Original Article

JHSMR Journal of Health Science and Medical Research

Factors Related to Sleep Quality among Older Adults in a Northeastern Province of Thailand

Siriprapa Rayayoi, BPH.[1], Patiphan Saengyarak, BPH.[2], Naruemol Kingkaew, Dr.P.H.[2]

[1]Samrong Subdistrict Health Promoting Hospital, Surin 34300, Thailand.

[2]Sirindhorn College of Public Health, Ubon Ratchathani, Faculty of Public Health and Allied Health Sciences, Praboromarajchanok Institute, Ubon Ratchathani 34190, Thailand.

Received 28 April 2025 ● Revised 23 June 2025 ● Accepted 26 June 2025 ● Published online 17 November 2025

Abstract:

Objective: This cross-sectional study aimed to determine the factors related to sleep quality among older adults aged 60 years and above in a northeastern province of Thailand.

Material and Methods: A total of 355 participants were randomly selected by multistage sampling between October and December 2024. Data collection tools included general characteristics, physical environment, family relationships, stress assessment, the Thai Geriatric Depression Scale (TGDS-15), and the Pittsburgh Sleep Quality Index (PSQI). The instrument's content validity was ≥0.67 for each item, and the reliability was 0.77. Descriptive statistics and multiple logistic regression analysis were performed using a statistical software package. A p-value set at <0.05.

Results: Average age of participants was 68.59±8.741 years old; 45.7% had no underlying medical conditions and 23.1% lived in a rural area. Factors associated with sleep quality were being female (aOR, 0.58; 95% CI, 0.352 to 0.954), living in a rural area (aOR, 1.97; 95% CI, 1.104 to 3.493), having severe problems related to their physical environment (aOR, 3.60; 95% CI, 1.362 to 9.510), having moderate stress (aOR, 2.11; 95% CI, 1.219 to 3.635), and having signs of depression (aOR, 2.12; 95% CI, 1.270 to 3.553).

Conclusion: People in both urban and rural areas should be supported by intervention programs in order to increase good sleep quality. Furthermore, encouraging family bonding can promote a supportive home environment, strengthen relationships, and enhance overall family well-being. Activities that promote mental health, such as exercise, recreational activities, and meditation, are suggested to help reduce stress and depression in this population.

Keywords: a Northeastern Province, older adults, sleep quality, Thailand

Contact: Naruemol Kingkaew, Dr.P.H.
Sirindhorn College of Public Health, Ubon Ratchathani, Faculty of Public Health and Allied Health Sciences, Praboromarajchanok Institute, Ubon Ratchathani 34190, Thailand.
E-mail: nkingkaew@scphub.ac.th

J Health Sci Med Res 2026;44(3):e20251282
doi: 10.31584/jhsmr.20251282
www.jhsmr.org

Introduction

Sleep quality among older adults is crucial for health and well-being. Sleep disturbances, including insomnia and restless sleep, are significant because they lead to cognitive impairment and increased risk of accidents[1]. Additionally, age-related changes, changes in social relationships[2], physical environment, and emotional management, which more commonly affect older adults, may negatively impact sleep quality, leading to several types of chronic diseases.

Sleep quality impacts physical and mental health. A study by the National Sleep Foundation in the United States revealed that older adults generally experienced both quantitative and qualitative poor sleep quality. In the study, 32.1% of individuals aged 60–69 years reported poor sleep quality, and this result increased to 52.5% among those aged ≥80 years. Changes in sleep patterns, such as difficulty falling asleep and frequent nighttime awakenings, presented in 39% of older adults. Typically, older adults should get approximately 7.5 hours of sleep per night[3].

