Huma Barigas: Journal of Medical and Health Sciences
Volume 1 Nomor 1 2026
Tersedia Online: https://abecen.com/index.php/index/

Beyond Medical Students' Academic Activities: Sleep Quality, Blood Pressure, and Early Cardiovascular Risk

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ABSTRACT
Sleep quality is an important determinant of medical students' health because it is associated with academic workload, psychological pressure, and physiological changes, including blood pressure. This study aims to describe sleep quality and blood pressure and to examine the relationship between sleep quality and blood pressure among students of the Faculty of Medicine, Universitas Palangka Raya. This study employed an analytical observational method with a cross-sectional design. The sample consisted of 269 students selected through total sampling based on the established inclusion and exclusion criteria. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), while blood pressure was measured using a sphygmomanometer. The data were analyzed using Spearman's correlation test. The results showed that 77% of respondents had good sleep quality, while 23% had poor sleep quality. Regarding blood pressure, 70.3% of respondents were categorized as normal, 21.6% as prehypertensive, and 8.2% as having grade 1 hypertension. Bivariate analysis revealed a significant relationship between sleep quality and blood pressure, with $p < 0.001$ and a correlation coefficient of 0.574. These findings indicate that poorer sleep quality is associated with a greater tendency toward increased blood pressure. Therefore, sleep quality should be considered an early indicator of cardiovascular risk among medical students. The findings are relevant as a basis for early screening, sleep hygiene education, stress management, and regular blood pressure monitoring within the university environment.

ARTICLE HISTORY
Received 5 April 2026
Accepted 3 June 2026
Published 12 June 2026

KEYWORDS
sleep quality; blood pressure; medical students; cardiovascular risk; PSQI

Introduction

Sleep quality is an important determinant of student health, particularly among medical students who face heavy academic workloads, demanding study schedules, assessment pressure, and the need to adapt physically and psychologically. Poor sleep quality not only affects concentration, academic performance, and mental well-being, but is also associated with more serious physiological risks, including increased blood pressure. Makarem et al. (2021) explain that sleep disturbances may influence blood pressure through sympathetic nervous system activation, hormonal changes, circadian rhythm disruption, and an increased risk of hypertension. The American Heart Association has also included sleep as an important component of Life's Essential 8 for maintaining cardiovascular health (Lloyd-Jones et al., 2022). Therefore, sleep among medical students should be understood not only as a basic need for rest, but also as an indicator of cardiovascular health from a young age.

Medical students are particularly vulnerable to sleep disturbances because medical education requires sustained concentration, long study hours, academic pressure, and substantial lifestyle adjustments. Through a systematic review and meta-analysis conducted in Southeast Asia, Satriono et al. (2024) showed that the prevalence of poor sleep quality among medical students is high. Truong et al. (2025) also found that poor sleep quality is common among medical students, particularly during the clinical phase of education. Vidović et al. (2025) emphasized that sleep quality among medical students is associated with mental health, indicating that sleep disturbances may form part of a broader health problem. These findings show that medical students should not be regarded as an automatically healthy young population because academic pressure may be associated with changes in sleep behavior and physiological risk.

Although research on sleep quality among medical students has developed, most studies have focused on the prevalence of poor sleep quality, stress, anxiety, depression, mental health, and academic performance. Meanwhile, the relationship between sleep quality and blood pressure among medical students remains relatively underexplored, particularly in local Indonesian contexts. Blood pressure is an important physiological indicator that may reflect early cardiovascular risk. Hafizhah et al. (2024) showed that sleep quality and stress levels were associated with blood pressure among medical students in Indonesia. However, similar studies need to be strengthened across different institutions and regions because sleep patterns, academic workloads, lifestyle habits, and campus environments may vary.

