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Psychological Stress, Sleep Quality, and Blood Pressure in Young Adults: Cross-Sectional Study

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Abstract

Background: Blood pressure regulation is influenced not only by biological and lifestyle factors but also by psychological and behavioral determinants, including psychological stress and sleep quality. Chronic stress and sleep disturbances may activate the sympathetic nervous system and the hypothalamic–pituitary–adrenal axis, contributing to elevated blood pressure even in young adulthood.

Objective: To examine the association between psychological stress, sleep quality, and blood pressure among young adults aged 20–40 years.

Methods: This observational cross-sectional study was conducted in Pandanan Village, Klaten Regency, Central Java, Indonesia, from March to May 2025. A total of 100 adults aged 20–40 years were recruited using purposive sampling. Psychological stress was assessed using the Perceived Stress Scale (PSS), sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), and blood pressure was measured using a calibrated digital sphygmomanometer. Blood pressure categories were defined according to international standards. Associations were analyzed using the chi-square test with a significance level of 0.05.

Results: Psychological stress was significantly associated with blood pressure status ($p = 0.004$), with a higher prevalence of elevated blood pressure observed among participants reporting severe to very severe stress levels. Sleep quality was also significantly associated with blood pressure ($p < 0.001$), with poor sleep quality predominating among participants with elevated blood pressure.

Conclusion: Higher psychological stress levels and poor sleep quality are significantly associated with elevated blood pressure among young adults. These findings highlight the importance of stress management and sleep quality improvement as components of early, non-pharmacological strategies for blood pressure control.

Keywords
Psychological Stress; Sleep Quality; Blood Pressure; Young Adult; Cross-Sectional Studies

Introduction

Blood pressure is a fundamental physiological parameter that reflects cardiovascular health and ensures adequate tissue perfusion. Hypertension remains one of the most significant global public health challenges, contributing substantially to cardiovascular morbidity and mortality worldwide.[1] According to the World Health Organization, more than one billion adults globally are affected by hypertension, and a substantial proportion of cases remain undiagnosed or inadequately controlled.[2] Although hypertension has traditionally been considered a condition affecting older populations, recent epidemiological evidence indicates that elevated blood pressure is increasingly observed among young adults.[2]

This emerging trend is particularly concerning because elevated blood pressure in young adulthood often develops silently and may persist over time, leading to premature cardiovascular disease later in life. Early-onset blood pressure elevation has been associated with a higher lifetime risk of stroke, coronary heart disease, and other cardiovascular complications.[3] Consequently, identifying modifiable determinants of blood pressure among young adults is critical for the development of effective preventive strategies.

In Indonesia, national health surveys have reported a steady increase in the prevalence of hypertension over the past decade, including among adults of productive age. This pattern mirrors global trends and underscores the growing burden of cardiovascular risk factors among younger populations.[4,5] Young adults are frequently exposed to multiple stressors related to academic demands, occupational pressure, urbanization, and socioeconomic challenges, which may contribute to adverse cardiovascular profiles even before clinical hypertension is diagnosed.[6]

Blood pressure regulation is influenced by a complex interaction of biological, behavioral, and psychosocial factors. While traditional risk factors such as genetic predisposition, obesity, physical inactivity, and dietary habits are well established, psychological stress has increasingly been recognized as an important contributor to blood pressure dysregulation.[7,8] Chronic psychological stress may activate the sympathetic nervous system and the hypothalamic–pituitary–adrenal axis, resulting in sustained elevations in catecholamines and cortisol. These neuroendocrine responses can promote vasoconstriction, increase cardiac output, and elevate peripheral vascular resistance, thereby contributing to persistently increased blood pressure.[9,10]

In addition to psychological stress, sleep quality represents a key behavioral determinant of cardiovascular regulation. Adequate and restorative sleep plays an essential role in maintaining autonomic balance and metabolic homeostasis. Poor sleep quality—characterized by difficulty initiating or maintaining sleep, reduced sleep duration, or non-restorative sleep—has been associated with increased sympathetic activity, impaired nocturnal blood pressure dipping, and heightened cardiovascular risk. Individuals with chronic sleep disturbances may therefore be more susceptible to elevated blood pressure and the development of hypertension.[11,12]

Psychological stress and sleep quality are closely interconnected and may exert synergistic effects on blood pressure regulation. Individuals experiencing high stress levels are more likely to report sleep disturbances, while persistent poor sleep may further exacerbate perceived stress. This bidirectional relationship may amplify adverse neuroendocrine and autonomic responses, thereby increasing vulnerability to elevated blood pressure. Such interactions may be particularly relevant among young adults, whose cardiovascular regulatory systems are still adapting to cumulative environmental and psychosocial exposures.[13]

Several observational studies published between 2020 and 2025 have reported significant associations between psychological stress, sleep disturbances, and blood pressure outcomes in adult populations. These studies provide growing evidence that stress-related and sleep-related mechanisms may contribute to early blood pressure elevation, even in individuals without diagnosed hypertension.[13,14] However, much of the existing literature has examined psychological stress and sleep quality separately or has focused primarily on older adults and clinical populations.

