Analysis Of Work Climate And The Increase Of Blood Pressure Of Construction Workers In Pamekasan Regency

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Abstract

The excessive exposure of work climate can cause health problems to workers. One of the problems is a change in physiological response in the form of increased blood pressure. The purpose of this study is to determine the relationship between the work climate and the increase of blood pressure in construction workers in Pamekasan Regency. This study is a descriptive observational study with a cross sectional design. The contingency coefficient correlation test was used to analyze and determine the relationship of the variables. The subjects were 19 construction workers in Pamekasan Regency, East Java, Indonesia drawn from the population according to the specified criteria. To collect the data, several different instruments were used. *Questtemp 36* was used to measure the workclimate, direct observation with the standard of SNI 7269-2009 was carried out to assess the physical workload and sphygmomanometer was used to measure the blood pressure. The blood pressure measurement was carried out the someone with the medical competence. The result of work climate exposure showed that most of workers (84.3%) were exposed to beyond-threshold-value work climate. The results of blood pressure measurement showed that (36.8%) workers showed abnormal blood pressure. The statistical analysis for the correlation of work climate and the increase in blood pressure showed a moderate correlation with the contingency coefficient value of 0.314. It is recommended for companies in this construction project to add blower fan to the working areas where the work climate exceeds the threshold limit value (TLV) as well as at workers' resting places. In addition, companies are suggested to hold periodic health checks, especially routine blood pressure checks.

Keywords: *work climate, workload, blood pressure*

Introduction

Hot work climate is a physical factor, a micrometeorology of the work environment, which is related to air temperature, humidity, air movement speed, and radiation heat. The comfortable temperature for Indonesians to work is in the range of 24-26ºC with 35%-60% humidity. More than that range, workers will likely feel uncomfortable as the working environment being too hot. The continuous hot and humid working environment will reduce work productivity and bring a negative impact on the safety and health of workers[12].

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Workers who are in a hot working environment can experience excessive exposure to a hot work climate by means of heat that arises from the production process that spreads throughout the work environment. The heat increases the air temperature in the work environment. Hot work climate in the work environment can be emitted from the body to the surrounding environment by conduction, convection and sweat evaporation. The heat can also be transferred from the environment to the body through radiation and convection[9]. Responding the heat, the thermoregulatory system in the hypothalamus will respond by performing controls such as conduction, convection, radiation and evaporation. This is to regulate body temperature and maintain the body heat to 36–37ºC. However, the hot exposure that continuously ignored can cause the control system to stop working[7].

A hot work climate increases the workload and has a negative impact on the physiological response of

workers. Therefore, workers need to have good health condition and acclimatization to work in the workplace. The physiological reaction to the exposure to heat pressure can also be an indicator to identify the danger of physical factors, especially the presence of heat stress in the workplace environment[9]. One of physiological responses that caused by hot work climate is increases in blood pressure[2].

Based a study in Machine Division at PT. PLN (Persero) and found increase in blood pressure after exposure to a hot work climate. The measurement of blood pressure showed that the average of systolic and diastolic before exposure to heat was 116.33 mmHg and 79.00 mmHg and after the exposure to be 123.29 mmHg and 80.89 mmHg. These results showed an increase of 6.96 mmHg in systolic blood pressure and of 1.89 mmHg in diastolic blood pressure[6].

Based a research on the Confined Space Heater division in PT. Nippon Shokubai Indonesia. Her result showed that there was an increase in the average pulse and blood pressure with Wet Bulb Globe Temperature Index value of 34.9ºC. The results of physiological responses examination showed an increase before and after work. Blood pressure measurement showed that the average systolic and diastolic pressure before work was 124.85 mmHg and 72.05 mmHg, while the average systolic and diastolic after work was 126.05 mmHg and 72.45 mmHg. It then can be concluded that the pulse and blood pressure of workers increase as they work in high temperatures workplace[14].

Furthermore, if heat exposure continuous and the physiological impact is not immediately addressed, health risk will increase due to the hot workplace. There are several occupational illnesses caused by hot exposure in the workplace, such as Heat Edema, Heat Cramps, Heat Exhaustion, Heat Syncope, Heat Stroke[3]. Data from the CDC (Center for Disease Control and Prevention) also reported 20 cases of heat-related illnesses, 13 of them died and 7 of them suffered non-fatal losses but their suffering affected other workers. From 2001 to 2010, there were more than 28,000 hospitalizations in 20 countries participating in the tracking program from the CDC[10].

