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by Yuharika Pratiwi

Submission date: 24-Aug-2024 07:18PM (UTC+0700)
Submission ID: 2437207231
File name: Amikveteran_vol_3_no_3_september_2024_hal_96-102.pdf (294.34K)
Word count: 2704
Character count: 14793

International Journal of Medicine and Health
Vol. 3 No. 3 September, 2024
e-ISSN: 2962-1178, p-ISSN: 2962-0880, Pages 96-102
DOI: https://doi.org/10.55606/ijmh.v3i3.4163
Available online at: https://journal.amikveteran.ac.id/index.php/ijmh

Relationship Between Lactic Acid Levels And Work Fatigue In Palm Oil Harvesters At PT. X Kampar Regency

Yuharika Pratiwi[1*], Dinda Queenty Dzakiyah Hartono[2], Ruswaldi Munir[3]
[1-3]Medical Professional Study Program, Faculty Of Medicine, Abdurrab University,Indonesia

Address: Jl. Riau Ujung No. 73, Tampan, Air Hitam, Payung Sekaki, Air Hitam, Kec. Payung Sekaki, Kota Pekanbaru, Riau 28291
*Corresponding author: yuharika.pratiwi@univrab.ac.id**

Abstract. *Work fatigue is a condition caused by physical and mental activities that exceed capacity. According to National Safety Council data, > 60% of work accidents are caused by fatigue. In Indonesia, the agriculture, fisheries, plantation, and forestry sectors occupy the second position in the cause of work accidents. Work fatigue can be caused by both internal and external factors. Fatigue caused by external factors causes changes in the body's biochemical processes so that lactic acid builds up in the muscles. Initial survey on PT. X is located in Kampar Regency, information was obtained that there were cases of work accidents in harvesters which were mostly caused by work fatigue. Objective To determine the relationship between lactic acid levels and work fatigue in palm oil workers in PT. X Kampar Regency Methods This study was conducted using observational analytical methods, cross sectional research design. The sampling technique uses total sampling, as many as 114 samples have met the inclusion criteria. Bivariate analysis uses the Spearman test. Result p-value = 0.000; r = 0.607 with strong correlation strength and positive direction Conclusion There is a relationship between lactic acid levels and physical fatigue in harvesters*

Keywords *: Lactic acid, Physical work fatigue, Palm oil workers*

1. BACKGROUND

Work fatigue is a condition that arises from physical or mental activity that exceeds an individual's capacity or ability. Work fatigue can result in decreased performance, work errors, work accidents and health problems [1]. The National Safety Council states that more than 60% of work accidents are caused by fatigue. Of around 2,000 workers who have experienced accidents, it is known that 97% of them have at least one risk factor for fatigue at work [2]. In Indonesia, the agriculture, fisheries, plantations and forestry sectors rank second in cases of work accidents [3]. Fatigue generally refers to a reduction in work ability and endurance which is characterized by the emergence of a sensation of fatigue and lack of work motivation [4]. The components that cause work fatigue come from external factors (work environment and including workload, work shifts and work periods) and internal factors [5]. One physiological indicator that can be used to measure work fatigue is the level of lactic acid in the blood. Lactic acid is a byproduct of anaerobic metabolism, which is the process of producing energy without oxygen. When workers perform physical activity that exceeds the available oxygen capacity, muscles will produce lactic acid as an alternative energy source (Rusdiawan et al., 2020).[1] In workers in palm oil mills, fatigue due to work factors most often comes from ergonomic factors, namely bending the neck, back and shoulders, lifting work tools for long periods of

Received July 02, 2024; Received July 16, 2024; Accepted August 22,2024; Online Available August 24,2024
* Yuharika Pratiwi, yuharika.pratiwi@univrab.ac.id

time can increase levels of lactic acid which is a metabolic product of fatigue. [6] Fatigue at work has the potential to have a negative impact on worker performance and motivation. Workers who experience fatigue tend to experience decreased concentration, which can be the cause of work accidents.[2]

PT. X is a palm oil processing factory company in Kampar Regency which also has plantations. The plantation area at PT. X is 326,348 Ha. Oil palm harvesters work not only on company-owned plantations, but also on community-owned plasma plantations. Harvesters work per day in 16 rows, each row consisting of approximately 33 oil palm trees. Based on the results of an initial survey with written interviews with PT palm oil plantation harvesters. X, it was found that 90% of harvesters experienced very high physical fatigue. This risks causing work accidents. Work accidents due to fatigue are often experienced by workers at PT. X means falling, slipping, cutting your hand. This can have an impact on production errors and equipment operation. Losses arising from these conditions include medical costs, compensation for injured workers, which can reduce productivity and the company's reputation.

