FACTORS AFFECTING THE HYDRATION STATUS OF FOUNDRY WORKERS

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ABSTRACT

Hydration status is a description of the conditions of workers when they lack fluid intake after work, one of which is due to the temperature of the workspace that exceeds the threshold value.This study aims to determine the effect of respondent characteristics and workspace temperature on hydration status in PT X metal foundry workers. This type of research is explanatory quantitative research with a cross sectional approach. The population in this study were PT X metal foundry workers, who were taken using purposive sampling technique, and obtained a sample of 69 people. Respondent data collection related to age, nutritional status, length of service, and volume of water intake using a questionnaire, workspace temperature data obtained through Questamp measurements, and hydration status data obtained through urine color tables. Data analysis included univariate analysis and bivariate analysis, using the spearman rank test and chi-square test. The results showed that the majority of workers were dehydrated. It was found that age, tenure, nutritional status, and heat had no correlation with hydration status. While between water intake and hydration status (p = 0.006) indicates that there is a relationship between the volume of water intake and hydration status, with the direction of the strength is not strong enough and a negative linear pattern. The conclusion obtained from this study is that there is an effect of hydration status on the volume of water intake with a negative correlation direction, while other independent variables are not related to the hydration status of metal foundry workers of PT X.

Keywords: Heat Temperature, Hydration Status, Metal Casting

INTRODUCTION

Work climate is one of the physical factors in the workplace that has the potential to cause potential hazards and can cause health problems. Hot workspace temperatures can be obtained from a combination of external heat from the environment and internal body heat generated from metabolic processes. The hot workspace temperature in the work environment depends on air temperature, humidity, the presence of heat-producing equipment or materials, air movement such as ventilation and wind, the amount of work and clothing used while working (Aulia et al., 2023).

Workers exposed to high heat and humidity can experience dehydration, dizziness, nausea, fatigue and even loss of consciousness. If these conditions are allowed to persist, they can lead to decreased performance and an

increased risk of accidents (Huda & Suwandi, 2019). Workers working in hot working climates can also cause the workforce to become tired quickly due to the loss of fluids and salts. Dehydration is a condition where the body loses fluids due to hot temperatures that cause sweating. Prolonged dehydration and sustained fatigue can have adverse effects on the body (Amalia & Widajati, 2019).

The metal casting industry is one of the workplaces that has heat exposure due to the production process. Heat exposure is generated by the presence of furnaces used to melt metal. The results of the preliminary study showed that workers work for almost eight hours per day, outside of overtime when pursuing targets. A total of 75% of the 8 workers admitted to feeling dizzy, thirsty, body aches, and feeling hot while working. When thirsty, workers prefer to consume tea or coffee or other sugary drinks, rather than drinking water.

Overview

In the human body, 80% of the components are liquid (water), so it can be said that water is an important component in the human body. Drinking water is included in the intake of important nutrients in the body, to help in the digestive process, as well as to protect human health (Kusumawardani & Larasati, 2020; Utama, 2019). Fluids in the human body also function to conduct heat throughout the body, where the increasing energy and heat exposure, as a result of metabolism and muscle contraction, fluids function as thermoregulators (the ability to or maintain optimal body temperature) (Rahmuniyati et al., 2016).

Human fluid requirements differ depending on age, gender, weight, physical activity, and exposure to the surrounding environment. Normally, humans have a water consumption requirement of eight glasses or the equivalent of 2 liters per day. Generally, the body's fluid needs are adjusted according to energy intake, body surface area, or individual body weight. In addition, the amount of water needed each day should be balanced with the amount of energy used, known as fluid balance (M. P. Sari, 2017). Ensuring workers have adequate fluid intake is a highly effective intervention measure to maintain their health and productivity during work (Jacklitsch et al., 2016).

Hot working climate arises due to a combination of temperature, humidity, air velocity, and heat radiation, as well as the level of heat expenditure generated by the worker's body as a result of the work process. Hot working climate is one of the physical factors that can affect labor activity which can cause occupational disorders and diseases (PAK) (Aulia et al., 2023). The existence of discomfort due to the hot working climate as a physical factor in the workplace can cause fatigue, drowsiness, increase the number of work errors, and reduce body stability (Guspriyono, 2019).

One of the body's responses to rising temperatures outside the body is sweating. Sweat is a liquid electrolyte consisting of sodium, potassium, and chloride. The mechanism of sweating is not solely due to heat, as the body has a passive diffusion mechanism. Excessive sweat production during work can cause a decrease in the amount of body fluids or called dehydration, and loss of salt levels in the body (Iridiastadi & Yassierli, 2015). Dehydration is a fluid imbalance or lack of water in the body, occurring when water expenditure exceeds intake, such as

from beverages. In a certain period of time, sodium loss due to sweating, can cause blood pressure to drop, heart rate to increase, and reduced blood flow to the surface of the body, as an effort to dissipate heat (Kusumawardani & Larasati, 2020).

