The Correlation between Work Stress and Hypertension among Industrial Workers: A Cross-sectional Study

A D Rengganis¹*, A B Rakhimullah²,3 and H Garna⁴,5

¹ Faculty of Medicine, Universitas Islam Bandung, Bandung, Indonesia.
² Faculty of Medicine, Universitas Padjadjaran, Bandung, Indonesia.
³ Post Graduate Program, Universitas Islam Bandung, Bandung, Indonesia.
⁴ Pediatric Department, Universitas Islam Bandung, Bandung, Indonesia.
⁵ Pediatric Department, Universitas Padjadjaran, Bandung, Indonesia

*Corresponding author: anggirengganis52@gmail.com

Abstract. Hypertension is the most prevalent non-communicable disease in Indonesia. Stress is one of the modifiable risk factors of hypertension. Work stress is a complaint or disorder of physical, psychological, or social conditions, related to work and can be experienced by workers. This study was aimed to investigate the correlation between work stress and hypertension among industrial workers. A cross-sectional study in 100 male workers in the production department of a manufacturing industry in Bekasi, Indonesia, was conducted. The measurement of work stress was obtained by Work Stress Questionnaire (WSQ) and categorized as workers with work stress and without work stress. Hypertension was defined according to 2018 ESC/ESH Guidelines for the management of arterial hypertension. The relationship of variables was analyzed by chi-square test and stated as prevalence ratio (PR). The confounder of age was adjusted using logistic regression. The prevalence of hypertension was significantly higher in workers with work stress, PR = 5.58, 95% CI 1.54–20.23 (p=0.005). Adjusted PR after adjusting for age was 6.27, 95% CI 1.71–23.06 (p=0.006). In conclusion, there is a significant correlation between work stress and hypertension among industrial workers.

1. Introduction
Non-communicable diseases (NCDs) have become a health burden in developing countries, such as Indonesia. Hypertension is a preventable disease and is associated with several factors such as an unhealthy lifestyle, including smoking, sedentary lifestyle, and consumption of alcohol [1]. Hypertension has also become a health problem in developing countries including Southeast Asian countries. Several study reports show an increasing hypertension prevalence in developing countries. Urbanization, population aging, shifting of dietary habits, and psychosocial stress may have associated with the increasing hypertension prevalence in developing countries [2,3]. Interestingly, the implication of social or physiological stress in several domains, including hypertension, are being investigated, including work-related stress, person-to-person relationship stress, and low socioeconomic status [4,5].

Work stress is considered a serious occupational health problem, and, to date, it has been the subject of a large number of studies. Work stress is the physical and emotional response that occurs as the implication of imbalance between job demands and the ability, resources, or needs of the worker [6]. Work stress is considered as one of the frequent factors in the occurrence of hypertension [7].
Indonesia, the industrial sector is the sector that currently contributes most to Indonesia's annual gross domestic product (GDP) growth. The two most important sub-sectors of industry are mining and manufacturing, both being major pillars of the nation's economy since the 1970s. Hence, in the manufacturing sector alone, Indonesia absorbed 16.3 million workers in 2017. Thus, industrial workers are an important population to be concerned in health prevention, including hypertension prevention. To date, research on hypertension and its related factors, especially work stress in industrial workers, is limited.

This study was aimed to investigate the correlation between work stress and hypertension among industrial workers in Indonesia.

2. Methods
This study has been approved by the Ethics Committee of Health Research, Faculty of Medicine, Universitas Islam Bandung, Number: 156/Ethics Committee.FK/III/2018. This study was quantitative-analytical observational cross-sectional. The study was conducted at one of the manufacturing industries in Cikarang, Bekasi, West Java, in November 2018. The sample was selected using a simple random sampling method with the number calculated according to the sample needs for unpaired categorical comparative analysis, which is 98 people. The subjects of this study were workers from the production division who met the inclusion criteria and were not included in the exclusion criteria. The inclusion criteria for this study were all workers who had actively worked at least three months in the company, while the exclusion criteria were subjects who smoked and consumed alcohol as well as subjects having a history of diabetes mellitus, heart disease, and kidney disease. These diseases were validated according to the employee physical health data in the Industrial Health Unit.

