR=7.31; 95% CI: 1.33-40.15; p=0.022). Regarding blood pressure, female gender was a protective factor (Adjusted OR=0.19; p=0.003), while elevated body mass index (BMI) (Adjusted OR=3.76; p=0.034) and insulin use (Adjusted OR=4.72; p=0.049) were significant risk factors.
Conclusions: Sleep quality was not associated with glycemic or blood pressure control in T2DM patients in this primary care setting. Clinical management should prioritize other significant determinants, including gender, BMI, and insulin therapy, to optimize patient outcomes.

Keywords: Sleep quality, Glycemic control, Type 2 diabetes mellitus, Primary care, Blood pressure control

INTRODUCTION

Non-communicable diseases (NCDs) are the leading cause of mortality in Thailand, accounting for 74% of all deaths.[1] Notably, DM contributes to 4% of this total mortality, emphasizing its critical importance to the public health of the Thai population. Sleep is a fundamental homeostatic process intrinsically linked to circadian rhythms, facilitating the accumulation and preservation of bodily energy. Insufficient sleep or circadian misalignment adversely affects health, specifically by impairing insulin sensitivity.[2] Evidence further indicates that the incidence of diabetes is higher among individuals with poor sleep quality compared to those with optimal sleep.[3] Consequently, the world health organization (WHO) has established definitions for healthy sleep as a vital dimension of holistic healthcare.[4]

Literature reviews indicate high prevalences of poor sleep quality across several Asian countries, including 47.6% in

Japan and 56.8% in China.[5,6] Such impairments are recognized as a major factor in the worsening of glycemic control among patients with T2DM.[6] Furthermore, both excessively short and long sleep durations have been associated with suboptimal glycemic regulation.[7] In Thailand, however, evidence regarding the relationship between sleep quality and glycemic control in T2DM patients remains insufficient to draw definitive conclusions. Existing research is primarily limited to urban populations in Bangkok-such as studies conducted at the endocrine clinic of Ramathibodi Hospital-which may not be generalizable to semi-urban or rural settings.[8]

Therefore, this study aimed to investigate the association between sleep quality and glycemic control among T2DM patients in a semi-urban primary care setting at Phra Nakhon Si Ayutthaya Hospital. Identifying sleep quality as a significant factor could provide a novel therapeutic pathway to improve glycemic management, potentially reducing disability, complications, and mortality. Specifically, the primary objective was to examine the relationship between sleep quality and glycemic control in T2DM patients attending this primary care unit. The secondary objectives were to identify other factors associated with glycemic control and to explore the correlation between sleep quality and blood pressure control within this population.

METHODS

Study design and setting

This cross-sectional study was conducted at the primary care unit of Phra Nakhon Si Ayutthaya Hospital. Data collection took place from September 2024 to February 2025.

Participants

A total of 109 patients with T2DM were recruited through convenient sampling. Inclusion criteria consisted of patients aged 18 years or older who were proficient in the Thai language. Exclusion criteria were defined to minimize confounding factors, including shift workers, pregnant women, and patients diagnosed with obstructive sleep apnea (OSA). Additionally, patients with psychiatric disorders or severe clinical comorbidities-such as acute infections, sepsis, malignancy, cirrhosis, end-stage renal disease, heart failure, or recent major accidents-were excluded.

Sample size calculation

The sample size was determined based on a previous study identifying the proportion of poor glycemic control as 71.4% in patients with poor sleep quality (PSQI score >5) compared to 44.4% in those with good sleep quality (PSQI score ≤5). Using a one-sided test with a 5% significance level and 80% power, and assuming a case-to-control ratio of 1:1.22, a minimum of 98 participants was required. After accounting for a 10% dropout rate, the final target sample size was 109 participants, comprising 49 patients with poor glycemic control and 60 patients with good glycemic control.

Instruments and data collection

The research instrument consisted of two primary sections:

Part 1: Demographic and clinical data

This included sex, age, body weight, height, BMI, blood pressure, smoking and alcohol consumption history, and the use of subcutaneous insulin.

Part 2: Sleep quality assessment

Sleep quality was assessed using the Thai version of the PSQI. The PSQI evaluates seven domains of sleep, providing a global score ranging from 0 to 21. In accordance with validated thresholds, a global score of <6 was classified as "good sleep quality," while a score of 6-21 was classified as "poor sleep quality."

