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# Hot Work Climate can Increase the Hypertension of Production Workers in PT X Batam City

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Iklim kerja panas merupakan kombinasi suhu udara, kelembaban udara, kecepatan pergerakan, dan suhu radiasi. Panas timbul dari mesin atau peralatan produksi, iklim, dan kerja otot manusia. Panas juga dapat mempengaruhi fungsi tubuh yaitu detak jantung dan denyut nadi, peningkatan tekanan darah, dan konsentrasi. Tujuan penelitian ini adalah untuk mengetahui hubungan iklim kerja panas dan faktor daya tahan tubuh dengan kejadian hipertensi pada pekerja produksi di PT. Penelitian ini merupakan jenis penelitian kuantitatif dengan menggunakan desain cross sectional. Populasi dalam penelitian ini adalah pekerja produksi di PT. Teknik pengambilan sampel yang digunakan adalah total sampling dan analisis statistik chi-square. Hasil penelitian menunjukkan terdapat hubungan antara iklim kerja panas (p value 0,044), faktor ketahanan aklimatisasi (p value 0,002), umur (p value 0,008), masa kerja (p value 0,015), dan status gizi (p value 0,017). dengan kejadian hipertensi. Dari hasil penelitian disimpulkan terdapat hubungan antara iklim kerja panas, aklimatisasi, umur, masa kerja, dan status gizi dengan hipertensi. Sehingga disarankan agar perusahaan memberikan edukasi kepada pekerja terkait hipertensi dan melatih mereka dalam menyesuaikan suhu tubuh terhadap tekanan panas, menambah ventilasi, dan memeriksa tekanan darah secara rutin.

## INTRODUCTION

According to the Basic Health Law of the Republic of Indonesia No. 9 of 1960, Chapter 1, Article 2, what is meant by healthy is the fulfillment of physical, mental, and social conditions. Occupational health is a condition that aims to achieve the highest degree of physical, mental, and social health for workers by preventing and treating diseases caused by workers and the work environment (Venugopal et al., 2019).

Hypertension is a condition of increased systolic blood pressure ≥140 mmHg and diastolic blood pressure ≥90 mmHg due to a disturbance in the vascular system, which results in obstruction of the supply of oxygen and nutrients transported by blood to the body tissues that need it (Suling, 2018). Hypertension is also called the silent killer because it is one of the deadly diseases that occurs without any symptoms as a form of warning to its victims (Syntya, 2021). In addition to death, the continuous increase in hypertension can increase the risk of complications such as stroke, heart attack, and kidney failure (Kimura et al., 2020).

Heat can cause dilatation of peripheral blood vessels, so that the balance of blood circulation will be disturbed. This study showed that the incidence of heat-related illness with lost working days was 1,432 cases. According to the case data analyzed by Jansen, it was found that industries that

have cases due to heat stress illness were per 100,000 workers in Indonesia in 2019 (BPJS Ketenagakerjaan RI) (Liem & Mansyur, 2018).

According to WHO data, worldwide there are 972 million people, or 26.4% of the world's population, experiencing hypertension; the percentage may increase to 29.2% in 2025. Of the 972 million people with hypertension, 333 million cases are in developed countries, and the remaining 639 are in developing countries (Wegman et al., 2018). Based on Basic Health Research (Riskesdas) 2019, the prevalence of hypertension in the population aged 18 years and over in Indonesia is 31.7%. Clinical symptoms of hypertension can appear in varying degrees in each individual and are almost the same as symptoms in other diseases, namely headache, heaviness in the head, heart palpitations, difficulty breathing after strenuous activity or heavy lifting, easy fatigue, and vertigo (McCormick et al., 2022).

The hot working climate has several factors, namely those that affect the hot working climate, namely, effective temperature, temperature index of the ball and wet (ISBB), and prediction of the speed of sweat discharge for 4 hours, and factors that affect endurance, namely, age, gender, work period, workload, rest time, work variation, acclimatization, and nutritional status (Kassim et al., 2019). However, in this study, the variables that can be raised by researchers are acclimatization, age, tenure, and nutritional status because these variables are the most influential causes of hypertension in production workers at PT X.

