

Stress and protein intake are associated with short sleep duration among hypertensive patients

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary Background. Hypertensive patients usually have shorter sleep duration compared to the healthy population. Short sleep duration in hypertensive patients increases the risk of hypertension co-morbidity incidence and is caused by dietary intake, stress or other lifestyle factors.

Objectives. This study aimed to determine the relationship between stress and other factors related with sleep duration in hypertensive patients.

Materials and methods. This study used a cross-sectional design with a sample size of 98 hypertensive patients who regularly received treatment for at least six months prior to data collection. Data was collected at Tegal Gundil Primary Healthcare, West Java, Indonesia, in 2017. Sleep duration was determined through the self-reported method, stress was assessed using the Perceived Stress Scale (PSS) questionnaire, dietary intake using the Semi-Quantitative Food Frequency Questionnaire (SFFQ), physical activity using the Global Physical Activity Questionnaire (GPAQ) and the presence of a roommate using the Pittsburgh Sleep Quality Index (PSQI).

Results. The results showed that the average of hypertensive patients' sleep duration was 6.39 hours, with 54% of respondents sleeping less than the recommended duration (7 hours). A positive correlation was found between stress and sleep duration ($p = 0.020$; $r = 0.235$) and protein intake and sleep duration ($p = 0.041$; $r = 0.266$). The presence of a roommate also had a significant relation with sleep duration ($p = 0.023$; OR = 4.45 (1.32–15.01)).

Conclusions. It was found that stress, protein intake and the presence of a roommate were associated with short sleep duration among hypertensive patients.

Key words: sleep, life style, proteins, hypertensive patient.

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Background

Hypertension contributes to 13% of all deaths globally, with an estimated 60% of total cases increasing by 2025 [1]. Hypertension is known as an incurable disease, yet blood pressure can be managed through engaging in a healthy lifestyle, such as a healthy diet, adequate physical activity and sufficient sleep duration. However, a cross-sectional study showed that hypertensive patients only had an average of 6.3 hours of sleep per night [2], shorter than that of non-hypertensive patients (6.9 hours) [3]. Insufficient sleep duration could trigger an increase in both systole and diastole blood pressures [4, 5]. One of the reasons is that shorter sleep duration increases the waking state, which subsequently triggers the sympathetic nervous system to work longer, and thus nighttime blood pressure levels increase [6]. Furthermore, the restorative process in the human body happens during sleep. Consequently, short sleep duration can increase the risk of developing both biological and behavioral chronic diseases.

Shorter sleep duration is commonly caused by lifestyle factors, including stress level and dietary intake [6–8]. A high level of stress is a major predictor of short sleep duration. It was found that acute stress decreases slow-wave sleep and rapid eye movement (REM) [7]. Dietary intake, focusing on specific dietary components, has been shown to have an effect on sleep duration, quality and behaviors [6]. In fact, high carbohydrate, high fat, low protein and low fiber intake are all associated with short sleep duration [6, 8].

West Java was the fourth province with the most cases of hypertension in Indonesia. There was a 29.4% prevalence of hypertension, higher than the national prevalence of 25.8% [9]. In Bogor specifically, there is a 29.3% prevalence of hypertension, similar to West Java [10]. Tegal Gundil Health Center is one of the main health centers in Bogor. Hypertension was the most common chronic disease managed there, with 3,409 cases in 2017. As short sleep duration was commonly found in hypertensive patients, it was interesting to see the relationship between sleep and other factors, particularly in Bogor, because it has not been widely studied yet. Therefore, this study aimed to find the relation between stress, dietary intake and other selected factors with sleep duration in patients with hypertension.

Materials and methods

A cross-sectional design was applied to this quantitative study, which was conducted from July to September 2017. The study included 98 hypertensive patients who satisfied the inclusion criteria as follows: diagnosed with hypertension by health personnel, 25–64 years of age and received regular treatments from Tegal Gundil Health Center, which is located in the northern district of Bogor city, Indonesia, for at least six months prior to data collection. The data was collected through performing anthropometric measurements and interviewing subjects using a set of questionnaires at Tegal Gundil Health Center by trained undergraduate students of nutritional studies.