2. THEORETICAL STUDY

Fatigue generally refers to a reduction in work ability and endurance which is characterized by a sensation of tiredness and decreased work motivation [4]. There are two factors that cause work fatigue, namely: external factors (work environment and including workload, work shifts and work periods) and internal factors (individual components including gender, nutrition, sleep quality, age and smoking habits) [5]. For workers in palm oil mills, most of the causes of fatigue come from work factors, including ergonomic factors such as: bending the neck, back and shoulders, lifting work tools for a long time can increase levels of lactic acid which is a metabolic product of fatigue. [6]

Lactic acid is produced from anaerobic metabolism or carbohydrate metabolism without oxygen which arises due to a lack of oxygen to support muscle energy production [7]. At rest, normal lactic acid levels in the blood are around 0.5-2 mmol/L. The body usually gets rid of lactic acid through the kidneys, liver and muscles. However, because the body cannot produce an amount of lactic acid commensurate with the rate of synthesis, the muscle pH will decrease, this will inhibit glycolysis enzymes. As a result, chemical reactions taking place in cells will be hampered, causing physical fatigue. [8].

3. RESEARCH METHODS

Observational research with cross sectional design. The research instrument used a questionnaire and a Roche Brand Accutrend Plus lactic acid measuring instrument. The inclusion criteria are all harvesters registered with PT. X, cooperative, and present during research. Meanwhile, the exclusion criteria in this study were: not willing to be a respondent, not present when the research took place, having a history of diseases that can increase lactic acid, a history of lactic acidosis, high blood pressure, heart disease and kidney disorders. Total sampling technique. There were 114 respondents who met the inclusion criteria.

4. RESULTS AND DISCUSSION

Characteristics of Respondents Based on Work Fatigue

Table 1. Description of Respondent Characteristics Based on Work Fatigue

Classification Fatigue	Frequency	Percentage (%)
Currently	13	11.4
Tall	54	47.4
Very high	47	41.2
Total	114	100.0

Based on Table 1, it was found that the majority of respondents experienced high work fatigue with 54 respondents (47.4%), very high work fatigue totaling 47 respondents (41.2%), and moderate work fatigue totaling 13 respondents (11.4%).

Characteristics of Respondents Based on Lactic Acid Levels

Table 2. Description of Respondent Characteristics Based on Lactic Acid Levels

Lactic Acid Levels	Frequency	Percentage (%)
< 2 mmol/l	13	11.4%
> 2 mmol/l	101	88.6%
Total	114	100.0

Based on Table 2, it was found that the majority of respondents had lactic acid values > 2 mmol/l (increased/hyperlactatemia), totaling 101 respondents (88.6%). Respondents who had lactic acid values < 2 mmol/l (not increased) were 13 respondents (11.4%).

Before testing the hypothesis, the researcher tested the normality of the data first. The data normality test in this study used the Kolmogorov-Smirnov test because the number of samples studied was 114 samples.

Table 3. Kolmogorov-Smirnov Normality Test Results

Tests of Normality			
	Kolmogorov-Smimov [a]		
	Statistics	Df	Sig.
Lactic Acid Levels	,525	114	,000
Fatigue Work	,267	114	,000

The results of the normality test using the Kolmogorov-Smirnov test for lactic acid levels and work fatigue obtained a significance value of 0.000. These results show a significance value of less than 0.05 (sig < 0.05) so it is stated that the data is not normally distributed. From the results of the normality test, the correlation test in this study used the Spearman correlation test.

