

## ORIGINAL ARTICLE

# The Association between Night Shift Work and Hypertension Among Workers at A Construction Company in Jakarta

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## ABSTRACT

**Introduction:** Night shift work, which can cause circadian misalignment, may be associated with increased blood pressure. The purpose of this research was to find out the prevalence of hypertension and the associated factors of hypertension among night shift and day shift workers at a construction company in Jakarta. **Methods:** The data used in this study was taken from records of general medical checkup which was held in August 2019. Data of 107 male workers (28 day shift workers, 79 night shift workers) were gathered. **Results:** The prevalence of hypertension in night shift workers (59.5%) was higher compared to that in the day shift workers (17.9%). Systolic blood pressures (SBPs) of the night shift workers (mean SBP = 137.58; SD = 15.05; CI 95% = 134.58-141.32) were significantly higher compared to day shift workers' (mean SBP = 122.14, SD = 13.24; CI 95% = 117.01-127.07). Diastolic blood pressures (DBPs) of night shift workers (mean DBP = 84.90; SD = 10.59; CI 95% = 82.53-87.27) were also significantly higher than day shift workers' (mean DBP = 76.54; SD = 10.85; CI 95% = 72.33-80.74). According to multiple logistic regression analysis, workers with night shifts (OR = 7.47; CI 95% = 2.48-22.51) and overweight (OR = 2.73; CI 95% = 1.04-7.18) were significantly associated with hypertension compared to day shift workers and normal weight workers, respectively, after adjusted by other covariates. **Conclusion:** Night shift workers faced higher risk of hypertension compared to day shift workers, particularly for those who were overweight.

**Keywords:** Diastolic blood pressure, Hypertension, Night shift workers, Overweight, Systolic blood pressure

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## INTRODUCTION

Hypertension is a high blood pressure which is indicated when the measurement reaches 140/90 mmHg and above. Mostly, it does not show any sign which makes many people fail to realize its presence (1). Based on Riset Kesehatan Dasar 2018 (The 2018 Basic Health Research), the prevalence of hypertension in Indonesia was 34.1%. This number was kept on increasing compared to the prevalence of hypertension in 2007 and 2013 (2). Uncontrolled hypertension for a long period may cause cardiovascular diseases (3). Cardiovascular diseases are considered as top causes of mortality in the world (4). In 2015, there were about 2.4 millions of death cases due to work-related diseases in which cardiovascular diseases placed as the top cause (33%) (5). Hypertension is considered as one of the main factors which may increase the risk of death in cardiovascular diseases (6). Hypertension, along with diabetes mellitus, dyslipidemia and physical inactivity, is still a major risk factor for cardiovascular diseases. Treatment of these conditions is cost-effective as they

affect productive section of the population (7–11). Risk factors for developing hypertension which cannot be controlled include race, family background, and age. Risk factors for developing hypertension which can be controlled include diet, smoking, alcohol intake, sedentary lifestyle, sleep disorder, overweight or obese, stress, and diabetes (1,12). Besides, recent study showed that night shift work caused elevation of blood pressure (13).

Shift work is management of working hours that allows the job to be done in a longer period, or even continuously, by succeeding the job from one worker to another (14). This working system is adopted by certain industries in order to enhance their productivities and/or because their operational requirements need the establishment of shift work system (15,16). Shift work system can be divided into two categories, namely fixed shift system and rotating shift system. Fixed shift system makes workers work in the same working hours, while the rotating one allows workers to work in different working hours every certain period of time (16). Shift works are usually done in the mining sectors, manufacturing sectors, wholesale and retail trades, accommodations and food services, transportations, postal and warehousing, communications, and construction sectors (17–19). In

2009, Australia had 8.6 million employees, 16% of which worked under shift work system (19). While in the UK, 14% of total employees were shift workers (20). Under the rotating shift work, the workers may have turn to work at night. This night shift work changes the workers' sleep pattern and causes disruption of human biological clock system, called circadian rhythms, which may interfere the workers' health (21).

Circadian rhythms are endogenously generated rhythms which have 24-h period cycle. They persist if surrounding conditions such as temperature, light, and posture are kept unchanged. They are produced by a pacemaker in the suprachiasmatic nuclei (SCN) of hypothalamus. Circadian rhythms regulate hormones and metabolism in human body, e.g. cortisol secretion, temperature regulation of core body, and stimulating hormone of melatonin and thyroid (22). Any disruption of circadian rhythms will affect the body pathologically (23,24). Melatonin is hormone of pineal gland which is connected with the timing system of circadian and controlled by SCN. In normal condition, melatonin will rise at night (dark phase), peak at early morning, and decline back to baseline level in the morning (22). A study by Anjum et al. found that during night shift, melatonin level declined at night and in the morning hours. Artificial light exposure received by the night shift workers inhibited melatonin production and potentially caused health problems (23,25). Inhibition of melatonin is related to sleep disorders, elevated risk of cancer, metabolic and cardiovascular disorders, neurogenerative disorders, mental disorders, reproductive function disorders, and traumatic central nervous system injury (25).

