

Effect of Physical Hazard on Lactic Acid Level

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Abstract- Labor certainly deal with the workload. The workload can be influenced by several factors, including the factor that comes from physical work environment such as temperature, ambient air humidity, air velocity, radiation, light intensity, noise, mechanical vibration and air pressure. The objective of this study is to know The effect of noise exposure and work climate on fatigue as measured by lactic acid in the blood of workers at PT. Iskandar Indah Printing Textile Surakarta.

Sample of this research consist of 42 workers who were divided into two different group. The first group as workers who work at high noise and heat stress, second group as control for comparison. The dependent variable in this study is fatigue which was measured by lactic acid. This reaserch shows that the mean intensity of the noise from the work environment weaving is 97,16 dBA higher than the threshold value (TLV) and mean intensity work environment office is 68,20 dBA. Mean work climate in weaving is 31,06°C higher than the threshold value (TLV) for average work load and office 25,82°C. Based on linear regression analysis showed that the correlation coefficient (adjusted R-square) is 0.500, which means that the independent variable that could explain the fatigue of 50% and 50% influenced by other factors with significant 0.004. Significant independent habit of exercise, work load, and noise. The major contributing variable is habbit of exercise ($\beta=0,442$). Recommendations for workers at PT. Iskandar Indah Textile are advised to perform stretching exercises (stretching) a few minutes on the sidelines to work to avoid fatigue caused due to static working conditions in some parts of the worker's body.

Index Terms- Physical hazard, fatigue, lactic acid

1. INTRODUCTION

Work is an activity or activity that is dynamic can't be released from the cycle of human life. Such activity includes both physical and mind in doing, releasing, designing and getting things in order to get a reward or wages. These activities will continue in the cycle of human life for the sake of securing the necessities of life.

Man in work is very different from the machine. Humans will use feelings, thoughts and social life in the work. Humans have a sense of love and hate, joy and sadness, daring and fear, has the will, the will, imagination and ideals. In addition, humans are also social beings who always interact with other creatures either at home, in the workplace and in the wider community so that it will affect their thoughts and considerations in determining the attitude and stance. Some of these factors greatly affect their situation in the job (Suma'mur, 2009).

Various health and safety issues that may arise in the work environment is the negative impact of a job, so it is necessary to guarantee the protection of all workers who work. As described in Law No. 13 of 2003 on employment, which states that the protection of workers, including protection of safety, health, morals maintenance work included a guarantee of protection is immoral and dignity of labor. Such

protection must be met by each company as a form of companies' compliance with rules and regulations that exist in Indonesia.

Each perform the work, labor will always be faced with the workload. The workload can be influenced by several factors that exist in the work environment, including the factor that comes from physical work environment such as temperature, ambient air humidity, velocity of air, radiation, light intensity, noise, vibration mechanical and air pressure (Tarwaka, 2010).

According to Roestam (2004) noise not only cause permanent health problems such as deafness, but can also cause interference psikologis form of discomfort, lack of concentration, insomnia, irritability. If the noise is received in a long time can cause psychosomatic diseases such as gastritis, stress, and fatigue. Vibration is also a hazard that often appear together with their noisy. Vibration is a physical factor that spreads to the human body, ranging from hand to resonate throughout the body (oscillation). As a result of these vibrations can lead to increased muscle tone that causes fatigue, where it is happening at a frequency of 20 Hz (Suma'mur, 2009).

Noise, vibration and climate in the work environment is the inevitable presence in an industry. The third factor that environment if not handled or

controlled properly can cause resonance of organs and tissue, affecting the work force is exposed in the form of complaints physiological fatigue. According to the study conducted previously by Rinawati (2013) mentioned that the noise and vibration in the working environment can be one of the causes of fatigue. The results showed that the correlation test the significance of values obtained with the p value is 0.000 (R 0.749). For the value of determination coefficient R² is 0.560, which means the intensity of mechanical vibration and noise intensity jointly capable of affecting 56.0% change in the variable fatigue.

Besides other research on fatigue done by Joko (2007) stated that the results of hypothesis testing research shows no significant effect between exposure to vibration, noise and knowledge K3 against fatigue with p value ($P < 0.010$) on labor taxi drivers of water (klotok) in Banjarmasin. Research conducted by Lukman et al, (2014) in the Online Journal of National Institute of Technology stated that noise is one of the physical environmental factors that can cause fatigue in the driver based on heart rate variability. The result of the correlation between noise with variable HRV has a strong enough correlation value. Explained that the existing noise can interfere with communication. Machinist will be required to be more concentration in listening to the information provided by Regulatory Train Journey (dispatcher), wherein the concentration of this excess will cause a machinist expend excess energy that accelerates fatigue.

