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RESEARCH ARTICLE

Association between sleep patterns, dietary habits, and work stress and hypertension incidence at Medan Johor Community Health Center

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ABSTRACT

Background: Hypertension has emerged as a major public health challenge in urban settings such as Medan City, where modern lifestyle transformations have led to deteriorated sleep quality, imbalanced dietary patterns, and elevated work-related stress levels among the working-age population. This study aimed to analyze the association between sleep patterns, dietary habits, and work-related stress with the incidence of hypertension at the Medan Johor Community Health Center.
Method: A quantitative analytical observational study employing a cross-sectional design was conducted. The study population comprised all primary hypertension patients aged 20 to 40 years registered at the health center, from which 99 participants were selected using purposive sampling based on predefined eligibility criteria. Data collection utilized validated modified instruments including the Pittsburgh Sleep Quality Index, Food Frequency Questionnaire, and Workplace Stress Scale, alongside direct blood pressure measurements using a sphygmomanometer. Univariate analysis described frequency distributions, while bivariate analysis employed the Chi-square test with a significance level of α=0.05.
Results: The results revealed that the majority of respondents exhibited poor sleep quality (64.6%), moderate dietary habits (58.6%), moderate work-related stress levels (55.6%), and confirmed hypertension (62.6%). Bivariate analysis demonstrated statistically significant associations between sleep patterns and hypertension incidence ($p<0.001$), dietary habits and hypertension incidence ($p<0.001$), and work-related stress and hypertension incidence ($p<0.001$).
Conclusion: These findings indicate that poor sleep quality, unhealthy dietary patterns, and elevated work-related stress are significantly associated with increased hypertension risk. The study concludes that multidimensional lifestyle interventions addressing sleep hygiene, nutritional balance, and workplace stress management are essential for hypertension prevention and control in primary health care settings.

Keywords: hypertension, sleep pattern, dietary habit, work stress

Introduction

Hypertension has long been recognized as one of the most pressing global public health challenges, affecting both developed and developing nations with substantial consequences for cardiovascular morbidity and mortality. This non-communicable disease serves as the primary risk factor for numerous serious cardiovascular events, including myocardial infarction, stroke, heart failure, end-stage renal disease, and peripheral vascular disease.[1] According to the most recent data released by the World Health Organization in 2025, approximately 1.4 billion adults aged 30 to 79 years worldwide are living with hypertension, representing nearly one third of the global population within this age range. Alarmingly, more than two thirds

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of individuals with hypertension reside in low- and middle-income countries, highlighting substantial disparities in both detection and management of this condition. The World Health Organization further reported that over 700 million affected individuals remain either undiagnosed or inadequately treated, with hypertension and its complications contributing to approximately 9.4 million deaths annually.[2] In China, a nation undergoing rapid epidemiological transition, the prevalence of hypertension among adults over 20 years of age reached 26.6%, with notable sex differences showing 29.2% among males and 24.1% among females.[3]

Globally, the rising trajectory of hypertension cases has been closely linked to modern lifestyle modifications, including deteriorating sleep quality, shifts in dietary consumption patterns, and escalating work-related stress levels.[4,5] In Indonesia, hypertension has become an escalating public health concern over the past decade. Data from the 2013 Basic Health Research (Riskesdas) reported a hypertension prevalence of 25.8% among the population aged 18 years and older, which increased to 34.1% in the 2018 survey. Disturbingly, the majority of individuals with hypertension in Indonesia remain unaware of their condition. The 2018 Riskesdas reported that only approximately 8.8% of affected individuals regularly consume antihypertensive medications, and most only discover their condition after experiencing serious complications.[6] This situation negatively impacts workforce productivity, increases workplace absenteeism, and diminishes overall quality of life.

