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Original Article

Insomnia as a Risk Factor for Cardiovascular Disease Among Adults in Eastern Indonesia

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Abstract

Background: Insomnia is a common sleep disorder with increasing prevalence among adults and has been linked to a higher risk of cardiovascular disease (CVD). This study aimed to investigate the association between insomnia severity and CVD risk among adults.

Methods: This correlational study with a cross-sectional design involved adults aged 30–59 years with insomnia. Participants were recruited using convenience sampling, at Kota Hospital and Bahteramas Hospital, Kendari, Indonesia, between November 2023 and April 2024. Insomnia severity was measured using the Insomnia Severity Index (ISI), and CVD risk was assessed using the Framingham Risk Score. Data were analyzed using the Pearson chi-square and multinomial logistic regression analysis.

Results: Of the 144 respondents, the majority were female (59.0%), aged >50 years (62.5%) with a mean age of 49.63±10.08 years. Gastroesophageal reflux disease (GERD) was the most common comorbidity (39.6%), and 57.6% were smokers. Most respondents had moderate insomnia (87%) and low CVD risk (66%). Severe insomnia was more frequently observed among participants with moderate and high CVD risk. A significant positive relationship was found between insomnia severity and CVD risk (p=0.000, r=0.669), with insomnia explaining 50.2% of the variance in CVD risk.

Conclusions: Insomnia is significantly associated with cardiovascular risk and may represent a modifiable lifestyle-related risk factor. Improving sleep quality may contribute to healthier lifestyles and reduced CVD risk.

Keywords: Adults, cardiovascular disease risk, insomnia, sleep disorder

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Introduction

Cardiovascular disease (CVD) is a growing global health concern, with its incidence increasing annually. CVD includes disorders of the heart and blood vessels such as coronary heart disease, cerebrovascular disease, rheumatic heart disease, and others.[1] In recent years, CVD has increasingly been observed in younger populations.[2] Atherosclerosis may develop early in life and remain asymptomatic until it progresses to a clinically significant stage. Consequently, young individuals affected by CVD may experience a substantial mortality burden.[2]

Among the various risk factors for CVD, insomnia has emerged as a notable contributor. Insomnia, one of the most prevalent sleep disorders, continues to rise in prevalence.[3] Chronic insomnia, defined by difficulty initiating or maintaining sleep occurring at least three times a week for at

least three months, is associated with elevated cardiovascular risk through a range of physiological and psychological mechanisms. 3. It is estimated that 30–50% of adults in the United States experience insomnia symptoms, with 15–20% experiencing short-term insomnia and 5–15% experiencing chronic forms.[3] Population-based studies report that approximately one-third of adults (30–36%) exhibit at least one symptom of nocturnal insomnia,[5] while up to half of all adults may experience short-term insomnia and one in ten long-term insomnia.[6]

Insomnia triggers physiological changes such as hypercortisolemia, elevated adrenocorticotropic hormone (ACTH), increased sympathetic activity (evident in raised norepinephrine levels), altered heart rate variability, and vascular endothelial dysfunction.[7] These changes directly impair cardiovascular function and elevate long-term risks for hypertension, coronary artery disease, and heart failure. Short sleep duration (<5 hours) and insomnia are also associated with increased hypertension risk.[7]

Adequate sleep is increasingly recognized as vital for preventing metabolic disorders such as obesity, diabetes, and cardiovascular disease, as well as accidents.[8] However, limited research has examined the link between insomnia and CVD incidence in adults, particularly within the Indonesian population. This study aimed to assess the association between insomnia and cardiovascular disease risk in adults, to help identify high-risk individuals and inform targeted prevention strategies.

Methods

This study employed a correlational design with a cross-sectional survey approach, conducted from November 2023 to April 2024 in Kendari City, Indonesia. The target population included adults experiencing insomnia who visited general clinics at Kendari City Hospital and Bahteramas Hospital. This study was approved by the Ethics Committee of Universitas Mandala Waluya (Approval No.: 84/KEP/UMW.01/X/2023). All participants received a full explanation of the study and provided written informed consent.

The respondents, aged between 30 and 59 years, were selected using a simple random sampling method, based on sampling strategies from previous research. Those who met the criteria for insomnia with an Insomnia Severity Index (ISI) score above 14 and had poor sleep quality indicated by a Pittsburgh Sleep Quality Index (PSQI) score greater than 5 were included. Individuals with depression, psychiatric disorders, psychotic conditions, or psychoactive substance use disorders were excluded from the study.

