

MAPPING INSOMNIA SEVERITY AMONG PROLANIS PATIENTS: A FORMATIVE STUDY IN A REMOTE AREA OF INDONESIA

Vania Angeline Bachtiar^{1*}, Perigrinus Hermin Sebong², Fransiska Inka Pratiwi³, Eviana Budiarti Sutanto⁴, Aprilia Karen Mandagie⁴, To Lidwina Prillya Indra Christyana⁴, Ferry Santoso⁵

¹Department of Neurology, Faculty of Medicine, Soegijapranata Catholic University, Semarang, Indonesia; ²Department of Public Health, Faculty of Medicine, Soegijapranata Catholic University, Semarang, Indonesia;

³Faculty of Medicine, Soegijapranata Catholic University, Semarang, Indonesia;

⁴Department of Biomedicine, Faculty of Medicine, Soegijapranata Catholic University, Semarang, Indonesia;

⁵Faculty of Medicine, Universitas Negeri Semarang, Indonesia.

Author Correspondence

Name : Vania Angeline Bachtiar,
Address : Jln. Pawiyatan Luhur Selatan IV
E-mail : vania@unika.ac.id

Abstract

Background: poor sleep quality among type-2 diabetes mellitus and hypertension patients is a neglected issue in pursuing a continuum of care for the patients. Only little information is available concerning the association between hypertensive and diabetes mellitus conditions and poor quality of sleep among the Indonesian elderly in rural areas. This study aims to assess insomnia severity among PROLANIS patients.

Methods: formative research was applied to map the current occurrence of insomnia severity among medical PROLANIS patients Puskesmas Pasir Sakti Lampung Timur. Data were collected through self-questionnaires (n=43). Univariate and ANOVA tests were used with significance (p-value < 0.05).

Results: the study included 43 participants, with a mean age of 66.02 (\pm 8.25). The Insomnia Severity Index mean scores were 12.26 \pm 5.13 (hypertension), 8.67 \pm 7.02 (type-2 diabetes mellitus), and 7.65 \pm 5.84 (type-2 diabetes mellitus + hypertension). Our study showed significant differences in the insomnia severity index score between chronic conditions.

Conclusions: There was a considerable difference in insomnia severity and sleep hygiene between patients with hypertension, type-2 diabetes mellitus, and type-2 diabetes mellitus + hypertension. Also, sleep hygiene significantly differed between routine and non-medical intake. Future assessment of sleep hygiene and insomnia severity should be intensive and incorporated into the PROLANIS program in Puskesmas. It is also needed for sleep quality literacy interventions among patients in rural areas.

Keywords: sleep disorder; sleep hygiene; hypertension; diabetes mellitus; rural area.

Introduction

The association between sleep and chronic conditions has garnered attention in recent years. In the general population, chronic sleep deprivation is estimated to affect up to 20 % (Edmealem et al., 2020). Poor sleep increases the risk of incidents in most chronic conditions,

including hypertension (HTN) and type 2 diabetes mellitus (DM) (Wang et al., 2023; Australian Institute, 2021; Darraj, 2023).

People with sleep duration lower than five hours are 1.9 times more at risk of DM and other chronic conditions such as Chronic Obstructive Pulmonary Disease (COPD), and Coronary Heart Disease (CHD) (Lu, 2022). Nighttime sleep deprivations have substantial adverse effects on the regulation of weight, sugar, and blood pressure because of endothelial dysfunction, sympathetic nervous system stimulation, and regulation and activation of systemic inflammation, which leads to further complications of chronic conditions such as diabetes and hypertension. Further, those who experience poor sleep quality impair their routine activities and exercise capacity, which results in an adverse prognosis of DM and hypertension. (Edmealem et al., 2020). Poor sleep quality may increase the risk of HTN due to short sleep duration (< 7 hours per night) and frequent sleep disorders (e.g., sleep apnea) (Li & Shang, 2021). Although much evidence has linked poor sleep quality to HTN risk, neither is considered a risk factor in HTN care (Jarrin et al., 2018). Patients do not report sleep disturbances when they visit healthcare facilities, which are often unrecognized and untreated. (Bhaskar et al., 2016; Almeneessier et al., 2018).

Most studies on sleep problems have recently been conducted on urban residents, with few studies among the rural population. However, high rates of sleep problems have also occurred, especially in rural areas. Recent reports have shown that the prevalence of sleep quality among the population in rural areas in Japan, China, and Brazil was 25.5%, 49.5%, and 42%. Among rural residents, the severity of insomnia is associated with HTN. Moreover, poor sleep was more frequent in rural residents with DM and HTN (Ju et al., 2021; Wolińska & Mroczek, 2022; Zhang & Tang, 2019). A study in Australia by Bourke et al. found that patients with chronic conditions in rural and remote areas are vulnerable to poor healthcare access (Harper et al., 2021). The status of HT and DM is associated with geographic, social, and economic factors, and epidemiologic characteristics likely changed, especially in rural areas (Xing et al., 2019). However, inadequate awareness of patients and lack of healthcare quality in rural regions challenge HTN and DM management (Chang et al., 2019; Mills et al., 2020). It poses a persistent disparity without the precise epidemiological mapping of the existing sleep quality between urban and rural areas.

