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COMPARISON OF BLOOD PRESSURE BEFORE AND AFTER EXPOSURE TO AIR TEMPERATURE IN FISHERMAN WORKERS

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ABSTRACT
The human body regulates its temperature to normal levels when exposed to cold temperatures, which allows it to adjust to changes in its surroundings. The force of blood that the heart pumps against the artery walls is called blood pressure. Variations in fishermen's blood pressure may be affected by the cold working environment. The purpose of this study was to determine the comparison of blood pressure before and after exposure to air temperature in fishermen workers. With a single group pretest-posttest quantitative research methodology, this study used an experimental pre-research design. Univariate data analysis, bivariate using the Wilcoson test and multivariate using MANOVA testing. The study population was 57 fishermen of Tanjung Tiram District. By using the basic random selection approach, the research sample amounted to 50 respondents. Data collection using primary data obtained directly from fishermen workers on the Tanjung Tiram coast using digital tension meters and observation sheets. The analytical tool used is SPSS. The results showed that there was a comparison of blood pressure before and after exposure to air temperature, meaning that exposure to air temperature can increase blood pressure both systole and diastole, so maintaining health is needed for workers who work as fishermen.

Keywords: air temperature; blood pressure; fisherman workers

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INTRODUCTION

Temperature, humidity, air movement speed, radiant heat, and the amount of heat a worker's body produces while working all contribute to the work environment. While extreme heat is one of the most common risks associated with workplace temperatures, extreme cold can also pose health risks (Bauer et al., 2022; Lopak et al., 2017; Telesca et al., 2023). According to the government, there is a higher risk of occupational health and accidents among fishermen. Common working conditions for fishermen include exposure to sunlight, bad weather and other environmental factors. There are several factors that contribute to health decline, in addition to the impact of age and lifestyle (Ratih et al., 2020). The above conditions also occur in fishermen workers in Tanjung Tiram Sub-district who mostly work at night and are exposed to quite cold air temperatures. Based on a survey conducted to fishermen who sail at night in Tanjung Tiram Subdistrict, it is known that fishermen not only operate in dangerous conditions, but they also experience heavy physical conditions due to being in open water for too long. Spreading, waiting, and pulling back the net are the actions of fishermen on the boat. While waiting for the catch, fishermen tend to engage in unhealthy habits such as smoking and consuming coffee. When conducting several short interview sessions with a number of fishermen who always sail at night, some fishermen admitted that working at night causes quite bad health symptoms such as colds, fatigue, dizziness and most of all hypertension.

The diseases caused by exposure to air temperature mentioned above are related to the fact that the human body should be busy during the day and needs sleep at night to restore energy and heal. Some studies also explain that the temperature of the work environment, especially cold temperatures, can increase blood pressure (Chen et al., 2021; Chen, Shang, et al., 2019; Chen, Xue, et al, 2019; Halil Gibran & Heriyani, 2020; Hartwig et al., 2021; Jayarajah & Seneviratne, 2019; Karim et al., 2021; Park et al., 2020; Polcaro-Pichet et al., 2019; Tochihara et al., 2021; Toffoli et al., 2023; Umishio et al., 2019; Wu et al., 2021a). However, there are research findings from Grace et.al, (2017) which state that there is a significant relationship between exposure to cold air temperatures and changes in systolic and distolic blood pressure before and after work.

Exposure to air temperature in the work environment can have a significant impact on fishermen's health, particularly in terms of blood pressure changes before and after sailing. Therefore, the implementation of Occupational Safety and Health (OSH) principles is key to protecting fishers from health risks associated with these environmental conditions. Regular monitoring of air temperature in the morning, afternoon and night is an important part of OHS management. The use of PPE (personal protective equipment) when fishermen are exposed to cold air temperatures is necessary. The use of PPE such as warm and insulating clothing in the form of waterproof clothing that can protect from wind and seawater, head and ear protection (hat or head cover), eye protection (protective glasses), hand and foot protection (waterproof gloves), waterproof shoes or boots, buoys and safety equipment (in the form of personal buoys), body temperature monitoring devices (portable body thermometers), emergency communication devices (radios or other communication devices), as well as conducting government safety training for fishermen on emergency measures, use of safety equipment, and handling extreme weather conditions. (Ulli et.al, 2021).

