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Correlation of Heat Stress to Hydration Status of Workers at Weaving Section of Textile Industries

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Abstract - *PT X is a company plastics and textiles that has 3 section of the production process, one of which is the weaving section. During work, workers are exposed to heat stress which can affect hydration status. The objective of the research is to investigate the correlation of heat stress to hydration status of the workers at weaving section PT X. This research used the observational analytical research method with cross sectional approach. Its population was all of morning work with 60 workers at weaving section PT X. Purposive sampling was used to determine its samples. They consisted of 37 workers. The heat stress was measured with Heat Stress Area and hydration status using urine specific gravity laboratory tests conducted by Solo Laboratory. The data were processed and analyzed by using the Spearman test. The result of this research show that the heat stress had a correlation with hydration status as indicated by the p-value = 0,001.*

Keywords *– Heat Stress; Hydration Status*
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1. Introduction

Structuring the work area needs to pay attention to the temperature of the work environment with the aim of creating a comfortable working environment. The comfort of working temperature for Indonesian people needed to do their jobs is between 24-26^{o}C (Suma'mur, 2009). Indonesian people basically acclimatize the tropical climate, with temperatures around 28-320C or even more (Suma'mur, 2014). Work in hot ambient temperatures can experience heat stress. Heat pressure is one of the physical hazard factors that can provide additional burdens and can reduce the quality of work so that it affects work productivity (Suma'mur, 2009).

Environmental heat exceeds body heat, the body will respond to the occurrence of vasodilation in peripheral blood vessels and spending a lot of sweat (Salami, 2015). The removal of sweat and unbalanced fluid supply into the body can cause dehydration (Triyana, 2012).

PT X is engaged in plastics and textiles. The initial survey on October 28, 2018 with the results of a 4 point heat pressure measurement had an average ISBB of 30.90C. Measuring workload with the pulse method, 10 workers have an average of 103 beats / minute included in the moderate workload category of 100-125 beats / minute, and work time of 8 hours and 1 hour of rest included in the category of 75% -100% working time. The suitability of the heat stress legislation in the weaving section has exceeded the NAV determined by the Minister of Manpower Regulation number 5 of 2018 concerning Occupational Safety and Health of the Work Environment on a work climate with a moderate workload and working time percentage of 75% -100% has a standard ISBB namely 280C. And the results of laboratory tests of urine specific gravity of 10 workers including 6 experienced moderate dehydration and 4 mild. Based on this background, researchers are interested in conducting research on "The Relationship of Heat Pressure with Hydration Status in Labor in the Weaving Section of PT X".

2. Research Methods

This type of research is observational analytic. The research design used was cross sectional. This research was conducted at PT X in December 2018 - June 2019. The population in this study was the morning work shift with a total of 60 workers. This study uses purposive sampling with certain considerations to be used as a sample

(Sugiyono, 2015). The sample used amounted to 37 workers. The independent variable in this study is heat pressure and the dependent variable in this study is the hydration status.

Heat pressure is the formulation of air temperature, humidity, speed of movement of air, and radiation temperature received by workers caused by a work activity and working environment conditions in the form of the measurement results of the average ISBB initial work and before a break in the weaving section of PT X. Retrieval of heat pressure data using the Heat Stress Area tool.

3. Results and discussion

PT X was established on October 9, 1997 engaged in plastics and textiles. Respondents in this study amounted to 37 workers in the weaving section, with age ≤ 40 years, nutritional status (normal body mass index or thin body), not sick (diabetes, vomiting, and diarrhea).

Table 1. Age Frequency Distribution

Characteristics	Mean	Min	Max	*P value*
Age <40 years old	29.91	19	39	0.430

Based on the table above it can be seen that the average age of 37 respondents is 30 years, with the youngest age 19 years and the oldest age is 39 years. Mann Whitney difference test results showed that there was no significant difference in hydration status based on age with a p value of 0.430 (p> 0.05).

