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Factors Contributing to Labor Fatigue in Tofu Factory in Kediri

Fahma Tanzila Lahudin[1], Rachmaniyah[1], Khambali[1], Rusmiati[1], Sahabat Sutanto[1], and Aini Ahmad[2]

[1] Department of Environmental Health, Health Polytechnic Ministry of Health Surabaya, Ministry of Health Republic of Indonesia, Indonesia
[2] KPJ International University College of Nursing and Health Sciences, Malaysia

Corresponding author: Fahma Tanzila Lahudin (e-mail: fahmatanz123@gmail.com).

ABSTRACT Fatigue has an impact and risk to workers, there are many work mistakes, decreased productivity, stress due to work, occupational diseases, and injuries caused by work accidents. The working climate with high temperatures has an effect on the occurrence of fatigue in the workforce. Preliminary studies conducted at the Kediri Tofu Factory showed that 3 workers said they were tired, 2 workers said they were very tired and 1 labor force said they were not too tired. The 6 workers said that in the production room it was hot. This study aims to find out the factors that contribute to labor fatigue in the Tofu Factory. This study is an observational study with a cross-sectional approach. Data collection was carried out by observation, interview and measurement. The population in the study was as many as 40 workers. The retrieval technique used is Ordinal Regression. The data obtained will be analyzed using the Ordinal Regression test. The variables in this study are labor fatigue as a bound variable and the hot work climate as a free variable. From statistical analysis, work fatigue is influenced by labor characteristics, namely age and gender ($p \leqslant 0.05$). The results of the measurement of fatigue before work showed that the entire workforce experienced low fatigue and fatigue after work as much as 22.2%, moderate fatigue as much as 33.3% and high fatigue as much as 44.4%. The results of measuring the working climate in the production space average 32C which means it exceeds the NAV. The results of statistical tests showed that there was a significant effect of the work climate on labor fatigue of $0.001 \leqslant 0.05$. This heat source comes from the fuel used in tofu boiling, which uses firewood and hot steam produced from boiling tofu so that body temperature increases and causes fatigue. Factors that affect labor fatigue are age, gender, and work climate. Advice to provide a place to drink, the addition of ventilation to reduce heat exposure.

INDEX TERMS hot working climate, labor, labor exhaustion, tofu factory.

I. INTRODUCTION

Employee safety means referring to their happiness in the workplace. Work safety is an important part that should be the main focus of a company. This is because occupational safety has a correlation with the sustainability of workers' lives [1]. All sources that are dangerous and are in the workplace also have various types. Bahay lurking one of them is physical hazards, including a hot working climate [2]. The hot working climate allows a person to be slower to work [3]. This hot climate also has an impact on decreasing the level of efficiency and productivity in work [4]. The hot working climate also has a direct impact on the increasing fatigue levels of workers [5].

Furthermore, working in a very hot climate work environment will make workers experience pressure from the hot temperatures around them. Heat pressure is one of the signs of the maximum threshold of receiving heat loads experienced when performing work and environmental factors (such as exposure to overheated ambient temperatures, humidity, air movement, and heat transfer radiation), physical loads that become heavier, rest periods that are severely less or even less than sufficient, and clothes that must be adapted to conditions [6]. Thus, a hot work environment causes the workforce to get tired quickly, drowsy, decreased ability to think and increases the number of work errors [7].

In addition, other factors that also cause fatigue include strenuous activities, workload, improper seating, wrong work attitudes, repetitive or even inadequate movements so that there is a possibility of injury, extreme or inadequate work environment, the psychology of employees who are most likely to vary, the need for calorie intake for workers who are

less than the minimum standard, and less than enough rest time [8]. Other factors that can increase worker fatigue are also some, such as excessive physical work activity, work activity that is mental and physical squeeze, work positions that are less or even not appropriate at all, work tends to be silent or static and lacks a lot of movement variations, attitudes that seem forced, monotonous work, extreme work environments, merntal pressures, work and rest time that does not meet the minimum standards of human health [9]. Based on the results of previous studies, the number of cases related to this topic of work fatigue is 18,828 (32.8%) for fatigue and 7,347 (12.8%) for disturbed sleep. For sleep disorders, significant predictors become: female sex, age over 49, current illness, hectic work, physically heavy work such as the presence of a hot climate, and shift work. For fatigue, significant predictors became female sex, under-49 age, high socioeconomic status, current illness, hot work climate, overtime work, and heavy physical labor.