METHOD

This study used a cross-sectional analytical survey methodology. This study was located in Tanjung Tiram District, the research was conducted on January 8-14, 2024. The population in this study were residents who worked as fishermen in Tanjung Tiram District, totaling 57 people. The sampling technique in this study used simple random sampling technique using the slovin formula and the number of samples used amounted to 50 people. Data taken from respondents directly are sample identity which includes name, age, and informed consent. Blood pressure measurement data were taken before and after respondents conducted fishing activities at night for 8 hours. Blood pressure was assessed using a digital tensimeter. This data was obtained from researchers who were filled in by residents who worked as fishermen in Tanjung Tiram District using a digital tensimeter and observation sheet. Data Processing and Analysis. Data processing is done by editing, coding, data entry, cleaning and tabulation. Data analysis can be done sequentially using a computer software system. The data analysis used in this study includes univariate and bivariate analysis. Todorov et al., (2020) define univariate analysis as a process to explain or describe the attributes of individual research variables. The purpose of univariate analysis in this study was to document the blood pressure measurements of fishermen performing fishing activities. The univariate data used consisted of blood pressure measurements taken before and after fishing activities. Bivariate analysis is a statistical technique used to examine the relationship between two variables. Bivariate analysis is used to ensure that there is a comparison between the two variables under study (Todorov et al., 2020). This study used bivariate analysis to determine blood pressure comparisons among fishermen before and after night fishing. Although there was no comparison (control) group in this study, at least observations were made to find out what changes arose after the program or experiment was carried out. This study initially conducted a data normality test with a significant value <significant alpha (5% or 0.05) before using a paired t-test statistical test to determine the difference in blood pressure before and after work due to exposure to temperature in the air.

RESULTS

Table 1.
Description of Respondents' Age Characteristics

Characteristics	N	Percentage (%)
Age (years)		
26-35	21	42
36-45	21	42
46-55	7	14
56-65	1	2
Gender		
Male	50	100

Based on the analysis of the characteristics of respondents, it can be seen that the age of respondents is four categories, the largest category is in early adulthood (26-35), and late adulthood (36-45) with 42% each.

Table 2.
Description of Blood Pressure Variables

		f	Minimum	Maximum	Mean	Std. Deviation
Sistole	Before	50	85,00	135,00	121,4000	9,11827
	After	50	104,00	138,00	125,8400	8,53650
Diastole	Before	50	61,00	87,00	77,1000	7,10921
	After	50	63,00	89,00	80,3200	6,36136

Based on descriptive analysis in table 2, it can be seen that the lowest systole blood pressure is 85 and the highest is 135. The average value produced by systole blood pressure before exposure to air temperature is 121.4 with a standard deviation value of 9.11827.

Table 3
Description of Blood Pressure Variables

Kategori	Sistole		Diastole	
	Before	After	Before	After
Low	6 (12,0%)	3 (6,0%)	9 (18,0%)	4 (8,0%)
Normal	36 (72,0%)	27 (54,0%)	38 (76,0%)	37 (74,0%)
Tall	8 (16,0%)	20 (40,0%)	3 (6,0%)	9 (18,0%)

Based on the data presented in Table 3, it is known that before or after exposure to air temperature, most respondents had systole and diastole pressures in the normal category. This indicates that there was an increase in blood pressure in the high category after exposure to air temperature.

Table 4.
Coastal air temperature

Morning AirTemperature	Daytime Air Temperature	Night Air Temperature
20-25 C^{o}	25-30 C^{o}	20-25 C^{o}

Table 5.

Data Normality Testing Results

Variabel	Test	Statistic	Sig.	Keterangan
Sistole	Before	0,907	0,001	Abnormal
	After	0,914	0,001	Abnormal
Diastole	Before	0,934	0,008	Abnormal
	After	0,869	0,000	Abnormal

Table 5, it can be seen that all variables both before and after exposure to air temperature produce significance values <significant alpha (5% or 0.05). Therefore, it can be stated that the systole and diastole blood pressure variables do not follow a normal distribution. Because the variables are not normally distributed, the analysis used in the study uses nonparametric analysis, namely the Wilcoxon test.

Table 6.
Testing results of air temperature on blood pressure increase

Variabel	Test	$\bar{x}$ ± SD	Statistics	*Sig.*	Keterangan
Sistole	Before	121,40± 9,11827	-6,067	0,000	Signifikan
	After	125,84± 8,53650			
Diastole	Before	77,10± 7,10921	-4,972	0,000	Signifikan
	After	80,32± 6,36136			

Based on table 6, it can be seen that the results of statistical test analysis with Wilcoxon on all variables produce significance values. Therefore, it can be stated that there is a significant difference in systole and diastole blood pressure before and after exposure to air temperature.

