



Increased Creatinine Levels Among Heat Exposed Workers In Grobogan Tiles Industry, Central Java, Indonesia

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ABSTRACT

Heat pressure in the tile production process occurs during the drying and burning stages. This working climate can lead to dehydration and more severe clinical consequences such as kidney problems and elevated creatinine levels in workers. This cross-sectional study involved 41 tile workers in Karangasem Village, Wirosari Grobogan District. This study aims to determine the relationship between age, BMI, body temperature, history of energy drinking disease, smoking habits, water consumption, length of work, and physical activity with creatinine levels. Data analysis

was in the form of univariate, bivariate and multivariate analysis and this research had conducted etical clearance. The results of this study are the variable age has an mean value of 33.59, the mean BMI of the respondents is 22.037 kg / m², the mean creatinine level is 1.102 mg / dL, the length of work has an mean value of 8.56 hours, the mean body temperature is 37.12 °C, total water consumption has a mean of 2.329 liters, the mean number of cigarettes smoked is 6.12 cigarettes per day and the mean physical activity is 1475.83 MET. Creatinine levels in the blood in workers who are not normal as many as 15 people (36.6%). History of disease, water consumption and age are related to blood creatinine levels. Meanwhile, the most dominant variables based on the logistic regression test were water consumption and age.

Keywords: Creatinine, Heat Exposure Workers

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INTRODUCTION

The process of making roof tiles includes the provision and processing of raw materials, printing, drying and burning. This series of processes puts workers in a hot working climate and is at risk of health problems, especially decreased kidney function and increased creatinine levels (Indriani, Siswandari and Lestari, 2017; Ueno *et al.*, 2018; Rojas-Valverde *et al.*, 2019; Venugopal *et al.*, 2020). The heat pressure in the work environment in the tile industry exceeds the threshold value. Exposure to hot work climates causes health problems with clinical conditions in the form of increased blood pressure, increased pulse rate, excessive sweating, and increased body temperature (NIOSH, 2016). Creatinine is a byproduct of the body's normal metabolism during energy production (Vigh-Larsen *et al.*, 2020). If creatinine increases, it indicates that there is a decrease in kidney function and a buildup of creatinine in the blood (Oginawati, Susetyo and Pratiwi, 2020)-(Hansson *et al.*, 2020)-(Pottel *et al.*, 2017). Factors that affect creatinine levels are age, BMI, body temperature, history of disease, energy drinks, smoking habits, drug consumption, drinking water consumption, physical activity, and length of work (Hidayati and Kushadiwijaya, 2008; Syahlani and et al, 2016; Nerbass *et al.*, 2017, 2019; Wegman *et al.*, 2018; Sawant *et al.*, 2018; Hansson *et al.*, 2019; Naik *et al.*, 2019; Rojas-Valverde *et al.*, 2019; Al-Bouwarthan *et al.*, 2020; Venugopal *et al.*, 2020).

The air temperature in tile burning reaches 6000C (Kartika and Darmawan, 2008). This condition greatly affects the health of workers (Nerbass *et al.*, 2017). Short-term health problems include muscle cramps, excessive sweating, fatigue (Krishnamurthy *et al.*, 2017),(Flouris *et al.*, 2018) while long-term health problems are kidney stones, ischemic heart disease, and liver disorders (NIOSH, 2016; Moyce *et al.*, 2017; Pradhan *et al.*, 2019). Health problems experienced by workers are 16% musculoskeletal, 8% cardio vascular, 3% neurological disorders, 1.5% ENT (Kemenkes RI, 2019). Creatinine is a chemical molecular waste produced from muscle metabolism (Oginawati, Susetyo and Pratiwi, 2020). Creatinine is carried by the blood to the kidneys and excreted in the urine.

There is a relationship between age, BMI, body temperature, medical history, energy drinks, smoking habits, drug consumption, drinking water consumption, physical activity and length of work with creatinine levels in tile-making workers. The purpose of this study was to determine the relationship between age, BMI, body temperature, history of energy drinking disease, smoking habits, water consumption, length of work, and physical activity with creatinine levels. The owner of the industry does not currently monitor the health of workers in comparison to the Minister of Manpower and Transmigration Regulation No. 02 / MEN / 1980 which discusses the need for workforce health checks in implementing work safety. Based on the explanation above, it is necessary to monitor creatinine levels as an effort to monitor the health conditions of workers and as an early indication of health problems due to heat stress.

METHODS

This research is an observational study. The approach used is cross-sectional, namely the observation or measurement of data that is carried out simultaneously at one time.



Respondents in this study were 41 workers with the characteristics of age, BMI, body temperature, and a history of tile-making disease in Karangasem Village RT 01 Wirosari Grobogan District.

The independent variables in this study were age, BMI, body temperature, history of disease, energy drinks, smoking habits, drinking water consumption, physical activity and length of work. The dependent variable is creatinine level.