Furthermore, there are also the results of the International Labour Organitation (ILO) research stated that of the 58,115 respondents studied, as many as 32.8% of them experienced fatigue. The survey, which was conducted in several developed countries, noted that some reported that between 10-50% of workers or employees in many companies experienced work fatigue with many obvious and unclear causal factors. This work fatigue is concentrated in figures with a total of 25% of all female workers experiencing work fatigue, while in male workers only 20% of the total male workers surveyed. With a prevalence of fatigue of about 20% among patients who come in need of health services [10]. Research conducted at the Opak Factory on Jalan Kutalimbaru, Tuntungan I Village, Medan also showed that opaque factory workers who experienced mild work fatigue were 3 people (10%), moderate work fatigue was 20 people (66.7%) and high fatigue was 7 people (23.3%) and the results of measuring the average temperature of 35.54□C, which means that the temperature in the production part of the opaque plant exceeded the threshold value [11]. Further, although fatigue is a key component of chronic fatigue syndrome, its definition and measurement are still relatively undeveloped. Most studies on fatigue have been work-oriented or task performance and have involved laboratory studies of healthy individuals, whereas studies on fatigue as encountered in clinical settings have received minimal attention from researchers [4].

Based on the abovemap, there are several real problems that the author encountered in the field. One of them is in the Gudange Tahu Tahu Takwa (GTT) Industry of Kediri Regency. Gudange Tahu Takwa (GTT) industry which is also a center for souvenirs typical of Kediri regency as a place to sell the products of existing SMEs, as well as being a destination location for tourists looking for souvenirs typical of Kediri. The preliminary study conducted at the Tahu Gudange Tahu Takwa Factory on July 11, 2021, was conducted on 6 respondents in the production department. The results of the preliminary study showed that 2 workers felt very exhausted by relieving fatigue throughout the body, stiff shoulders, back pain, drowsiness and frequent yawning and feeling difficult to concentrate and feeling lightheaded. Furthermore, the 3 workers felt the usual fatigue such as back pain, feeling thirsty, unable to concentrate, and often yawning while working and 1 worker feeling less tired just feel sleepy and often yawn and difficult to think. The manpower in this part of the production did not stay overnight in the factory and rested inside the factory. The results of measuring the hot working climate by assessing the Wet and Ball Temperature Index (ISBB) carried out at 2 points in the production room in the tofu boiling process and in the soybean boiling process averaged 31.95. The result of measuring wind speed is 0.31 m / s which means it is less high for ISBB 31.95, humidity measurement is 62% which means dry. The results of workload observations using the observation table regulated in Permenkes Number 70 of 2016 concerning Industrial Occupational Environment Health Standards and Requirements show that the production department workforce performs medium workloads with the activity of doing work using hands and arms, with arms and legs, with arms and waists, pushing, pulling light loads, walking normally. Based on the results of workload observations, it can be known that the NAV of ISBB in the production room is 28C with a working time of 8 hours and a break of 1 hour so that it can be concluded that the workforce with moderate workload in the production room is exposed to a work climate that exceeds the NAV.

Based on the results of the preliminary study above, it shows that the workforce experiences fatigue with a hot work climate, therefore it is necessary to conduct further research with the aim of raising the problem in a research paper entitled "Factors Contributing to Labor Fatigue in tofu factories, Kediri". Based on the results of the preliminary study above, it shows that the workforce experiences fatigue with a hot work climate, therefore it is necessary to conduct further research with the aim of raising the problem in a research paper entitled "Factors Contributing to Labor Fatigue in tofu factories, Kediri".

II. METHOD

The method used is observational using a cross sectional approach. The types of data used in this study are primary data including work fatigue, workload, working mass, age, and health status of workers. Data collection was carried out using observation, interview, and measurement methods. The study population was 40 workers/employees at the GTT Tofu Factory, Kediri Regency. The inclusion criteria in this study are labor in the soybean boiling, tofu boiling, and packing sections. Furthermore, the workforce who are willing to participate in the study. The exclusion criteria in this study are the administrative department workorce. This study was conducted using Ordinal Regression data retrieval

techniques. The data obtained were then analyzed with the Ordinal Regression test. The research variables used are labor fatigue as a bound variable and the hot work climate as a free variable.

III. RESULT

In the results of the study, data from the analysis of the influence of age, gender, and work climate on fatigue after work were presented. The following are the results of the analysis that has been carried out.

TABLE 1
Statistical Test of the Effect of Age on Labor Fatigue After Working in the Kediri Tofu Factory

Parameters		Estimate	Std. Error	Wald	df	Sig.
Threshold	KK = 1	1.521	1.235	1.517	1	.218
	KK = 2	3.879	1.372	7.998	1	.005
Location	usia	.118	.052	5.218	1	.022

Based on TABLE 1 the Parameter Estimates table above, it can be seen that the age variable has a significance value of 0.022. The value is less than α = 0.05 (0.022 < 0.05) which means that age affects labor fatigue after working at the Kediri Tofu Factory.