PT. X is an industry that processes crude palm oil (CPO) into cooking oil with several processes and stages of processing, consisting of a refinery plant, a fractionation plant, and a packaging plant that uses machines as a means of managing it (Sorensen et al., 2019). The machine produces a heat source for workers in the production area (Nuraeni, 2019). From the results of observations and interviews with several PT X production workers during the initial survey, which was conducted on February 16, 2022, it was found that out of 10 workers, there were 7 with hypertension with working hours of 8 hours per day (Foster et al., 2020). These workers were also exposed to a hot work climate from production machines in the work area, especially in the production are (Herabare & Maliya, 2021). Based on the results of measurements taken, the results were 30.55 °C with a heavy workload. In addition, the workers complained of excessive heat (Bolghanabadi et al., 2019).

The purpose of this study was to determine the relationship between the hot working climate, acclimatization endurance factor, age, working period, and nutritional status and the incidence of hypertension among production workers at PT X Batam (Journeay et al., 2023;Yong et al., 2020).

# METHOD

This study is a quantitative analysis using a cross-sectional research design. The population in the study were production workers of PT X Batam, totaling 42 workers. The sample size was 42 respondents using the total sampling technique. The research variables include independent variables (hot work climate and acclimatization endurance factors, working age, and nutritional status) and dependent variables (hypertension) (Ramos et al., 2021).

Based on the source of data obtained in two ways, namely primary data and secondary data, Primary data is obtained from the results of ISBB measurements and direct interviews with respondents (Mix et al., 2018). Meanwhile, secondary data was obtained directly in the form of documents or files from PT.X. Data processing procedures use computer applications using statistical tests and univariate and bivariate data analysis using the chi square test, which aims to find the relationship between two variables with a confidence level of 95% ($\alpha = 0.05$).

# RESULT AND DISCUSSION

Based on the results of the research conducted, the results of the hot working climate, acclimatization endurance factors, age, length of service, nutritional status, and hypertension in PT X production workers were obtained:

| Variable | N | % |
|---|---|---|
| Hot Work Climate | | |
| Under NAB | 16 | 38.1 |
| Above NAB | 26 | 61.9 |
| Acclimatisation | | |
| Acclimatised | 7 | 16.7 |
| No Acclimatised | 35 | 83.3 |
| Age | | |
| Early Adulthood | 15 | 35.7 |
| Late Adulthood | 23 | 54.8 |
| Elderly | 4 | 9.5 |
| Period of Service | | |
| < 1 Year | 22 | 52.4 |
| 1 – 3 Year | 14 | 33.3 |
| > 3 Year | 6 | 14.3 |
| Nutritional Status | | |
| Normal | 3 | 7.1 |
| Overweight | 16 | 38.1 |
| At Risk | 21 | 50.0 |
| Obesity | 2 | 4.8 |
| Blood Pressure | | |
| Normal | 5 | 11,9 |
| Pre Hypertension | 3 | 7,1 |
| Hypertension | 13 | 30,9 |
| Severe Hypertension | 17 | 40,4 |

**Table 1.** *Univariate Results Frequency Distribution of Respondents*

From the results of measurements taken at three measurement points using the ISBB measuring instrument, namely the questtemp heat stress monitor, it is known that the refinery plan room temperature is 31.48 °C with heavy workload. Fraction section room with a result of 36.3 °C with heavy workload, and refinery level 2 obtained a result of 29 °C with moderate workload. These measurements show that the temperature in the work environment has exceeded the threshold value set in SNI 7061 of 2019. It is known from table 1 that out of 42 respondents (100%), the majority of 26 respondents (61.9%) worked in a hot work climate above the NAB, while 16 respondents (38.1%) worked in a hot work climate below the NAB (Venugopal et al., 2020).