This research gap is increasingly important because the relationship between sleep quality and blood pressure is not straightforward. Blood pressure may be influenced by numerous other factors, including academic stress, caffeine consumption, physical activity, nutritional status, body mass index, device-use habits, family history, and psychological conditions. Therefore, when an association is identified between sleep quality and blood pressure, it should be interpreted cautiously because it may be affected by confounding factors. In the present study, an interesting phenomenon was observed because most respondents reported good sleep quality, yet some students were still classified as prehypertensive or as having grade 1 hypertension. This condition suggests that subjectively good sleep quality may not always correspond with an ideal physiological profile.

Based on this condition, the research gap addressed in this study concerns the need for an investigation that specifically connects sleep quality with blood pressure among medical students in a local Indonesian context, particularly at the Faculty of Medicine, Universitas Palangka Raya. The contribution of this study is not limited to describing students' sleep quality, but also includes determining whether sleep quality is associated with blood pressure as an indicator of early cardiovascular risk. Therefore, this study seeks to extend research on student health beyond sleep and mental health issues toward a more clinically oriented understanding of blood pressure and cardiovascular disease prevention from a young age.

This study was guided by three main research questions. First, what are the characteristics, sleep quality profiles, and blood pressure distributions of students at the Faculty of Medicine, Universitas Palangka Raya? Second, is sleep quality associated with blood pressure among medical students? Third, how can these findings be interpreted as a basis for early cardiovascular risk screening among young university students? These questions are important because sleep disturbances among medical students are not only related to the quality of rest, but may also serve as early indicators of physiological changes that require promotive and preventive attention.

Based on the literature review and the study objectives, the main hypothesis was that there is a significant relationship between sleep quality and blood pressure among medical students. Poorer sleep quality was expected to be associated with a greater tendency toward increased blood pressure. However, the results were interpreted proportionally because the study employed a cross-sectional design, meaning that the identified relationship could not be interpreted as a direct causal relationship. Thus, this study is expected to provide empirical support for strengthening sleep hygiene education, stress management, and regular blood pressure monitoring within medical education settings.

Method

This study employed an analytical observational method with a cross-sectional design, in which sleep quality and blood pressure were observed at the same time to assess the relationship between the variables at a single point of measurement. This design was selected because it is appropriate for examining associations between exposure factors and outcomes within a student population without conducting a direct intervention. In the context of this study, a cross-sectional approach was considered suitable because the primary objective was to describe sleep quality, blood pressure, and the relationship between the two among students of the Faculty of Medicine, Universitas Palangka Raya. This choice is also consistent with methodological studies emphasizing that cross-sectional designs are effective for preliminary association analyses in observational epidemiological research (Pérez-Guerrero et al., 2024). In addition, recent studies examining sleep quality and blood pressure among medical students have frequently used similar designs because they are efficient, relevant, and appropriate for highly mobile academic populations (Hafizhah et al., 2024).

The study was conducted at the Faculty of Medicine, Universitas Palangka Raya. This setting was selected because medical students are vulnerable to sleep disturbances due to academic workload, learning demands, adaptation pressure, and intensive daily schedules. The study population consisted of all active students enrolled in the Medical Study Program from the 2022, 2023, and 2024 cohorts, totaling 336 students. The sample was selected using total sampling, meaning that all members of the population who met the inclusion and exclusion criteria were included. Following eligibility screening and data-completeness assessment, 269 students were included in the final analysis.

The inclusion criteria were active students in the Medical Study Program at the Faculty of Medicine, Universitas Palangka Raya, from the 2022, 2023, and 2024 cohorts who were willing to participate and had signed the informed consent form. The exclusion criteria included students who did not complete the questionnaire, were taking antihypertensive medication, had a smoking habit, or had certain conditions that could affect sleep quality and blood pressure. These criteria were applied to maintain relative sample homogeneity and reduce potential bias from factors that could directly influence blood pressure.