Hydration status is a condition that describes the amount of fluid in the human body. The status describes our body in a condition of dehydration or overhydration or euhydration (enough hydration) (Kusuma, 2020). Signs and symptoms of mild dehydration include lethargy, excessive thirst, dizziness, aches, muscle cramps, easy fatigue and blurred vision when standing for a short duration, changes in enthusiasm, and weakened concentration. In the acute stage of dehydration, muscle stiffness, kidney failure, and blue lips will occur, leading to death if the body loses more than 6% of body weight in fluid (Thom & Adi, 2023). In dehydrated individuals, inadequate water consumption causes the body to adjust by drawing water from the blood. This process causes the blood to become thicker and increases the workload of the kidneys in the blood filtration process. In the long run, this can potentially cause damage to the kidney organs (Huda & Suwandi, 2019). Measurement of hydration status can be done in many ways, such as blood tests, urine tests, urine matching with urine color tables, and urine specific gravity examinations (Pratama et al., 2016).

The purpose of the study was to analyze the effect of respondent characteristics, volume of water intake, and workspace temperature on hydration status in PT X metal foundry workers.

RESEARCH METHODOLOGY

This research is a quanti-tative explanatory research with a cross sectional approach. The research was conducted in November 2023 on workers of PT X, a metal casting company in Ceper, Klaten. The independent variables studied in this study are the characteristics of respondents (which include age, nutritional status, length of service), workspace temperature, and volume of water intake. Meanwhile, the dependent variable in this study is the hydration status of workers.

This study used a purposive sampling method with inclusion criteria, namely workers who were exposed to heat and were at the research location when collecting data, so that a sample of 69 people was obtained. Data collection on respondents related to characteristics and volume of water intake using a questionnaire. Measurement of work climate using Questamp Heat Stress Monitor measurement tool, and measurement of hydration status in respondents measured using urine color table.

Data analysis in this study consisted of univariate analysis and bivariate analysis. Univariate analysis aims to describe the description of each variable, while bivariate analysis aims to explain the strength of the relationship between two variables, namely the independent variable and the dependent variable. Bivariate analysis testing in this study began with the normality test, which was then followed by the rank-spearman test, for numerical data, and the chi-square test, for categorical data.

This research has passed the ethical review by the Health Research Ethics Commission, Faculty of Public Health, Diponegoro University with No. 502/EA/KEPKFKM/2023.

RESULT

Univariate Analysis

In table 1 below, there are the results of univariate analysis of respondents consisting of age, nutritional status, working period, volume of water intake. The results of this study showed that there were 69 workers at PT X metal foundry and all of them were male, with the youngest age of workers being 24 years old and the oldest age being 67 years old. Body Mass Index (BMI) of workers is a minimum of 16.2 kg/m2 and a maximum of 38.6 kg/m2 . There were workers with a working period of only a few months, while the worker with the longest working period was 48 years old. The lowest volume of water intake was 960 ml, and the highest was 3500 ml.

Table 1. Characteristics of respondents and volume of water intake in metal foundry workers of PT X

Variables	N	Mininum	Maximum	Mean	Std Deviation
Age (years)	69	24	67	47,46	10,113
BMI (kg/m^2)	69	16,2	38,6	25,257	4,5969
Years of Service (years)	69	0	48	21,17	12,372
Water Intake Volume (mL)	69	960	3500	1954,49	682,703

Climate measurements in the PT X metal foundry work environment were carried out at 6 points, consisting of 4 points in the first production room and 2 other points in the second production room or finishing room. Measurements were made twice throughout the duration of the workers' work, namely at 10:00 and at 14:00. The average result of the ISBB measurement in the workplace is 310 C, with a minimum temperature of 290 C and a maximum temperature of 330 C. In accordance with Permenaker No.5 of 2018, this ISBB temperature is above the NAB (Threshold Value).

Table 2 shows that the majority of PT X foundry workers are dehydrated (78.3%).

Table 2. Hydration status of foundry workers of PT X

Variables Hydration Status	Frequency	Percentage
Not Dehydrated	15	21,7
Dehydration	54	78,3
Total	**69**	**100**

Bivariate Analysis

The results of the bivariate analysis of this study can be seen in table 3. Bivariate analysis is the result of statistical tests between the independent variable and the dependent variable. In table 3, it is known that age, tenure, and heat have no correlation with hydration status. The results of the correlation test between water intake and hydration status have a p value = 0.006 and a value of r = - 0.326, which indicates that there is a relationship between the volume of water intake and hydration status, with the direction of the strength / strength of the relationship is not

strong enough and a negative linear pattern.