In the last few decades, Indonesia has faced a recent increase in the prevalence of type-2 diabetes mellitus from 6.9 to 8.5% and hypertension from 25.8 to 34.1% (MoH, 2018). Significantly, the prevalence of HTN among the rural population in Indonesia increased by

33,7% from 2007 to 2018 (MoH, 2018). The government has implemented PROLANIS (Program Pengelolaan Penyakit Kronis/Chronic Disease Management Program) to tackle these. Although most diagnosed people receive some treatment, only half can be adequately controlled (Salamah et al., 2023). Less than half of the people with DM have been diagnosed. Reports show that 21% of DM patients are diagnosed, and only seven percent are adequately controlled (Sofyan et al., 2023). Previous studies in rural Indonesia also found that DM and HTN patients are more likely to experience poor sleep due to sociodemographic risk factors. However, poor sleep quality among DM and HTN patients is a neglected issue in pursuing a continuum of care for the patients. Only little information is available concerning the association between HTN and DM conditions and poor quality of sleep among the Indonesian elderly in rural areas. Limited studies have delved into their specific impact within the Indonesian context despite the global recognition of the role of these factors in DM and HTN (Alfaqeeh et al., 2024). Hence, reliable epidemiologic data on the current prevalence of sleep quality disorder are crucial in formulating specific strategies since previous studies suggested that Indonesia lags in psychosocial risk factor management (Peltzer & Pengpid, 2018; Kurnia et al., 2020). In the present study, we analyze a representative population in rural areas of Indonesia, aiming to profile the characteristics of sleep quality disorder among PROLANIS patients for future research directions on prevention and management strategies of HTN and DM in Indonesia.

Method

Design, Study Location, and Participants

We used a formative study with a rigorous assessment to identify potential sleep disturbances (Evans et al., 2015). This study was conducted at the Public Health Center, or Puskesmas Pasir Sakti Lampung Timur, Indonesia, from November 2022 to April 2023. This site was chosen considering the implementation of the Chronic Disease Management Program called Program Pengelolaan Penyakit Kronis (PROLANIS), which is relatively new. A national program initiated by the Social Insurance Administration Organization or Badan Penyelenggara Jaminan Sosial (BPJS) aims to provide a proactive healthcare service approach for patients with chronic diseases, particularly diabetes mellitus and hypertension. It is also derived to achieve the optimal quality of life in patients with chronic disease through effective and efficient healthcare services, including cost (Khoe et al., 2020). The participants were recruited according to the PROLANIS register. We used a total sampling technique due to the

limited number of PROLANIS patients registered at the Public Health Center, which we call Puskesmas. Our study received ethical approval from the Medical and Health Research Ethics Committee (MHREC), Faculty of Medicine, Public Health and Nursing -Dr. Sardjito General Hospital with the number KE/FK/1526/EC/2022.

Evaluated Parameter and Data Collection

The evaluated parameters used in this study were blood pressure, chronic conditions such as type 2 diabetes and hypertension, sleep hygiene, and insomnia severity. Chronic conditions data were collected from secondary routine data. Insomnia severity was evaluated using the Insomnia Severity Index (ISI). The ISI comprises seven items: sleep onset, sleep maintenance, early morning awakening, satisfaction level with current sleep pattern, interference with daily living, noticeability of impairment due to sleep difficulty, and level of distress caused by the sleep problem. Each item is rated on a Likert scale from 0 to 4 and is summed in total scores ranging from 0 to 28 (Morin et al., 2011). Sleep hygiene was measured using the Sleep Hygiene Index (SHI) created by Mastin (Mastin, 2006). The SHI is a thirteen-item self-reporting index for evaluating behavioral practices and environmental factors affecting sleep quality. Each item is rated on a Likert scale from 0 to 5 and is summed in total scores ranging from 13 to 75. (Chehri et al., 2019). The inclusion criteria for this study were age 18 years or older and without cognitive impairment. Most of the participants were personally informed about the background and objectives of our research at the beginning, before the data collection at Puskesmas. The questionnaire was filled in several days after they attended the PROLANIS monthly activities at Puskesmas. All PROLANIS patients gave their consent to participate in this study. We also collected sociodemographic data such as patients' age, sex, educational levels, marital status, income, smoking behavior, medicine intake, and knowledge regarding sleep hygiene.