The research process began with obtaining ethical approval, explaining the objectives and procedures of the study to participants, and obtaining informed consent. After participants provided consent, the researchers collected basic characteristic data, sleep quality data, and blood pressure measurements. Sleep quality was measured using the Indonesian version of the Pittsburgh Sleep Quality Index (PSQI). This instrument was used because it has been widely

applied in studies of sleep quality among university students and provides a practical method for assessing subjective sleep quality in observational research (De Moraes et al., 2024). The global PSQI score was then categorized into good and poor sleep quality according to the instrument's interpretation guidelines.

Blood pressure was measured using a sphygmomanometer by trained personnel who understood the standard measurement procedure. To reduce short-term measurement variation, participants were asked to rest in a seated position for at least five minutes before measurement. During the resting period, participants were instructed not to speak, avoid strenuous physical activity, and remain calm. Measurements were taken with the arm positioned at heart level while the participant was seated with the back supported, feet flat on the floor, and the arm relaxed.

Blood pressure was measured at least twice, with an interval of one to two minutes between measurements. When a substantial difference was found between the first and second readings, an additional measurement was performed to obtain a more stable value. The blood pressure value used in the analysis was the mean of the two most consistent final measurements. This procedure was applied because blood pressure is highly sensitive to temporary conditions, including physical activity, stress, caffeine consumption, anxiety, body position, and time of measurement. Therefore, repeated measurements and an adequate resting period were required to improve the reliability of blood pressure data.

To control time-related variation, blood pressure measurements were conducted within a relatively consistent time range throughout the data collection period. Whenever possible, participants were also instructed to avoid strenuous physical activity, caffeinated beverages, and heavy meals shortly before measurement. Through this procedure, the study attempted to minimize blood pressure variation caused by situational factors. Blood pressure results were subsequently categorized as normal blood pressure, prehypertension, or grade 1 hypertension according to the classification applied in the study.

Data processing consisted of editing, coding, data entry, and cleaning before statistical analysis. Editing was performed to verify the completeness and consistency of participant data. Coding involved assigning numerical codes to each variable to facilitate statistical analysis. The data were then entered into statistical software and checked again to prevent input errors, duplication, or misclassification. Sleep quality was classified based on the global PSQI score, while blood pressure was grouped according to the predefined blood pressure categories.

Data analysis consisted of univariate and bivariate analyses. Univariate analysis was used to describe participant characteristics and the distributions of sleep quality and blood pressure. The data were presented in frequency and percentage tables. Bivariate analysis was conducted using Spearman's correlation test because the analyzed variables were ordinal and the purpose was to assess the direction and strength of the relationship between sleep quality and blood pressure. A p-value of less than 0.05 was considered statistically significant. Spearman's correlation coefficient was used to assess the strength of the relationship so that the findings indicated not only whether a relationship existed, but also the magnitude of that relationship.

Through these procedures, the study sought to present the relationship between sleep quality and blood pressure with stronger methodological support. Nevertheless, because a cross-sectional design was used, the findings only demonstrate an association at a single point in time and cannot establish a direct causal relationship. Therefore, the results should be interpreted as preliminary evidence that may serve as a basis for further studies using longitudinal designs or multivariable analyses.

Results

Respondent Characteristics

This study involved 269 students from the Faculty of Medicine, Universitas Palangka Raya. Most respondents were 19 years old, accounting for 37.9%, and the majority were female, accounting

for 71.4%. This composition indicates that most respondents were in the transition to early adulthood, a period in which students begin adapting to academic demands, study routines, assignment pressure, and changes in rest patterns. Therefore, respondent characteristics provide an important basis for interpreting the relationship between sleep quality and blood pressure among medical students.

Distribution of Sleep Quality and Blood Pressure

Based on sleep quality measurements using the PSQI, most respondents had good sleep quality, comprising 207 students or 77.0%. Meanwhile, 62 respondents or 23.0% had poor sleep quality. Regarding blood pressure, 189 respondents or 70.3% were categorized as having normal blood pressure, 58 respondents or 21.6% as prehypertensive, and 22 respondents or 8.2% as having grade 1 hypertension.