Previous study also showed that working at the night shift had risk of decrease in work performance, obese, injury, and the development of various chronic diseases (26). Laboratory study by Morris CJ showed that short-term circadian misalignment elevated blood pressure and inflammatory markers on the healthy adults (27). While study by Souza et al on the shift workers showed that lifetime shift work was negatively associated with cardiac regulation component and positively associated with blood pressure component. Moreover, some studies also showed that workers who worked with night shift had increased risk of developing cardiovascular diseases (13,28).

Recently, Indonesia has been putting infrastructure development as one of its priorities. Thus, there were numerous road construction projects (29). Construction industries, which were also involved in those projects, were considered one of the main sectors that employed night shift workers (18). While many studies had investigated about the bad effects of night shift for workers' health (21,30–34), the study regarding the prevalence of hypertension and factors associated with it at the night shift workers were still a few. This study

aims to find out the prevalence of hypertension and other related factors contributing to it at night shift workers in a construction company in Jakarta.

## MATERIALS AND METHODS

This cross-sectional study was done in a private construction company in Jakarta, Indonesia. The data in this study was taken from the medical check-up records of 107 male workers. The medical check-up was done by the company in August 2019. Access to the data of the medical check-up results was granted by the company to enable data collection. This study had low risk to the workers since it only used medical records of workers and the anonymity of the data used in this study was strictly kept. Ethical approval for this study was obtained from The Research and Community Engagement Ethical Committee, Faculty of Public Health Universitas Indonesia (572/UN2.F10.D11/PPM.00.02/2020). The total workers examined were 134 workers, and 27 of them were female workers (excluded from the study). Total sampling was used in this study. There were 107 male workers in the company. All of them were taken as samples. Among 107 workers, 26.17% of them are fixed day shift workers, and the rest of them are rotational night shift workers.

Rotational shift work system in this company was 12-hours-shift work with 6 workdays and one day rest before the shift is rotated. This work system is applied to all construction workers at project and production sites during the project period which may last up to 6 months. Supporting data regarding personal details, job characteristics (night shift workers or day shift workers) and other information needed in this study were also gathered through interview with the Manager of General Affair and Human Capital Department.

The workers were divided into night shift workers and day shift workers. The workers' age were counted in year and classified into less than or equal to 35-years-old and more than 35-years-old for multivariate analysis. Workers' years of work were counted by adding the years of work in the current company and experiences of work at the same position in the prior company. For multivariate analysis, workers' years of work were classified into less than or equal to 20 years and more than 20 years. Body mass index (kg/m<sup>2</sup>) was counted by dividing worker's weight with the square of worker's height. It was then classified using the guidance of BMI measurement in adults issued by Health Ministry of Indonesia. Workers with BMI > 25 kg/m<sup>2</sup> were classified as overweight workers (35).

The blood pressure measurement was done during the general medical check-up in August 2019. The measurement was performed using digital sphygmomanometers (Polygreen KP 7550, standard complies with ANSI/AAMI) at daytime. The workers

wore short sleeves, therefore no clothing covered the arms. The worker was asked to sit, put his left arm on the table (around the same level with the worker's heart), and then the cuff was placed on the left arm, around 2-3 cm (approximately 2 fingers-breadth) above the elbow. Horizontal position of the cuff was adjusted according the mark on the cuff, so the tube placed at the center of the arm faced the front. The cuff was tightened and wrapped by attaching the Velcro (36). The measurement was taken twice with rest period about 2 minutes between the first and the second measurement. The mean of the measurement results (SBP and DBP) was recorded on the medical check-up record of each worker. The classification of hypertension was made based on JNC-8 guidelines so that the result of blood pressure measurement falls into four classes, namely normal tension, prehypertension (pre-HT), stage 1 hypertension (HT 1), and stage 2 hypertension (HT 2). Hypertension was defined as those workers with SBP  $\geq$  140 mmHg and/or DBP  $\geq$  90 mmHg. Those who were taking antihypertensive drugs were also considered as having hypertension (1).

Adequate exercise was classified as having a minimum three times of exercising in a week (37). Smoking status was classified as active smokers for those who had smoking every day and not smoking for past smokers or those who never smoke (28). Daily caffeine intake was classified depending on any caffeine-contained drinks consumed by workers every day. Statistical analysis was done using SPSS version 25, while multivariate analysis was done using multiple logistic regression.