Evidence simultaneously examining psychological stress, sleep quality, and blood pressure among young adults in community-based settings—particularly in low- and middle-income countries such as Indonesia—remains limited. This gap is important because young adulthood represents a critical period for the early development of cardiovascular risk profiles. Understanding how psychosocial and behavioral factors interact to influence blood pressure during this stage may inform targeted preventive and promotive interventions.

Therefore, the present study aimed to examine the association between psychological stress, sleep quality, and blood pressure among young adults aged 20–40 years using a cross-sectional design. It was hypothesized that higher levels of psychological stress and poorer sleep quality are associated with higher blood pressure among young adults. By focusing on a community-based population, this study seeks to contribute evidence supporting holistic, non-pharmacological approaches to early blood pressure management.

Methods

This study employed an observational analytic design with a cross-sectional approach to examine the association between psychological stress, sleep quality, and blood pressure among young adults. The cross-sectional design allowed the assessment of exposure variables and blood pressure status at a single point in time; however, because exposure and outcome were measured simultaneously, causal inference and temporal relationships could not be established. This methodological limitation was considered throughout data analysis and interpretation.

The study was conducted in Pandanan Village, Klaten Regency, Central Java, Indonesia, between March and May 2025. The community-based setting was selected to capture real-world patterns of psychological stress, sleep quality, and blood pressure among young adults outside of clinical environments. The target population consisted of permanent residents aged 20–40 years. Based on local administrative records, the total population within this age range was 1,005 individuals. Sample size was calculated using Slovin's formula with a margin of error of 10%, resulting in a minimum required sample of 100 participants. Although Slovin's formula is commonly applied in community surveys for feasibility, it does not account for effect size estimation or statistical power, which was acknowledged as a methodological limitation.

Participants were recruited using purposive sampling to ensure inclusion of individuals who met the predefined eligibility criteria and were able to complete questionnaires and undergo blood pressure measurement under field conditions. Inclusion criteria comprised adults aged 20–40 years who were permanent residents of the study area, willing to participate, and able to provide written informed consent. Individuals diagnosed with severe mental or cognitive disorders, those currently taking antihypertensive medication, and those using sleeping pills, sedatives, or anti-stress medication were excluded, as these factors could influence stress perception, sleep quality, or blood pressure measurements. The use of purposive sampling may have introduced selection bias and limited generalizability beyond the study population; therefore, the findings should be interpreted accordingly.

Psychological stress, sleep quality, and blood pressure were assessed as the main study variables. Psychological stress was defined as an individual's perceived level of stress in daily life and was measured using the 10-item Perceived Stress Scale (PSS-10). Sleep quality was defined as the subjective evaluation of sleep patterns and disturbances over the previous month and was assessed using the Pittsburgh Sleep Quality Index (PSQI). Blood pressure was defined as systolic and diastolic arterial pressure measured in millimeters of mercury using a digital sphygmomanometer and categorized according to international standards.

The Indonesian version of the PSS-10 has demonstrated acceptable psychometric properties in adult populations. Previous validation studies reported satisfactory internal consistency, with composite reliability values ranging from 0.81 among students to 0.93 among employed adults, as well as adequate construct validity based on confirmatory factor analysis. Sleep quality was assessed using the Indonesian version of the PSQI, which has demonstrated adequate reliability, with a reported Cronbach's alpha of approximately 0.72 in adolescent and adult populations, and has been widely used as a screening tool for subjective sleep quality in epidemiological research.

Blood pressure measurements were performed using a calibrated digital sphygmomanometer following a standardized protocol. Participants were instructed to rest for at least five minutes in a seated position prior to measurement, with feet flat on the floor and the upper arm supported at heart level. Blood pressure was measured once during the study visit due to field constraints. Repeated measurements were not performed, which represents a limitation given that current clinical recommendations generally advise multiple measurements to improve accuracy. Blood pressure values were categorized into low, normal, and high blood pressure. Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, in accordance with recommendations from the World Health Organization and the WHO–International Society of Hypertension classification.