The study began with an explanation and informed consent of the study subjects. Then, subjects who agreed and fulfilled the inclusion criteria as well as were not included in the exclusion were asked to fill out a set of questionnaires to assess work stress experienced and then carried out an examination of blood pressure. To all of the subjects, work stress assessment was conducted using the Work Stress Questionnaire (WSQ) made by the American Institute of Preventive Medicine [8]. The questionnaire was in English and translation was done in Indonesian and validation tests were conducted on the questionnaire. Cronbach’s alpha was 0.934. The questionnaire has a minimum score range of 55 to a maximum score of 275. The questionnaire results of each respondent were then categorized as stressful and not stressful. Based on the questionnaire it was concluded that an employee was under stressful conditions due to work or work stress if the score on filling out the questionnaire was more than 135 from a maximum score of 275.

The same mercury sphygmomanometer with an adult cuff size of 12.5cm and a stethoscope (Classic III Littmann® USA) were used to measure the blood pressure of each subject. The right arm of the subjects was used, meanwhile the subject was in the sitting position after five minutes of activity-free. The cuff was positioned at the level of the heart, snugly around the bare arm with the lower edge at least 1 inch above the ante-cubital fossa. During the measurement, to avoid muscle contraction and isometric exercise-dependent increases in BP, the back and arm were leant. The cuff was inflated to approximately 30mmHg above the level at the time of the radial pulse when it was not palpable. Then, by using a stethoscope placed on the brachial artery in the ante-cubital fossa, simultaneously the cuff was deflated slowly. During auscultation, phase I and V Korotkoff sounds were identified as systolic BP and diastolic BP, respectively. Three BP measurements in each subject were recorded, 1–2 min apart. An additional measurement was conducted only if the first two readings differed by more than 10mmHg. BP was stated from the average of the last two BP measurements. A systolic blood pressure of ≥ 140mmHg and/or a diastolic blood pressure of ≥ 90mmHg were considered as hypertension [9].

All statistics were analyzed by SPSS 22.0 software. Results were presented as the mean ± standard deviation (mean ± SD) and median with minimum and maximum value (median, min-max) for each numerical data. Data were presented as a fraction for each categorical data. Mann-Whitney U test was used to compare the blood pressures in industrial workers with vs. without stress. To analyze the
relationship between work stress and the prevalence of hypertension, the chi-square test was used. The confounder of age was adjusted using logistic regression. A p-value < 0.05 was set as the level of statistical significance.

3. Results

Data retrieval was carried out with a sample of 100 workers from a minimum sample size of 98 people. All samples obtained were men with a median of 41 years. The majority of workers are 41–50 years old. The youngest age is 21 years and the oldest age of all samples is 52 years.

Table 1. The frequency of hypertension in each age-group.

| Age-group (years old) | Hypertension | No hypertension | p-value* |
|-----------------------|--------------|-----------------|----------|
| 21–30                 | 3            | 16              | 0.001    |
| 31-40                 | 2            | 28              |          |
| 41-50                 | 21           | 25              |          |
| >50                   | 1            | 4               |          |
| Total                 | 27           | 73              | 100      |

*Chi-square test

Table 2. The frequency of work stress in each age-group.

| Age-group (years old) | With work stress | Without work stress | p-value* |
|-----------------------|------------------|---------------------|----------|
| 21–30                 | 15               | 4                   | 0.101    |
| 31-40                 | 20               | 10                  |          |
| 41-50                 | 31               | 15                  |          |
| >50                   | 1                | 4                   |          |
| Total                 | 67               | 33                  | 100      |

*Chi-square test

The frequency of hypertension was 27/100. Table 1 shows the occurrence of hypertension in each age-group. Meanwhile, the frequency of work stress was 67/100, and the frequency according to age-group is as shown in Table 2. The correlation between work stress and hypertension was recorded in Table 3. The prevalence of hypertension was significantly higher in workers with work stress, PR = 5.58, 95% CI 1.54–20.23 (p=0.005). Adjusted PR after adjusting for age was 6.27, 95% CI 1.71–23.06 (p=0.006).