Poor sleep quality, such as sleep disturbances and daytime sleepiness, results in lowering patients' overall health and quality of life. The China Health and Retirement Longitudinal Survey from 2011 to 2020, conducted among 9,063 participants, found that sleeping less than 4 hours per day and 4–6 hours per day was associated with most chronic diseases. Consequently, inadequate sleep is related to elevated risk for psychiatric diseases, arthritis, digestive diseases[4], cardiovascular diseases, oxidative stress, and inflammation[5]. Furthermore, it was supported that sleep quality significantly predicted the quality of life of Chronic obstructive pulmonary disease (COPD) patients[6]. Having good physical environments, such as proper ventilation and maintaining an optimal relative humidity level in the bedroom, are essential for the sleep quality of older adults. Social isolation, the loss of same-age peers, loneliness, family relationships, and social support may also affect sleep quality among older adults. This was supported by the University of Michigan Health and Retirement Study, which revealed that loneliness mediated the relationship between social support and sleep quality in older adults[7].

Thailand has approximately 13.64 million older adults aged 60 years and above, accounting for 19.5% of the total population[8]. This demographic shift has led Thailand to be classified as an aged society since 2022[9], which means individuals aged 60 years and above account for more than 10% and individuals aged 70 years and above for more than 7% of the total population. This data show that the Thai population structure has undergone significant changes[8]. The prevalence of poor sleep quality in Thailand varied according to different regions. A survey conducted between September and October 2017 among 254 older adults residing in Pracha Nivet village, Nonthaburi, revealed that 52.0% experienced poor sleep quality[10]. Of older adults in urban communities in the northern part of Thailand, 4.8% presented with good sleep quality[11]. A previous study in a northeastern province of Thailand revealed that 77.1% of older adults without dependence exhibited good sleep quality, while only 22.9% had poor sleep quality[3].

The reported results of poor sleep quality among older adults in each region of Thailand were uncertain. Physical environment, family relationships, and mental health typically impact sleep quality. Therefore, this study aimed to assess the prevalence of sleep quality and determine the factors related to sleep quality among older adults in a northeastern province of Thailand.

Material and Methods

Population and sample

Ubon Ratchathani is a province located in the northeastern region of Thailand, and it is the fourth-largest province by area in the country. The province includes 25 districts with a population of 1,869,608. The majority of the population works in rice farming and the cultivation of various field crops, such as kenaf, cassava, and peanuts[12]. In our study, we focused on older adults aged 60 years and above, approximately 349,658 people, or around 18% of

the total population[13]. Data were collected using multistage sampling. In the first stage, the study area was stratified into urban and rural zones based on the density of the population, infrastructure, transportation, and income[14]. Two districts were chosen. The urban area was the Mueang Ubon Ratchathani District, with a population of 3,571 older adults, and the rural area was the Nayear District, with a population of 1,067 older adults. In the second stage, stratification was based on gender.

Study design and sample size

This study was a cross-sectional study. A total sample size was calculated using the single proportion formula[15] in which p is defined based on the sleep quality of the Thai population from a previous study. The p was equal to 0.38[16], Z was equal to 1.96, and d was equal to 0.05. The total sample size was 355 people with a response rate of 100.0%. The participants were selected using proportional to size (PPS) sampling to represent the samples in the 2 areas. Out of 4,638 older adults in the selected areas, 3,571 resided in an urban area, from which 273 participants were selected. In a rural area, there were 1,067 older adults, and 82 were selected from this group. One participant per household was selected as an eligible sample. Inclusion criteria were older adults, aged 60 years and above, who were independent of others for daily activities, and could communicate in the Thai language verbally. Meanwhile, the exclusion criteria were participants with severe physical or mental illnesses that interfered with participation (e.g., advanced dementia, acute hospitalization).

Research instruments

The research instruments consisted of structured questionnaires as follows: Baseline characteristics including sex, age, physical history, and residence, which was divided into urban and rural areas.

Physical environment was assessed using items adapted from a previous study[15], which had been previously validated in older adults. It included 8 questions regarding issues such as lighting, noise, odors, temperatures, pets or insects, and room conditions. Answers were scored as 0=no problem at all, 1=mild problem, 2=moderate problem, and 3=severe problem. A total score of ≤8 was classified as 'no problem at all', 9–16 as 'mild problem', 17–24 as 'moderate problem', and 25–32 as 'severe problem'.