This kind of cases makes the companies suffer a loss as the productivity decreases due to workers take work leave for the health issues. Workers are also disadvantaged by large financial expenditures due to the cost of their medical treatment for their illness which is caused by the hot work climate. The purpose of this study is to identify the relationship between the work climate and the increase in blood pressure in construction workers in Pamekasan Regency.

Material and Method

Based on the method of retrieval of data, this is a quantitative study, a descriptive observational study with a cross sectional design. The subjects were construction workers. The study used total population sampling. The sample wes drawn from the population according to the specified criteria. The criteria were to have no history of hypertension and cardiovascular disesaes and willing to be the subject of this research. Based on the criteria, 19 construction workers in Pamekasan Regency, East Java, Indonesia were selected as the subject of this research.

Data used in this research were primary data as it was collected and measured directly in the workplace. There were three variables collected namely work climate, physical workload, and blood pressure. Those variables were measured using different methods. The work climate was measured with the Wet Bulb Globe Temperature (WTGB) using Questtempº36 Thermal Environment Monitor was used (wet-bulb temperature, dry-bulb temperature, globe temperature, relative humidity (RH), and absolute humidity). The workload of each worker was calculated using the assessment table for workload based on caloric requirements according to SNI 7269:2009[8]. The measurement of blood pressure was performed by someone with medical competence using sphygmomanometer. The secondary data was the profile of working area and list of the workers. Data was analyzed using *chi-square* which presented in a cross tabulation. The correlation level between variables can be seen from the *r* value on the output result from the contingency coefficient correlation. Data collection was carried out in March 2019 for one week.

Findings

Work Climate

The work climate was measured with the Wet Bulb Globe Temperature (WTGB) using Questtemp 36. The results of measurements obtained include Wet Temperatures (WT), Dry Temperature (DT), Radiation Temperature (RT), and Wet Bulb Globe Temperature (WGBT). The result for work climate measurement is shown in table 1.

Table 1 Results work climate of Wet-Bulb Temperature, Dry-Bulb Temperature, Globe Temperature, Wet Bulb Globe Temperature (WBGT) in the construction area in Pamekasan Regency.

Location	Result			
	WT(0C)	DT (0C)	RT (0C)	WGBT (0C)
Room 1	26.7	29.8	35.2	28.8
Room 2	26.5	29.7	34.9	28.6
Room 3	26.7	29.8	34.5	28.6
Room 4	26.4	29.6	33.9	28.3
Room 5	26,7	29.8	34.5	28.6
Room 6	26,3	32.6	29.6	28.2
Average	26,5	30,2	33,7	28,8

Table 1 shows that the highest WBGT is in the Room 1 which is 28.8 ºC and the lowest is in the Room 6 with the temperature of 28.2 ºC. The average wet temperature is 26.5 ºC. The average dry temperature is 30.2 ºC. The average radiation temperature is 33.7 ºC Given that temperatures data, the WBGT was calculated and came with the average WBGT of 28.8 ºC. To determine the working climate whether appropriate or not with a threshold limit value (TLV) on workers was determined by comparing the measured indoor WBGT index, the workload based on the energy level expenditure and caloric needs according to SNI 7269:2009, and patterns of work with established standards. The standard used was the Regulation of the Minister of Manpower and Transmigration No. 5 of 2018. A light workload is categorized as ≤ 200 kcal/h, a medium workload is200 kcal/hr < workload ≤ 350 kcal/h, and a heavy work load is 350 kcal/hr < workload ≤ 550 kcal/h Therefore, the working climate is divided into 2 two categories (> TLV and ≤ TLV).

The result shows that 3 workers (15.7%) were exposed to safe work climate in accordance with the threshold limit value (TLV) and the rest samples (84.3% or 16 workers) were exposed to unsafe work climate, beyond the threshold limit value. The hot work climate they received in the work environment will be an extra heat load in addition to the heat load generated by the their body. This can bring a negative result that influences their health and can lead to health problems, one of which is the increase in blood pressure[9].

Hot work climate, especially one that exceeds the threshold value, can cause health problems to workers, both physical and psychological problems. A high-temperature work environment needs to be carefully supervised as it can cause bigger problems than the low-temperature one. This is due to the fact that human will generally be easier to protect themselves from the effects of low temperatures than high temperatures[11].

Workers who exposed to the hot work climate, will more likely to show signs or symptoms of discomfort such as increasing blood pressure, increasing body temperature, headaches, nausea, and other symptoms of excessive exposure to heat. To be continuously exposed to excessive heat makes workers to acclimatize as a sign of environment adaptation. Among body adaptation mechanism are sweating efficiency, stable circulation, relatively low pulse and low body temperature. Therefore, the caused symptoms are less seen than of those who do not acclimatize[3].