The research instrument used interviews with questionnaires for variables of age, body temperature, disease history, energy drinks, smoking habits, drinking water consumption, length of work and the Global Physical Activity Questionnaire (GPAQ) questionnaire for physical activity variables. As well as the calculation of the Body Mass Index (BMI).

The data obtained were interpreted in three parts, namely univariate, bivariate and multivariate. Chi-square analysis was used to determine the relationship between the independent and dependent variables for the bivariate test and for the multivariate test using multiple logistic regression to determine the most dominant influencing variable. This research has received proper ethics from the KEPK FKM UNIMUS number 362 / KEPK-FKM / UNIMUS / 2020.

RESULTS

1. Univariate



Table 1. Frequency Distribution of Respondents by Age, BMI, Body Temperature, History of Disease, Consumption of Energy Drinks, Smoking Habits, Drinking Water Consumption, Physical Activity, Length of Work, and Creatinine Levels

Variable	Category	f	Percentage (%)	Min	Max	Mean	Std. Deviation
Age	< 30 years	21	51,2	21	58	33,59	10,102
	≥ 30 years	20	48,8				
BMI	Normal	34	82,9	18,1	26,7	22,037	2,4781
	Abnormal	7	17,1				
Body temperature	Normal	26	63,4	36,5	38,1	37,120	0,5326
	High	15	36,6				
History of Disease	There is	15	36,6	-	-	-	-
	Not	26	63,4				
Energy drink	Yes	19	46,3	-	-	-	-
	Not	22	53,7				
Smoking habit	Yes	22	53,7	0	21	6,12	6,838
	Not	19	46,3				
Drinking water consumption	Enough	21	51,2	1,0	5,0	2,329	1,2728
	Less	20	48,8				
Physical Activity	Low	13	31,7	500	4100	1475,83	1203,866
	Moderate	17	41,5				



Variable	Category	f	Percentage (%)	Min	Max	Mean	Std. Deviation
	High	11	26,8				
Length of working	< 8 hours	9	22	7	10	8,56	1,184
	≥ 8 hours	32	78				
Creatinine Levels	Normal	26	63,4	6	2	1,102	0,3927
	Abnormal	15	36,6				

Table 1 explains that most of the respondents aged <30 years were 21 people (51.2%) with a minimum value of 21 years and a maximum of 58 years with an average of 33.59, and a standard deviation of 10.102. The body mass index of the most respondents was the normal BMI of 34 people (82.9%) with the largest respondent being 26.7 kg / m², an average of 22.037 kg / m² and a standard deviation of 2.4781. The results of body temperature measurement showed that most of the respondents had normal body temperature as many as 26 people (63.4%) with a maximum result of 38.1 °C. The maximum number of cigarettes smoked is 21 cigarettes per day. Most respondents did not have a history of disease as many as 26 people (63.4%), respondents did not consume energy drinks as many as 22 people (53.7%), sufficient drinking water consumption was 21 people (51.2%) with an average amounting to 2.329 liters. Moderate physical activity as many as 17 people (41.5%) with a minimum value of 500 MET. The length of work ≥ 8 hours worked as many as 32 people (78%) with a minimum value of 7 hours, a maximum of 10 hours with an average of 8.56. The creatinine levels of most respondents were normal as many as 26 people (63.4%) with a maximum value of 2.0 mg / dL, a mean of 1.102 mg / dL and a standard deviation of 0.3927.

2. Bivariate

Table 2. Results of Bivariate Analysis

Variable	Category	Creatinine				Amount		p value
		normal		abnormal		f	%	
		f	%	f	%			
History of disease	Not	22	84,6	4	15,4	26	100,0	0,000
	There is	4	26,7	11	73,3	15	100,0	
Amount		26	63,4	15	36,6	41	100,0	
Drinking water consumption	Not	13	59,1	9	40,9	22	100,0	0,746
	Yes	13	68,4	6	31,6	19	100,0	
Amount		26	63,4	15	36,6	41	100,0	
Smoking habit	Not	11	57,9	8	42,1	19	100,0	0,533
	Yes	15	68,2	7	31,8	22	100,0	
Amount		26	63,4	15	36,6	41	100,0	
Physical Activity	High	5	45,5	6	54,5	11	100,0	0,351
	Moderate	12	70,6	5	29,4	17	100,0	
	Low	9	69,2	4	30,8	13	100,0	
Amount		26	63,4	15	36,6	41	100,0	
	Normal	17	65,4	9	34,6	26	100,0	0,749



Variable	Category	Creatinine				Amount		p value
		normal		abnormal		f	%	
		f	%	f	%			
Body Temperature	High	9	60,0	6	40,0	15	100,0	0,693
Amount		26	63,4	15	36,6	41	100,0	
BMI	Normal	22	64,7	12	35,3	34	100,0	
	Abnormal	4	57,1	3	42,9	7	100,0	0,076
Amount		26	63,4	15	36,6	41	100,0	
Length of working	<8	8	88,9	1	11,1	9	100,0	
	≥8	18	56,3	14	43,8	32	100,0	0,000
Amount		26	63,4	15	36,6	41	100,0	
Water Consumption	Enough	20	95,2	1	4,8	21	100,0	
	Less	6	30,0	14	70,0	20	100,0	0,004
Amount		26	63,4	15	36,6	41	100,0	
Age	<30	18	85,7	3	14,3	21	100,0	
	≥30	8	40,0	12	60,0	20	100,0	
Amount		26	63,4	15	36,6	41	100,0	

Based on the chi square test, it is known that energy drinks, smoking habits, physical activity, body temperature, BMI and length of work are not related to blood creatinine levels. Meanwhile, history of disease, water consumption and age were related to creatinine levels in the blood of workers who were exposed to heat, so that these variables were continued into logistic regression analysis.