In brief, insomnia severity was assessed using the Insomnia Severity Index (ISI), with scores ranging from 0–28. Higher scores indicated more severe insomnia.[9] The ISI was a 7-item self-reported questionnaire, evaluating (1) the difficulty falling asleep, (2) the difficulty staying asleep, (3) early morning awakening, (4) satisfaction with current sleep pattern, (5) interference with daily functioning, (6) noticeability of sleep problems by others, and (7) the distress caused by sleep difficulties. Each item was scored 0–4, producing a total score of 0–28. Score 0–7 designated as no clinically significant insomnia, score 8–14 as subthreshold insomnia, score 15–21 as moderate insomnia, and score 22–28 as severe insomnia.

Furthermore, overall sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) with scores ranging from 0–21. A global score >5 indicated poor sleep quality.[9] PSQI was a 19-item self-reported questionnaire, assessing sleep quality over the past month that consisted of 7 components: (1) subjective sleep quality, (2) the sleep latency, (3) the sleep duration, (4) habitual sleep efficiency, (5) sleep disturbances, (6) use of sleeping medication, and (7) daytime dysfunction. Each component was scored 0–3, yielding a global score of 0–21. The sleep quality was categorized as good sleep quality (score ≤5) and poor sleep quality (score >5).[10] The researchers provided a standardized explanation for each questionnaire item to ensure participant understanding.

Cardiovascular disease risk was assessed using the Framingham Risk Score (FRS), including data on age, gender, cholesterol levels, smoking status, and blood pressure.[11] FRS was categorized into three levels, which were low risk (FRS <10%), medium risk (FRS 10–19%), and high risk (FRS >20%). The FRS had demonstrated strong performance across Asian populations, with area under the curve (AUC) values ranging from 0.7 to 0.8, indicating good suitability for this demographic.12 Of note, blood pressure was measured using a calibrated sphygmomanometer, conducted by trained research assistants. Cholesterol tests were performed in the hospital laboratory by certified laboratory personnel.

Respondent characteristic data, clinical

profile, insomnia data, and cardiovascular risk level were analyzed using univariate descriptions. The association between insomnia and CVD risk was analyzed using the Pearson Chi-square test and multinomial logistic regression. All analyses were performed using IBM SPSS Version 24, with a significance level set at $p<0.05$

Results

In total, 144 respondents were included with the mean age was 49.63±10.07 years. The majority of respondents was being over 50 years old (62.5%), female (59.0%), with a high school education (46.5%), married (52.8%). Interestingly, they had comorbidity such as gastroesophageal reflux disease (GERD) (39.6%), had a smoking habit (57.6%). Most respondents had a low risk of cardiovascular disease (66%) with an average systolic blood pressure of 144.72±11.44 mmHg and diastolic blood pressure of 84.70±8.01 mmHg. The mean of total cholesterol was 196.88±18.89 mg/dl and HDL was 39.51±8.48 mg/dl as depicted in Table 1. Moreover, most of the respondents experienced moderate insomnia (87%).

Among respondents categorized as low risk for cardiovascular disease, 84.2% (n=80) experienced moderate insomnia (Table 2). Among those classified as having moderate cardiovascular risk, 78.8% (n=26) reported severe insomnia. There was a statistically significant association between insomnia severity and cardiovascular disease risk (p=0.000), with a strong positive correlation (r=0.669), indicating that insomnia severity was associated with an increased risk of cardiovascular disease.

Furthermore, the average age of low-risk of cardiovascular disease was 46.74±10.01 years, whereas for moderate risk the average age was 54.27± 4.95 years and for high-risk had an average age of 57.25±2.88 years. There was a significant relationship between the average age of respondents among those experiencing risk of CVD (Table 3).

Furthermore, the average age of those with moderate insomnia was 45.77±10.97 years and for those with severe insomnia, the average age was 55.53±3.99 years. The statistical test results yielded a p-value of 0.000, indicating that there was a correlation between the two types of insomnia by age (Table 3).