These results reveal an important pattern. Although most students had good sleep quality, nearly one-third of the respondents still had blood pressure above the normal range. In other words, generally good sleep quality was not fully accompanied by an ideal blood pressure profile. This finding suggests that students' blood pressure may not be associated only with sleep quality, but may also be influenced by other factors, such as academic stress, caffeine consumption, physical activity, nutritional status, dietary patterns, and psychological conditions.

Relationship between Sleep Quality and Blood Pressure

The relationship between sleep quality and blood pressure is presented in the following cross-tabulation.

Table 1. Cross-Tabulation of Sleep Quality and Blood Pressure among Students

Sleep Quality	Normal Blood Pressure	Prehypertension	Grade 1 Hypertension	Total
Good	174 (64.7%)	29 (10.8%)	4 (1.5%)	207 (77.0%)
Poor	15 (5.6%)	29 (10.8%)	18 (6.7%)	62 (23.0%)
Total	189 (70.3%)	58 (21.6%)	22 (8.2%)	269 (100%)

Based on Table 1, students with good sleep quality were predominantly classified as having normal blood pressure, comprising 174 students or 64.7% of all respondents. In contrast, the proportion of abnormal blood pressure was higher among students with poor sleep quality. Of the 62 students with poor sleep quality, 29 were classified as prehypertensive and 18 as having grade 1 hypertension. This pattern indicates that poorer sleep quality is associated with a greater tendency to fall within higher blood pressure categories.

The Spearman correlation test produced a p-value of less than 0.001 and a correlation coefficient of 0.574. This result indicates a significant positive relationship of moderate to strong magnitude between sleep quality and blood pressure. In other words, poorer sleep quality was associated with a greater tendency toward increased blood pressure. This finding confirms that sleep quality is not only related to the comfort and adequacy of rest, but is also meaningfully associated with blood pressure as a physiological indicator.

Discussion

Respondent Characteristics and Early Vulnerability among Medical Students

The results show that the respondents were predominantly 19-year-old female students. This composition represents a group in the transition to early adulthood who are undergoing academic, social, and psychological adaptation. Among medical students, this phase is often accompanied by heavy study demands, examination pressure, practical training requirements, lifestyle changes, and unstable sleep patterns. This condition is important because medical

students are frequently reported to experience sleep disturbances and psychological pressure because of the demanding and competitive nature of medical education (Satriono et al., 2024; Truong et al., 2025; Vidović et al., 2025).

This finding is consistent with Schmickler et al. (2023), who showed that students' sleep quality is influenced by sociodemographic factors, mental health, and lifestyle habits. Angelillo et al. (2024) also found that female students tended to report poorer sleep quality than male students. Therefore, the predominance of female respondents in this study should be considered an important contextual factor because sex may be associated with sleep patterns, stress, and physiological responses to academic demands. However, demographic composition should not be used as the sole explanation because sleep quality and blood pressure may also be influenced by academic stress, caffeine consumption, physical activity, body mass index, diet, device use, and psychological conditions.

Recent studies also show that medical students cannot automatically be regarded as a healthy population merely because they are young. Satriono et al. (2024) reported that the prevalence of poor sleep quality among medical students in Southeast Asia remains high. Vidović et al. (2025) also showed that sleep quality among medical students is associated with mental health conditions, including stress, anxiety, and depression. Therefore, the findings of the present study reinforce the argument that medical students should be an important target group for promotive and preventive health programs because sleep disturbances and physiological changes may emerge from the early stages of medical education.

The Paradox of Good Sleep Quality and Blood Pressure That Is Not Entirely Normal

An important finding of this study is that most respondents had good sleep quality, yet nearly one-third had blood pressure above the normal range. A total of 21.6% of respondents were classified as prehypertensive, while 8.2% were classified as having grade 1 hypertension. This condition indicates that subjectively good sleep quality does not necessarily correspond fully with an ideal physiological profile. This is important because the PSQI assesses sleep quality based on respondents' perceptions and experiences, meaning that differences may still exist between perceived sleep quality and actual physiological conditions.