Statistical analysis

Data were analyzed using STATA software. Descriptive statistics were utilized to summarize demographic and clinical characteristics, with categorical variables presented as frequencies and percentages.

For the univariable analysis, the association between sleep quality and glycemic control was evaluated using the Chi-square test, with 95% confidence intervals (CI). To address potential confounding, a causal inference framework was established using a directed acyclic graph (DAG). The DAG was constructed based on a comprehensive literature review and expert opinions via the DAGitty web-based tool.[11] Through this process, BMI, smoking status, and alcohol consumption were identified as key confounders for adjustment.

A multivariable logistic regression model was subsequently performed to determine the independent association between sleep quality and glycemic control while adjusting for the identified confounders. Results were reported as adjusted odds ratios (aOR) with 95% CIs. Statistical significance for all tests was defined as a two-tailed $p<0.05$.

Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved by the human research ethics committee of Phra Nakhon Si Ayutthaya Hospital on August 28, 2024 (Protocol no. 0139/2567).

Participation was entirely voluntary, and written informed consent was obtained from all participants prior to

enrollment. To ensure confidentiality, personal identifiers were removed and replaced with unique study-specific identification numbers (running numbers). Participants identified as having poor sleep quality received basic sleep hygiene counseling; further investigation and referral to specialists were provided for those with clinical indications. Additionally, participants with suboptimal glycemic control were managed and followed up according to standard clinical practice guidelines.

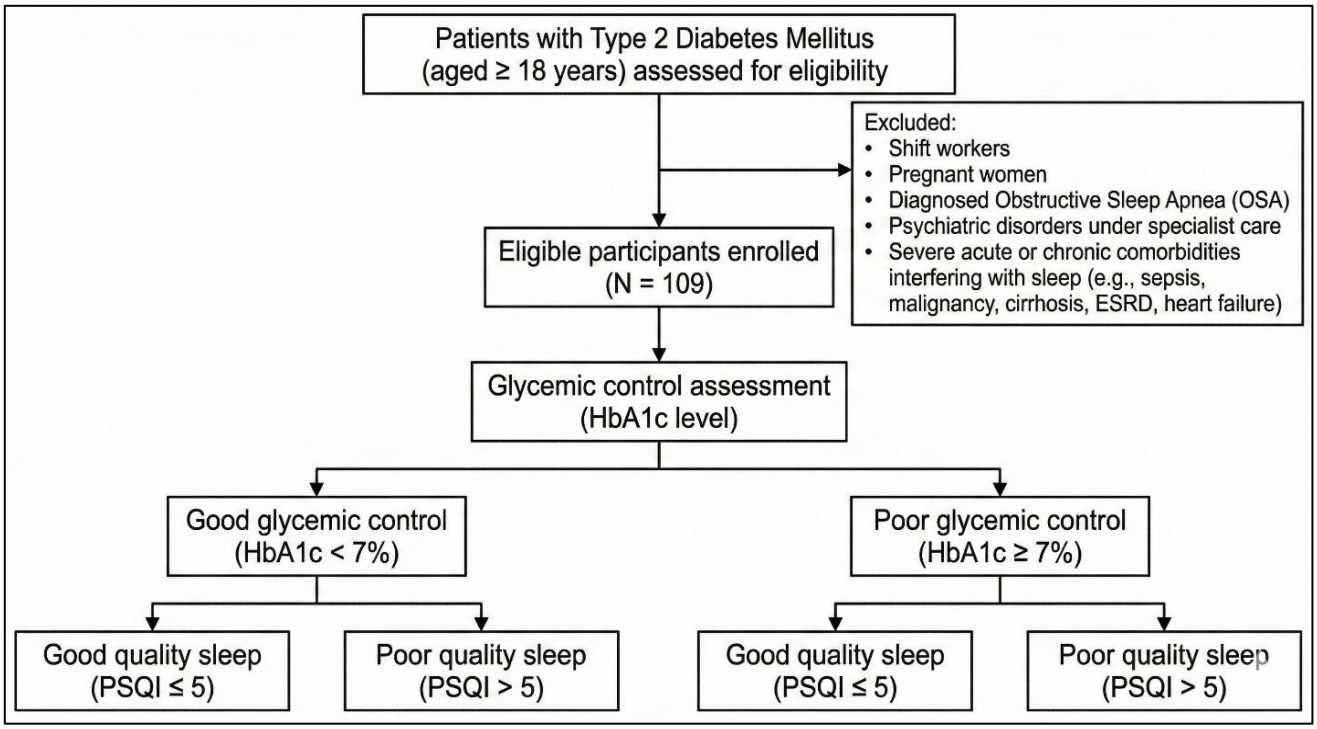

Figure 1: The presentation of the study flow.