Interestingly, there was a relationship between CVD risk and gender as shown in Table 4. Most of women (91.8%) women had experienced low risk of CVD; whereas men had only for 28.8% and more having moderate risk (p 0.000), indicating a significant relationship

Table 1 Characteristics of Respondents, Insomnia Status, and Risk of Cardiovascular Disease (n=144)

Variable	n (%) or mean±SD
Age (years)	49.63±10.076
≤ 50 years	54 (37.5)
> 50 years	90 (62.5)
Gender	
Male	59 (41.0)
Female	85 (59.0)
Last education	
Bachelor	47 (32.6)
High school	67 (46.5)
Primary school	30 (20.8)
Marital status	
Married	76 (52.8)
Widow/widower	52 (36.1)
Single	16 (11.1)
Occupation	
Civil servant	29 (20.1)
Retired	15 (10.4)
Private employees	38 (26.4)
Businessman	27 (18.8)
Housewife	35 (24.3)
Comorbidities	
GERD	57 (39.6)
Chronic kidney disease	39 (27.1)
COPD	32 (22.2)
Pain	16 (11.1)
Smoking habit	
Smoker	83 (57.6)
Non-smoker	61 (42.4)
Risk of cardiovascular disease	
Low risk	95 (66.0)
Moderate risk	33 (22.9)
High risk	16 (11.1)
Blood Pressure (mmHg)	
Systolic blood pressure	144.72±11.44
Diastolic blood pressure	84.70±8.01
Total cholesterol (mg/dl)	196.88±18.89
HDL cholesterol (mg/dl)	39.51±8.48
Insomnia	
Moderate insomnia	87 (60.4)
Severe insomnia	57 (39.6)

Note: GERD= Gastroesophageal reflux disease; COPD= Chronic obstructive pulmonary disease; HDL= High-density lipoprotein

Table 2 Relationship Between Insomnia and Risk of Cardiovascular Disease Among Adults in Eastern Indonesia(n=144)

Insomnia	Risk of cardiovascular disease			Total	p-value	r
	Low (n=95) n (%)	Moderate (n=33) n (%)	High (n=16) n (%)			
Moderate	80 (84.2)	7 (21.2)	0 (0)	87	0.000	0.669
Severe	15 (15.8)	26 (78.8)	16 (100)	57		

Note: r = correlation coefficient. Statistically significant at p<0.05

Table 3 Mean Age Distribution by Cardiovascular Disease Risk and Insomnia Status in Eastern Indonesia

Variable	Mean	SD	95% CI	p-value
Risk of Cardiovascular Disease				
Low risk	46.74	10.01	44.52–48.96	0.000*
Moderate risk	54.27	4.95	52.52–56.03	
High risk	57.25	2.88	55.71–58.79	
Insomnia Status				
Moderate insomnia	45.77	10.97	-12.753 – -6.759	0.000*
Severe insomnia	55.53	3.99		

Note: SD = standard deviation; CI = confidence interval. Statistically significant at p<0.05

between gender and CVD risk and that women had a 27.52 times chance of being at risk of CVD (OR 27.52; CI 95% 10.57 – 71.66).

Similarly, 77.6% women had experienced moderate insomnia; whereas only 35.6% male had moderate insomnia, indicating a significant difference (p=0.000) in the proportion of insomnia occurrences between female and male with female were 6.28 times more likely to experience insomnia compared to male.

Furthermore, the regression test yielded a p-value of less than 0.05 with a Chi-square (X^2) value of 76.354, indicating that at least one factor which was insomnia had a statistically significant association with cardiovascular disease risk in adults. The Nagelkerke R^2 value of 0.502 suggested that insomnia accounted for 50.2% of the variance in cardiovascular disease risk in this study; while the remaining 49.8% was attributed to other factors not included in the model.

Discussion

The results of this study confirm a significant association between insomnia and cardiovascular disease (CVD) risk. The more severe the insomnia, the higher the associated risk of CVD. This finding is consistent with previous studies indicating that insomnia and excessive daytime sleepiness are linked to impaired cardiac function.[13] Patients with insomnia have a 45% increased risk of developing CVD7 and exhibit significantly higher rates of mortality from CVD, including myocardial infarction (MI), coronary heart disease (CHD), and stroke.[14]

Several mechanisms may explain this association. These include dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, autonomic nervous system dysfunction, and increased sympathetic nervous system (SNS) activity, which promote inflammation and atherogenesis. Insomnia is correlated with elevated SNS activity and increased levels of cortisol, a key hormone involved in sleep regulation.[15] In patients with insomnia, the secretion of adrenocorticotropic hormone (ACTH) and cortisol is elevated, reflecting HPA axis hyperactivity. Elevated cortisol levels contribute to vascular inflammation, hypertension, and elevated heart rate, all of which can lead to cardiovascular dysfunction if sleep disturbances remain untreated.[7]