3. Multivariate

Table 3. Results of multivariate analysis

Variable	β	P value	Exp β
Age Category	2,179	0,089	8,838
Water Consumption Category	4,044	0,004	57,076
Constanta	-2,779	0.096	0,062

Based on the results of multiple logistic regression tests in Table 3, it is explained that the factors that affect the creatinine levels of tile industry workers in Karangasem Village RT 01 Wirosari Grobogan District are age and drinking water consumption.

DISCUSSION

Based on the results of the chi square test, it was explained that age, drinking water consumption, and history of illness were factors that were related to creatinine levels. Age based on test results is one of the factors associated with creatinine levels (Dally et al., 2020). Creatinine levels in older people are much higher than in younger people (Isnabella, 2018). As



a person gets older, the kidneys work process dysfunction (Guinovart et al., 2017). This is because the kidney cells experience necrosis, where the function of the cells has been working continuously, so that they experience disruption in the process of filtering metabolic waste products in the body (Yuliana, 2018).

The results of this study indicate that creatinine levels are influenced by drinking water consumption. Respondents in this study have varied drinking water consumption habits, based on the amount of drinking water they consume each day. Consumption of water from food sources and drinks is very much needed by the body for the process of circulation in the body for cell transport and regulating body temperature, this loss of water will cause dehydration (Pendidikan et al., 2016). Lack of fluids can damage organs and accumulate toxins in the blood which can cause deterioration of kidney function. creatinine is a sign or examination to determine the function of both kidneys (Nerbass et al., 2019), (Pédehontaa-Hiaa et al., 2020), and (Wegman et al., 2018). If there is impaired kidney function, creatinine levels increase (Oginawati, Susetyo and Pratiwi, 2020).

Workers who have been exposed to heat have a history of disease that can affect blood creatinine levels. Like hypertension, which is the cause of chronic kidney disease which is marked by an increase in creatinine levels in the blood (Hidayati and Kushadiwijaya, 2008), (Loho, Rambert and Wowor, 2016). The chronic increase in pressure and strain on the arterioles and glomerulus can cause sclerosis of the glomerular blood vessels (Sawant et al., 2018), (Riesberg et al., 2018). A decrease in the number of nephrons will cause an adaptive process, namely an increase in blood flow, an increase in the glomerular filtration rate and an increase in urine output in the nephrons that are still persistent. This process involves hypertrophy and vasodilation of the nephrons as well as functional changes that reduce vascular resistance and reabsorption of tubules in the surviving nephrons. Changes in kidney function over a long period of time can result in further damage (Loho, Rambert and Wowor, 2016), (O'Brien, Upson and Buckley, 2017).

In addition to hypertension, other diseases that can cause an increase in creatinine levels are diabetes militus (Syahlani and et al, 2016), (Sorensen et al., 2019). The hyperglycemic state due to diabetes can interfere with the work of the kidneys because the threshold for blood sugar is 180 mg% so that if hyperglycemia occurs, the kidneys cannot filter and absorb a certain amount of glucose in the blood, one indicator of kidney function is to assess the Glomerular Filtration Rate (GFR) (Pottel et al., 2017), (Sawant et al., 2018). The GFR provides information about the amount of functioning kidney tissue, if the GFR value decreases, the urea and creatinine levels will increase (Sawant et al., 2018).

The results of multiple logistic regression tests show that the factors that play a role are age and drinking water consumption. Factors affecting creatinine levels of tile industry workers in Karangasem Village RT 01 Wirosari Grobogan Subdistrict are age category and drinking water consumption category. Workers who are <30 years old and consume enough drinking water have a probability

High creatinine levels are 96.89% compared to workers aged ≥ 30 years and less drinking water consumption, namely the probability of high creatinine levels of 99.99%. From this equation, it can be interpreted that workers who are ≥ 30 years old and consume less drinking water have a risk of high creatinine levels of 0.9689 times.



CONCLUSION AND RECOMMENDATION

The results of research conducted in tile industry workers in Karangasem Village RT 01 Wirosari Grobogan District showed that disease history, water consumption and age were related to blood creatinine levels. Meanwhile, the most dominant variables based on the logistic regression test were water consumption and age. It is important to carry out further research on how to reduce creatinine levels in the blood in workers.

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