According Ramdan (2007) in his study mentioned that the working environment temperature and noise are physical factors that can interfere with the work if not properly controlled. Statistical results obtained arithmetic $t = -4.142$ and $p = 0.000$ ($p < 0.05$) in the group that worked with the temperature and noise under the NAB, $t = -7.472$ and $p = 0.000$ ($p < 0.05$) for groups that work with temperature and noise above the NAV, which means that there are significant differences in feelings of fatigue in the group that worked with the temperature and noise above NAV compared with the group that works with the temperature and noise under the NAB. According Sahab (1997) when the hot environmental conditions combined with physical load, the load received by the worker becomes larger so that fatigue can occur in a short period of time.

In healthy people, the amount of blood lactic acid levels ranged from 1 to 1.8 mmol / L. Blood lactic acid levels that are above the normal average (greater than 2 mmol / L) is an indication of fatigue (Fox, 1993, Mattner, 1988, in Pangestu, 2014). According to Mc - Gee and Bowman in Mc Ardle (2002) states that a threshold concentration of lactic acid in the blood is 4 mmol / L of blood indicate muscle activity has become anaerobic, or without oxygen supply, while the threshold concentration of blood lactic acid

reaches 8 mmol / L virgin or more indicates someone has already started to experience physical fatigue.

PT. Iskandar Indah Printing Textil is a company engaged in the field of weaving (weaving), and printing fabrics. The process of making fabric in PT. Iskandar Indah Printing Textile consists of three phases: preparation consisting of winding, warping, zising, and ricing, then the stage of weaving yarn into fabric which is also called the process / weaving / loom, and the last stage is the office that consists of inspecting and folding. Based on this background, the researchers wanted to conduct further research on the effects of noise, climate (WBGT) and vibration (whole body) against fatigue by taking into account the independent variables are derived from the individual characteristics of workers in PT. Iskandar Indah Printing Textile Surakarta.

2. METHOD

The study was designed as an observational study and conducted by cross sectional method. Samples were obtained by using the technique of strata sampling. The Population in this study was all employees at weaving and office PT. Iskandar Indah Textile Surakarta and after calculated the sample size of this study are 42 workers that 29 weaving and 13 office.

The dependent variable in this study is fatigue which was measured by lactic acid and the independent variables are the characteristics of workers (age, year, habit of exercise, nutrition status, work load, time of measurement), and environmental factors (noise and work climate). In this study worker's lactic acid level compared with normal value 2 mmol/l.

3. RESULT

This reaserch shows that the mean intensity of the noise from the work environment weaving is 97,16 dBA higher than the threshold value (TLV) and mean intensity work environment office is 68,20 dBA. Mean work climate in weaving is 31,06°C higher than the threshold value (TLV) for medium workload and work climate at office 25,82 °C. The average age of the respondents is 42.88 or 43 years. The min age of the respondents was 20 years and the max was 60 years. The Most age of respondents were > 43 years. The average tenure of respondents in the weaving section and the office was 21.5 years. Analysis description habit exercising, nutritional status and workload at respondents at weaving and office can be seen in Table 1.

Table 1. Description Sports Habits, Nutrition Status and Workload of Respondents at Weaving and Office

Respondents Characteristic	Frequency	Mean (calorie/hour)	
		Weaving	Office
Sports habits	Yes	13	
	No	29	
Nutrition status	Nutrition (less)	1	
	Good nutrition	8	
	Nutrition (over)	33	
Work load	Low	32	
	Medium	10	202,41
	High	-	191,01

Table 2. Description of Fatigue by Lactic Acid in Blood Of The Respondents at Weaving and Office

Test	Lactic Acid Level in Blood (mmol/l)			
	Mean		Min	Max
	Office	Weaving		
Before working	1,55	1,15	0,10	4,90
After working	2,63	1,66	0,10	5,80
Difference before and after working	1,07	0,50	-1,70	4,80

Multivariate analysis performed in this study is the linear regression test. Linear regression was conducted to analyze the effect of each independent variable on the dependent variable and look Which most influential independent variable on the dependent variable. Here are the results of linear regression of factors which effect on fatigue is seen by lactic acid levels in the blood can be seen in Table 3.

Table 3. Analysis of The Effect between the Dependent Variables and Independent Variables (Lactic Acid Levels in Blood After Work)

Independent variable	Rsquare	Anova Pvalue	β	P
Age			-0,064	0,750
Tenure			0,172	0,382
Habits exercising			0,442	0,003*
Good nutrition			0,494	0,183
Malnutrition (over)	0,500	0,004	0,622	0,096
Work load			0,336	0,022*
Time of Measurement			-0,158	0,237
noise			-0,755	0,003*
Climate			0,448	0,069

4. DISCUSSION

Based on Minister of Manpower and Transmigration No.Per.13/MEN/X/2011 on the Threshold Limit Value Physical and emical Factor at work, that the value of noise in workplace for 8 hours is 85 dBA and the value of climate in workplace for 8 hours with medium workload is 28 °C.