Data Analysis

We provide univariate analysis for the categorical variables using proportion, while we use mean (standard deviation) for numerical variables. Our study presented the ISI and SHI scores in total (numeric) and subcategory scores. In all tests, a p-value of ≤ 0.05 was considered significant. Continuous data are reported as the mean and standard deviation (SD), and the categorical data are represented as a proportion (%). We used analyses of variance (ANOVA) for the continuous variables and Chi-square for the categorical variables. The chi-square test

was used to investigate the association between the total score of the ISI and the sociodemographic variables examined. The regression model determined the significant predictors of insomnia severity. We used SPSS 25.0 for all analyses.

Results and Discussion

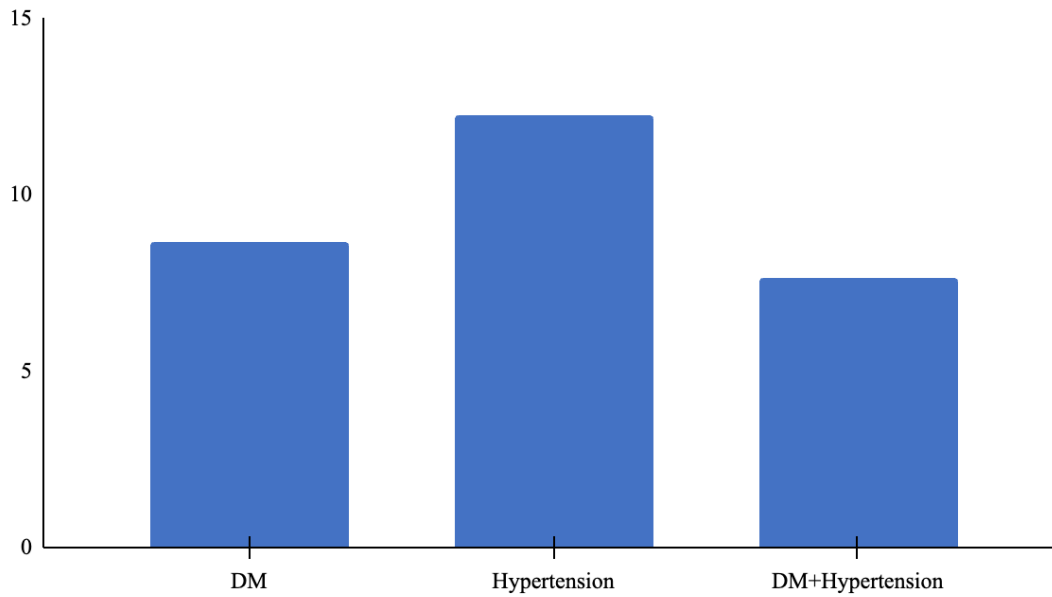
The study included 43 participants, with a mean age of 66.02 (\pm 8.25). The differences in sleep problems in chronic conditions were measured using the Insomnia Severity Index (ISI). To ensure the internal consistency of the ISI items, we tested all items on the participants previously; thus, the results were good. The mean scores of the ISI items are presented in Table 1.

Table 1. Insomnia Severity Index

No	Item	Mean (SD)	r _{it}	Alpha del
1	Problems Falling asleep	1.79 (1.31)	.736	.866
2	Problems staying asleep	1.88 (1.29)	.836	.850
3	Early awakening	1.35 (1.02)	.771	.861
4	Dissatisfaction	1.79 (0.96)	.543	.887
5	Functional Impairment	1.05 (0.92)	.535	.887
6	Noticeability	1.28 (1.07)	.676	.872
7	Distress	1.33 (1.01)	.685	.871

The mean score item ranges from 0 to 4; the scale range of response ranges from a minimum score of 0 to a maximum score of 28; SD refers to standard deviation; r_{it} is a part-whole-corrected item-test-correlation; and alpha del refers to the Cronbach’s alpha if the item is deleted. All the items contributed substantially to the part of the corrected item test correlations, ranging from 0.535 to 0.836, and Cronbach’s alpha was 0.88.

Figure 1. Insomnia Severity Index by Chronic Diseases



The overall mean score of the ISI was 10.19 (± 5.85). In all chronic conditions, hypertension (HTN) patients reported more severe sleep problems than type-2 diabetes mellitus (DM) and diabetes mellitus + hypertension (DM+HTN) did. The ISI mean scores were 12.26 ± 5.13 (HTN), 8.67 ± 7.02 (DM), and 7.65 ± 5.84 (DM+HTN). The most significant sleep problems were observed among HTN patients (Figure 1).