This study has found that moderate and high CVD risk is more common among individuals with severe insomnia. These findings may be influenced by participant characteristics such as gender, occupation, comorbid conditions, and smoking habits. In our current study, female respondents have outnumbered males,

Table 4 Distribution of Cardiovascular Disease Risk and Insomnia by Gender in Eastern Indonesia

	Female n (%)	Male n (%)	Total (n=144)	OR (95% CI)	p-value
Cardiovascular disease risk					
Low risk	78 (91.8)	17 (28.8)	95	27.52 (10.57–71.66)	0.000*
Moderate risk	6 (7.1)	27 (45.8)	33		
High risk	1 (1.2)	15 (25.4)	16		
Insomnia					
Moderate insomnia	66 (77.6)	21 (35.6)	87	6.28 (3.01–13.14)	0.000*
Severe insomnia	19 (22.4)	38 (64.4)	57		

Note: OR = odds ratio; CI = confidence interval. Statistically significant at $p < 0.05$

Table 5 Results of Multinomial Logistic Regression Analysis

Model	Fit Statistics (−2 Log Likelihood)	Likelihood Ratio Chi-Square (χ^2)	df	p-value	Nagelkerke R^2
Intercept Only	88.474	–	–	–	0.502
Final Model	12.120	76.354	2	0.000*	

Note: df = degrees of freedom; Statistically significant at $p < 0.05$

and insomnia is more frequently reported among women. Moreover, women are over 6 times more likely to experience insomnia and have 27.52 times chance of being at risk of CVD, supported by previous studies showing that women are more likely to experience insomnia than men.[16,17] It may likely be due to the influence of estrogen and progesterone on sleep cycles and cardiovascular regulation.[18]

Insomnia is a complex disorder with multifactorial causes, and women face unique sleep-related challenges across the lifespan. These include hormonal fluctuations during menstruation, pregnancy, and menopause, higher rates of mood disorders, and greater exposure to psychosocial stressors such as economic hardship and gender-based discrimination.[19] These factors may increase vulnerability to insomnia and, consequently, CVD.

Disruptions to the circadian rhythm may also contribute to insomnia symptoms.[20] Shift workers, who are made up a large portion of participants in this this study, often experience altered sleep patterns, physical stress, and irregular dietary habits, all of which are known to impair sleep quality.[21] In this study, most respondents are employed in government or private sectors, with an average systolic blood pressure of 145 mmHg, indicating elevated cardiovascular risk.

High blood pressure is closely linked with gastroesophageal reflux disease (GERD),[22] which is frequently reported among individuals with insomnia.[22] During sleep, physiological changes such as reduced peristalsis, decreased saliva production, and supine positioning increase esophageal acid exposure and exacerbate GERD symptoms. Additionally, sleep suppresses the reflexes that prevent reflux into the esophagus and larynx, thereby intensifying GERD-related discomfort[23] In this study, many respondents have been found to have GERD, which can mimic cardiac symptoms such as chest pain and is often mistaken for ischemic heart disease. Interestingly, GERD and coronary artery disease (CAD) may share several risk factors, including smoking.[24]

A considerable number of respondents in this study have reported smoking habits. Smoking is responsible for over 30% of deaths from CHD.[25] Female smokers, in particular, exhibit a higher mortality rate from CVD than male smokers, with a 25% greater risk of CHD for women exposed to the same level of tobacco use.[26] Smoking contributes to oxidative stress, impaired platelet function, inflammation, and vascular dysfunction, all of which exacerbate atherosclerosis.[27] Additionally, nicotine is a stimulant that disrupts sleep when used at night, and insomnia is a well-documented symptom of nicotine withdrawal.[28]

Healthy sleep habits are increasingly recognized as essential for preventing CVD.[29] Sleep plays a crucial role in metabolic regulation, emotional well-being, cognitive performance, and memory. Adequate, high-quality sleep at appropriate times promotes

physical and mental health and enhances quality of life. Addressing insomnia should be a clinical priority. Recognizing sleep as a fundamental aspect of health requires the integration of diagnostic and therapeutic strategies to improve sleep outcomes. Various nursing interventions have been shown to reduce insomnia symptoms. For example, care models based on the Human Becoming theory and the Self-Care Deficit Nursing theory have effectively reduced insomnia severity among post-stroke patients with urinary incontinence.[30] One such intervention is sleeping hygiene, which is commonly used to manage insomnia.[29,30] Although research on sleep hygiene remains limited, its implementation is widespread in clinical settings. Sleep hygiene encompasses behavioral and environmental practices that support restful sleep and reduce the risk of sleep disorders.