This paradox may be explained by several factors. First, blood pressure is strongly influenced by academic stress. Huang et al. (2024) showed that perceived stress among university students was associated with poorer sleep quality through complex psychological mechanisms. Sayed et al. (2024) also found that medical students experienced high stress levels and poor sleep quality, accompanied by unhealthy habits such as energy drink consumption. In the context of the present study, students who perceived their sleep as good may still have elevated blood pressure if they experienced substantial academic stress, examination pressure, or anxiety.

Second, caffeine consumption may provide an alternative explanation. Students often consume coffee, tea, energy drinks, or other caffeine sources to maintain concentration while studying. Claydon et al. (2023) explained that university students frequently engage in behaviors associated with poor sleep quality, including higher caffeine and alcohol consumption. Other research has also shown that caffeine consumption among students is associated with sleep quality and mental health (Sulaiman et al., 2024). Therefore, even when sleep quality is reported as good, caffeine consumption, particularly in the afternoon or evening, may still affect blood pressure, sleep duration, and physiological recovery.

Third, nutritional status and body mass index should also be considered. Song et al. (2023) found that body mass index was positively associated with blood pressure among medical students. Meher et al. (2023) also showed that hypertension among young adults was associated with several risk factors, including obesity, unhealthy lifestyles, alcohol consumption, smoking, and low physical activity. Therefore, abnormal blood pressure among the students in this study

cannot be explained solely by sleep quality, but should also be interpreted alongside metabolic and lifestyle factors.

Fourth, physical activity plays an important role in maintaining blood pressure and sleep quality. The American Heart Association includes physical activity, healthy sleep, body weight, blood pressure, and other behavioral components in Life's Essential 8 as measures of cardiovascular health (Lloyd-Jones et al., 2022). Therefore, sleep quality should be viewed as part of a broader cardiovascular health framework. Students with relatively good sleep may still have abnormal blood pressure if they have low physical activity, an unbalanced diet, or an increased body mass index.

Relationship between Sleep Quality and Blood Pressure

The Spearman test showed a significant relationship between sleep quality and blood pressure, with $p < 0.001$ and a correlation coefficient of 0.574. This coefficient indicates a positive relationship of moderate to strong magnitude. In other words, poorer sleep quality was associated with a greater tendency toward increased blood pressure. The cross-tabulation also showed a consistent pattern. Students with good sleep quality were more frequently classified as having normal blood pressure, whereas students with poor sleep quality were more frequently classified as prehypertensive or as having grade 1 hypertension.

This finding supports Makarem et al. (2021), who explained that sleep disturbances may affect blood pressure through sympathetic nervous system activation, hormonal changes, inflammation, circadian rhythm disruption, and impaired cardiometabolic regulation. Hafizhah et al. (2024) also found that sleep quality and stress levels were associated with blood pressure among medical students. Therefore, sleep quality in the present study should not be understood only as a lifestyle behavior, but also as a factor associated with a clinically meaningful physiological indicator.

Nevertheless, the relationship between sleep quality and blood pressure should not be interpreted too simplistically. A cross-sectional design only demonstrates an association at one point in time and cannot establish causality. In addition, blood pressure may be influenced by temporary conditions, such as anxiety during measurement, physical activity before examination, caffeine consumption, insufficient rest, body position, and measurement timing. Therefore, the relationship identified in this study is more appropriately interpreted as a meaningful association that still requires further examination using longitudinal designs and multivariable analyses.

This finding also has clinical significance because hypertension among young adults is receiving increasing attention. Meher et al. (2023) showed that hypertension in young adults is associated with an increased risk of heart disease, stroke, and kidney disorders. Shin et al. (2023) also emphasized that hypertension among individuals aged 18 to 39 years requires attention because long-term exposure to elevated blood pressure may increase the risk of hypertension-related organ damage. Therefore, the presence of prehypertension and grade 1 hypertension among some students in this study should be viewed as an early warning sign that requires monitoring rather than as a negligible finding.