Table 2. Sociodemographic Characteristics Of The Participant

Variable	Frequency	Proportion	Valid Percent	Cum. Percent	p-Value
Male	1	2.3	2.3	2.3	.731
Female	42	97.7	97.7	100	
	43	100	100		
Education Level					.460
Elementary School	26	60.5	60.5	60.5	
Junior High School	1	2.3	2.3	62.8	
Senior High School	1	2.3	2.3	65.1	

Variable	Frequency	Proportion	Valid Percent	Cum. Percent	p-Value
Male	1	2.3	2.3	2.3	.731
Female	42	97.7	97.7	100	
	43	100	100		
Education Level					
Elementary School	26	60.5	60.5	60.5	.460
None	15	34.9	34.9	100	
	43	100	100		
Marital Status					
Divorce	16	37.2	37.2	37.2	.041*
Married	26	60.5	60.5	97.7	
No Married	1	2.3	2.3	100	
	43	100	100		
Income (monthly)					
Yes	21	48.8	48.8	48.8	.174
No	22	51.2	51.2	100	
	43	100	100		
Smoking					
Smoker	40	93	93	93	.669
Non-Smoker	3	7	7	100	
	43	100	100		
Knowledge					
Good	4	9.3	9.3	9.3	.536

Variable	Frequency	Proportion	Valid Percent	Cum. Percent	p-Value
Male	1	2.3	2.3	2.3	.731
Female	42	97.7	97.7	100	
	43	100	100		
Education Level					.460
Elementary School	26	60.5	60.5	60.5	
Worst	12	27.9	27.9	37.2	
Moderate	27	62.8	62.8	100	
	43	100	100		

The majority of participants were female (0.97), with the most educational level being elementary school (0.60), married (0.60), and smoking behavior (0.93). Participants' sleep hygiene index was generally considered moderate (0.62). Regarding the ISI clinical classification, 44.2%, 30.2%, 23.3%, and 2.3% of participants were categorized as having subthreshold, no clinically significant, moderately severe, and severe insomnia. The results of the univariate analysis found that only the marital status of sociodemographic factors was associated with insomnia severity among the participants (Table 2).

Table 3. Impact Of Chronic Conditions and Treatment Adherence on Sleep Quality

	ISI Score			SHI Score		
	Mean	SD	p-value	Mean	SD	p-value
Chronic conditions						
DM (type 2)	8.67	7.02	0.039*	31	4.58	0.040*
Hypertension	12.26	5.13		29.74	5.86	
DM+Hypertension	7.65	5.81		25.76	3.75	
Medicine Intake						
Routine	11.0	6.23	0.217	30.04	5.12	0.002*
None	8.67	4.92		24.93	4.13	

Table 3 presents mean ISI and SHI scores derived from chronic condition type and medicine intake. There were significant differences between the participants regarding the type of chronic condition. The HTN patients reported relatively many sleep problems, both in terms of insomnia severity and sleep hygiene scores. Medicine intake had no significant impact on ISI items, in contrast with sleep hygiene—participants whose routine medicine intake significantly contributed to a good level of sleep hygiene index.

The analysis to estimate the predictor factor of sleep hygiene for insomnia severity is shown in Table 4. Overall, the variance of insomnia severity was explained by $R = .76$; $F(3,047) = 63.9$; $p < .006$. However, only item ninth ($\beta = .382$; $p < .015$) significantly determined the model.

Table 4. Predicting Insomnia Severity From Sleep Hygiene Items

Predictor	b	SE b	β	t	p
1. Taking daytime naps lasting \geq 2 hours	-0.337	0.889	-0.056	-0.379	0.708
2. Going to bed at different times from day to day	1.132	0.898	0.227	1.26	0.218
3. Getting out of bed at different times from day to day	-0.927	0.676	-0.22	-1.37	0.181
4. Exercising to the point of sweating within 1 hour of going to bed	0.664	2.339	0.053	0.284	0.779
5. Staying in bed longer than you should, two or three times a week	0.109	0.612	0.028	0.179	0.859
6. Using alcohol, tobacco, or caffeine within 4 hours of going to bed or after going to bed	0.763	0.598	0.184	1.277	0.212
7. Doing something that may wake you up before bedtime (e.g., watching television, reading books/newspapers)	0.434	0.587	0.105	0.739	0.466
8. Going to bed feeling stressed, angry, upset, or nervous	1.304	0.738	0.25	1.766	0.088
9. Using your bed for things other than sleeping (e.g., watching television, reading, eating, or working)	1.511	0.586	0.382	2.577	0.015*
10. Sleeping on an uncomfortable bed (e.g., poor mattress or pillow quality, too many or not enough blankets)	0.499	6.252	0.026	0.08	0.937
11. Sleeping in an awkward bedroom (e.g., too bright, too stuffy, too hot, too cold, or too noisy)	-1.3	3.033	-0.114	-0.429	0.671
12. Doing something important before sleep (e.g., paying bills, planning a schedule, or working)	-1.373	2.617	-0.131	-0.524	0.604
13. Thinking, planning, or worrying when you are in bed	1.201	0.791	0.25	1.518	0.14

The quality of sleep among patients with chronic conditions might be assessed to help them manage their conditions better. Our study revealed that the difference in the ISI score among PROLANIS patients was significantly related to the type of chronic condition. Considering the growing prevalence of DM and HTN among the Indonesian population, the present study provided crucial input for setting up chronic condition management program priorities to meet the existing challenges.