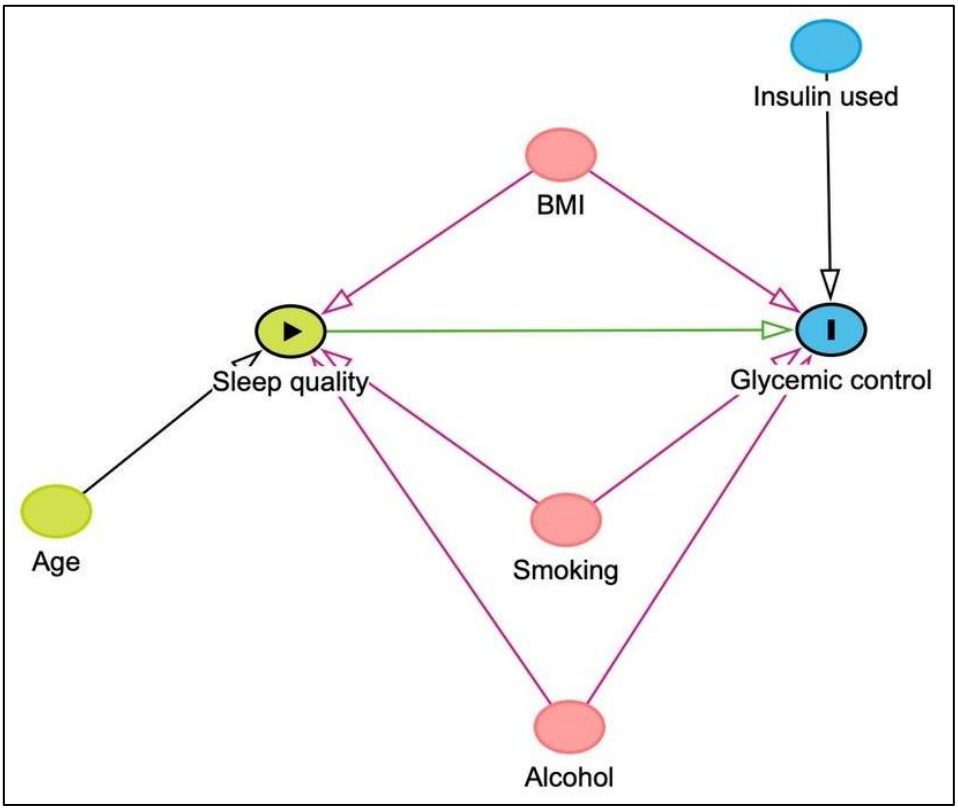

Figure 2: The presentation of the DAG diagram.

RESULTS

Characteristics of the study population

A total of 109 patients with T2DM were enrolled in the study. Based on their glycemic status, 60 patients (55.05%) achieved optimal glycemic control, while 49 patients (44.95%) were classified as having poor glycemic control.

The study population was predominantly female (69.72%), with males accounting for 30.28%. Regarding age distribution, 71.56% of the participants were aged between 60 and 88 years, while 28.44% fell within the 18-59 age group. In terms of clinical characteristics, a significant majority of participants (75.23%) had a BMI of 23.0 kg/m^2 or higher, with only 24.77% having a BMI below 23.0 kg/m^2.

Lifestyle factors and treatment modalities were also documented: 7.34% were current smokers, 9.17% reported alcohol consumption, and the 9.17% were currently undergoing insulin therapy. Detailed demographic and clinical characteristics are summarized in the Table 1.

Association between sleep quality and glycemic control

The association between sleep quality and glycemic control among patients with T2DM was evaluated using multivariable logistic regression. After adjusting for potential confounders identified via the DAG-including BMI, smoking, and alcohol consumption-the analysis revealed no statistically significant association between sleep quality and glycemic control (Adjusted OR=0.77; 95% CI: 0.35-1.71; p=0.523) (Table 2).