Family relationships were assessed using 16 questions. The questions were adapted from a previous study[17]. Examples of these questions include: 'When you encounter problems, you receive support from your family. Family members demonstrate generosity and mutual assistance. You engage in shared hobbies and plan activities together. In cases of conflict, you and your family member seek resolution through peaceful means'. Responses were scored as 1=not true at all, 2=slightly true, 3=moderately true, and 4=very true. A total score of ≤27 was classified as 'worse relationship' and 28–54 as 'good relationship'.

Stress was measured using a stress assessment scale[18]. The participants were asked about experiencing sleep disturbances, including insomnia or excessive sleep, reduced concentration, irritability, restlessness, anxiety, feelings of dissatisfaction, and reluctance to engage in social interactions. Responses were scored as 0 = never or rarely, 1=somewhat, 2=occasionally, and 3=regularly. A total score of ≤4 was classified as 'mild', 5–7 as 'moderate', 8–9 as 'high', and 10–15 as 'very high'.

Depression was measured using the Thai Geriatric Depression Scale (TGDS-15)[19]. The participants were asked questions about things such as their life satisfaction, memory, motivation, sense of life's worth, and feeling hopeless about their current situation. Answers were scored as 0=no, and 1=yes. A zero score indicated no depression. A total score of 1 to ≥6 indicated the presence of depression, for which follow-up was recommended or a referral to a physician for clinical assessment was made, and ≥11 was considered as diagnosed with severe depression.

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI)[20]. It assessed both quantitative and qualitative sleep quality over a 1-month time interval and comprised 7 components, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The global PSQI score ranged from 0 to 21. A PSQI score greater than 5 was interpreted as poor sleep quality and a score lower than 5 as good sleep quality.

The content validity was examined by 3 experts in the field. It resulted in a reliability estimate of ≥0.67 for each item, and the reliability was determined to be 0.77.

Data collection

Data were collected by 2 data collectors from October to December 2024 after being trained. All participants were interviewed using the structured questionnaire after written informed consent was obtained.

Ethical approval

The study's protocols were approved by the Ethics Committee of the Sirindhorn College of Public Health, Ubon Ratchathani Province (No. SCPHUB-S2024-018, August 9, 2024). All collected data were kept confidential.

Statistical analysis

Data were analyzed using statistical analysis software. Descriptive statistics such as percentages, means, and standard deviations were used to describe all variables in the study. Chi-square tests were used for categorical data. Multiple logistic regression was used to examine the association between study factors and sleep quality. The statistical significance was set at a p-value of ≤0.05.

Results

Baseline characteristics

Table 1 describes the general characteristics of the 355 older adults who participated in the study. The majority were female (65.4%, n=232), with a mean age of 68.59 years. Most participants (76.9%) lived in an urban area, and 45.7% of all participants reported having no underlying medical conditions. Nearly half (48.5%) experienced mild problems related to their physical environment. A substantial proportion (75.5%) reported good family relationships. In terms of mental health, 5.6% exhibited very high levels of stress, while 0.6% showed signs of severe depression.

Table 1 General characteristics of the 355 older adults in a Northeastern Province, Thailand

Variable	Total (n=355)	%
Sex		
Male	123	34.6
Female	232	65.4
Age, year		
60-69	230	64.8
70-79	83	23.4
≥80	42	11.8
Mean±S.D.=68.59±8.741		
Resident area		
Urban	273	76.9
Rural	82	23.1
Physical history		
Not having medical conditions	162	45.7
Diabetes Miletus	96	27.0
Hypertension	72	20.3
Hyperlipidemia	25	7.0
Physical environment		
Not having problem	63	17.7
Mild	172	48.5
Moderate	83	23.4
Severe	37	10.4
Family relationships		
Good	268	75.5
Worse	87	24.5
Stress		
Mild	221	62.3
Moderate	105	29.6
High	9	2.5
Very high	20	5.6
Depression		
No	221	62.2
Having signs	132	37.2
Severe	2	0.6

Data are presented as number (%) or mean±S.D.

Comparison of the overall sleep quality index and its components between older adults living in urban and rural areas

Table 2 shows that duration of sleep (p-value<0.001), sleep disturbances (p-value=0.038), sleep latency (p-value<0.001), and total sleep quality (p-value=0.010) were statistically significant among participants living in different areas.