Sleep disorder remains a neglected issue in primary healthcare services, especially in remote areas. Sometimes, healthcare services focus on managing chronic diseases and neglect other physiological conditions. The literature study in 2020, using the Theoretical Domains

Framework (TDF), revealed multiple barriers to recognizing and diagnosing insomnia, such as knowledge or awareness of the negative physical and mental health impact associated with insomnia and lack of training for identifying insomnia symptoms (Ogeil et al., 2020).

The association of sleep disorders with HTN and DM is at least partly due to pathophysiological changes in the neuroendocrine and autonomic nervous systems and the high prevalence of unhealthy behavior in people who sleep short (Deng et al., 2017; Edmealem et al., 2020).

Poor sleep or insomnia is associated with lower physical activity and increased daytime sleepiness, which mediates the relationship between insomnia and hypertension (McClain et al., 2014). Physical inactivity, higher food intake, and poor food quality are independent predictors of hypertension, especially in adulthood. Insomnia symptoms can increase hypertension risk by disrupting circadian rhythmicity and leading to circadian misalignment (Patterson et al., 2020; Gangwich, 2014).

The suprachiasmatic nucleus, which controls the endogenous circadian rhythm, may become metabolically flattened and arrhythmic due to restricted sleep and chronically inverted behavioral cycles that are mismatched with 24-hour light-dark cycles (Gangwich, 2014; Bass & Takahashi, 2010). Furthermore, these are associated with activity at unconventional circadian times, leading to a desynchrony between the master clock in the brain and the peripheral clocks in the organs, thus creating a state of metabolic dysfunction that predisposes to hypertension (Morris et al., 2017; Gangwich, 2014). Collectively, these behaviors disrupt circadian rhythmicity, leading to nondipping blood pressure, higher daytime, and increased hypertension risk (Gangwich, 2014).

Poor sleep duration is associated with decreased leptin, increased ghrelin, increased appetite and hunger (i.e., cravings for sweets, starches, and salty foods), higher energy intake, and poor overall diet quality (Reid et al., 2019). Patients with poor sleep and insomnia may also have irregular eating behaviors, including longer food intake hours and increased nighttime eating (Dashti et al., 2015).

Poor sleep and insomnia symptoms may affect human body functions, such as metabolic decreased glucose tolerance, insulin resistance, and endocrine regulation through elevated cortisol levels (Duan et al., 2023). Existing shards of evidence have shown that insomnia is associated with an increased risk of obesity two times greater and also disturbs glucose homeostasis and tolerance (Duan et al., 2023). Insomnia symptoms are associated with an increased risk of DM two times greater (Koopman et al., 2020; Yao et al., 2022). Some

studies have shown that the prevalence rates of insomnia and insomnia symptoms in people with DM reached up to 30% and increased hemoglobin A1C levels (Koopman et al., 2020).

Apart from insomnia, sleep hygiene is another critical element of sleep quality. (Alanazi et al., 2023; Baranwal et al., 2023) In the present study, we concluded that there is a significant difference in sleep hygiene scores between DM, HTN, and DM+HTN patients. We also found the differences between patients with routine medicine intake and those with non-routine medicine intake. This result aligns with a previous study that found that poor sleep hygiene increases the likelihood of HTN (Lo et al., 2018). Patients with poor DM control are more than two times at risk of poor sleep hygiene (Richa et al., 2023).

Our study's main strengths and novelty are its information on insomnia severity and sleep hygiene prevalence. This information is necessary to provide a baseline for monitoring and informing the development of new strategies for improving HTN and DM control. Our study gained ISI and SHI in rural settings, which is key to developing strategies for better detecting and controlling HTN and DM.

However, our study has several limitations. First, the study used a small number of samples due to a lack of actual numbers of DM, HTN, and DM+HTN patients in the whole population around Puskesmas Pasir Sakti Lampung Timur administrative areas. Thus, our findings might be generalizable to other populations with differences in Puskesmas's capacity to implement the PROLANIS program. Second, this study only considered baseline linearity measurement between chronic conditions, sleep hygiene, and insomnia. Although our findings suggested reasonable epidemiological data, we could not control the potential confounding factors. Thus, the truth of causality or association must be identified using many samples.