A comfortable temperature for Indonesians, who are accustomed to the tropical climate, to do activities is the temperature ranging from 24-26ºC, by acclimatizing with temperatures around 28-32ºC with 85% - 95% humidity. Hot temperatures can reduce the ability to think and even worse when it reach the temperature above 32ºC. In addition, hot temperatures also result in a lack of agility, long reaction time, and slow decision making. Therefore, hot temperature can decrease work efficiency and productivity[12].

Blood Pressure

Increased blood pressure is one of the causes of occupational diseases and productivity decreases. Blood pressure was measured using a *sphygmomanometer*. The increase of blood pressure was divided into two categories, normal and abnormal. The normal increase showed the systolic of < 140 mmHg, while the abnormal was the systolic of > 140 mmHg[1].

The result shows that the lowest blood pressure before working is 100/70 mmHg, the highest is 130/100 mmHg, and the average is 117.8/80/5 mmHg. The measurement result of blood pressure after working shows that the lowest is 110/80, the highest 160/100 and the average is 127.4/89.4 mmHg. Based on the results of blood pressure measurements before and after work, it is known that all respondents experienced an increase in blood pressure. As the increase blood pressure increases, 12 workers (63.2%) showed an increase but were still in the normal category and 7 workers (36.8%) showed an increase and were in the category of abnormal blood pressure.

An increase in blood pressure is classified to be above the threshold if it passes the limit of hypertension. The limit is systolic blood pressure (SBP) of ≥ 140 mmHg and/or diastolic blood pressure (DBP) of ≥ 90 mmHg in two different measurements[1]. Every individual who experiences changes in blood pressure has a mechanism to distribute blood in varying amounts to various parts of the body, depending on what someone is doing and the current condition of the person. The main reason why blood pressure changes up and down is to keep the capillary blood pressure at the same condition and remain constant. It is also to change the spiral muscles that surround the smallest arteries (arterioles) that cause changes in blood pressure[4]. Someone who does a job that expose them to heat will experience an increase in blood pressure as the work environment temperature increases. In addition, physiological changes in blood pressure will also occur when someone does excessive and continuous physical work[11].

Work Climate and the Increase of Blood Pressure

Table 2 Cross Tabultaion of Relationship beetwen Work Climate and The Increase of Blood Pressure

Work Climate	Blood Pressure				Total	
	Normal		Abnormal			
	n	%	n	%	n	%
≤ TLV	3	100	0	0	3	100
>TLV	9	56,3	7	43,8	16	100
Total	12	63,1	7	36,9	19	100

Table 2 shows that respondents who work in the working environment with the unsafe work climate (exceed the threshold value) experience the increase in their blood pressure. Seven of them experienced abnormal blood pressure, while 9 of them experience an increase but still below or on the threshold limit value. Respondents who work in the safe work climate experience normal increase of blood pressure. None of them showed abnormal blood pressure. Statistical analysis showed that there is a correlation between work climate and the increase in blood pressure of construction workers in Pamekasan Regency. It is shown by the Contingency Coefficient value of 0.341, which means that there is a moderate correlation between the two variables.

Workers work under the influence of a hot environment, the brain still controls body temperature by monitoring blood temperature. However, when the blood temperature rises, the body begins to take control of the heat mechanism. Comprehensive control of the mechanism resulted in increasing body heat. This can also cause the heat regulating system to rise, which then encourages the increase of blood pressure. The increasing blood pressure makes the heart pump more

blood[9].

One effort to prevent workers from experiencing work-related illnesses as a result of a hot work climate is to consume mineral water at least 1 glass (150-200 cc) every 15 - 20 minutes[13]. The body needs to replace fluids and electrolytes lost due to exposure to heat by drinking water. Therefore, there is a need for media promotion, periodic health checks and training for workers about health hazards due to exposure to heat[10].

Conclusion

The measurement result of WBGT showed that the highest is Room 1 with temperature of 28.8 ºC and the lowest is in the Room 6 with the temperature of 28.2 ºC. It also showed that (84.3% %) workers were exposed to beyond work climate in accordance with the threshold limit value (TLV). The measurement of blood pressure showed that 12 workers (63.2%) showed normal blood pressure. There were 7 workers (36.8%) who showed abnormal blood pressure. There was also a moderate correlation of work climate and the increase in blood pressure with contingency coefficient value of 0.314.

It is recommended for companies in this construction project to add blower fan to the working areas where the work climate exceeds the threshold limit value (TLV) as well as at workers' resting places. In addition, companies are suggested to hold periodic health checks, especially routine blood pressure checks.

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