Table 2 Comparison of the sleep quality index and its components between urban and rural areas among the 355 older adults in a Northeastern Province, Thailand

Variable	Total (n=355)	Urban area n=273 (%)	Rural area n=82 (%)	p-value
Sleep duration (hr)				<0.001***
≥7	180	150 (83.3)	30 (16.7)	
6-7	138	93 (67.4)	45 (32.6)	
5-6	25	24 (96.0)	1 (4.0)	
<5	12	6 (50.0)	6 (50.0)	
Sleep disturbances				
Never	10	10 (100.0)	0 (0.0)	0.038*
<1 time/week	276	217 (78.6)	59 (21.4)	
1-2 times/week	35	25 (71.4)	10 (28.6)	
≥3 times/week	34	21 (61.8)	13 (38.2)	
Sleep latency (scores)				
0	55	48 (87.3)	7 (12.7)	<0.001***
1-2	186	157 (84.4)	29 (15.6)	
3-4	113	68 (60.2)	45 (39.8)	
5-6	1	0 (0.0)	1 (100.0)	
Day dysfunction				
Never	120	75 (73.5)	27 (26.5)	0.152
<1 times/week	205	164 (80.0)	41 (20.0)	
1-2 times/week	45	33 (73.3)	12 (26.7)	
≥3 times/week	3	1 (33.3)	2 (66.7)	
Habitual sleep efficiency (%)				
≥85	212	156 (73.6)	56 (26.4)	0.162
75 to 84	62	54 (87.1)	8 (12.9)	
65 to 74	21	17 (81.0)	4 (19.0)	
<65	60	46 (76.7)	14 (23.3)	
Subjective sleep quality				0.393
Very good	132	107 (81.1)	25 (18.9)	
Fairly good	201	151 (75.1)	50 (24.9)	
Fair bad	20	14 (70.0)	6 (30.0)	
Very bad	2	1 (50.0)	1 (50.0)	
Use of sleeping medication				0.055
Never	192	145 (74.0)	50 (26.0)	
<1 time/week	110	91 (82.7)	19 (17.3)	
1-2 times/week	43	35 (81.4)	8 (18.6)	
≥3 times/week	10	5 (50.0)	5 (50.0)	
Total				
Good sleep quality (0-5 scores)	170	141 (82.9)	29 (17.1)	0.010*
Poor sleep quality (6-21 scores)	185	132 (71.4)	53 (28.6)	

Data are presented as number (%), p-value by chi-square * p-value<0.05, **p-value<0.01, ***p-value<0.001

Factors associated with sleep quality among the 355 older adults

In the multivariate analysis, after adjusting for all other variables in the model, the significant factors were being female (aOR, 0.58; 95% CI, 0.352 to 0.954), in a rural area (aOR, 1.97, 95%CI, 1.104 to 3.493), having severe problem with their physical environment (aOR, 3.60; 95% CI, 1.362 to 9.510), having moderate stress (aOR, 2.11; 95% CI, 1.219 to 3.635), and having signs of depression (aOR, 2.12; 95% CI, 1.270 to 3.553), as presented in Table 3.

Table 3 Multiple logistic regression for predictor variables in relation to sleep quality of the 355 older adults in a Northeastern Province, Thailand

Variable	aOR	95% CI	p-value
Sex			
Male	1.00	reference	
Female	0.58	0.352-0.954	0.032*
Resident area			
Urban	1.00	reference	
Rural	1.97	1.104-3.493	0.022*
Physical environment			
No having problem	1.00	reference	
Mild	1.06	0.557-2.032	0.850
Moderate	2.07	0.987-4.364	0.057
Severe	3.60	1.362-9.510	0.010*
Family relationships			
Good	1.00	reference	
Worse	2.23	1.306-4.150	0.004**
Stress			
Mild	1.00	reference	
Moderate	2.11	1.219-3.635	0.008**
High	2.20	0.422-11.432	0.349
Very high	2.64	0.776-8.983	0.120
Depression			
No	1.00	reference	
Having signs	2.12	1.270-3.553	0.004**
Severe	0.62	0.036-10.857	0.746

aOR=adjusted Odds ratio, 95% CI=95% confidence interval
*p-value<0.05, **p-value<0.01, ***p-value<0.001