Table 2. Distribution of Nutrition Status Tendencies

Characteristics	Median	Min	Max	*P value*
IMT (Normal and Thin)	21.24	17.43	24.97	0.374

From the above table it can be seen that the median nutritional status of 37 respondents is 21.24 kg / m2, with the lowest nutritional status of 17.43 kg / m2 and the highest nutritional status of 24.97 kg / m2. Mann Whitney test results showed that there was no significant difference in hydration status based on nutritional status with a p value of 0.374 (p> 0.05). All respondents numbered 37 not in a state of diabetes, vomiting, and diarrhea.

Table 3. Tabulation of Gender with Hydration Status

Characteristics	Category	Light dehydration	Moderate dehydration	*P value*
Gender	Male	4	2	0.442
	Female	23	8	
	Total	**27**	**10**	

It can be seen that male gender numbered 6 respondents including mild dehydration of 4 respondents and 2 respondents experiencing moderate dehydration, female gender of 31 respondents including mild dehydration of 23 respondents and 8 respondents experiencing moderate dehydration. Mann Whitney difference test results showed that there was no significant difference in hydration status based on sex with a p value of 0.442 (p> 0.05).

Table 4. Tendency for Drinking Water Consumption

Characteristics	Mean	Min	Max	*P value*
Drinking Water Consumption (ml)	937.03	600	1300	0.0001

Based on the table above it can be seen that the average drinking water consumption is 937 milliliters, with the least drinking water consumption is 600 milliliters and the most drinking water consumption is 1300 milliliters. Mann Whitney difference test results obtained that there are significant differences in the status of hydration based on drinking water consumption.

Table 5. Frequency Distribution of Heat Pressure

Heat Pressure Average 31,12^{0}C	Frequency	Percentage (%)
< Average	20	54,1
> Average	17	45,9
Total	**37**	**100**

The results of measurements of heat pressure that are exposed to respondents from 9 points with 2 times each measure are known to mean heat pressure of 31.120C with 20 respondents exposed to heat pressures <average and 17 respondents exposed to heat pressures> average.

Table 6. Frequency Distribution of Hydration Status

Hydration Status (g/ml)	Category	Frequency	Percentage (%)
1.010 - 1.020	Light dehydration	27	72.9
1.021 - 1.030	Moderate dehydration	10	27.1
	Total	**37**	**100**

From the table above it can be seen that all respondents experienced dehydration with mild dehydration category (1,010-1,020 g / ml) totaling 27 out of 37 respondents and moderate level dehydration (1,021-1,030 g / ml) totaling 10 out of 37 respondents.

Table 7. Data Normality Test

Variable	N	*P value*
Heat Stress	37	0.034
Hydration Status	37	0.008

From the results above, the normality of data using the Shapiro-Wilk heat pressure test p value = 0.034 (p> 0.05 normal distribution) and hydration status p value = 0.008 (p> 0.05 normal distribution) can be concluded that the heat pressure and hydration status data not normally distributed, so the correlation test uses the Spearman test.

Table 8. Test the Relationship of Heat Pressure with Hydration Status

Variable	Significances (*p*)	Correlation Coefficient (*r*)
Heat Stress Hydration Status	0.001	0.542

Spearman correlation analysis results heat pressure data with hydration status using SPSS obtained p = 0.001 (p <0.05) which means that there is a significant relationship between heat pressure and hydration status with the correlation coefficient r = 0.542 the value of the strength is between 0.40 - 0.599 and the direction of the positive correlation (+) when the heat pressure increases, the weight value of the urine will also increase.

4. Discussion

In this study had respondents with age ≤ 40 years and the average age of respondents was 30 years. According to Siswantar and Ika (2006) aged> 40 years will experience a decrease in the ability of the skin to resist sweating and loss of the skin's ability to restore body temperature and sensitivity to thirst when exposed to a hot environment. Based on the Mann Whitney test, the p-value of 0.430 (p> 0.05) shows that there is no significant difference in hydration status based on age.