Data collection was conducted directly by the research team in the community setting. Eligible participants received a standardized explanation regarding the study objectives, procedures, potential risks, and benefits, after which written informed consent was obtained. Participants completed the self-administered PSS-10 and PSQI questionnaires under supervision to minimize missing data, followed by blood pressure measurement according to the standardized protocol. All data were recorded anonymously using unique participant identification codes to ensure confidentiality.

Data were analyzed using statistical software. Univariate analysis was performed to describe participant characteristics, psychological stress levels, sleep quality, and blood pressure categories using frequencies and percentages. Bivariate associations between psychological stress and blood pressure, as well as between sleep quality and blood pressure, were examined using the chi-square test. A two-tailed p-value of less than 0.05 was considered statistically significant. No multivariable analysis was conducted to adjust for potential confounding variables such as age, sex, body mass index, physical activity, smoking behavior, or dietary factors; therefore, the reported findings represent unadjusted associations. Effect size measures, including odds ratios or prevalence ratios, were not calculated.

Potential sources of bias included selection bias related to purposive sampling and information bias due to self-reported stress and sleep questionnaires. Several potential confounders were not measured or controlled for, which may have influenced the observed associations. These limitations were acknowledged and addressed in the interpretation of the results.

The study protocol was reviewed and approved by the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta (Approval No. 1571/KEPK-FIK/X/2025). All participants were informed of their right to decline or withdraw from the study at any time without consequence, and confidentiality was maintained throughout the research process.

Results

Participant Flow

A total of 112 adults aged 20–40 years were initially assessed for eligibility in Pandanan Village, Klaten Regency. After screening, 12 individuals were excluded because they met the exclusion criteria, including current use of antihypertensive medication or sedatives, or declined to participate. Consequently, 100 participants were included in the final analysis. The process of participant selection, reasons for exclusion, and inclusion in the final analysis is illustrated in Figure 1.

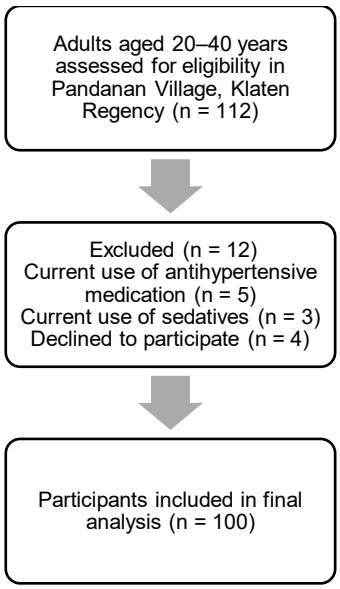

Figure 1. Flow diagram of participant selection and inclusion.

Baseline Characteristics of Participants

The baseline characteristics of the study participants are presented in Table 1. The majority of participants were aged 30–40 years (54.0%) and female (57.0%). Regarding psychological stress, 45.0% of participants reported moderate stress levels, while 35.0% reported severe to very severe stress. Poor sleep quality was reported by 60.0% of participants. More than half of the participants (51.0%) were classified as having high blood pressure.

Table 1. Baseline Characteristics of Participants (n = 100)

Characteristic	n	%
Age group (years)		
20–29	46	46.0
30–40	54	54.0
Sex		
Male	43	43.0
Female	57	57.0
Stress level (PSS)		
Normal–Mild	20	20.0
Moderate	45	45.0
Severe–Very severe	35	35.0
Sleep quality (PSQI)		
Good	40	40.0
Poor	60	60.0
Blood pressure category		
Low	4	4.0
Normal	45	45.0
High	51	51.0

Association Between Psychological Stress and Blood Pressure

The association between psychological stress level and blood pressure category is shown in Table 2. Participants with normal to mild stress predominantly had normal blood pressure, whereas those with higher stress levels exhibited a greater prevalence of elevated blood pressure. Among participants reporting severe to very severe stress, 80.0% were classified as having high blood pressure. Chi-square analysis demonstrated a statistically significant association between psychological stress level and blood pressure ($p = 0.004$). No effect size estimates, such as odds ratios or prevalence ratios, were calculated because the analysis was limited to bivariate comparisons without multivariable adjustment.