Factors associated with blood pressure control

Multivariable logistic regression analysis demonstrated no statistically significant association between sleep quality and blood pressure control among study participants. However, female gender, BMI≥23.0 kg/m², and insulin therapy identified as significant independent predictors of BP control (Table 3). Specifically, female gender served as protective factor for BP control (Adjusted OR=0.19; p=0.003). In contrast, BMI≥23.0 kg/m² (Adjusted OR=3.76; p=0.034) and use of insulin therapy (Adjusted OR=4.72; p=0.049) were significantly associated with a higher likelihood of poor blood pressure control.

Table 1: Baseline characteristics of the study participants, (n=109).

Characteristics	Optimal glycemic control (HbA1c <7%), (n=60) (%)	Poor glycemic control (HbA1c ≥7%), (n=49) (%)	P value
Sex			
Male	20 (33.3)	13 (26.5)	0.442
Female	40 (66.7)	36 (73.5)	
Age (in years)			
<60	15 (25.0)	16 (32.7)	0.378
≥60	45 (75.0)	33 (67.3)	
Smoking status			
Yes	7 (11.7)	1 (2.0)	0.055
No	53 (88.3)	48 (98.0)	
Alcohol consumption			
Yes	5 (8.3)	5 (10.2)	0.736
No	55 (91.7)	44 (89.8)	
BMI (kg/m²)			
<23.0	17 (28.3)	10 (20.4)	0.34
≥23.0 (Overweight/obesity)	43 (71.7)	39 (79.6)	
Insulin therapy			
Yes	2 (3.3)	8 (16.3)	0.019*
No	58 (96.7)	41 (83.7)	
Sleep quality (PSQI)			
Good (score≤5)	32 (53.3)	27 (55.1)	0.854
Poor (score >5)	28 (46.7)	22 (44.9)	

*Values are presented as number (percentage) unless otherwise specified. P values were calculated using the Chi-square test or Fisher's exact test where appropriate. *Statistically significant at p<0.05. HbA1c-Glycated hemoglobin, BMI-Body mass index, PSQI-Pittsburgh sleep quality index.

Table 2: Multivariable logistic regression analysis of factors associated with poor glycemic control (HbA1c ≥7.0%).

Factors	Crude OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Primary predictors				
Sleep quality (Poor: PSQI >5)	0.93 (0.41-2.13)	0.854	0.77 (0.35-1.71)	0.523
Exploratory factors				
Sex (Female)	1.38 (0.56-3.49)	0.442	1.23 (0.46-3.26)	0.682
Age (≥60 years)	0.69 (0.27-1.72)	0.378	0.57 (0.22-1.45)	0.238
Current smoking	0.16 (0.003-1.32)	0.055	0.07 (0.005-1.00)	0.05
Current alcohol consumption	1.25 (0.27-5.79)	0.736	1.95 (0.39-9.69)	0.415
BMI (≥23.0 kg/m²)	1.54 (0.58-4.24)	0.34	1.69 (0.64-4.45)	0.288
Insulin therapy	5.66 (1.04-56.54)	0.019*	7.31 (1.33-40.15)	0.022*

*Adjusted OR was calculated using a multivariable logistic regression model including all parameters listed in the table. Potential confounders adjusted as identified by DAG: BMI, smoking status, and alcohol consumption. *Statistically significant at p<0.05. OR-Odds ratio; CI-Confidence interval; HbA1c-Glycated hemoglobin, PSQI-Pittsburgh sleep quality index, BMI-Body mass index.

Table 3: Multivariable logistic regression analysis of factors associated with uncontrolled blood pressure.

Factors	Crude OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Primary predictor				
Poor sleep quality (PSQI >5)	1.79 (0.74-4.35)	0.154	1.43 (0.56-3.61)	0.453
Exploratory factors				
Sex (Female)	0.46 (0.18-1.18)	0.069	0.19 (0.06-0.56)	0.003*
Age (≥60 years)	2.60 (0.90-8.61)	0.055	2.88 (0.88-9.40)	0.079
Current smoking	0.27 (0.006-2.26)	0.2	0.18 (0.02-1.91)	0.154
Current alcohol consumption	0.48 (0.05-2.60)	0.358	0.32 (0.05-2.24)	0.252
BMI (≥23.0 kg/m^2)	2.67 (0.86-9.90)	0.065	3.76 (1.11-12.77)	0.034*
Insulin therapy	3.45 (0.75-17.66)	0.057	4.72 (1.00-22.22)	0.049*

*Adjusted OR was calculated using a multivariable logistic regression model including all parameters listed in the table. Potential confounders adjusted as identified by DAG: BMI, smoking status, and alcohol consumption. *Statistically significant at p<0.05. OR-Odds ratio; CI-Confidence interval, PSQI-Pittsburgh sleep quality index, BMI-Body mass index.