The Role of Potential Confounding Factors

The results show a meaningful relationship between sleep quality and blood pressure, but interpretation must consider potential confounding factors. Academic stress is the first important factor. Medical students face heavy academic workloads, demanding study schedules, examination requirements, and competitive pressure. These factors may increase sympathetic nervous system activity, impair sleep quality, and influence blood pressure. Huang et al. (2024) showed that perceived stress was directly associated with poorer sleep quality among university students. Vidović et al. (2025) also showed that sleep disturbances among medical students were associated with symptoms of poor mental health.

The second factor is caffeine consumption. Caffeine may temporarily improve alertness, but it may also prolong sleep latency, reduce sleep quality, and affect cardiovascular responses in some individuals. Claydon et al. (2023) showed that caffeine consumption was one of the student behaviors associated with poor sleep quality. Sulaiman et al. (2024) also reported a relationship among caffeine consumption, sleep quality, and mental health in university students. Therefore, caffeine consumption should be included in future studies so that the relationship between sleep quality and blood pressure can be interpreted more accurately.

The third factor is physical activity and nutritional status. Low physical activity may worsen cardiometabolic profiles, whereas sufficient physical activity may help maintain healthy blood pressure and sleep quality. Lloyd-Jones et al. (2022) positioned physical activity, sleep, body mass index, and blood pressure as important components of cardiovascular health. Song et al. (2023) found that body mass index was positively associated with blood pressure among medical students. Therefore, future research should directly measure physical activity and body mass index to determine whether sleep quality remains associated with blood pressure after these factors are controlled.

The fourth factor includes dietary patterns, salt intake, and family history of hypertension. Meher et al. (2023) emphasized that hypertension among young adults may be influenced by lifestyle and biological factors. Among university students, frequent consumption of fast food and high-sodium foods, insufficient physical activity, and a family history of hypertension may increase the risk of abnormal blood pressure. Therefore, sleep quality should not be treated as the sole explanatory variable, but as one component within an interacting network of cardiovascular risk factors.

Implications for Early Student Health Screening

The findings have practical implications for health promotion in university settings. The identified relationship between sleep quality and blood pressure suggests that student health screening should not focus only on general physical complaints, but should also include sleep quality, academic stress, caffeine consumption, physical activity, body mass index, and blood pressure. This is important because prehypertension and grade 1 hypertension were already identified among some young students.

Through Life's Essential 8, the American Heart Association recognizes sleep as an important component of cardiovascular health together with diet, physical activity, nicotine exposure, body mass index, blood lipids, blood glucose, and blood pressure (Lloyd-Jones et al., 2022). Therefore, sleep quality may serve as an entry point for cardiovascular health education from a young age. In medical schools, this approach is particularly relevant because students are not only future health professionals, but also a group vulnerable to unhealthy lifestyle patterns arising from academic demands.

In practical terms, universities may develop regular blood pressure screening, sleep hygiene education, stress counseling, interventions to reduce excessive caffeine consumption, physical activity promotion, and healthy eating education. These programs should not be designed merely as supplementary activities, but as integral components of student health promotion. Therefore, the findings are relevant to early cardiovascular risk screening and not only to the academic discussion of the relationship between sleep quality and blood pressure.

Study Limitations

This study has several limitations. First, the cross-sectional design only enabled the identification of an association at one point in time and could not establish the direction of causality between sleep quality and blood pressure. Second, sleep quality was measured using the self-reported PSQI, meaning that the results depended on respondents' perceptions and may have been affected by reporting bias. Third, although blood pressure was measured directly, it may still have been

influenced by temporary conditions, such as stress, physical activity, caffeine consumption, body position, measurement time, and anxiety.