TABLE 2
Statistical Test of the Effect of Sex on Labor Fatigue After Working at the Kediri Tofu Factory

Parameters		Estimate	Std. Error	Wald	Df	Sig.
Threshold	KK = 1	-7.770	2.165	12.875	1	.000
	KK = 2	-5.016	1.413	12.601	1	.000
Location	JK	-4.066	1.242	10.715	1	.001

Based on TABLE 2 the Parameter Estimates table above, it can be seen that the signification value in the sex variable is 0.001 which means less than α = 0.05. Then it can be concluded that gender affects labor fatigue after work.

TABLE 3
Statistical Test of the Effect of Work Climate on Labor Fatigue After Working at the Kediri Tofu Factory

Parameters		Estimate	Std. Error	Wald	df	Sig.
Threshold	[KK = 1]	.362	.761	.227	1	.634
	[KK = 2]	3.116	1.196	6.784	1	.009
Location	[IK=1]	4.066	1.242	10.715	1	.001
	[IK=2]	0[a]	.	.	0	.

Based on TABLE 3 the Parameter Estimates table above can be seen that the working climate variable has a significance value of 0.001. The value is smaller than α = 0.05 (0.001 < 0.05) which means that there is an influence of the work climate on labor fatigue after working at the Kediri Tofu Factory.

IV. DISCUSSION

This research has weaknesses and limitations, namely the respondents who will be studied only in the production department. Based on the results of the research above, the following is a presentation of the research results to be discussed further to find out whether the research results are in accordance with previous research or related theories.

A. *Age*

The results of the study average age of the workforce were 25 years with an age range of 19 to 53 years. Age is one of the triggering factors for work fatigue. The results of processing data with ordinal regression show that p = 0.022 or p<0.05, it can be concluded that there is an influence of age on labor fatigue after work. With a fairly young age, people will be able to work much harder and heavier. While the old person will decrease his ability [12]. Employees with old age will get tired quickly and no longer as strong as when they were young, resulting in a decrease in work productivity and will gradually weaken further [13].

This research is directly proportional to the theory that the older the workforce, the faster the workforce will get tired [7] and the results in this study show that the average workforce is 25 years old. There are 9 workers over the age of 30 and the majority experience moderate and high fatigue.

B. *Gender*

Based on the results of the study, it showed that as many as 29 workers were male and 7 workers were female. The results of processing data using ordinal regression obtained results of p = 0.001 which means less than α = 0.05. Then it can be concluded that there is an influence of gender on labor fatigue after work.

This is directly proportional to the statement that fatigue indicates quite a variety of conditions for each individual [14], although all of them nevertheless lead to a complete decline in the ability and physical endurance of workers [15]. In the male sex, the endurance of the body will be stronger than that of the female [16]. This statement is directly proportional to the theory that men's endurance is stronger than that of women [17]. Compared with the results of the author's research now, results were found that were in line with the theory, namely the majority of male workers were 29 people and 7 other people with the female sex. In the workforce with the female sex the majority experienced high fatigue.

C. *Working Climate*

Based on the results of the work climate ordinal regression test on labor fatigue after work, a significant result of p =

0.001 which means that it is smaller than α = 0.05 (0.001<0.05) it can be concluded that there is an influence of the work climate on labor fatigue after work. The Threshold Value of Physical Factors in the Workplace is known that the working climate in the production space exceeds the NAV of 28.0□C. While the average result of ISBB at 10.00 WIB in the production room was 31.6 and at 14.00 WIB it was 32.4□C with a working time of 8 hours per day resting 1 hour. The workforce exposed to the hot working climate will have a reaction in which the body temperature slowly increases, followed by an increased body temperature as well. This then triggers the release of sweat and increased metabolism in the body [18]. When this happens, the next stage is that the heat from the body will remain trapped in the body. This is because the ambient temperature is also quite high, retaining heat from within the body out [19]. The heat source in this study is the fuel used in tofu boiling, namely using firewood and labor exposed to the fire, the next heat source is hot steam produced from tofu boiling and soybean boiling, so that labor exposed from environmental conditions enters the body. Excessive heat pressure can cause the body temperature to rise, sweat to come out, which causes the body to lose fluids, salts and causes fatigue [20].

The results of this author's research are in line with Manullang's research (2018) with the results of an analysis carried out regarding the effect of work climate on work fatigue that the value of Sig<0.05 which shows that there is a significant influence between hot working climate temperature and work fatigue [6]. Furthermore, the results of this study are also in accordance with previous studies which stated that environmental heat significantly affects the cardiovascular system and thermoregulation in workers who perform light and heavy work tasks [21]. In addition, the heat of the environment was shown to affect the magnitude of the frequency shift during laborious muscle contractions in the typist rather than the lifter [22]. These results suggest that: (1) the performance of sedentary workers performing light manual tasks can be severely affected by the heat of the environment; and (2) environmental heat may be of secondary importance to the nature of the task investigated at the level of muscle fatigue [14].