DISCUSSION

This study found no significant association between sleep quality and glycemic control, as measured by HbA1c, in patients with T2DM. These findings are congruent with meta-analyses by Azharuddin et al and Lee et al which reported that while sleep quality may be associated with fasting blood sugar (FBS), it does not significantly correlate with HbA1c levels.[12,13] This suggests that the physiological impact of sleep quality may primarily influence short-term glucose fluctuations rather than long-term glycemic status, as reflected by HbA1c, which represents average blood glucose over a three-month period.

Our analysis further revealed that HbA1c-based glycemic control was significantly associated with insulin therapy, a finding consistent with Haghighatpanah et al.[14] Notably, the majority of participants in this study (90.83%) did not require insulin, reflecting the typical profile of a primary care population where disease severity and clinical complexity are generally lower than those in specialist or university clinics described by Tang et al and Zhu et al.[6,15] It is possible that in patients with less advanced T2DM, the effect of sleep quality on long-term glycemic regulation is either non-existent or too subtle to achieve clinical significance.

In contrast, certain studies-notably Tang et al and Zhu et al reported results that differ from ours.[6,15] These discrepancies may be attributed to differences in study populations and ethnic backgrounds. Both aforementioned studies focused on Chinese populations, where the prevalence of poor glycemic control (HbA1c≥7%) was 46.63%, comparable to the 44.95% observed in this study.[6] However, Tang et al identified a significant association between poor sleep and higher HbA1c (OR 1.048; 95% CI 1.007-1.092; p=0.023).[6] Ethnicity may therefore play a role in how sleep architecture interacts with metabolic pathways. Furthermore, differences in the PSQI cut-off thresholds-where Tang et al and Zhu et al utilized scores of >8 and ≥8, respectively, compared to our threshold of >5 could lead to variations in participant categorization and subsequent statistical outcomes.[6,15]

Regarding blood pressure, we identified sex, BMI, and insulin therapy as significant predictors of control, aligning with previous literature.[16-18] Morris et al suggested that the better blood pressure control often observed in females may be linked to higher medication adherence.[16] Similar to our glycemic findings, sleep quality showed no significant association with blood pressure control, which is consistent with the meta-analysis by Lo et al.[19] This may further underscore that

sleep disturbances, in this particular population, do not exert a long-term physiological impact sufficient to disrupt chronic blood pressure management.

Strengths and limitations

A major methodological strength of this study is the integration of a DAG to systematically identify and adjust for confounders through multivariable logistic regression. Additionally, the stringent exclusion of patients with psychiatric disorders minimized potential bias related to pre-existing sleep-disrupting conditions.

However, several limitations must be acknowledged. The sample size was relatively small, and the use of convenience sampling may limit the generalizability of the findings. As a cross-sectional study, it captures only a snapshot of the relationship between sleep and health outcomes, precluding any conclusions regarding causality or long-term longitudinal effects.

Future directions

Future research should involve larger, multicenter cohorts or longitudinal designs. Such studies would provide the necessary power to detect subtle effects and enable the tracking of sleep quality's impact on glycemic and cardiovascular health over time.