Conclusion

This formative study shed light on sleep quality among patients with hypertension, type 2 diabetes mellitus, and type 2 diabetes mellitus + hypertension. There was a significant difference in insomnia severity and sleep hygiene between HTN, DM, and DM+HTN patients. Also, sleep hygiene significantly differed between routine and non-medical intake. Sleep hygiene and insomnia severity assessment should be intensive and incorporated into the PROLANIS program. Sleep quality literacy should be improved among patients in rural areas.

Acknowledgments

We thank all the participants, Puskesmas staff, and the district health office of Lampung Timur. Special thanks to Mr. Ferdinandus Krisna Pukan from the Faculty of Medicine, Soegijapranata Catholic University, Indonesia, for his contributions during the research process.

References

1. Edmealem, A., Degu, S. G., Haile, D., Gedfew, M., Bewket, B., & Andualem, A. (2020). Sleep quality and associated factors among diabetes, hypertension, and heart failure patients at Debre Markos referral hospital, Northwest Ethiopia. *Sleep Disorders*, 6125845. <https://doi.org/10.1155/2020/6125845>
2. Wang, Y., Jiang, G., Hou, N., Chen, M., Yang, K., Wen, K., Lan, Y., & Li, W. (2023). Effects and differences of sleep duration on the risk of new-onset chronic disease conditions in middle-aged and elderly populations. *European Journal of Internal Medicine*, 107, 73–80. <https://doi.org/10.1016/j.ejim.2022.11.005>
3. Australian Institute of Health and Welfare. (2021). Sleep problems as a risk factor for chronic conditions. Cat. no. PHE 296. Canberra: AIHW. <https://doi.org/10.25816/d2d7-p797>
4. Darraj A. (2023). The link between sleeping and type 2 diabetes: A systematic review. *Cureus*, 15(11), e48228. <https://doi.org/10.7759/cureus.48228>
5. Lu, C., Liao, B., Nie, J., Wang, W., & Wang, Y. (2020). The association between sleep duration and chronic diseases: A population-based cross-sectional study. *Sleep Medicine*, 73, 217–222. <https://doi.org/10.1016/j.sleep.2020.05.005>
6. Li, C., & Shang, S. (2021). Relationship between sleep and hypertension: Findings from the NHANES (2007-2014). *International Journal of Environmental Research and Public Health*, 18(15), 7867. <https://doi.org/10.3390/ijerph18157867>
7. Jarrin, D. C., Alvaro, P. K., Bouchard, M. A., Jarrin, S. D., Drake, C. L., & Morin, C. M. (2018). Insomnia and hypertension: A systematic review. *Sleep Medicine Reviews*, 41, 3–38. <https://doi.org/10.1016/j.smrv.2018.02.003>
8. Bhaskar, S., Hemavathy, D., & Prasad, S. (2016). Prevalence of chronic insomnia in adult patients and its correlation with medical comorbidities. *Journal of Family Medicine and Primary Care*, 5(4), 780–784. <https://doi.org/10.4103/2249-4863.201153>
9. Almeneessier, A. S., Alamri, B. N., Alzahrani, F. R., Sharif, M. M., Pandi-Perumal, S. R., & BaHammam, A. S. (2018). Insomnia in primary care settings: Still overlooked and undertreated? *Journal of Natural Science*. (1), 64-8. https://doi.org/10.4103/JNSM.JNSM_30_18
10. Ju, Y. J., Lee, J. E., Choi, D. W., Han, K. T., & Lee, S. Y. (2021). Association between perceived environmental pollution and poor sleep quality: results from a nationwide general population sample of 162,797 people. *Sleep Medicine*, 80, 236–243. <https://doi.org/10.1016/j.sleep.2021.01.043>