The studied variables were sleep duration, macro-nutrient and fiber intake, coffee consumption, nutritional status, physi-



cal activity, stress level, smoking habit and existence of a roommate. Sleep duration was defined as the length of usual sleep time obtained by calculating the difference between sleep and wake time. Intake of macro-nutrient, fiber and coffee were obtained through an interview using the Semi-quantitative Food Frequency Questionnaire (SFFQ), which was then compared to the Indonesian RDA and categorized as “inadequate”, “adequate” or “excessive”. Protein, fat, carbohydrate and fiber intake was measured in grams per day, energy in calories per day and coffee consumption in cups per day. Anthropometric measurement was used to obtain Body Mass Index (BMI), and height and weight was measured using microtoise and Tanita Weight Scale BC541, respectively. BMI was categorized into “Obese ($\geq 27 \text{ kg/m}^2$)” and “Not obese ($< 27 \text{ kg/m}^2$)”, referring to guidelines from the Indonesia Health Ministry of BMI Categorizations for Indonesian Adult. Physical activity was measured using the Global Physical Activity Questionnaire (GPAQ). Stress level was measured using the Perceived Stress Scale (PSS) by considering hard life conditions, such as uncontrolled or unpredictable situations. The roommate variable was distinguished by whether they had a roommate/bedmate or not using a question listed in the Pittsburgh Sleep Quality Index (PSQI). Data concerning smoking was collected through an interview and was subsequently categorized as “currently smoking” or “currently not smoking”.

Univariate and bivariate data analysis was performed. The hypothesis of whether there is a correlation between dietary intake and stress with sleep duration in hypertensive patients was checked using the Pearson's correlation and chi-square test; $p < 0.05$ was considered to be significant for all tests.

Ethical considerations

Ethical approval number No. 2/3/UN2.F10/PPM.00.02/2017 was obtained from the Ethics Commission for Research and Public Health Services, Faculty of Public Health, Universitas Indonesia. The participants were also informed about the study and provided both verbal and written consent before the data collection process began.

Results

Among 98 hypertensive patients (12 males, 96 females) aged 25 years and above who participated in this study, as much as 12.2% and 87.8% were categorized to have hypertension grade 1 and 2, respectively. Of all subjects, 45.4% were diagnosed with hypertension for more than 24 months. The subjects' average sleep duration was 6.39 hours, with 54% of subjects having a sleep duration shorter than the recommendation (7 hours). The participants' average BMI was $27.17 \pm 4.82 \text{ kg/m}^2$; as much as 51% and 30% of the subjects were obese and overweight, respectively. Table 1 presents the distribution of variables in numerical data.

Variables	Mean \pm SD	Median	Min	Max
Age	51.70 \pm 8.84	52.50	26.00	65.00
BMI (kg/m^2)	27.17 \pm 4.82	27.27	18.50	40.00
Stress	18.32 \pm 6.77	17.00	8.00	40.00
Sleep duration (hours)	6.38 \pm 1.39	6.50	2.00	9.25
Energy intake (kcal)	1514.82 \pm 564.21	1479.45	451.40	3128.20
Protein intake (g)	53.91 \pm 27.50	47.05	8.90	138.90
Fat intake (g)	54.48 \pm 27.80	47.80	13.00	142.70
Carbohydrate intake (g)	202.50 \pm 77.09	190.55	56.30	421.90
Fiber intake (g)	10.00 \pm 4.12	9.61	1.30	24.41

We found that most of our respondents had a low education background (71%) and were unemployed (81%). After comparing patients' nutritional intake with the Indonesian RDA, this study discovered that a majority of patients had adequate energy (52%), inadequate protein (64.29%), adequate carbohydrate (54%) and inadequate fiber (54%) intake.