In this study had 37 respondents with normal nutritional status and thin. According to Metta (2012) obesity or excess body fat when exposed to a hot environment will be difficult to release heat in the body so that it is not good in returning the core temperature and fluid requirements are directly proportional to body size. Based on the Mann Whitney test, the p-value of 0.374 (p> 0.05) shows that there is no significant difference in hydration status based on nutritional status.

In this study there were 37 respondents who did not experience pain (diabetes, vomiting, and diarrhea). According to Nelms et al (2010) diabetics facilitate dehydration due to loss of fluid through the urine to balance glucose in high blood pressure and someone who is sick of vomiting will lose fluid from the vomit thus increasing the potential for dehydration. According to Triyana (2012) diarrhea pain facilitates dehydration due to fluid loss through the gastrointestinal tract.

The heat pressure contained in the weaving section is caused by the condition of the room which is covered with asbestos so that when exposed to the sun's heat, asbestos will store heat, then 12 vents with a size of 10 x 25 centimeters mounted above the entrance and exit doors so that air circulation is less smooth which causes air heat inside the room cannot be exchanged with outside air, then there is no exhaust fan or blower and no air conditioning, in addition there are 60 units of weaving machines that are operated so that these conditions can cause pressure. The results of the measurement of heat pressure exposed to respondents from 9 points with 2 times each measure are known to mean heat pressure of 31.120C with 20 respondents exposed to heat pressure <average and 17 respondents exposed to heat pressure> average and workload including the moderate category determined based on workload using the pulse method where the average pulse of work is 109.78 beats / minute (moderate workload) and working time is 8 hours work 1 hour rest (75% -100%). According to the Regulation of the Minister of Manpower number 5 of 2018 concerning Occupational Safety and Health of the Work Environment on a work climate with a moderate workload and the percentage of working time 75% -100% has a standard ISBB of 280C, so that it is summarized from the average results of heat pressure measurements in the weaving exceeds NAV.

Measurement of hydration status in this study in collaboration with Solo Laboratory and obtained the results of all respondents experiencing dehydration with the amount of mild dehydration (1,010-1,020 g / ml) of 27 respondents and moderate level of dehydration (1,021-1,030 g / ml) of 10 respondents.

Bivariate statistical test results to determine the relationship between variables in this study obtained p =

0.001 (p <0.05) which means there is a significant relationship between heat pressure and hydration status. With the correlation coefficient value obtained r = 0.542 shows the strength value is between 0.40 - 0.599, which means the correlation of heat pressure with hydration status is moderate with a positive correlation direction (+) which means that if the heat pressure increases, the hydration status will increase (value BJU increases) or more dehydration occurs, so heat stress has a contribution to the hydration status or dehydration state. According to Kenefick et al, (2012) during physical work in hot environments, sweat production often exceeds water consumption which can trigger water shortages or dehydration. According to Fajrianti, Shaluhyah and Lestantyo (2017) the occurrence of a state of dehydration caused by hot work environment factors can be prevented by drinking 200 - 300 milliliters / 30 minutes of water. The results of research conducted for the supply of drinking water in the work area have not been fulfilled and there is no socialization about the need for drinking water consumption when working causes workers to be less in meeting drinking water consumption needs. The absence of information on checking the urine itself (PURI) on the toilet causes the worker does not know the description of hydration status when working. The existence of uncontrolled confounding factors such as sex, drinking water consumption, physical activity and consumption of diuretic drugs, so as to facilitate the dehydration state.

5. Conclusion

Measurement of heat pressure in the weaving section of PT X from 9 measurement points were all above the NAV with an average yield of 31.12^{0}C.

The hydration status of workers in the weaving section of PT X showed that 37 respondents were all dehydrated with 27 respondents experiencing mild dehydration and 10 respondents experiencing moderate dehydration. There is a significant relationship between heat pressure and hydration status of workers in the weaving section of PT X with p value = 0.001.

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