Discussion

The prevalence of poor sleep quality was 52.11% (185/355) in this study. Female participants had significantly lower odds of poor sleep quality compared to males. Conversely, in a study of 2,731 older adults conducted in a rural area of China between 2019 and 2020, female participants had higher odds of poor sleep quality than males[21]. Regarding the residence area, poor sleep quality was higher in urban areas than rural areas (71.6 vs 28.6%), and this study reported that the total score for poor sleep quality was also higher than other studies among older adults in urban communities in the northern region[11] and older adults without dependence in the northeastern region of Thailand[3]. The differences may arise from the fact that this study was generalized into 2 different residency areas, urban and rural. Furthermore, health conditions can also be related to the phenomenon of poor sleep quality[4-6]. Duration of sleep among older adults in urban areas and rural areas was significantly different. This is consistent with a study in China that found that older adults took more than 5 minutes to fall asleep and woke up for about 14.4 minutes during the night[5]. This may be due to room conditions, humidity[5], and REM sleep behavior disorders[22].

The prevalence of sleep disturbances 3 or more times a week was found to be approximately twice as high in an urban area compared to a rural area (61.8% vs. 38.2%). In this study, resident area was defined based on the density of population, infrastructure, and transportation. These conditions may reflect the quality of sleep, particularly factors related to sleep disturbances, such as lighting, noise, odors, temperatures, or insects in their rooms. A meta-analysis and systematic review in China also supported that sleep disturbances increased the risk of the onset of depression in older adults[23]. Sleep latency, or difficulty falling asleep at night, is often linked to poor sleep quality. When sleep latency is prolonged, participants may experience negative

effects from various factors, such as stress, depression, and anxiety. Conversely, experiencing poor sleep quality can contribute to longer sleep latency. The struggle between sleep latency and poor sleep quality can be synergistic and reinforce each other, significantly impacting overall well-being and daytime function. Sleep problems among older adults are more common than among younger people. Complaints of insomnia, snoring, and daytime dysfunction among this population should not be taken lightly, as they can contribute to symptoms of physiologic and psychiatric sleep disorders.

The physical environment also plays a crucial role in the regulation of the sleep-wake cycle. One study in China reported that environmental characteristics, such as temperature and social environment, were significantly related to sleep[24]. They not only impacted sleep quality among older adults, but were also associated with mental health and sleep among children[25]. In addition, there was an experimental study that found that humidity in the bedroom/CO_2 reflected autonomic function, respiration, thermoregulation, and inflammation of the participants[5]. The sleep quality of older adults was found to be sensitive to low relative humidity. When the humidity level dropped to 40%, their sleep efficiency declined by 3.5% and they spent 8.9 minutes less in deep sleep compared to when the humidity was at 60%. The older adults also took 5.6 minutes longer to fall asleep and woke up for an additional 14.4 minutes during the night. This decline in sleep quality may increase sleep disorders and sympathetic nerve activity[5]. This study found that participants who had severe problems with their physical environments had higher odds of poor sleep quality than participants who had good physical environments.

Good family relationships were directly associated with mental health and sleep quality[26]. This study demonstrated that poorer family relationships were significantly associated with poor sleep quality; participants with bad family relationships were more than 2 times more likely to experience poor sleep quality compared to participants who had good relationships. It also supported that living status, such as living with family or sharing accommodations, was a mediating factor affecting sleep quality. Meanwhile, participants living alone did not show any significant effect of poor sleep patterns at all[26].

Stress, depression, and anxiety disrupt sleep patterns, and they are mediators between sleep quality and internalized symptoms[27]. This study found that participants with moderate stress experience more than 2 times more poor sleep quality. Additionally, those who had signs of depression also presented more than twice the poor sleep quality compared to participants who had no depression. However, this was inconsistent with a 4-year follow-up study among 4,940 participants in England that determined that financial stress was not significantly associated with sleep quality or future risk of high-risk participants[28].