Multivariate testing was used to determine the effect of air temperature on blood pressure simultaneously. The analysis was conducted using manova analysis. The test criteria states that if the significance value < level of significance (alpha = 5% or 0.05) then it can be stated that there is an effect of air temperature on increasing blood pressure simultaneously. The results of the analysis are described as follows. Testing the effect of air temperature on blood pressure simultaneously was carried out using MANOVA analysis with Bias-corrected and accelerated bootstrapping (BCa). The test criteria states that if the significance value < level of significance (alpha = 5% or 0.05) then it can be stated that there is an influence on the effect of air temperature on blood pressure. The results of the analysis test are described as follows:

Table 7.
MANOVA Testing Results

Effect		Value	f	Sig.
Intercept	Pillai'sTrace	0.995	9823.197	0.000
	Wilks' Lambda	0.005	9823.197	0.000
	Hotelling'sTrace	202.540	9823.197	0.000
	Roy'sLargestRoot	202.540	9823.197	0.000
Treatment	Pillai'sTrace	0.065	3.395	0.038
	Wilks' Lambda	0.935	3.395	0.038
	Hotelling'sTrace	0.070	3.395	0.038
	Roy'sLargestRoot	0.070	3.395	0.038

Based on the table above, it can be seen that the results of the MANOVA statistical test analysis for all tests produce a significance value < alpha (5% or 0.05). Therefore, it can be stated that there is an effect of air temperature on blood pressure.

DISCUSSION

Based on hypothesis testing and analysis, it is known that there is a difference in blood pressure of fishermen workers before and after exposure to air temperature. In addition, the blood pressure of night fishermen is higher after exposure to air temperature than before exposure to night temperature. Individuals exposed to cold air (~12-13°C) for 8 hours/day for 31 days, showed significantly reduced shivering and lower core temperatures in cold weather. Seawater exposure is limited to a relatively small area of the body. For example, fishermen and fish filleters work long hours each day with one or both hands immersed in cold water, and have been shown to maintain higher finger and hand temperatures and lower systemic blood pressure during hand immersion in cold water compared to control subjects. Although fishers have good adaptation to temperature seawater at night, fishermen still have cardiovascular risks such as hypertension (Yurkevicius et al., 2022).

Air temperature, especially cold temperature, has a short-term effect on blood pressure (Xu et al., 2019) because exposure to cold temperatures can increase activation and vasoconstriction of the sympathetic nervous system, and reduce endothelial function, which can lead to increased blood pressure (Park et al., 2020). The results of this study are in line with the findings showing that the percentage of patients with large-artery atherosclerosis (LAA) in the low-temperature group was significantly greater than that in the non-low-temperature group ($p<0.05$) because low temperatures can cause an increase in platelets and red blood cells, as well as increase blood viscosity, adhesion and platelet activation, all of which can lead to thrombosis (Chen et al., 2019), 2021; Chen, Shang, et al., 2019; Halil Gibran & Heriyani, 2020; Hartwig et al., 2021; Jayarajah & Seneviratne, 2019; Karim et al., 2021; Polcaro-Pichet et al., 2019; Tochihara et al., 2021; Toffoli et al., 2023; Umishio et al., 2019; Wu et al., 2021a).

The findings of this review are also consistent with those of Janssen et al. (2023), who found that cold temperatures were associated with decreased thermal comfort and poorer respiratory and cardiovascular health. This means that moderately cold temperatures can have a high effect on blood pressure. The results also showed that cold temperatures in temperate and cold regions can adversely affect a variety of health conditions, including cardiovascular (blood pressure, electrocardiogram abnormalities, blood platelet count), respiratory (COPD symptoms, respriatoryviral infections), sleep, physical performance, and general health.

Based on descriptive analysis, it can be seen that systole blood pressure before exposure to air temperature produces the lowest systole of 85 and the highest of 135. The average value produced by systole blood pressure before exposure to air temperature is 121.4 with a standard deviation value of 9.11827. The standard deviation value is smaller than the average, indicating that the diversity of systole blood pressure before exposure to air temperature between respondents tends to be small. Then it is known that the systole blood pressure after exposure to air temperature produces the lowest systole of 104 and the highest of 138. The average value produced by systole blood pressure after exposure to air temperature is 125.84 with a standard deviation value of 8.53650. The standard deviation value is smaller than the average, indicating that the diversity of systole blood pressure after exposure to air temperature between respondents tends to be small. Diastole blood pressure before exposure to air temperature produced the lowest diastole of 61 and the highest of 87. The average value produced by diastole blood pressure before exposure to air temperature is 77.10 with a standard deviation value of 7.10921. The standard deviation value is smaller than the average, indicating that the diversity of diastole blood pressure before exposure to air temperature between respondents tends to be small. Then it is known that the diastole blood pressure after exposure to air temperature produces the lowest diastole of 63 and the highest of 89. The average value produced by diastole blood pressure after exposure to air temperature is 80.32 with a standard deviation value of 6.36136. The standard deviation value is smaller than the average, indicating that the diversity of diastole blood pressure after exposure to air temperature between respondents tends to be small. However, it is known that before exposure to night temperatures, 16.0% of respondents had systole pressure in the high category and 6.0% of respondents had diastole pressure in the high category. After exposure to night temperatures, it was found that 40.0% of respondents had systole pressure in the high category and 18.0% of respondents had diastole pressure in the high category. This shows that there is an increase in blood pressure in the high category after exposure to night temperatures.