Table 3. The correlation of work stress and hypertension.

| Work Stress | Hypertension | No Hypertension | p-value* |
|-------------|--------------|-----------------|----------|
| Yes         | 24           | 43              | 0.005    |
| No          | 3            | 30              |          |
| Total       | 27           | 73              | 100      |

*Chi-square test

Table 4. Blood pressures comparison among work stress status.

| Work Stress | Work Stress | Without Work Stress | p-value* |
|-------------|-------------|---------------------|----------|
| Systolic    | Mean ± SD   | 127.16 ± 13.17      | 112.12 ± 13.46 | <0.001 |
| Median (Min-Max) | 130.00 (100.00-150.00) | 110.00 (100-150) |          |
In addition, the systolic and diastolic blood pressure was compared among groups according to work stress status. There was a significant difference in blood pressure between industrial workers with work stress and without work stress (p<0.001).

4. Discussion

In our study, hypertension occurs in a part of industrial workers and predominates in 41–50 group of age. Shittu et al. revealed a study finding in industrial workers that only a quarter of total workers had normal blood pressure, 26.9% were in the pre-hypertensive stage, 20.3% were in stage 1 while 77.4% were in stage 2 [10]. Those results marked a difference to our result. A meta-analysis conducted by Bosu reported hypertension among workers was 11-68% in the range [11]. Based on the grouping of age, workers aged 45–54 dominated the distribution of hypertension among industrial workers, which is similar to our study.

Frequency of workers with work stress burden was obtained in a recent study. Based on the results of this study, work stress is experienced by the majority of the subjects. A study conducted by Rao and Ramesh reported that stress in the industrial workers population was 18% [12], while, in a study by Lotfizadeh et al., the frequency of work stress in the manufacturing industry in the population of workers with a total sample of workers was 53% with all samples male and having an average age of 37 years [13]. This number does not differ significantly from the incidence of work stress in this study, which is 67% with a maximum age of 41-50 years. The results of our study are similar to the study of Lotfizadeh et al., which states that work stress occurs in manufacturing industrial workers [13].

In our recent study, the frequency of hypertension in industrial workers with work stress was higher than in workers without stress. Gamage et al. conducted an investigation about the correlation between work stress and hypertension among workers [14]. In that study, the sum of scores of efforts, rewards, and over-commitment and the effort-reward ratio was used to measure the job stress. Meanwhile, blood pressure was measured and classified according to JNC-7 standard. The study showed effort-reward imbalance and high efforts increased the risk of hypertension by 2- to 3-fold. On the other hand, Hanson et al. via a cross-sectional study to French workers, concluded that there was no association between work stress and hypertension [15].

Psychosocial stress, including work-related stress, promotes transient elevation in blood pressure, in reflection to short-term alteration in the autonomic nervous system. As responses to the stressor, there is a cascade of alterations in the nervous, cardiovascular, endocrine, and even the renal systems, as the impact of the perception of acute stress. These changes are part of the stress response by the body. Hence, it indicates acute stress-induced systemic responses are short-lived and re-established immediately after the stress is relieved. However, acute stress response can shift to the maladaptive state if the stressor is sustained. Prolonged stimulation of the autonomic nervous system to the cardiovascular system can lead to persistent increased blood pressure. Furthermore, vascular dysfunction might occur. Some behavior responses are associated with stress. The stress subject might use behavior defense mechanisms, including overeating, alcohol consumption, and poor sleep, may aggravate the physiological, and shift to the pathological response to prolonged/chronic stress [7,16,17].

As a limitation in our study, we did not account some confounders, such as dietary habits, sleep behavior, and hereditary factors. However, we have controlled the confounder of smoking and alcohol consumption as well as a cardio-reno-metabolic disease by design in the exclusion criteria.

5. Conclusion
In conclusion, there is a significant correlation between work stress and hypertension among industrial workers. Future research should be conducted with the consideration of specific measurement of exposure and other outcomes of stress. The subject’s perception of hypertension may be influenced by the quality of life, including stress, and also should be accounted.

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