The 42 respondents who have a habit of exercising only 13 people (31.0 %), have good nutrition 8 people (19.0 %) remaining malnourished over 33 people (78.6 %) and malnutrition 1 (2.4 %). Workers who have low in workload as many as 32 people (76.2 %) and who have medium workload was as much as 10 people (23.8%). The average low workload experienced by all respondents was (191.01 calories/hour) at office, but the medium one at weaving was (202,41 calories/hour).

Measurements were made as much as two times, before and after work. The average yield of lactic acid levels in the blood before working office section 1.55 mmol/l and weaving 1.15 mmol/l. For the minimum value between the office and weaving are the same, namely 0.10 mmol/l and the maximum value was 4.90 mmol/l were found in respondents from the weaving. Lactic acid levels in the blood after the respondent works in the office was 2.63 mmol/l and weaving of 1.66 mmol/l with a standard deviation of 1.62 mmol/l, while the minimum value for the section office and weaving are the same ie 0.10 mmol/l. Maximum value was 5.80 mmol/l and contained in section respondents office. The difference between the after work and before working in the office of 1.07 mmol/l and in the weaving of 0.50 mmol/l with a minimum value of -1.70 mmol/l and a maximum of 4.80 mmol/l.

The threshold values for determining the fatigue failure of a person in this study refers Fox, 1993; Mattner, 1988; in Pangestu, 2014 stated that the lactic acid levels that are above the normal average is greater than 2 mmol/l is indicative their fatigue in a person. See the reference values known that the measurement of fatigue based on the average results did not show any fatigue, but based on the data of individuals it is known that fatigue in this study categorized as moderate, as is evidenced by the maximum value reached 5.80 mmol/l after the respondent works.

Based on table 3 shows that the independent variables together significantly influence the occurrence of fatigue in workers based on the levels of lactic acid in the blood. It can be seen from the P (0,004), which means < 0.05 . The influence that can be provided by the independent variables simultaneously viewable by Rsquare value (0.500), which means the simultaneous independent variables can affect the occurrence of fatigue by 50 %, while 50 % more likely influenced by other factors not examined in this penelitiann like monotony of work, shift work, overtime, work motivation, job stress, work conflict and lighting.

In this research not all the independent variables can influence the occurrence fatigue, only 3 variable independent that can influence occurrence fatigue. They are exercise habit, workload and noise. The most influential variable in this study is the habit of exercise, it is seen by $\beta = 0.442$.

The research results obtained in line with research conducted by Setyowati et al., (2014) states that the results of multivariate analyzes were carried out on the results of research one of the physical work environment factors that influence the occurrence of fatigue in workers in Jepara furniture is noise and work climate. Another study conducted by Farida (2008) also stated that in his research work load influences the occurrence of fatigue.

Exercise habits is a variable that is used to see the condition of fitness which is owned by the respondent, where fitness is closely related to maximal oxygen intact (VO₂max) person. Pangestu (2014) in his study mentioned that the level of maximal oxygen consumption (VO₂max) high can help the process decreased levels of lactic acid in the blood quickly and vice versa that the level of maximal oxygen consumption (VO₂max) is low can help the process decreased levels of blood lactic acid slowly.

5. CONCLUSION

Based on the results of measurements of physical factors in the weaving and office, the result of noise exposure weaving section average was 97.16 dBA and office section 68.20 dBA. For the working climate exposure (WBGT) weaving division Average 31.06 °C

with a medium workload and office division 25.82 °C with a high workload.

The measurement of fatigue in the weaving section of workers and office use indicators lactic acid levels in the blood before working the mean is 1.15 mmol/l for weaving section and 1.55 parts office, while after work 1.66 mmol/l for weaving section and 2.63 mmol/l at the office.

There are three independent variables that influence in the study of the occurrence of fatigue in workers in the weaving and office of the 8 variables studied were noise, workload and exercise habits based indicators levels of lactic acid in the blood, while the analysis results using reaction times result not significant. For the most dominant variable to the onset of fatigue in this study is a variable exercise habits of respondents with $\beta = 0.444$.

6. SUGGESTION

Suggestion from this study are the company in order to improve the management of environmental conditions of work, especially physical work environment according to results of this study, it is suggested that the company can carry out repairs and maintenance of the machine regularly so that physical factors such as noise and vibration can be minimized its existence and future use of any of these machines can be longer. considering the work has been weaving for climate go beyond a specified threshold value for the category of the workload being then the supply of mineral water (plain water) of the water tea is more advisable to avoid dehydration on workers. Workers both weaving and office part advised to perform stretching exercises (stretching) a few minutes on the sidelines to work to avoid fatigue caused due to static working conditions in some parts of the worker's body.

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