Blood pressure variations may have a significant impact on the diagnosis and treatment of hypertension in regions where the four seasons are well defined. Clinical studies have shown a direct relationship between seasonal variations in blood pressure and blood pressure levels, although the underlying process remains unknown. In addition, clinical studies have shown that ambulatory blood pressure in winter is higher during the day, but blood pressure in summer is higher at night. The mechanism behind this variation may be related to the sympathetic nervous system being activated by low temperatures; a multicenter study found that glomerular filtration rate and norepinephrine levels increased at cold temperatures. However, these effects were only seen in patients with normal blood pressure, for reasons yet unknown (Rios et al.,2023).

According to research by Wu et al. (2021), extremely cold temperatures have a tremendous effect on the core temperature of the human body, causing a significant increase in blood pressure. Therefore, it can be concluded that core temperature tends to stabilize during adaptation. The combination of vasoconstriction and skeletal muscle shivering caused by sudden cold exposure slightly increases core temperature. In addition, the effect of cold exposure on core temperature did not disappear immediately after entering the third stage. Core temperatures of all participants recovered to baseline values after 40 minutes of recovery at 24°C. It is reasonable to conclude that the opposite pattern of temperature change will cause the core temperature to react in the opposite direction and return to its original state within a certain time. It is important to note that core temperature varies within 0.5 during cold exposure, so extreme cold conditions do not cause dramatic changes in core temperature within a limited period of time. Instantaneous temperature changes have a significant impact on the human body. Opposite significant changes occur due to changes of the same magnitude but opposite direction, this is consistent with the previous findings of Chen, Xueet al. (2019) that blood pressure increased significantly after exposure to cold conditions The increase in blood pressure can be caused by skin vasoconstriction and an increase in blood volume simultaneously. Blood vessels constrict to reduce heat loss. However, the findings of Zheng et al. (2021) showed a significant negative relationship between outdoor temperature and blood pressure in a highland environment in northwest China. In addition, blood pressure showed significant seasonal variation. The relationship between blood pressure and temperature varies by season and individual demographic characteristics (age, gender, BMI), unhealthy behaviors (smoking and alcohol consumption), and chronic disease status (CVD, hypertension, and diabetes).

In relation to the results of the research and discussion, it can be seen that doing work at night has a risky effect on the occurrence of hypertension, so it is necessary to do some prevention of work accidents. Therefore, the implementation of Occupational Safety and Health (OSH) principles is key to protect fishermen from health risks associated with these environmental conditions. Regular monitoring of air temperature in the morning, afternoon, and evening is an important part of OHS management. The use of PPE (personal protective equipment) when fishermen are exposed to cold air temperatures is necessary. The use of PPE such as warm clothing and isolation in the form of waterproof clothing that can protect from wind and sea water, this clothing should have an insulating layer to maintain the body temperature of fishermen. The second is head and ear protection, in the form of a hat or head cover, which has the function of protecting the head from the sun and helps maintain body temperature. The third is eye protection, in the form of protective glasses, which have the function of protecting the eyes from sunlight, wind, and sea water splashes. The fourth is hand and foot protection, in the form of waterproof gloves, which function to protect hands from seawater and cold winds. The fifth is waterproof shoes or boots, which prevent the feet from being exposed to water and maintain body temperature. Then the sixth is a buoy and safety equipment, in the form of a personal buoy, this must be worn so that fishermen stay afloat if they fall into the water. The seventh is a body temperature monitoring tool, in the form of a portable body thermometer, which is useful for monitoring the body temperature of fishermen and avoiding the risk of hypothermia. The eighth is emergency communication, in the form of communication tools, such as radios or other communication devices for emergency situations. Finally, safety training should be provided to fishermen on emergency measures, the use of safety equipment, and handling extreme weather conditions. (Ulli et.al, 2021).

CONCLUSION

Based on the results of the analysis that has been done, it is known that there is a significant comparison of systole and diastole blood pressure before and after exposure to air temperature. This means that there is a significant effect of air temperature on systole and diastole blood p r e s s u r e . The average value of systole and diastole blood pressure after exposure to air temperature is higher than before, indicating that air temperature is able to significantly increase blood pressure. The use of PPE (personal protective equipment) when fishermen are exposed to cold air temperatures is very necessary. The use of PPE such as warm and insulating clothing in the form of waterproof clothing that can protect from wind and sea water, head and ear protection (hat or head cover), eye protection (protective glasses), hand and foot protection (waterproof gloves), waterproof shoes or boots, buoys and safety equipment (in the form of personal buoys), body temperature monitoring devices (portable body thermometers), emergency communication devices (radios or other communication devices), as well as conducting government safety training for fishermen regarding emergency actions, use of safety equipment, and handling extreme weather conditions. (Ulli et.al, 2021).

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