This cross-sectional study has 3 limitations. First, it was unable to determine a causal relationship and demonstrated weak associations between the study variables and sleep quality. Therefore, a longitudinal study should be conducted to determine causality in the future. Second, the study should be expanded to include larger sample sizes and other regions to confirm the findings and increase generalizability. Lastly, an experimental study is recommended for further study in order to investigate the physical environmental factors related to sleep quality among older adults.

Conclusion

Sex, resident area, physical environment, family relationships, stress, and depression had significant negative relationships with sleep quality among older adults in a northeastern province in Thailand. Interventions supporting participants living in both urban and rural areas should be created. Encouraging family bonding through shared activities such as regular family meals, digital-free time, and

collaborative tasks, alongside programs like communication skills, could promote a supportive home environment, strengthen relationships, and enhance overall family well-being. Mental health activities such as exercise, recreational activities, or meditation are recommended to help reduce stress and depression in this population.

Conflict of interest

The authors have no conflict of interest to declare.

Acknowledgement

The authors would like to acknowledge the Sirindhorn College of Public Health, Ubon Ratchathani Province, Faculty of Public Health and Allied Health Sciences, Praboromarajchanok Institute, for their support of this research, and the Village Health Volunteers in Ubon Ratchathani Province, who supported the data management.

References

1. Misra S, Malow BA. Evaluation of sleep disturbances in older adults. Clin Geriatr Med 2008;24:15-26. doi: 10.1016/j.cger.2007.08.011.
2. Akhter-Khan SC, Aein NMP, Wongfu C, Prina M, Wai KM, Mayston R, et al. Social relationship expectations, care, and loneliness in later life: perspectives from Thai and Myanmar adults in northern Thailand. SSM Ment Health 2023;4:100279. doi: 10.1016/j.ssmmh.2023.100279.
3. Chopsiang L, Khantichitr P, Khantichitr P. Factors related to sleep quality among the elderly without dependence in Ubon Ratchathani Province. J Nurs Health Care 2023;41:1-11.
4. Li Q, Chan NY, Zhang L, Wong SY, Yang X. Mapping the 9-year sleep trajectory and its implications for chronic disease risks among middle-aged and older adults. J Psychosom Res 2025;188:111967. doi: 10.1016/j.jpsychores.2024.111967.
5. Yan Y, Lan L, Gong P, Guo C. How humidity and CO2 affect the sleep of older adults? Insights for improving sleep quality through environmental control. Build Environ 2025;271:112628. doi: 10.1016/j.buildenv.2025.112628.
6. Afroz DN, Patalano F, Naujoks C, Gutzwiller F. Impact of sleep disturbance on health-related quality of life in chronic obstructive pulmonary disease (COPD): what do we know so far? Value Health 2019;22:S883. doi: 10.1016/j.jval.2019.09.2549
7. Seo S, Reilly S, You W, Williams I, Mattos MK. The relationship between social relationships and sleep quality in older adults: loneliness as a mediator and cognitive status as a moderator. Geriatr Nurs 2024;60:628-35. doi: 10.1016/j.gerinurse2024.10.036
8. National Statistical Office. Key findings: employment of the elderly in Thailand in 2023. [homepage on the Internet]. Bangkok: National Statistical Office; 2025 [cited 2025 Mar 31]. Available from: https://www.nso.go.th/nsoweb/storage/
9. Department of Provincial Administration, Ministry of Interior. Statistics of the Thai elderly in 2022 [homepage on the Internet]. Bangkok: Department of Provincial Administration; 2025 [cited 2025 Mar 31]. Available from: https://stat.bora.dopa.go.th/new_stat/webPage/statByProvince.php?year=67.
10. Chinvararak C, Tangwongchai S, Dumrongpiwat N. Sleep quality and its associated factors in the elderly at Pracha niwet village. J Psychiatr Assoc Thailand 2018;63:199-210.
11. Suri K, Sununsirikul K, Tonsuvan K. Quality of sleep and associated factors in elderly at urban community, Nakhon Sawan. Reg 3 Med Public Health J. 2022;19:15-27.
12. Wikipedia. Ubon Ratchathani Province. [homepage on the Internet] Ubon Ratchathani: Wikipedia; 2025 [cited 2025 Mar 31]. Available from: https://en.wikipedia.org/wiki/Ubon_Ratchathani_province
13. The National Health Security Office [homepage on the Internet]. The proportion of population by age. [cited 2025 Mar 31]. Available from: https://ubon.nhso.go.th/starter/region/pop-proportion.php?utm_source
14. National Statistical Office. Reporting to a study guideline for defining urban and rural areas in Thailand [homepage on the Internet]. Bangkok: National Statistical Office; 2025 [cited 2025 Mar 31]. Available from: https://catalogapi.nso.go.th/api/doc/department/D08/SD08_08/SD08_08_55_8.pdf?utm_source
15. Daniel WW. Determination of sample size for estimating proportions. 10th ed. New York: John Wiley & Sons; 2010.
16. Lumjumjung A, Thitichatchawan I, Supprasert W, Kigpiboon C, Klinsurai P, Meesuk N. Factors affecting sleep quality of the elderly in Bansuan subdistrict, Mueang district, Chonburi province. Res Dev Health Syst J 2024;17:96-109.
17. Busarakham C. Factors influencing depression among older adults in the community of Nakhon Pathom Province