Relationship between Lactic Acid Levels and Work Fatigue

Table 4. Spearman Correlation Test Results of the Relationship between Lactic Acid Levels and Work Fatigue

Correlations				
Spearman's rho			Lactic Acid Levels	Fatigue Work
	Lactic Acid Levels	r	1000	,607
		p-value	.	,000
		N	114	114
	Fatigue Work	r	,607	1000
		p-value	,000	.
		N	114	114

Based on Spearman correlation test results in Table 4 obtained p-value¬ = 0.000, results the show that there is significant relationship between rate sour lactate with fatigue work on the harvester palm oil at PT. X. Apart from that , value is also obtained coefficient correlation (r) is 0.607 which is significant strength correlation strong . From these test results were also obtained that study This own direction correlation positive which means the more tall rate sour lactate owned by the respondent , then the more high score too fatigue work on the respondent and vice versa .

correlation test results in research This obtained p-value = 0.000 (p <0.005) and r value = 0.607 which shows exists correlation strong between rate sour lactate and fatigue works and exists connection significant positive , where increasingly tall rate sour lactate , increasingly high level too fatigue work experienced by respondents . This positive correlation means that lactic acid accumulation, which is often an indicator of muscle fatigue and work intensity, is closely related to the level of fatigue reported by workers. This research is in line with research

conducted by Hidayah (2018) which examined the relationship between lactic acid levels in the blood and work fatigue in formwork workers for the Gunawangsa Tidar Superblock Apartment Project at PT. PP (Persero) Tbk found a significant difference between lactic acid levels in the blood before and after working as a palm oil harvester. Before work, oil palm harvesters had an average blood lactic acid level of 0.263 mmol/l, and after work, the average was 0.883 mmol/l1. The Wilcoxon Signed Ranks Test statistic showed that N positive ranks = 16 with Asymp . Sig. (2-tailed) = 0.001. (4 mmol/l).[8]

One physiological indicator that can be used to measure work fatigue is the level of lactic acid in the blood. Lactic acid is a byproduct of anaerobic metabolism, which is the process of producing energy without oxygen. When workers perform physical activity that exceeds the available oxygen capacity, muscles will produce lactic acid as an alternative energy source (Rusdiawan et al., 2020).[1]

When the body is working, energy is needed to support performance. The main source of energy comes from the breakdown of glycogen, the process of breaking down glycogen produces lactic acid. When muscles contract, lactic acid will build up and interfere with muscle performance, causing fatigue. When physical activity increases, oxygen consumption will also increase. However, as it reaches its peak, oxygen consumption begins to decrease, which contributes to fatigue due to increased lactic acid. When physical activity exceeds the body's ability to provide sufficient oxygen, the muscles will initiate an anaerobic process to produce energy, which will ultimately produce more lactic acid. The heavier the physical activity carried out, the more anaerobic metabolic processes will increase so that lactic acid levels also increase. This lactic acid will then build up in the muscles, causing swelling and inhibiting the muscles' ability to contract. This causes symptoms of fatigue (Rahayu et al., 2020).[9]

In general, lactic acid levels in the blood increase as the intensity and duration of physical activity increases, because heavy physical activity can increase the body's energy requirements and use up available oxygen, forcing the body to switch to anaerobic metabolism (Dengo et al., 2023) .[10]

Palm harvesters are one group of workers who are at risk of experiencing work fatigue because they have to work in the sun, high temperatures and high humidity. Apart from that, palm harvesters also have to do work that requires a lot of physical effort, such as bending the body, looking up with the neck >5o, neck bending downwards for a long period of time and repeatedly. This work can increase lactic acid levels in the blood of palm harvesters.[11]

The relationship between lactic acid levels in the blood and work fatigue in palm oil harvesters can be explained by ergonomic theory. According to ergonomic theory, work fatigue

occurs when there is an imbalance between job demands and worker abilities. Job demands can include workload, work environment, and work organization. Workers' abilities can include work capacity, health and motivation. When work demands exceed the worker's abilities, the worker will experience work stress. Work stress can trigger physiological reactions, such as increased heart rate, blood pressure, and lactic acid levels in the blood. High levels of lactic acid in the blood can inhibit the flow of blood and oxygen to the muscles, causing work fatigue.[1]

5. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this discussion, it can be concluded that there is a positive relationship between lactic acid levels in the blood and work fatigue in palm harvesters. The higher the level of lactic acid in the blood, the higher the level of work fatigue experienced by palm harvesters. The results of this research emphasize the need for attention in managing work fatigue in palm oil harvesting workers. Interventions that can help manage lactic acid levels, such as physical exercise programs that increase aerobic capacity, better workload management, and adequate rest, are essential to reduce the impact of fatigue. Implementing this strategy will not only improve worker welfare but can also increase productivity and safety in the workplace. This research provides a strong basis for the development of better occupational health policies in the palm oil plantation industry.

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PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7