Acclimatization results from 42 respondents (100%) The majority of 33 respondents (83.3%) were not acclimatized, while 7 respondents (16.7%) were well acclimatized. Age of Workers Out of 42 respondents (100%), the majority of 23 respondents with a percentage (54.8%) were late adults, while 15 respondents (35.7%) were early adults, and 4 respondents (9.5%) were elderly (Evia et al., 2022). The working period of 42 respondents (100%) showed that the majority of 22 respondents (52.4%) worked for less than 1 year, while 14 respondents (33.3%) worked for 1 to 3 years, and 6 respondents (14.3%) worked for more than 3 years. Nutritional status of 42 respondents (100%), the majority of 21 respondents (50%) with nutritional status at risk, 16 respondents (38.1%) with overweight nutritional status, 3 respondents (7.1%) with normal nutritional status, and a minority of 2 respondents (4.8%) with obese nutritional status Blood pressure of 42 respondents (100%), the majority (17 respondents (40.4%) with severe hypertension, 13 respondents (30.9%) with hypertension, and 5 respondents (11.9%) with normal blood pressure, a minority of 3 respondents with a percentage (7.1%) with pre-hypertension (Thomas et al., 2019).

| Variables | High Blood Pressure | | | | | | | | Total | | P value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Normal | | Pre-hypertension | | hypertension | | Severe Hypertension | | | | |
| | n | % | n | % | n | % | n | % | N | % | |
| Hot Work Climate | | | | | | | | | | | 0.044 |
| Under NAB | 1 | 6.3 | 2 | 12.5 | 8 | 50 | 5 | 31.9 | 16 | 100 | |
| Above NAB | 4 | 15.4 | 1 | 3.8 | 4 | 15.4 | 17 | 65.4 | 26 | 100 | |
| Acclimatisation | | | | | | | | | | | 0.002 |
| Acclimatised | 3 | 42.9 | 2 | 28.6 | 1 | 14.3 | 1 | 14.3 | 7 | 100 | |
| No Acclimatised | 2 | 5.7 | 1 | 2.9 | 11 | 31.4 | 21 | 60 | 35 | 100 | |
| Age | | | | | | | | | | | 0.008 |
| Dewasa Awal | 2 | 13.3 | 0 | 0 | 6 | 40 | 7 | 46.7 | 15 | 100 | |
| Dewasa Akhir | 3 | 13 | 1 | 4.3 | 4 | 17.4 | 15 | 65.2 | 23 | 100 | |
| Lansia | 0 | 0 | 2 | 50 | 2 | 50 | 0 | 0 | 4 | 100 | |
| Period of Service | | | | | | | | | | | 0.015 |
| < 1 year | 0 | 0 | 1 | 4.5 | 8 | 36.4 | 13 | 59.1 | 22 | 100 | |
| 1 – 3 Year | 5 | 35.7 | 1 | 14.3 | 1 | 7.1 | 6 | 42.9 | 14 | 100 | |
| > 3 Year | 0 | 0 | 0 | 0 | 3 | 50 | 3 | 50 | 6 | 100 | |
| Nutritional Status | | | | | | | | | | | 0.017 |
| Normal | 0 | 0 | 0 | 0 | 3 | 25 | 0 | 0 | 3 | 100 | |
| Overweight | 1 | 6.3 | 1 | 6.3 | 6 | 37.5 | 8 | 50 | 16 | 100 | |
| At Risk | 3 | 14.3 | 1 | 4.8 | 3 | 14.3 | 14 | 66.7 | 21 | 100 | |
| Obesity | 1 | 50 | 1 | 50 | 0 | 0.0 | 0 | 0.0 | 2 | 100 | |

**Table 2.** *Bivariate Results Of The Relationship Between Hot Work Climate, Acclimatization Endurance Factors, Age, Working Period, Nutritional Status, And The Incidence Of Hypertension In Production Workers Of PT.X. Batam City*

# DISCUSSION

## Relationship between Hot Work Climate With Hypertension

Based on the Chi-square statistical test results, the p value is 0.044, where $\alpha < 0.05$, which means Ho is rejected. There is a significant relationship between the hot work climate and high blood pressure in the production workers of PT X Batam City.