Table 2. Association Between Psychological Stress Level and Blood Pressure

Stress level	Low BP n (%)	Normal BP n (%)	High BP n (%)	Total n (%)
Normal–Mild	0 (0.0)	15 (75.0)	5 (25.0)	20 (100)
Moderate	1 (2.2)	26 (57.8)	18 (40.0)	45 (100)
Severe–Very severe	3 (8.6)	4 (11.4)	28 (80.0)	35 (100)
p-value (χ^2 test)				0.004

Association Between Sleep Quality and Blood Pressure

Table 3 presents the association between sleep quality and blood pressure category. Participants reporting good sleep quality predominantly had normal blood pressure, whereas those with poor sleep quality showed a markedly higher prevalence of elevated blood pressure. Among participants with poor sleep quality, 70.0% were classified as having high blood pressure. The chi-square test indicated a statistically significant association between sleep quality and blood pressure ($p < 0.001$). These findings represent unadjusted associations and should be interpreted accordingly.

Table 3. Association Between Sleep Quality and Blood Pressure

Sleep quality	Low BP n (%)	Normal BP n (%)	High BP n (%)	Total n (%)
Good	0 (0.0)	31 (77.5)	9 (22.5)	40 (100)
Poor	4 (6.7)	14 (23.3)	42 (70.0)	60 (100)
p-value (χ^2 test)				< 0.001

Summary of Main Findings

Overall, the results indicate that both psychological stress and sleep quality were significantly associated with blood pressure status among young adults aged 20–40 years. Higher stress levels and poorer sleep quality were consistently accompanied by a greater prevalence of elevated blood pressure. Because the analysis was limited to bivariate comparisons in a cross-sectional design, no causal inference can be made from these findings.

Discussion

This study examined the association between psychological stress, sleep quality, and blood pressure among young adults aged 20–40 years in a community-based setting. The main findings indicate that both higher psychological stress levels and poorer sleep quality were significantly associated with elevated blood pressure. These results highlight the relevance of psychosocial and behavioral factors in blood pressure regulation even at a relatively young age. Importantly, given the cross-sectional nature of the study, the observed associations should be interpreted as non-causal.

The significant association between psychological stress and blood pressure observed in this study is biologically plausible and consistent with current theoretical and empirical evidence. Chronic psychological stress is known to activate the sympathetic nervous system and the hypothalamic–pituitary–adrenal axis, resulting in increased secretion of catecholamines and cortisol. Sustained activation of these neuroendocrine pathways can promote vasoconstriction, increase heart rate, and elevate peripheral vascular resistance, thereby contributing to higher blood pressure.[15] Observational studies published in recent years have reported similar associations between perceived stress and elevated blood pressure or hypertension risk in adult and young adult populations, supporting the consistency of the present findings.[16]

In young adults, stress-related blood pressure elevation is particularly concerning because it may represent an early stage in the development of long-term cardiovascular risk. Psychological stress experienced during early adulthood—often related to academic demands, occupational pressure, financial instability, and social transitions—may exert cumulative effects on cardiovascular regulation.[17,18] If sustained over time, these effects may contribute to the progression from transient blood pressure elevation to established hypertension later in life. The present findings therefore reinforce the importance of early identification and management of stress-related cardiovascular risk factors.

The association between sleep quality and blood pressure identified in this study further supports the role of behavioral determinants in cardiovascular regulation. Poor sleep quality has been linked to autonomic imbalance, characterized by increased sympathetic activity and reduced parasympathetic tone, as well as impaired nocturnal blood pressure dipping. These physiological alterations may predispose individuals with chronic sleep disturbances to elevated blood pressure and increased hypertension risk.[14] The higher prevalence of elevated blood pressure among participants reporting poor sleep quality in this study is consistent with recent international observational evidence demonstrating associations between sleep disturbance, short sleep duration, and adverse blood pressure profiles in young and middle-aged adults.[19]

Sleep quality is particularly relevant in young adult populations, who often experience irregular sleep patterns due to academic, occupational, and social demands. Chronic sleep deprivation or poor sleep quality during this life stage may disrupt circadian regulation and stress-response systems, thereby amplifying cardiovascular vulnerability. The present findings add to the growing body of evidence emphasizing sleep quality as an important, yet often overlooked, component of early cardiovascular risk assessment.[20,21]

Psychological stress and sleep quality are closely interconnected and may exert synergistic effects on blood pressure regulation. Individuals experiencing high levels of stress are more likely to report difficulty initiating or maintaining sleep, while persistent sleep disturbances may further exacerbate perceived stress. This bidirectional relationship may amplify adverse neuroendocrine and autonomic responses, resulting in a greater likelihood of elevated blood pressure. Although the present study did not formally test interaction effects, the simultaneous assessment of stress and sleep quality provides valuable insight into their combined relevance for blood pressure status among young adults.[13]

From a clinical and public health perspective, the findings of this study have important implications for non-pharmacological blood pressure management in young adults. Early preventive strategies that address psychological stress and sleep quality may help mitigate the progression of elevated blood pressure before the onset of clinical hypertension. Interventions such as stress management education, relaxation techniques, breathing exercises, and sleep hygiene counseling may be particularly beneficial when implemented in community-based and primary care settings.