A limitation of this study is data that have been collected at a single point in time and without intervention, therefore, it cannot establish causality. Future research should logically point to methodological improvements, and practical implications, while clearly acknowledging that causality cannot yet be inferred; whereas longitudinal studies are needed to clarify causality and to evaluate whether improving insomnia severity can lead to a reduction in cardiovascular outcomes.

In conclusion, there is a relationship between insomnia and cardiovascular disease risk. The severity of insomnia is positively associated with the level of CVD risk. Based on these findings, routine assessment of insomnia should be incorporated into cardiovascular risk screening. Sleep health interventions may serve as an important preventive strategy to reduce cardiovascular disease risk. Since insomnia is considered a modifiable condition, improving sleep quality through healthy lifestyle habits can significantly reduce the risk of cardiovascular disease.

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Authors' Contributions
HH, FF, and EE contributed to study conception and design. HH and WAZ conducted data collection. HH, EE, and NN performed data analysis and interpretation. HH, FF, and WAZ drafted the manuscript. HH and NN critically revised the manuscript.

Conflict of Interest
The authors declare no conflict of interest.

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During the preparation of this work, the authors used ChatGPT for paraphrasing and text generation in several sections. The authors reviewed and edited the content as needed and take full responsibility for the final manuscript.

References

1. World Health Organization. Cardiovascular disease [Internet]. 2023 [cited 2023 Aug 4]. Available from: https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1.
2. Rethemiotaki I. Global prevalence of cardiovascular diseases by gender and age during 2010–2019. Atheroscler Dis. 2023;8:e196–e205. doi:10.5114/amsad/176654.
3. Fietze I, Laharnar N, Koellner V, Penzel T. The different faces of insomnia. Front Psychiatry. 2021;12:683943. doi:10.3389/fpsyt.2021.683943.
4. Dean YE, Shebl MA, Rouzan SS, Bamousa BA, Talat NE, Ansari SA, et al. Association between insomnia and the incidence of myocardial infarction: a systematic review and meta-analysis. Clin Cardiol. 2023;46(4):376–85. doi:10.1002/clc.23984.
5. Morin CM, Jarrin DC. Epidemiology of insomnia: prevalence, course, risk factors, and public health burden. Sleep Med Clin. 2022;17(2):173–91. doi:10.1016/j.jsmc.2022.03.003.
6. Kementerian Kesehatan Republik Indonesia. Kurang tidur lebih berisiko sakit jantung? [Internet]. 2023 [cited 2023 Aug 7]. Available from: https://yankes.kemkes.go.id/view_artikel/2257/kurang-tidur-lebih-berisiko-sakit-jantung.
7. Andersen ML, Poyares D, Tufik S. Insomnia and cardiovascular outcomes. Sleep Sci. 2021;14(1):1–2. doi:10.5935/1984-0063.20200109.
8. Gordon NP, Yao JH, Brickner LA, Lo JC. Prevalence of sleep-related problems and risks in a community-dwelling older adult population: a cross-sectional survey-based