Similar phenomena are observable at the regional level, particularly in Medan City. According to the 2022 Medan City Health Profile, hypertension ranks among the ten most prevalent diseases, with 65,904 recorded cases. Within the service area of the Medan Johor Community Health Center, 1,722 active hypertension patients were documented in 2022, representing an approximate 21% increase compared to 2018 when 1,420 active patients were recorded. This increase is suspected to be associated with urban lifestyle changes in this area.[7] A 2023 study of college students in Papua found that 78% experienced poor sleep quality over the past month, with female students showing poorer sleep (48%) compared to males (30%).[8] Another study assessing sleep quality and anxiety among college students in West Kalimantan revealed widespread sleep disturbances in this population.[9] National data from the Indonesia Family Life Survey (2014-15) found that 11.0% of older Indonesians had clinically significant insomnia symptoms, affecting 34,839 participants. Poor sleep has measurable health consequences: research has demonstrated correlations between inadequate sleep duration and negative health outcomes among Indonesian adults.[10] Regarding work-related health risks, a foundational study on Jakarta office employees confirmed that moderate or high qualitative job stressors increase hypertension risk by seven-fold (ORa = 7.47; 95% CI = 1.40-39.76), while moderate or high quantitative stressors increase risk by four-fold (ORa = 4.10; 95% CI = 1.06-15.90). The study identified workload increases, career development pressures, age, obesity, smoking habits, and family history of hypertension as significant risk factors. Work-related stress elevates blood pressure through physiological mechanisms involving cortisol and adrenaline hormone release, making stress management critical for preventing hypertension among Indonesian workers.[11]

The physiological mechanisms linking sleep patterns to hypertension are well established. Poor sleep quality disrupts the autonomic nervous system balance, particularly through increased sympathetic nervous system activity, which directly elevates blood pressure.[12,13] Persistent sleep disturbances also lead to elevated stress hormone levels, including cortisol, which contributes to vasoconstriction. Additionally, inadequate restorative sleep impairs the normal nocturnal cardiovascular recovery process, preventing the physiological blood pressure dip that typically occurs during sleep.[14,15] Sleep deprivation also activates inflammatory pathways and oxidative stress mechanisms, further damaging vascular endothelium and promoting atherosclerosis.[16]

Regarding dietary influences on hypertension, the biological pathways are equally well characterized. High sodium intake promotes fluid retention, expanding blood volume and increasing pressure against vessel walls.[17,18] Saturated fat consumption contributes to atherosclerotic plaque formation, elevating peripheral vascular resistance.[19] The frequent consumption of fast food, processed items, and sugar-sweetened beverages also promotes weight gain, which indirectly increases cardiac workload.[20–22] The Indonesian population's increasing reliance on convenience foods, coupled with declining traditional dietary patterns rich in vegetables and legumes, has created a nutritional environment conducive to hypertension development.[23–25]

The relationship between work-related stress and hypertension operates through both direct physiological and indirect behavioral pathways. Chronic stress activates the sympathetic nervous system and increases secretion of adrenaline and cortisol, elevating heart rate and constricting blood vessels. When

sustained over time, these acute responses can transition into sustained blood pressure elevation. Furthermore, work-related stress adversely affects health behaviors, including sleep disruption, increased consumption of comfort foods typically high in sodium and fat, and reduced physical activity, all of which compound cardiovascular risk.[25,26] The coping capacity of individuals and the availability of social support systems can modify these effects, but the fundamental association between occupational stress and hypertension has been consistently demonstrated across diverse workplace settings.[26]

Despite the substantial body of evidence linking these lifestyle factors to hypertension, a notable knowledge gap exists regarding their combined and interactive effects within the specific demographic and cultural context of Medan Johor. The local population includes many residents with varying educational backgrounds, occupational distributions spanning farming, labor, and formal employment, and traditional health beliefs that may modify the relationships observed in other settings. Based on the background outlined above, this study aimed to identify and analyze the association between sleep patterns, dietary habits, and work-related stress with the incidence of hypertension among patients at the Medan Johor Community Health Center.

Method

This quantitative study employed an analytic observational approach with a cross-sectional design. In this design, independent and dependent variables were measured simultaneously at a single time point. No intervention was provided; data were collected using questionnaires to identify relationships between sleep patterns, dietary habits, work stress, and hypertension incidence. The study was conducted at the Medan Johor Primary Health Center (UPT Puskesmas Medan Johor) from October 2025 until completion.

The population comprised all patients with primary hypertension aged 20 to 40 years registered at the health center, totaling 7,337 individuals. Sample size was calculated using the Slovin formula with a 10% margin of error, yielding 99 respondents. Purposive sampling was used based on predetermined inclusion and exclusion criteria. Inclusion criteria were: (1) hypertensive patients with blood pressure ≥130/90 mmHg seeking care at the health center; (2) age 20 to 40 years; (3) willing to sign informed consent; (4) had a history of hypertension and agreed to be a respondent. Exclusion criteria were: (1) hypertension with comorbidities or complications; (2) unable to read and write.