The findings are also relevant to physiotherapy practice. Physiotherapists are increasingly involved in health promotion and preventive care and may play a role in addressing psychosocial and behavioral factors related to cardiovascular health. Through interventions such as exercise prescription, relaxation and breathing techniques, posture correction, and lifestyle education,

physiotherapists can contribute to stress reduction and sleep quality improvement. Integrating these approaches into routine physiotherapy practice may support holistic blood pressure management, particularly among young adults who may not yet require pharmacological treatment.

Several methodological limitations of this study should be acknowledged. First, the cross-sectional design precludes causal inference and does not allow determination of temporal relationships between psychological stress, sleep quality, and blood pressure. Second, purposive sampling may have introduced selection bias and limits the generalizability of the findings beyond the study population. Third, the analysis was limited to bivariate associations, and no multivariable analysis was conducted to control for potential confounders such as body mass index, physical activity, dietary intake, smoking status, or socioeconomic factors. Residual confounding may therefore have influenced the observed associations.

Measurement-related limitations should also be considered. Psychological stress and sleep quality were assessed using self-reported questionnaires, which may be subject to reporting or recall bias. Additionally, blood pressure was measured at a single time point, which may not fully capture day-to-day variability or white-coat effects. Although standardized measurement procedures were applied, repeated measurements would have improved the accuracy of blood pressure classification.

Regarding external validity, the study population consisted of young adults residing in a single community in Central Java, Indonesia. Sociocultural, environmental, and lifestyle factors unique to this setting may limit the applicability of the findings to other populations or regions. Therefore, caution is warranted when generalizing the results to broader or more diverse young adult populations.

Despite these limitations, this study has several strengths. It focuses on an understudied age group by examining young adults rather than older or clinical populations. In addition, it simultaneously assesses psychological stress and sleep quality in relation to blood pressure, providing a more integrated perspective on psychosocial and behavioral determinants of early cardiovascular risk. The community-based design enhances the relevance of the findings for preventive health strategies outside of clinical settings.

Future research should employ longitudinal or prospective cohort designs to clarify the temporal relationships between psychological stress, sleep quality, and blood pressure. Multivariable analytical approaches are needed to control for key confounding factors and to estimate effect sizes. Intervention studies evaluating stress reduction and sleep improvement strategies may also provide stronger evidence to support non-pharmacological approaches for blood pressure control in young adults.

Conclusion

This study demonstrates that psychological stress and sleep quality are significantly associated with blood pressure among young adults aged 20–40 years in a community-based setting. Participants reporting higher levels of psychological stress and poorer sleep quality exhibited a markedly greater prevalence of elevated blood pressure, highlighting the importance of psychosocial and behavioral determinants in early cardiovascular risk profiles.

Although causal relationships cannot be inferred due to the cross-sectional design, the findings suggest that stress and sleep-related factors may play a meaningful role in blood pressure regulation even before the onset of established hypertension. Young adulthood represents a critical period for cardiovascular risk development, and early identification of modifiable factors during this stage may offer important opportunities for prevention.

From a clinical and public health perspective, the results underscore the potential value of non-pharmacological approaches to blood pressure management in young adults. Interventions focusing on stress reduction and sleep quality improvement may help prevent the progression of elevated blood pressure and support long-term cardiovascular health. Integrating such strategies into community-based health promotion, primary care services, and preventive physiotherapy programs may contribute to more comprehensive and sustainable cardiovascular risk reduction.

Author Contribution

Conceptualization: Indah Mutiara Barokah, Wahyu Tri Sudaryanto
Methodology: Indah Mutiara Barokah, Wahyu Tri Sudaryanto
Data curation: Indah Mutiara Barokah
Formal analysis: Indah Mutiara Barokah, Wahyu Tri Sudaryanto
Writing—original draft: Indah Mutiara Barokah
Writing—review & editing: Wahyu Tri Sudaryanto
Supervision: Wahyu Tri Sudaryanto

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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This study received no external funding.

Ethics Statement

This study was approved by the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta (Ethical Approval No. 1571/KEPK-FIK/X/2025). All participants received a complete explanation of the study objectives and procedures and provided written informed consent prior to participation.

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