study. BMC Public Health. 2022;22:2045. doi:10.1186/s12889-022-14443-8.
9. Bastien CH, Vallières A, Morin CM. Validation of the insomnia severity index as an outcome measure for insomnia research. Sleep Med. 2001;2(4):297–307. doi:10.1016/S1389-9457(00)00065-4
10. Carpi M. The Pittsburgh sleep quality index: a brief review. Occup Med (Lond). 2025;75(1):14–5. doi:10.1093/occmed/kqae121.
11. Dehghan A, Jahangiry L, Khezri R, Jafari A, Pezeshki B, Rezaei F, et al. Framingham risk scores for determination of the 10-year risk of cardiovascular disease in participants with and without the metabolic syndrome: results of the Fasa Persian cohort study. BMC Endocr Disord. 2024;24(1):95. doi:10.1186/s12902-024-01621-5
12. Kasim SS, Ibrahim N, Malek S, Ibrahim KS, Aziz MF, Song C, et al. Validation of the general Framingham Risk Score (FRS), SCORE2, revised PCE and WHO CVD risk scores in an Asian population. Lancet Reg Health West Pac. 2023;35:100742. doi:10.1016/j.lanwpc.2023.100742
13. Sabrina I. Comparison of Framingham Risk Score (FRS) and QRISK2 result for adults in productive age to WHO chart. JIMKI J Ilm Mhs Kedokt Indones. 2021;8(3):41–6. doi:10.53366/jimki.v8i3.135.
14. Fotbolcu H, Soysal P. Effect of insomnia and excessive daytime sleepiness on cardiac functions in older adults. Psychogeriatrics. 2023;23(5):800–7. doi:10.1111/psyg.12999.
15. Zheng B, Yu C, Lv J, Guo Y, Bian Z, Zhou M, et al. Insomnia symptoms and risk of cardiovascular diseases among 0.5 million adults: a ten-year cohort study. Neurology. 2019;93(23):e2110–20. doi:10.1212/WNL.0000000000008581.
16. Javaheri S, Redline S. Insomnia and risk of cardiovascular disease. Chest. 2017;152(2):435–44. doi:10.1016/j.chest.2017.01.026.
17. Cheng T, Yu D, Tang Q, Qiu X, Li G, Zhou L, et al. Gender differences in the relationship between the systemic immune-inflammation index and all-cause and cardiovascular mortality among adults with hypertension: evidence from NHANES 1999–2018. Front Endocrinol (Lausanne). 2024;15:1436999. doi: 10.3389/fendo.2024.1436999.
18. Merklinger-Gruchała A, Goździalska A, Bień A, Grzesik-Gąsior J. Age-dependent association between insomnia and body mass index among young women: evidence from a cross-sectional study. J Clin Med. 2025;14(24):8904. doi: 10.3390/jcm14248904.
19. Thurston RC, Chang Y, Kline CE, Swanson LM, El Khoudary SR, Jackson EA, et al. Trajectories of sleep over midlife and incident cardiovascular disease events in the Study of Women's Health Across the Nation. Circulation. 2024;149(7):545–55. doi:10.1161/CIRCULATIONAHA.123.066491
20. Morssinkhof MWL, van Wylick DW, Priester-Vink S, van der Werf YD, den Heijer M, van den Heuvel OA, et al. Associations between sex hormones, sleep problems and depression: a systematic review. Neurosci Biobehav Rev. 2020;118:669–80. doi:10.1016/j.neubiorev.2020.08.006
21. Benge E, Pavlova M, Javaheri S. Sleep health challenges among women: insomnia across the lifespan. Front Sleep. 2024;3:1322761. doi:10.3389/frsle.2024.1322761
22. Nobre B, Rocha I, Morin CM, Cruz MME. Insomnia and circadian misalignment: an underexplored interaction towards cardiometabolic risk. Sleep Sci. 2021;14(1):55–63. doi:10.5935/1984-0063.20200025
23. Boivin DB, Boudreau P, Kosmadopoulos A. Disturbance of the circadian system in shift work and its health impact. J Biol Rhythms. 2022;37(1):3–28. doi:10.1177/07487304211064218
24. Eisa M, Sandhu A, Prakash R, Ganocy SJ, Fass R. The risk of acute myocardial infarction in patients with gastroesophageal reflux disease. J Neurogastroenterol Motil. 2020;26:471–6. doi:10.5056/jnm19192.
25. Gurges P, Murray BJ, Boulos MI. Relationship between gastroesophageal reflux disease and objective sleep quality. J Clin Sleep Med. 2022;18(12):2731–8. doi:10.5664/jcsm.10198.
26. Song JH, Kim YS, Choi SY, Yang SY. Association between gastroesophageal reflux disease and coronary atherosclerosis. PLoS One. 2022;17(5):e0267053. doi:10.1371/journal.pone.0267053.
27. Gallucci G, Tartarone A, Lerose R, Lalinga AV, Capobianco AM. Cardiovascular risk of smoking and benefits of smoking cessation. J Thorac Dis. 2020;12(7):3866–76. doi:10.21037/jtd.2020.02.47.
28. Nuñez A, Rhee JU, Haynes P, Chakravorty S, Patterson F, Killgore WDS, et al. Smoke at night and sleep worse? The associations

between cigarette smoking with insomnia severity and sleep duration. Sleep Health. 2021;7(2):177–82. doi:10.1016/j.sleh.2020.10.006

29. Lavie CJ, Virani SS, Slipczuk L. The role of sleep in cardiovascular disease. Curr Atheroscler Rep. 2024;26(7):249–62. doi:10.1007/s11883-024-01207-5
30. Heltty H, Sitorus R, Haryanto H. Impact of applying the theory of human becoming and self-care deficit theory of nursing on insomnia in after-stroke urinary incontinence patients. Front Nurs. 2024;3:259–66. doi:10.2478/FON-2024-0028.