Furthermore, the results of this study are also supported by the theory of the existence of aspects that state that usually the average work fatigue score is 85.09 ± 41.49, and the average score of the hot climate is 67.15 ± 12.73. There is a significant inverse relationship between work fatigue and a hot working climate. Comparison of hot work climates and their subscales between employment and demographic variables and this difference is significant. Furthermore, cumulative burnout, work attitudes, and hot working climates differ significantly between different temperatures. This suggests that there is a relationship between work burnout and a hot work climate. Issues related to safety factors and risks in the workplace due to the high temperatures that exist, in addition to being economical, are also important from the human aspect. In addition, the activities of workers or employees in the production department close to the heat source are more important than other groups because it is the company's kitchen, taking care of the most important part, namely producing company products that will be sold to customers and must be maintained for safety and health; thus, efforts to reduce the hot work climate more about the safety and health of workers in the work environment can reduce the fatigue that occurs to workers [4].

D. Work Fatigue

Work fatigue is a mechanism of protection of the body to avoid further damage so that recovery occurs after rest. Usually fatigue in a person is characterized by different conditions for each individual [15].

Based on the results of the author's research, labor fatigue before work obtained the results of the entire workforce experiencing low work fatigue. The after-work workforce showed that the workforce who experienced mild work fatigue after work was 8 people (22.2%), moderate work fatigue after work as many as 12 people (33.3%) and high fatigue after work as many as 16 people (44.4%). It can be seen that there is a difference in fatigue before work with fatigue after work. The results will show that the greater the total value obtained, the higher the level of fatigue experienced by the workforce. The score based on the IFRC of 0-40 means low work fatigue, a score of 41-60 which is moderate work fatigue, 61-90 which is high work fatigue, 91-120 i.e. very high work fatigue [23].

This is in accordance with previous research, where the environment, especially the work climate greatly affects how the conditions of the workers are. Hot temperatures and exceeding standards will cause fatigue faster than normal temperatures. This of course will have an impact on worker productivity which of course has an impact on the sustainability of the company. Then many cases of workers are exposed to heat. In the case of a worker who died, 7 cases where the worker experienced symptoms of a heat strain with a moderate and heavy workload. One of the dangers that are often found in industry is the physical danger in the form of a hot work climate. The combination of the use of tools and machines and materials in the production process is one of the sources of heat in the working climate for workers that can be found in various industries. This explains that workers exposed to heat will experience an increased pulse rate [24]. The pulse may change due to an increase in cardiac output or cardiac output required by the working muscles [25]. The heat exposure received by workers in a hot environment makes the body regulate the balance of heat in the blood so that there is an increase in blood flow, the heart pumps more blood so that blood pressure rises [19].

V. CONCLUSION

From the above exposure, it can be concluded that the factors that affect labor fatigue are age, gender, and work climate; the results of measuring labor fatigue before work that experiences low fatigue by 100%; The results of the measurement of labor fatigue after work showed that the workforce experienced low fatigue by 22.2%. The workforce

experienced moderate fatigue as much as 33.3% and as many workers who experienced high fatigue as much as 44.4%. The majority of the workforce very often feels thirsty; The results of the working climate measurement showed that the average working climate in the production room was 32C which means that it exceeded NAB by 28C; The average humidity measurement result is 63.15% which means dry. The average wind speed measurement result is 0.685 which means less high; and the results of the statistical test with the Ordinal Regression test obtained a significant result of 0.001 where Sig<0.05. The value shows that there is an influence of the work climate on labor fatigue at the Kediri Tofu Factory.

The advice of the authors based on this study is that it is better for the owners of tofu factories in Kediri to provide a drinking place that is not far from labor so that it can replace the fluids lost in the body when traveling and carrying out control efforts such as adding ventilation to reduce heat exposure and so that air circulation in the production room, especially in the boiling tofu and packing area, becomes smooth and good. Furthermore, with high-temperature work environment conditions is an additional burden in the form of heat pressure that causes subjective deficiencies in workers and can cause disruption to the workforce. To minimize heat stress from the work climate that exceeds the threshold value, the company should also apply periodic health checks, before working stretching for 3-5 minutes and recommending workers consume water every 20 minutes at work. Theoretically, the authors suggest that these results could be used as a reference for other researchers developing primarily the influence of the work climate on labor fatigue.

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