## RESULTS

107 medical records of male workers were involved in this study. According to the medical records, no workers were taking any antihypertensive drugs. Workers' characteristics were described in Table I and Table II. The mean age of day shift workers was 39.75-years-old (SD = 11.27; CI 95% = 35.38-44.12), while the mean age of night shift workers was 40.96-years-old (SD = 12.62; CI 95% = 38.14-43.79). The mean years of work in day shift workers was 15.30 years (SD = 8.59; CI 95% = 11.97-18.63), while the mean years of work in night shift workers was 16.44 years (SD = 10.50; CI 95% = 14.09-18.79). SBPs of night shift workers (mean SBP = 137.58; SD = 15.05; CI 95% = 134.58-141.32) were significantly higher than day shift workers' (mean SBP = 122.14, SD = 13.24; CI 95% = 117.01-127.07). DBPs of night shift workers (mean DBP = 84.90; SD = 10.59; CI 95% = 82.53-87.27) were also significantly higher than day shift workers' (mean DBP = 76.54; SD = 10.85; CI 95% = 72.33-80.74). In Table II, based on BMI calculation, overweight in day and night shift workers were 28.6 % and 27.8%, respectively. Alcohol consumptions in day and night shift workers were 7.1 % and 6.3 %, respectively. Active smokers in day and night shift workers were 71.4% and 78.5 %,

**Table I: Workers' Characteristics of Age, Years of Work, SBP and DBP**

Variables	Day Shift Workers (n=28 workers)		Night Shift Workers (n=79 workers)	
	Mean ( $\pm$ SD)	CI 95%	Mean ( $\pm$ SD)	CI 95%
Age	39.75 ( $\pm$ 11.27) years old	35.38- 44.12 years old	40.96 ( $\pm$ 12.62) years old	38.14-43.79 years old
Years of Work	15.30 ( $\pm$ 8.59) years	11.97- 18.63 years	16.44 ( $\pm$ 10.50) years	14.09-18.79 years
SBP*	122.14 ( $\pm$ 13.24) mmHg	117.01- 127.07 mmHg	137.58 ( $\pm$ 15.05) mmHg	134.58- 141.32 mmHg
DBP**	76.54 ( $\pm$ 10.85) mmHg	72.33- 80.74 mmHg	84.90 ( $\pm$ 10.59) mmHg	82.53-87.27 mmHg

\*systolic blood pressure; \*\* diastolic blood pressure

**Table II: Workers' Characteristics of BMI, Alcohol, Smoking, Caffeine, Exercise and Hypertension**

Variables	Day Shift Workers (n=28 workers)	Night Shift Workers (n=79 workers)
	Frequency (%)	Frequency (%)
<b>BMI</b>		
Overweight	8 (28.6)	22 (27.8)
Not overweight	20 (71.4)	57 (72.2)
<b>Alcohol</b>		
Regular Consumption	2 (7.1)	5 (6.3)
No	26 (92.9)	74 (93.7)
<b>Smoking</b>		
Active Smokers	20 (71.4)	62 (78.5)
Not Smoking	8 (28.6)	17 (21.5)
<b>Daily Caffeine Intake</b>		
Yes	26 (92.9)	74 (93.7)
No	2 (7.1)	5 (6.3)
<b>Adequate Exercise</b>		
Yes	3 (10.7)	1 (1.3)
No	25 (89.3)	78 (98.7)
<b>Hypertension</b>		
	5 (17.9)	47 (59.5)

respectively. Daily caffeine intakes in day and night shift workers were 92.9% and 93.7%, respectively. Adequate exercises in day and night shift workers were 10.7 % and 1.3 %, respectively. The prevalence of hypertension in night shift workers (59.5%) was higher compared to day shift workers (17.9%).

In day shift workers, the proportion of normal tension, pre-HT, HT 1, and HT 2 were 45%, 40%, 10% and 5 %, respectively, as described in Table III. While in night shift workers, the proportion of normal tension, pre-HT, HT 1, and HT 2 were 11.8%, 29.4%, 41.2% and 17.6%, respectively.

Based on statistical analysis, age, SBP, and DBP were distributed normally, while years of work was not distributed normally. For multivariate analysis, SBPs and

**Table III: Prevalence of Hypertension (HT) According to JMC-8 Classification**

JNC 8 Classification	Day Shift Workers (n=28 workers)	Night Shift Workers (n=79 workers)
	Frequency (%)	Frequency (%)
Normal	9 (45)	6 (11.8)
Pre-HT*	8 (40)	15 (29.4)
HT 1**	2 (10)	21 (41.2)
HT 2***	1 (5)	9 (17.6)

\*prehypertension; \*\*stage 1 hypertension; \*\*\*stage 2 hypertension

DBPs were used to determine the status of hypertension. Workers' age were classified as ≤ 35-years-old or > 35-years-old. Workers' years of work were classified as ≤ 20 years or > 20 years.