Statistical analysis showed a significant positive correlation between stress with sleep duration ($p = 0.020$; $r = 0.235$) (Table 2). A similar correlation was also found between protein intake and sleep duration in hypertensive patients ($p = 0.041$; $r = 0.266$). We also found a significant difference in sleep duration between subjects who had a roommate and those who slept alone ($p = 0.023$; OR = 4.45 (1.32–15.01)). Subjects with roommates were 4.46 (CI 95% = 1.32–15.01) times more likely to have insufficient sleep duration than subjects who slept alone.

Table 2. Correlation between dietary intake and stress with sleep duration in hypertensive patients

Variable	Sleep duration	
	p	r
Energy intake	0.272	0.112
Protein intake	0.041*	0.266
Fat intake	0.256	0.116
Carbohydrate intake	0.411	0.084
Fiber intake	0.935	0.008
Coffee consumption	0.523	0.067
Stress	0.020*	0.235

*Notes: $p < 0.05$ (Pearson's correlation test), $r =$ Pearson's coefficient.

Table 3. Differences between sleep duration based on the characteristics of hypertensive patients

Variable	Category	Sleep duration		p	OR (95% CI)
		Deficient	Sufficient		
		n (%)	n (%)		
Sex	Male	8 (66.7)	4 (33.3)	0.532	1.822 (0.510–6.506)
	Female	45 (52.3)	41 (47.7)		
Physical activity	Active ($\geq 600 \text{ METs/week}$)	37 (58.7)	26 (41.3)	0.304	1.690 (0.735–3.887)
	Inactive ($< 600 \text{ METs/week}$)	16 (45.7)	19 (54.3)		
BMI	Obese ($\geq 27 \text{ kg/m}^2$)	16 (31.4)	35 (68.6)	0.367	1.691 (0.677–4.224)
	Not obese ($< 27 \text{ kg/m}^2$)	10 (21.3)	37 (78.7)		
Roommate	Have roommate	49 (59.8)	33 (40.2)	0.023*	4.455 (1.322–15.007)
	Sleep alone	4 (25.0)	12 (75.0)		
Smoking	Currently smoking	9 (31.0)	20 (69.0)	0.686	1.376 (0.528–3.590)
	Currently not smoking	17 (24.6)	52 (75.4)		

Table 3. Differences between sleep duration based on the characteristics of hypertensive patients

Variable	Category	Sleep duration		p	OR (95% CI)
		Deficient	Sufficient		
		n (%)	n (%)		
Protein intake	Inadequate	32 (50.8)	31 (49.2)	0.506	0.688 (0.298–1.590)
	Adequate	21 (60.0)	14 (40.0)		
Fat intake	Excessive	9 (18.4)	40 (81.6)	0.109	0.424 (0.167–1.076)
	Adequate	17 (34.7)	32 (65.3)		
Carbohydrate intake	Excessive	10 (22.2)	35 (77.8)	0.509	0.661 (0.265–1.650)
	Adequate	16 (30.2)	37 (69.8)		
Energy intake	Excessive	9 (19.1)	38 (80.9)	0.174	0.474 (0.187–1.202)
	Adequate	17 (33.3)	34 (66.7)		
Fiber intake	Inadequate	27 (50.9)	26 (49.1)	0.636	0.759 (0.341–1.689)
	Adequate	26 (57.8)	19 (42.2)		

Discussion

It is important for hypertensive patients to have adequate sleep duration to support the hypertension treatment and prevent further increase in blood pressure [3, 5, 11, 12]. However, in this study, we found that hypertensive patients had shorter sleep duration when compared to the non-hypertensive population. We also found a positive correlation between stress and sleep duration, this is possibly related to the participants' stress management [13]. It is also found that having inadequate protein intake – possibly tryptophan – and a roommate can reduce sleep time [14].