11. Wolińska, W., & Mroczek, B. (2022). Sleep problems and related factors in rural and urban populations in Western Pomerania, Poland. *Annals of Agricultural and Environmental Medicine*, 29(3), 443–452. <https://doi.org/10.26444/aaem/152740>
12. Zhang, Y., & Tan, X. (2019). Compliance with care and poor sleep quality among hypertensive adults in a mountainous area of Hubei Province, People's Republic of China. *Patient Preference and Adherence*, 13, 1221–1227. <https://doi.org/10.2147/PPA.S212241>
13. Harper, C., Bourke, S. L., Johnson, E., Green, J., Anish, L., Muduwa, M., & Jones, L. (2021). Health care experiences in rural, remote and metropolitan areas of Australia. *Online Journal of Rural Nursing and Health Care*, 21(1), 67-84. <https://doi.org/10.14574/ojrnhc.v21i1.652>
14. Xing, L., Jing, L., Tian, Y., Lin, M., Du, Z., Yan, H., Ren, G., Dong, Y., Sun, Q., & Liu, S. (2019). Urban-Rural disparities in status of hypertension in northeast China: A population-based study, 2017-2019. *Clinical Epidemiology*, 11, 801–820. <https://doi.org/10.2147/CLEP.S218110>
15. Chang, H., Hawley, N. L., Kalyesubula, R., Siddharthan, T., Checkley, W., Knauf, F., & Rabin, T. L. (2019). Challenges to hypertension and diabetes management in rural Uganda: a qualitative study with patients, village health team members, and health care professionals. *International Journal for Equity in Health*, 18(1), 38. <https://doi.org/10.1186/s12939-019-0934-1>.
16. Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews. Nephrology*, 16(4), 223–237. <https://doi.org/10.1038/s41581-019-0244-2>.
17. MoH. Riset Kesehatan Dasar (Basic Health Research), Vol. 130–135, 156–159 (Research and Development Board, Ministry of Health. Government of Indonesia, 2018).
18. Salamah, S., Khafiyya, A. N., Ramadhani, R., Arfiana, M. R., Syamsuri, I., Faizah, N. N., Nugraha, D., Arifin, B., & Alkaff, F. F. (2023). Outcomes of the Indonesian Chronic Disease Management Program (PROLANIS) in patients with hypertension during the COVID-19 pandemic in Rural Areas: A preliminary evaluation study. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*, 29, e939797. <https://doi.org/10.12659/MSM.939797>
19. Sofyan, H., Diba, F., Susanti, S. S., Marthoenis, M., Ichsan, I., Sasmita, N. R., Seuring, T., & Vollmer, S. (2023). The state of diabetes care and obstacles to better care in Aceh, Indonesia: a mixed-methods study. *BMC Health Services Research*, 23(1), 271. <https://doi.org/10.1186/s12913-023-09288-9>
20. Alfaqeeh, M., Sofa, D., Alfian, R. (2024). Factors associated with diabetes mellitus among adults: Findings from the Indonesian Family Life Survey-5, Endocrine and Metabolic Science. *Endocrine and Metabolic Science*, 14. doi.org/10.1016/j.endmts.2024.100161.
21. Peltzer, K., & Pengpid, S. (2018). The Prevalence and social determinants of hypertension among adults in Indonesia: A cross-sectional population-based national survey. *International Journal of Hypertension*, 2018, 5610725. <https://doi.org/10.1155/2018/5610725>.

22. Kurnia, A. D., Melizza, N., Ruhyanudin, F., Masruroh, N. L., Prasetyo, Y. B., Setyowati, C. I., & Khoirunnisa, O. (2022). The Effect of educational program on hypertension management toward knowledge and attitude among uncontrolled hypertension patients in rural area of Indonesia. *Community Health Equity Research & Policy*, 42(2), 181–188. <https://doi.org/10.1177/0272684X20972846>.
23. Evans, R., Scourfield, J., & Murphy, S. (2015). Pragmatic, formative process evaluations of complex interventions and why we need more of them. *Journal of Epidemiology and Community Health*, 69(10), 925–926. <https://doi.org/10.1136/jech-2014-204806>
24. Khoe, L. C., Wangge, G., Soewondo, P., Tahapary, D. L., & Widyahening, I. S. (2020). The implementation of community-based diabetes and hypertension management care program in Indonesia. *PLoS ONE* 15(1). <https://doi.org/10.1371/journal.pone.0227806>
25. Morin, C. M., Belleville, G., Bélanger, L., & Ivers, H. (2011). The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep*, 34(5), 601-8. <https://doi.org/10.1093/sleep/34.5.601>
26. Mastin, D. F., Bryson, J., & Corwyn, R. (2006). Assessment of sleep hygiene using the Sleep Hygiene Index. *J Behav Med*, 29(3), 223-7. <https://doi.org/10.1007/s10865-006-9047-6>
27. Chehri, A., Parsa, L., Khazaie, S., Khazaie, H., & Jalali, A. (2021). Validation of the sleep hygiene index for the elderly. *Journal of Public Health*, 29(4): 787-793. <https://doi.org/10.1007/s10389-019-01180-3>.
28. Ogeil, R. P., Chakraborty, S. P., Young, A. C., & Lubman, D. I. (2020). Clinician and patient barriers to the recognition of insomnia in family practice: A narrative summary of reported literature analysed using the theoretical domains framework. *BMC Family Practice*, 21(1), 1. <https://doi.org/10.1186/s12875-019-1070-0>
29. Deng, H. B., Tam, T., Zee, B. C. Y., Chung, R. Y. N., Su, X., Jin, L., Chan, T. C., Chang, L. Y., Yeoh, E. K., & Lao, X. Q. (2017). Short sleep duration increases metabolic impact in healthy adults: a population-based cohort study. *Sleep*, 40(10). <https://doi.org/10.1093/sleep/zsx130>
30. McClain, J. J., Lewin, D. S., Laposky, A. D., Kahle, L., & Berrigan, D. (2014). Associations between physical activity, sedentary time, sleep duration and daytime sleepiness in US adults. *Preventive Medicine*, 66, 68–73. <https://doi.org/10.1016/j.ypmed.2014.06.003>
31. Patterson, P. D., Mountz, K. A., Budd, C. T., Bubb, J. L., Hsin, A. U., Weaver, M. D., Turner, R. L., Platt, T. E., Guyette, F. X., Martin-Gill, C., Buysse, D. J., & Callaway, C. W. (2020). Impact of shift work on blood pressure among emergency medical services clinicians and related shift workers: A systematic review and meta-analysis. *Sleep Health*, 6(3), 387–398. <https://doi.org/10.1016/j.sleh.2020.03.006>
32. Gangwisch J. E. (2014). A review of evidence for the link between sleep duration and hypertension. *American Journal of Hypertension*, 27(10), 1235–1242. <https://doi.org/10.1093/ajh/hpu071>
33. Bass, J., & Takahashi, J. S. (2010). Circadian integration of metabolism and energetics. *Science (New York, N.Y.)*, 330(6009), 1349–1354. <https://doi.org/10.1126/science.1195027>