Data were collected using modified questionnaires: the Pittsburgh Sleep Quality Index (PSQI) to measure sleep patterns, the Food Frequency Questionnaire (FFQ) to measure dietary habits, and the Workplace Stress Scale to measure work stress levels. Blood pressure was measured directly using a calibrated sphygmomanometer. Data were analyzed using univariate and bivariate methods. Univariate analysis described the frequency distribution of each variable. Bivariate analysis used the chi-square test with a significance level of $\alpha = 0.05$ to determine relationships between independent and dependent variables. Results were presented in tables with narrative interpretation.

Results

A total of 99 respondents completed the study, representing 100% of the target sample. All participants met the inclusion criteria and completed all components of the data collection protocol. The sociodemographic characteristics of the sample reflected the target population of young adult hypertension patients at the Medan Johor Community Health Center. The majority of respondents were female, comprising 71 respondents or 71.7% of the sample, while 28 respondents or 28.3% were male. The age distribution showed that the largest group was aged 31 to 35 years with 38 respondents or 38.4%, followed by those aged 26 to 30 years with 24 respondents or 24.2%, those aged 36 to 40 years with 21 respondents or 21.2%, and those aged 20 to 25 years with 16 respondents or 16.2%. The mean age of respondents was 31.4 years with a standard deviation of 5.2 years. Regarding educational attainment, the majority of respondents had completed senior high school, with 48 respondents or 48.5% falling into this category. Junior high school graduates comprised 22 respondents or 22.2%, tertiary education graduates comprised 18 respondents or 18.2%, and primary school or lower comprised 11 respondents or 11.1%. Occupation data indicated that the largest category was formal sector employment, with 41 respondents or 41.4% working in offices, government positions, or private companies. Farmers or laborers comprised 24 respondents or 24.2%, homemakers comprised 20 respondents or 20.2%, and self employed individuals comprised 14 respondents or 14.1%. The duration of hypertension diagnosis varied, with 48 respondents or 48.5% having been

diagnosed for less than one year, 31 respondents or 31.3% for one to three years, and 20 respondents or 20.2% for more than three years. Complete sociodemographic data are presented in Table 1.

Univariate analysis was performed to describe the distribution of the main study variables, including sleep patterns, dietary habits, work-related stress, and hypertension status. Table 2 presents the complete distribution of these four variables. Regarding sleep quality, the majority of respondents exhibited poor sleep patterns. Specifically, 64 respondents or 64.6% were categorized as having poor sleep quality, while 35 respondents or 35.4% had good sleep quality. The mean Pittsburgh Sleep Quality Index score was 7.8 with a standard deviation of 2.9, substantially above the cutoff score of five that distinguishes good from poor sleep quality. Among the seven component scores, the most problematic domains were sleep latency, with 52 respondents or 52.5% reporting taking more than 30 minutes to fall asleep; sleep duration, with 48 respondents or 48.5% sleeping less than six hours per night; and daytime dysfunction, with 44 respondents or 44.4% reporting moderate to severe difficulty staying awake during daytime activities.

Table 1. Sociodemographic characteristics of respondents (N=99)

Characteristic	Frequency (n)	Percentage (%)
Sex		
Male	28	28.3
Female	71	71.7
Age group (years)		
20-25	16	16.2
26-30	24	24.2
31-35	38	38.4
36-40	21	21.2
Education level		
No formal / Primary school	11	11.1
Junior high school	22	22.2
Senior high school	48	48.5
Tertiary (college/university)	18	18.2
Occupation		
Formal employment	41	41.4
Farmer/laborer	24	24.2
Homemaker	20	20.2
Self-employed	14	14.1
Duration of hypertension diagnosis (years)		
<1	48	48.5
1-3	31	31.3
>3	20	20.2

For dietary habits, the largest group of respondents demonstrated sufficient dietary patterns, with 58 respondents or 58.6% falling into this category. Good dietary patterns were observed in 25 respondents or 25.3%, while poor dietary patterns were found in 16 respondents or 16.2%. The mean Food Frequency Questionnaire score was 45.3 with a standard deviation of 8.7. The most common dietary practices contributing to suboptimal scores included frequent consumption of high sodium foods, with 61 respondents or 61.6% reporting adding extra salt to their meals regularly; low fruit consumption, with 54 respondents or 54.5% consuming fruits less than three times per week; low vegetable consumption, with 49 respondents or 49.5% consuming vegetables less than three times per week; and frequent fast food consumption, with 42 respondents or 42.4% reporting fast food intake at least three times per week.