Table 3. Correlation test between independent variables and hydration status in foundry workers of PT X

Variables	Hydration Status	
	p	r
Age	0,260	0,137
Years of Service	0,257	-0,138
Workspace Temperature	0,362	0,111
Water Intake Volume	0,006	-0,326

Table 4 shows that more workers who have abnormal nutritional status are dehydrated (80%) compared to workers who have normal nutritional status. The chi-square test between nutritional status and hydration status has a p-value of 0.949, so this means that there is no relationship between nutritional status and hydration status.

Table 4. Test of the relationship between nutritional status and hydration status in metal foundry workers of PT X

BMI	Hydration Status				Total	
	Not Dehydrated		Dehydration			
	f	%	f	%	f	%
Normal	8	23,5	26	76,5	34	100
Not Normal	7	20	28	80	35	100
Total	15	-	54	-	69	-

DISCUSSION

Based on the relationship test in this study, it was found that there was no relationship between age and hydration status in PT X foundry workers. As we age, the amount of fluid in the body tends to decrease, and the thirst response also tends to decrease, making it difficult for older people to know when they should drink water. In addition, kidney function also tends to decline with age, so the body loses more water through urine. (Amaliya, 2018; Sarijuwita & Tan, 2023). The results of this study are in line with previous research that there is no relationship between age and hydration status. (Nilamsari, 2023).

Research conducted on PT.X metal foundry workers found that there was no relationship between nutritional status and hydration status (p-value 0.949). Of the 69 respondents studied, it showed that as many as 80% of the total respondents were dehydrated with abnormal nutritional status. Abnormal nutritional status consists of three BMI categories, namely underweight, obese, and overweight. The majority of PT X foundry workers who have abnormal nutritional status fall into the obese and overweight categories. Those who have abnormal nutritional status and experience many

dehydration events, as a result of the amount of water in muscle cells is greater than in fat cells, causing the total amount of fluid in the body of obese individuals to be lower than that of non-obese individuals. This suggests that obese individuals may be at risk of health problems, including the potential for dehydration. However, from the results of the study it is also known that the incidence of dehydration is also experienced by many workers with normal nutritional status, because the main factors causing dehydration are determined by adequate fluid intake as needed and environmental conditions with high temperatures. (Andayani & Dieny, 2013; N. A. Sari & Nindya, 2018).

The results of this study indicate that there is no relationship between working period and hydration status. This occurs because workers who work at PT X metal foundry have acclimatized to the working temperature around them. Heat acclimatization is one method that can play a role in reducing the body's negative response to heat stress (Nofianti, 2019). Work period is the duration or time in which a person works at a location. Workers who work in hot conditions are considered to be well acclimatized after being regularly exposed to heat for more than two years of service. Prolonged tenure can be considered an indicator of a worker's expertise in performing their duties, as the types of activities performed are consistent and habit-forming (Sari, 2018). The temperature of the workspace, which is not related to hydration status in this study, is also one of the consequences of acclimatization that has been carried out by workers, so that workers feel accustomed and sensitivity to thirst is low (Tarwiyanti, 2020).

The results showed that there is a relationship between the volume of water intake and hydration status in PT X foundry workers. The negative correlation coefficient value indicates an opposite relationship, which means that the lower the level of drinking water consumption, the greater the possibility of dehydration. It is recommended that drinking water consumption when working in hot environments should be done as often as possible, with an interval of 250 mL every 15-20 minutes (Jacklitsch, 2016). If workers consume water when they feel thirsty only, they will be at risk of dehydration, because the feeling of thirst is less responsive in heat stress conditions and is not sensitive enough to signal the body's need for greater fluid intake. It is recommended that workers in hot environments consume a minimum of 2.8 liters of water per day, but the results of this study found that the average worker consumed only 1954 liters of drinking water per day, which is very far from the minimum amount of water consumption in workers with hot environments. This is in line with previous research, that there is a relationship between the volume of water intake and hydration status. Workers in hot environments need to pay more attention to the frequency of drinking more often. Lack of fluid intake in accordance with body needs can be caused by workers' drinking habits. Ignorance of workers about the information on the adequacy of drinking water that must be consumed and the dangers of dehydration makes workers experience symptoms of dehydration (Atmojo et al., 2023; M. P. Sari, 2017; Tarwiyanti et al., 2020).

CONCLUSION

The conclusion of this study is that the variable most related to hydration status is the volume of water intake (p-value 0.006), while for other variables including age, nutritional status, working period, and work environment temperature are not related to the hydration status of workers at PT X metal foundry. Suggestions for workers should consume drinking water in accordance to NIOSH recommend-dations, every 15 to 20 minutes consuming 250 mL of mineral water, while suggestions for future researchers are to be able to measure hydration status more accurately such as urine measurements using urine specific gravity.

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