(Unpublished Master's thesis). Christian University: Bangkok; 2012.

18. Ministry of Public Health, Thailand [homepage on the Internet]. Stress Assessment Scale (ST-5). [cited 2025 Mar 31]. Available from: https://kkhos.moph.go.th/kkhos/data_office/ST5.pdf
19. Ministry of Public Health, Thailand [homepage on the Internet]. Thai Geriatric Depression Scale (TGDS-15) Nonthaburi: Ministry of Public Health; 2025. [cited 2025 Mar 31]. Available from: https://web.stanford.edu/~yesavage/TGDS.pdf
20. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28:193-213. doi: 10.1016/0165-1781(89)90047-4.
21. Zhou Y, Li Z, Li J, Wang X, Qi K, Zhang S, et al. Sex difference in the association between sedentary behavior and sleep quality: a longitudinal study among older adults in rural China. J Am Med Dir Assoc 2023;24:1520-6.e2. doi: 10.1016/j.jamda.2023.03.022.
22. Tatineny P, Shafi F, Gohar A, Bhat A. Sleep in the elderly. Mo Med 2020;117:490-5.
23. Bao YP, Han Y, Ma J, Wang RJ, Shi L, Wang TY, et al. Co-occurrence and bidirectional prediction of sleep disturbances and depression in older adults: meta-analysis and systematic review. Neurosci Biobehav Rev 2017;75:257-73. doi: 10.1016/j.neubiorev.2017.01.032.
24. Rao J, Ma J, Dong G. Exploring the effects of multi-dimensional geographic environment on daily sleep and physical activity based on Actigraph data. Health Place 2024;90:103370. doi: 10.1016/j.healthplace.2024.103370.
25. Lercher P, Dzhambov AM, Persson Waye K. Environmental perceptions, self-regulation, and coping with noise mediate the associations between children's physical environment and sleep and mental health problems. Environ Res 2025;264:120414. doi: 10.1016/j.envres.2024.120414.
26. Tong LK, Li YY, Liu YB, Zheng MR, Fu GL, Au ML. The mediating role of sleep quality in the relationship between family health and depression or anxiety under varying living status. J Affect Disord 2025;369:345-51. doi: 10.1016/j.jad.2024.10.004.
27. Meng R, Xu J, Luo Y, Mastrotheodoros S, Jiang C, Garofalo C, et al. Perceived stress mediates the longitudinal effect of sleep quality on internalizing symptoms. J Affect Disord 2025;373:51-9. doi: 10.1016/j.jad.2024.12.046.
28. Hamilton OS, Steptoe A. Financial stress and sleep duration in immune and neuroendocrine patterning. An analytical triangulation in ELSA. Brain Behav Immun 2025;127:396-408. doi: 10.1016/j.bbi.2025.03.006.