34. Morris, C. J., Purvis, T. E., Hu, K., & Scheer, F. A. (2016). Circadian misalignment increases cardiovascular disease risk factors in humans. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(10), E1402–E1411. <https://doi.org/10.1073/pnas.1516953113>
35. Reid, M., Maras, J. E., Shea, S., Wood, A. C., Castro-Diehl, C., Johnson, D. A., Huang, T., Jacobs, D. R., Jr, Crawford, A., St-Onge, M. P., & Redline, S. (2019). Association between diet quality and sleep apnea in the multi-ethnic study of atherosclerosis. *Sleep*, *42*(1), zsy194. <https://doi.org/10.1093/sleep/zsy194>
36. Dashti, H. S., Scheer, F. A., Jacques, P. F., Lamon-Fava, S., & Ordovás, J. M. (2015). Short sleep duration and dietary intake: epidemiologic evidence, mechanisms, and health implications. *Advances in Nutrition (Bethesda, Md.)*, *6*(6), 648–659. <https://doi.org/10.3945/an.115.008623>
37. Duan, D., Kim, L. J., Jun, J. C., & Polotsky, V. Y. (2023). Connecting insufficient sleep and insomnia with metabolic dysfunction. *Annals of the New York Academy of Sciences*, *1519*(1), 94–117. <https://doi.org/10.1111/nyas.14926>
38. Koopman, A. D. M., Beulens, J. W., Dijkstra, T., Pouwer, F., Bremmer, M. A., van Straten, A., & Rutters, F. (2020). Prevalence of insomnia (symptoms) in T2D and association with metabolic parameters and glycemic control: Meta-analysis. *The Journal of Clinical Endocrinology and Metabolism*, *105*(3), 614–643. <https://doi.org/10.1210/clinem/dgz065>
39. Yao, W., Luo, J., Yu, X., Jiang, W., & Zhang, D. (2022). Insomnia symptoms are associated with an increased risk of type 2 diabetes mellitus among adults aged 50 and older. *Sleep & Breathing*, *26*(3), 1409–1416. <https://doi.org/10.1007/s11325-021-02497-8>
40. Alanazi, E. M., Alanazi, A. M. M., Albuhairey, A. H., & Alanazi, A. A. A. (2023). Sleep hygiene practices and its impact on mental health and functional performance among adults in Tabuk City: A cross-sectional study. *Cureus*, *15*(3), e36221. <https://doi.org/10.7759/cureus.36221>
41. Baranwal, N., Yu, P. K., & Siegel, N. S. (2023). Sleep physiology, pathophysiology, and sleep hygiene. *Progress in Cardiovascular Diseases*, *77*, 59–69. <https://doi.org/10.1016/j.pcad.2023.02.005>
42. Lo, K., Woo, B., Wong, M., & Tam, W. (2018). Subjective sleep quality, blood pressure, and hypertension: A meta-analysis. *Journal of Clinical Hypertension (Greenwich, Conn.)*, *20*(3), 592–605. <https://doi.org/10.1111/jch.13220>
43. Richa, D. R., Datta, N., Raj, V., Kumar, R., & Venugopal, V. (2023). Sleep quality in type 2 diabetes mellitus patients attending a tertiary care hospital in West Bengal: A cross-sectional study. *Cureus*, *15*(9), e46163. <https://doi.org/10.7759/cureus.46163>