CONCLUSION

In conclusion, this study found no statistically significant association between sleep quality and glycemic control among patients with T2DM in a primary care setting at Phra Nakhon Si Ayutthaya Hospital. However, insulin therapy was identified as a significant determinant of glycemic control, while gender, BMI, and insulin therapy were significantly associated with blood pressure management within this population. These findings suggest that for T2DM patients managed in primary care-who typically present with lower clinical complexity and less frequent insulin requirements compared to those in tertiary settings-sleep quality may not be a primary driver of long-term glycemic status. Consequently, healthcare providers should prioritize other metabolic and clinical factors to optimize patient outcomes. Future longitudinal research with larger sample sizes is warranted to further elucidate the causal relationships between sleep architecture and chronic metabolic control.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. World Health Organization. Noncommunicable diseases country profiles 2018. Geneva: World Health Organization. 2018. Available at: https://www.who.int/publications/i/item/ncd-country-profiles-2018. Accessed on 3 December 2025.
2. Reutrakul S, Van Cauter E. Interactions between sleep, circadian function, and glucose metabolism: implications for risk and severity of diabetes. Ann N Y Acad Sci. 2014;1311:151-73.
3. Lou P, Zhang P, Zhang L, Chen P, Chang G, Zhang N, et al. Effects of sleep duration and sleep quality on prevalence of type 2 diabetes mellitus: a 5-year follow-up study in China. Diabetes Res Clin Pract. 2015;109:178-84.
4. World Health Organization. WHO technical meeting on sleep and health. Bonn: World Health Organization Regional Office for Europe; 2004. Available at: https://iris.who.int/handle/10665/349782. Accessed on 3 December 2025.
5. Sakamoto R, Yamakawa T, Takahashi K, Suzuki J, Shinoda MM, Sakamaki K, et al. Association of usual sleep quality and glycemic control in type 2 diabetes in Japanese: a cross sectional study. Sleep and Food Registry in Kanagawa (SOREKA). PLoS One. 2018;13(1):e0191771.
6. Tang YZ, Meng LL, Li DQ, Min Y, Zhu YJ, Li CG, et al. Interaction of sleep quality and sleep duration on glycemic control in patients with type 2 diabetes mellitus. Chin Med J (Engl). 2014;127(19):3543-7.
7. Kim BK, Kim BS, An SY, Lee MS, Choi YJ, Han SJ, et al. Sleep duration and glycemic control in patients with diabetes mellitus: Korea national health and nutrition examination survey 2007-2010. J Korean Med Sci. 2013;28(9):1334-9.
8. Reutrakul S, Siwasaranond N, Nimitphong H, Saetung S, Chirakalwasan N, Ongphiphadhanakul B, et al. Relationships among sleep timing, sleep duration and glycemic control in Type 2 diabetes in Thailand. Chronobiol Int. 2015;32(10):1469-76.
9. Sitasuwan T, Bussaratid S, Ruttanaumpawan P, Chotinaiwattarakul W. Reliability and validity of the Thai version of the Pittsburgh Sleep Quality Index. J Med Assoc Thai. 2014;97(3):S57-67.
10. Tsai YW, Kann NH, Tung TH, Chao YJ, Lin CJ, Chang KC, et al. Impact of subjective sleep quality on glycemic control in type 2 diabetes mellitus. Fam Pract. 2012;29(1):30-5.
11. Textor J, Hardt J, Knüppel S. DAGitty: a graphical tool for analyzing causal diagrams. Epidemiology. 2011;22(5):745.
12. Azharuddin M, Kapur P, Adil M, Ghosh P, Sharma M. The impact of sleep duration and sleep quality on glycaemic control in Asian population with type 2 diabetes mellitus: a systematic literature review and meta-analysis of observational studies. Clin Epidemiol Glob Health. 2020;8(3):967-75.
13. Lee SWH, Ng KY, Chin WK. The impact of sleep amount and sleep quality on glycemic control in type 2 diabetes: a systematic review and meta-analysis. Sleep Med Rev. 2017;31:91-101.
14. Haghighatpanah M, Nejad ASM, Haghighatpanah M, Thunga G, Mallayasamy S. Factors that correlate with poor glycemic control in type 2 diabetes

mellitus patients with complications. Osong Public Health Res Perspect. 2018;9(4):167-74.
15. Zhu BQ, Li XM, Wang D, Yu XF. Sleep quality and its impact on glycaemic control in patients with type 2 diabetes mellitus. Int J Nurs Sci. 2014;1(3):260-5.
16. Morris AB, Li J, Kroenke K, Bruner-England TE, Young JM, Murray MD. Factors associated with drug adherence and blood pressure control in patients with hypertension. Pharmacotherapy. 2006;26(4):483-92.
17. Stamler J. The INTERSALT Study: background, methods, findings, and implications. Am J Clin Nutr. 1997;65(2):626S-42S.
18. Randeree HA, Omar MA, Motala AA, Seedat MA. Effect of insulin therapy on blood pressure in NIDDM patients with secondary failure. Diabetes Care. 1992;15(10):1258-63.
19. Lo K, Woo B, Wong M, Tam W. Subjective sleep quality, blood pressure, and hypertension: a meta-analysis. J Clin Hypertens (Greenwich). 2018;20(3):592-605.

Cite this article as: Chavalit T, Phithakwongrojn K, Bosittipichet T, Leesri T. Association between sleep quality and glycemic control among patients with type 2 diabetes mellitus: a cross-sectional study in a Thai primary care setting. Int J Community Med Public Health 2026;13:1674-80.