A hot work climate is a combination of air temperature, air humidity, air velocity, and radiant temperature. Heat comes from machinery and production equipment, weather, and muscle work. Heat affects human body functions if exposed continuously and exceeds the threshold value, namely increasing blood pressure, heart or pulse rate, and concentration (Asyik et al., 2018). The threshold value of a hot working climate is regulated in Regulation No. 70 of the Minister of Health of the Republic of Indonesia concerning health standards and requirements for the industrial work environment. The threshold value of a hot working climate with a heavy workload is 28 °C, and a moderate workload is 29 °C. Continuous exposure to a hot work climate can cause various health problems, including increased blood pressure, heatstroke, dehydration, and fatigue (Akbar et al.,

2019).

This is in line with research conducted by Tri Lestari (2018). According to the results of statistical tests, there is a significant relationship between a hot work climate and high blood pressure in workers, with a p value of 0.001. In a similar study conducted by Asyik (2018), the results of statistical tests showed a significant relationship between a hot work climate and increased blood pressure, with a p value of 0.000 (Butler-Dawson et al., 2019).

## Relationship between acclimatization With hypertension

Based on the Chi-square statistical test results, the p value is 0.002, where $\alpha < 0.05$, which means Ho is rejected. There is a significant relationship between acclimatization and high blood pressure in the production workers of PT X Batam City. Exposure to heat for hours can disturb the balance of the body, so the body secretes sweat as a compensatory mechanism. The body's heat center is located in the brain, which regulates blood flow through vessels in the skin, such as sweat, at temperatures above the threshold value of < 28 °C. In the process of acclimatization, the heart rate is faster and the rate of sweat output increases. According to Saridewi, it is stated that there is a significant relationship between increased blood pressure in workers before and after exposure to heat stress, so that it can interfere with their condition (Al-Bouwarthan et al., 2020).

This is in line with research conducted by Endargo and Hartini (2015). According to the results of statistical tests, there is a significant relationship between acclimatization and blood pressure, with a p value of 0.028. Similar research was conducted by Tri Lestari (2018), and the results of statistical tests showed a significant relationship between acclimatization and high blood pressure with a p value of 0.008.

## Relationship of Age with Hypertension

Based on the results of the Chi-square statistical test, the p value is 0.008, where $\alpha < 0.05$, which means Ho is rejected. There is a significant relationship between age and high blood pressure in the production workers of PT X Batam City.

Age is the length of a person's existence measured in units of time, and in terms of chronology, a normal individual is then shown the degree of development in anatomical and physiological terms. As a person ages, the greater the risk of developing hypertension in old age, the increase in blood pressure is only in the form of a systolic increase; this is due to structural changes in the area of large blood vessels (Marcinkiewicz et al., 2018). As age increases, changes occur in the arteries in the body to widen, and the recoil of blood accommodated through the blood vessels decreases. This reduction causes blood pressure to increase. In addition, this can cause disruption of neurohormonal mechanisms such as the renin-angiotensin-aldosterone system (Purba & Suryani, 2020).

This is in line with research conducted by Nuraeni (2019). According to the results of statistical tests, there is a significant relationship between age and high blood pressure, with a p value of 0.001. Similar research was conducted by Aristotle (2014), and the results of statistical tests showed a significant relationship between age and hypertension with a p value of 0.001.

## Relationship of the Working Period with Hypertension

Based on the Chi-square statistical test results, the p value is 0.015, where $\alpha < 0.05$, which means Ho is rejected. There is a significant relationship between working hours and high blood pressure among production workers at PT X Batam City.

The working period is the length of time calculated from the first time the worker is employed by

the company based on the employment agreement. The hot work environment makes the limbs require additional effort to maintain the balance of body heat; if exposed continuously, they will experience the risk of health problems (AH, 2021). The working period, according to Suma'mur, is the vulnerable time people have worked from the first day of starting work and can be interpreted as a piece of time where the workforce enters a business area until a certain time limit (Vickers, 2017). The longer a person is exposed, the more he will be exposed to the hazards posed by the work environment. Someone who has a longer duration of exposure has higher complaints (Levi et al., 2018).