Regarding work-related stress, the majority of respondents experienced moderate stress levels. Specifically, 55 respondents or 55.6% were categorized as having moderate work-related stress, 24 respondents or 24.2% experienced severe stress, and 20 respondents or 20.2% reported mild stress. The mean Workplace Stress Scale score was 30.6 with a standard deviation of 8.4 out of a maximum possible score of 50. The most frequently endorsed sources of work-related stress included heavy workload, reported by 67 respondents or 67.7%; time pressure and tight deadlines, reported by 59 respondents or 59.6%; lack of control over work processes, reported by 48 respondents or 48.5%; and interpersonal conflicts with colleagues or supervisors, reported by 32 respondents or 32.3%.

For hypertension status, direct blood pressure measurements showed that the majority of respondents met the criteria for hypertension diagnosis. Specifically, 62 respondents or 62.6% were categorized as hypertensive, while 37 respondents or 37.4% had normal blood pressure readings. Among hypertensive

respondents, the mean systolic blood pressure was 142.3 mmHg with a standard deviation of 9.6 mmHg, and the mean diastolic blood pressure was 91.7 mmHg with a standard deviation of 6.8 mmHg. Among normotensive respondents, the mean systolic blood pressure was 116.4 mmHg with a standard deviation of 5.2 mmHg, and the mean diastolic blood pressure was 75.8 mmHg with a standard deviation of 4.5 mmHg.

Table 2. Distribution of study variables (N=99)

Variable	Category	Frequency (n)	Percentage (%)
Sleep patterns	Good	35	35.4
	Poor	64	64.6
Dietary habits	Good	25	25.3
	Sufficient	58	58.6
	Poor	16	16.2
Work-related stress	Mild	20	20.2
	Moderate	55	55.6
	Severe	24	24.2
Hypertension status	Normal	37	37.4
	Hypertension	62	62.6

Bivariate analysis using the Chi-square test was conducted to examine the association between each independent variable and hypertension status. Table 3 presents the complete cross-tabulation results for all three associations. The first analysis examined the relationship between sleep patterns and hypertension. Among respondents with good sleep quality, 32 respondents or 91.4% had normal blood pressure, while only 3 respondents or 8.6% were hypertensive. In contrast, among respondents with poor sleep quality, 59 respondents or 92.2% were hypertensive, while only 5 respondents or 7.8% had normal blood pressure. The Chi-square test yielded a p value of less than 0.001, which is below the significance threshold of 0.05. This result demonstrates that poor sleep quality is significantly associated with elevated blood pressure in this population.

The second analysis examined the relationship between dietary habits and hypertension. Among respondents with good dietary patterns, 24 respondents or 96.0% had normal blood pressure, while only 1 respondent or 4.0% was hypertensive. Among respondents with sufficient dietary patterns, 11 respondents or 19.0% had normal blood pressure, while 47 respondents or 81.0% were hypertensive. Among respondents with poor dietary patterns, 2 respondents or 12.5% had normal blood pressure, while 14 respondents or 87.5% were hypertensive. The Chi-square test yielded a p value of less than 0.001, indicating a statistically significant association between dietary habits and hypertension status. The pattern of association showed a clear gradient, with worse dietary patterns corresponding to higher proportions of hypertension.

The third analysis examined the relationship between work-related stress and hypertension. Among respondents with mild work-related stress, all 20 respondents or 100.0% had normal blood pressure, and none were hypertensive. Among respondents with moderate work-related stress, 15 respondents or 27.3% had normal blood pressure, while 40 respondents or 72.7% were hypertensive. Among respondents with severe work-related stress, 2 respondents or 8.3% had normal blood pressure, while 22 respondents or 91.7% were hypertensive. The Chi-square test yielded a p value of less than 0.001, demonstrating a statistically significant association between work-related stress levels and hypertension status. The association followed a clear dose response pattern, with higher stress levels associated with progressively higher proportions of hypertension. The bivariate analysis results consistently demonstrated that all three independent variables showed statistically significant associations with hypertension status, with p values all below 0.001.