Table IV shows the factors associated with hypertension using logistic regression analysis. In simple logistic

**Table IV. Factors Associated with Hypertension (n=107 workers)**

Variables	Simple Logistic Regression		Multiple Logistic Regression	
	OR (95% CI)	P-value	OR (95% CI)	P-value
<b>Night Shift Work</b>				
No	-	-	-	-
Yes	6.76 (2.33-19.63)	0.0001	7.47 (2.48-22.51)	<b>0.0001</b>
<b>Age group</b>				
≤ 35 years old	-	-	-	-
> 35 years old	1.82 (0.84-3.97)	0.131	1.31 (0.47-3.67)	0.603
<b>Years of work</b>				
≤ 20 years	-	-	-	-
> 20 years	2.59 (1.07-6.30)	0.036	2.22 (0.84-5.86)	0.108
<b>BMI</b>				
Not overweight	-	-	-	-
Overweight	2.30 (0.97-5.49)	0.060	2.73 (1.04-7.18)	<b>0.042</b>
<b>Alcohol</b>				
No	-	-	-	-
Regular Consumption	0.78 (0.17-3.67)	0.754	1.28 (0.22-7.39)	0.783
<b>Smoking</b>				
Not Smoking	-	-	-	-
Active Smokers	1.96 (0.78-4.94)	0.154	2.03 (0.71-5.83)	0.189
<b>Daily Caffeine Intake</b>				
No	-	-	-	-
Yes	0.36 (0.07-1.92)	0.228	0.23 (0.03-1.78)	0.159
<b>Adequate Exercise</b>				
Yes	-	-	-	-
No	1.93 (0.169-21.88)	0.598	0.577 (0.04-7.99)	0.682

regression analysis, night shift work (OR=6.76) and years of work > 20 years (OR=2.59) were significantly associated with the prevalence of hypertension. However, in multiple logistic regression analysis, night shift work (OR=7.47) and overweight (OR=2.73) showed significant associations with the prevalence of hypertension, after being adjusted with age, years of work, alcohol, smoking, daily caffeine intake, and adequate exercise. The Crude OR was counted using simple logistic regression analysis, while adjusted OR was calculated by multiple regression analysis.

## DISCUSSION

In this study, the prevalence of hypertension was compared between day shift workers who worked at office hours and night shift workers who worked with 12-hours-rotational shift (6 consecutive working days with one-day break before the shift's schedule rotated). The workers worked at a private construction company in Jakarta. In this study, the prevalence of hypertension in night shift workers was found to be significantly higher compared to that in day shift workers. Besides, it was also found that workers with overweight had significantly higher risk of hypertension.

Previous studies have found that workers who worked with night shift faced higher risk to develop cardiovascular diseases due to the disruption of circadian rhythm (13,28). This disruption was caused by the changes in sleep pattern that would be faced by those who worked at night (24). Night shift workers, exposed to artificial light at night that inhibit melatonin production, have their melatonin level declines at night and in the morning hours (23,25). Blood pressure may be reduced by the presence of melatonin hormone. Melatonin may act through some mechanisms, which are, through a hypothalamic direct effect, by causing the relaxation of aortic smooth muscle, by reducing catecholamine level, or by acting as an antioxidant which decreases blood pressure (38). The disruption in melatonin production may make blood pressure cannot be reduced and thus elevates abnormally. In this study, SBPs and DBPs of night shift workers were significantly higher compared to day shift workers. As a result, night shift workers had higher prevalence of hypertension.

In this study, workers with overweight had higher risk of hypertension. Overweight is seen as one of the intermediate factors of cardiovascular diseases in which its presence may elevate the incidence risk of heart attack, stroke, heart failure, and other complications (4). Obesity-related hypertension mechanisms possibly occur through the retention of sodium, elevated circulating renin-angiotensin, elevated activity of sympathetic nervous system, elevated adipose renin-angiotensin, corrupted function of vascular endothelial, or other vascular mechanisms. Those mechanisms influence the elevation of blood pressure in overweight

people (39).

This study was a cross sectional study. Therefore, although it controlled confounding variables, it could not establish causal relationship. Most workers in both groups (day shift workers and night shift workers) were active smokers which also consumed caffeine daily and did not have adequate exercise. Therefore, the actual associations among smoking, caffeine intake, and adequate exercise to hypertension may not correctly establish. Further study regarding preventive strategies to lower the risk of hypertension in night shift workers is needed.

## CONCLUSION

The prevalence of hypertension in night shift workers was higher than day shift workers. Multivariate analysis showed that night shift and overweight had significant influence on the prevalence of hypertension in the workers. Therefore, night shift workers possessed higher risk of hypertension compared to day shift workers, particularly for those who were overweight.

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