This is in line with research conducted by Asyik et al. (2018). According to the results of statistical tests, there is a significant relationship between tenure and the incidence of high blood pressure in workers, with a p value of 0.001. Similar research conducted by Harahap (2016) showed that there was a significant relationship between working period and increased blood pressure with a p value of 0.000.

### Relationship between nutritional status with hypertension

Based on the Chi-square statistical test results, the p value is 0.017, where $\alpha < 0.05$, which means Ho is rejected. There is a significant relationship between nutritional status and high blood pressure in the production workers of PT X Batam City.

Nutritional status is one of the factors that can affect an increase in blood pressure, or hypertension. A person who has excess body weight tends to experience hypertension influenced by a person's physiology, namely insulin resistance and hyperinsulinemia, sympathetic nervous system activity and renin angiotenin, as well as changes in the kidney organs that cause an increase in blood pressure (Royke & Langingi, 2021). Nutrition also affects the occurrence of hypertension, determined by the physical need for energy and nutrients obtained from food, the physical impact of which is measured anthropometrically. Nutrition increases the risk of hypertension for several reasons: the greater a person's body mass, the more blood is used to supply oxygen to the body's tissues; this makes the blood volume increase and puts greater pressure on the arterial walls (Parker et al., 2018).

This is in line with research conducted by Fauziah (WHO, n.d.). The results of the statistical test found a significant relationship between nutritional status and blood pressure, with a p value of 0.030. And similar research was conducted by Asyik (2018); the results of statistical tests showed a significant relationship between nutritional status and increased blood pressure, with a p value of 0.035 (Sari & Faizah, 2018).

## CONCLUSION

From the results of research and discussion of the relationship between a hot working climate and endurance factors and the incidence of hypertension among production workers at PT X Batam City, it is concluded:

1. There are 42 respondents (100%); the majority of 26 respondents (61.9%) work in a work climate above the NAB, while 16 respondents (38.1%) work in a work climate below the NAB.
2. There were 42 respondents (100%) the majority 33 respondents (83.3%) were not acclimatised while 7 respondents (16.7%) were acclimatised.
3. There were 42 respondents (100%); the majority, 23 respondents (54.8%), were late adults, while 15 respondents (35.7%) were early adults, and 4 respondents (9.5%) were elderly.
4. There were 42 respondents (100%); the majority of 22 respondents (52.4%) worked under 1 year; 14 respondents (33.3%) worked 1-3 years; and 6 respondents (14.3%) worked for

more than 3 years.

5. There were 42 respondents (100%), the majority 21 respondents (50%) with nutritional status at risk, 16 respondents (38.1%) with overweight, 3 respondents (7.1%) with normal nutritional status, and 2 respondents (4.8%) with obese nutritional status.
6. There were 42 respondents (100%), the majority (17 respondents (40.4%) with severe hypertension, 13 respondents (30.9%) with hypertension, 5 respondents (11.9%) with normal blood pressure, and 3 respondents (7.1%) with pre-hypertension.
7. There is a significant relationship between the hot working climate and the incidence of hypertension among production workers at PT X Batam City, with a p value of 0.044 ($\alpha < 0.05$).
8. There is a significant relationship between acclimatization and the incidence of hypertension among production workers at PT X Batam City, with a p value of 0.002 ($\alpha < 0.05$).
9. There is a significant relationship between age and the incidence of hypertension in production workers in the PT X Kota Batam year, with a p value of 0.008 ($\alpha < 0.05$).
10. There is a significant relationship between the working period and the incidence of hypertension among production workers at PT X Batam City, with a p value of 0.015 ($\alpha < 0.05$).
11. There is a significant relationship between nutritional status and the incidence of hypertension among production workers at PT X Batam City in 2022, with a p value of 0.017 ($\alpha < 0.05$).

## SUGGESTIONS

The company installs exhaust fans in the production area where possible, which is useful for speeding up air circulation. Conduct regular blood pressure checks on workers. Provide heat education, training, and acclimatization training to new workers. Provide a healthy canteen for workers. Organize working hours to avoid prolonged exposure to hot temperatures.

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