In this study, the average sleep duration of hypertensive patients was 6.39 hours. This is quite similar to the average of sleep duration of hypertensive patients in another study (6.3 hours) [2]. However, these results were lower than the average sleep duration (6.8–6.9 hours) of the general population, as obtained from different studies [3, 11]. In addition, it did not meet the recommendation sleep time of 7–9 hours for adults [12]. These studies revealed that the sleep duration of hypertensive patients was lower than that of the general population. This result is consistent with the theory that hypertension plays a role in reducing sleep [5]. A decrease in blood circulation in the brain, in areas that are normally active, occurs in hypertensive patients. This can produce cognitive and behavioral changes, such as sleep deprivation and disorders [1]. This can be dangerous for hypertensive patients, because sleep deprivation could, in turn, increase blood pressure [5, 15].

In this particular study, a positive correlation was found between stress and sleep duration. Different results were found in another study, which indicated that subjects with higher stress were more likely to have a short sleep duration [16]. However, a similar result was also found in another study, which showed that subjects with depressive symptoms slept 25 minutes longer than subjects with no depressive symptoms [17]. This was possibly related to stress management. A person's response to stress consists of three stages: alarm, resistance and fatigue. In the alarm stage, a fight or flight response occurs while increasing the energy expenditure needed to either defend one's self or run away. In the resistance stage, responses were increased further by ensuring that the body will spread the initial stress response activated by the HPA (hypothalamus-pituitary-adrenal) axis. Finally, in the fatigue stage, the body is no longer able to maintain these responses while experiencing energy loss [13]. There is a possibility that the subjects in this study had emotional fatigue, either related to solving or avoiding their problems.

Additionally, our study confirmed that the proportion of stress among hypertensive patients who were not physically active was higher than those who were active. The systematic physical activity performed by patients with treatment-resistant arterial hypertension reduces anxiety, symptoms of depression and pain intensity [18].

Gender was also a contributing factor in stress management. Men were more likely to solve problems, while women

were more likely to avoid problems [16]. The subjects in this study were mostly females, with a higher average stress score (18.6) than males (16.17). Thus, there was a possibility that the female subjects preferred to avoid problems through sleeping.

Among hypertensive patients who had 'deficient' sleep duration, the proportion of those with roommates was higher than those who slept alone. This was in contrast to another study, which indicated longer sleep duration in adults with roommates than in adults who slept alone. However, the quality of the relationship was very crucial in this. A bad relationship and communication could decrease sleep duration, affect physical and mental health and influence the household [19]. Furthermore, roommates could also cause noise (such as snoring or from using electronic devices), which was the biggest source of sleep disturbance [20]. Potentially, disturbances from roommates could disrupt the subjects' sleep.

A bidirectional relationship between sleep duration and dietary intake currently exists [21]. A correlation between protein intake and sleep duration was found in this study and is in keeping with several other studies in which subjects who had 'deficient' sleep duration also had lower protein intake [6, 8]. A positive correlation between protein intake and sleep duration might be caused by foods that are rich with tryptophan, such as egg whites, seafood and soybean by-products [14]. Such products were often consumed by subjects in this study. Tryptophan, an essential amino acid commonly found in protein-rich foods, directly correlates with sleep, given its abilities to increase drowsiness and sleep time. Moreover, tryptophan is a serotonin precursor, which is also associated with sleep duration. Because serotonin is a precursor in melatonin production, one of the most effective ways for serotonin to affect sleep is through changes in melatonin levels [22]. Therefore, a low protein intake was associated with short sleep duration.

It would be necessary to perform a larger-scale study to compare the results. Further studies using more types of studies other than cross-sectional could be carried out to supplement the results in order to show the cause and effect.

Conclusions

A low protein intake, high stress levels and the presence of a roommate were found as the risk factors of short sleep duration in hypertensive patients. This result indicates the importance of promoting longer sleep duration as a secondary and tertiary measure for patients with hypertension through encouraging patients to increase protein consumption and manage stress in order to prevent the incidence of hypertension comorbidity.

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