Fourth, the study did not use multivariable analysis to control for potential confounders, such as academic stress, nutritional status, physical activity, caffeine consumption, dietary patterns, and family history of hypertension. Fifth, the sample was drawn from one faculty at one university, so generalization to all medical students or university students in Indonesia should be made cautiously. Nevertheless, the study provides an important contribution by demonstrating that sleep quality is associated with blood pressure among young medical students and is relevant to the development of early health screening programs in university settings.

Conclusion

This study shows that sleep quality is significantly associated with blood pressure among students of the Faculty of Medicine, Universitas Palangka Raya. Most respondents had good sleep quality, but blood pressure was not entirely within the normal range because cases of prehypertension and grade 1 hypertension were still identified. This finding indicates that subjectively good sleep quality may not always correspond with an ideal physiological profile.

The Spearman test showed a significant positive relationship between sleep quality and blood pressure, with a correlation coefficient of 0.574. This means that poorer sleep quality was associated with a greater tendency toward increased blood pressure. Therefore, sleep quality may be positioned as a relevant early indicator in cardiovascular risk screening among medical students.

However, the results should be interpreted proportionally because the cross-sectional design cannot establish causality. Blood pressure may also be influenced by other factors, including academic stress, caffeine consumption, physical activity, nutritional status, dietary patterns, and family history. Therefore, future research should employ longitudinal or cohort designs, include multivariable analyses, and use objective instruments such as actigraphy or digital sleep monitoring to improve the accuracy of sleep assessment.

In practical terms, the findings may serve as a basis for universities to develop sleep hygiene education, stress counseling, regular blood pressure monitoring, and early cardiovascular risk screening for students. Through these measures, student sleep health can be understood not only as an academic issue, but also as an important component of cardiovascular disease prevention from a young age.

Acknowledgment

The authors would like to express their sincere gratitude to the Faculty of Medicine, Universitas Palangka Raya, for the academic support and facilities provided during the implementation of this study. The authors also thank all medical students who voluntarily participated in the research. Appreciation is extended to all parties who assisted with participant recruitment, questionnaire administration, blood pressure measurement, data collection, and manuscript improvement. Their non-financial support contributed substantially to the successful completion of this study.

Research Ethics Statement

This study was conducted in accordance with the ethical principles governing research involving human participants, including respect for autonomy, confidentiality, voluntary participation, and responsible reporting of research findings. Before participating in the study, all participants received information regarding the research objectives, procedures, potential benefits, and possible risks. Written informed consent was obtained from each participant. Participant identities were kept confidential, and all collected data were used exclusively for research and academic publication purposes. Ethical approval was obtained from the Research Ethics

Committee of the Faculty of Medicine, Universitas Palangka Raya, in accordance with applicable institutional requirements.

Author Contributions

Shelvi Andina: conceptualization, investigation, data collection, formal analysis, interpretation of findings, and writing of the original draft.
Dian Mutiasari: methodology, data validation, academic supervision, manuscript review and editing, and corresponding author responsibilities.
Nisa Kartika Komara: investigation, data collection, data curation, data processing, and interpretation of findings.
Abi Bakring Balyas: content validation, methodological review, interpretation of findings, and critical review of the manuscript.
Trilianty Lestarisa: academic supervision, critical revision of the manuscript, final review, and approval of the final version.
All authors have read, reviewed, and approved the final version of the manuscript.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the research, authorship, or publication of this article.

Artificial Intelligence Use Statement

The authors declare that artificial intelligence, if used, was employed only as a limited technical support tool for language editing, sentence refinement, grammar checking, and improving manuscript readability. All research processes, including research design, participant recruitment, data collection, statistical analysis, interpretation of findings, discussion, and conclusions, remain the full responsibility of the authors.

Data Availability Statement

The data supporting the findings of this study consist of participant characteristics, Pittsburgh Sleep Quality Index scores, blood pressure measurements, cross-tabulation results, and statistical analysis outputs. The dataset is not publicly available because it contains information involving human participants and is subject to research ethics and confidentiality requirements. De-identified data and additional information regarding the analysis may be obtained from the corresponding author upon reasonable request and subject to institutional approval.

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