Table 3. Bivariate analysis of sleep patterns, dietary habits, and work-related stress with hypertension status (N=99)

Variable	Category	Normal Blood Pressure n (%)	Hypertension n (%)	Total	P-Value
Sleep patterns	Good	32 (91.4%)	3 (8.6%)	35	<0.001
	Poor	5 (7.8%)	59 (92.2%)	64	
Dietary habits	Good	24 (96.0%)	1 (4.0%)	25	<0.001
	Sufficient	11 (19.0%)	47 (81.0%)	58	
	Poor	2 (12.5%)	14 (87.5%)	16	
Work-related stress	Mild	20 (100.0%)	0 (0.0%)	20	<0.001
	Moderate	15 (27.3%)	40 (72.7%)	55	
	Severe	2 (8.3%)	22 (91.7%)	24	

Discussion

This study found significant associations between sleep patterns, dietary habits, and work stress with hypertension incidence among respondents at the Medan Johor Primary Health Center. The findings align with established physiological mechanisms and prior research. Poor sleep quality can disrupt autonomic nervous system balance, particularly increasing sympathetic nervous system activity, which raises blood pressure. Persistent sleep disturbance also increases stress hormones such as cortisol, contributing to vasoconstriction.[13,27] Additionally, lack of quality rest impairs nocturnal cardiovascular recovery, preventing the normal physiological dip in blood pressure.[28] These findings are consistent with previous studies showing that poor sleep quality is associated with increased hypertension risk.[12,29]

High sodium and low fiber intake cause fluid retention, increasing blood volume and vascular pressure. High saturated fat intake promotes plaque formation in blood vessels, increasing peripheral resistance. Fast food consumption, processed foods, and sugary drinks contribute to weight gain, indirectly increasing cardiac workload.[19,30,31] This study's findings are supported by prior research demonstrating significant associations between unhealthy dietary patterns and elevated blood pressure, although physical activity and genetic factors may modify this relationship.[32,33]

The physiological pathways linking prolonged stress to cardiovascular strain are well-documented; chronic stress activates the sympathetic nervous system and triggers a cascade of adrenaline and cortisol, resulting in heightened heart rate, vasoconstriction, and sustained blood pressure elevation.[34] Beyond these direct pathways, work-related stress fundamentally reshapes daily habits by driving behavioral patterns like sleep disturbances, poor dietary choices, and physical inactivity, which collectively compromise overall cardiovascular health.[35] These findings reinforce a broader body of literature establishing a clear link between heightened stress levels and the onset of hypertension, while highlighting how the severity of this impact remains heavily modified by an individual's personal coping mechanisms and the strength of their social support systems.[36]

This study has several strengths, including the use of validated instruments (PSQI, FFQ, Workplace Stress Scale) and direct blood pressure measurement rather than self-reported diagnosis. The sample size was adequate for bivariate analysis. However, several limitations must be acknowledged. The cross-sectional design precludes causal inference; relationships observed may be bidirectional. Data collection relied on self-reported questionnaires, introducing potential recall and social desirability bias. Purposive sampling may limit generalizability to other populations. The study did not assess potential confounders such as physical activity, family history of hypertension, medication use, or socioeconomic status. Future longitudinal studies with larger, randomly selected samples and objective sleep and stress measurements are needed to confirm causal relationships.

These findings have several practical implications. At the health center level, routine screening for sleep disturbances, dietary risks, and work stress should be integrated into hypertension management protocols. Health promotion programs should include sleep hygiene education, practical guidance on low-sodium and high-fiber diets, and stress management techniques such as relaxation training or mindfulness. Workplace interventions, including flexible scheduling and employee assistance programs, may reduce work stress among at-risk populations. At the policy level, local health authorities should support community-based lifestyle modification programs targeting young adults, who are increasingly affected by hypertension. Collaboration with employers to implement workplace health promotion initiatives is recommended. Future research should evaluate the effectiveness of multicomponent interventions addressing sleep, diet, and stress simultaneously.

Conclusion

This study found significant associations between sleep patterns, dietary habits, and work stress with hypertension incidence among 99 respondents at Medan Johor Primary Health Center ($p < 0.001$ for each association). Poor sleep pattern, unhealthy diet, and higher work stress were consistently associated with higher proportions of hypertension. These findings highlight the need for integrated prevention strategies targeting multiple lifestyle factors simultaneously. Health centers should enhance health promotion programs focusing on sleep quality, balanced nutrition, and stress management. Future research should explore additional variables such as physical activity, family history, and medication adherence using longitudinal designs.

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