

Overview of Increased Lactic Acid and Work Fatigue in Harvesting Workers at PT. X Kampar Regency

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Abstract. Work fatigue is a physical condition that weakens workers, causing less than optimal work capacity and endurance. Lactic acid is produced from anaerobic metabolism or carbohydrate metabolism without oxygen. This happens because there is not enough oxygen to support muscle energy production. The body that cannot produce the amount of lactic acid that is comparable to the rate of its synthesis, then the muscle pH will decrease, this is what inhibits glycolysis enzymes resulting in physical fatigue. Physical fatigue is the effect of increased levels of lactic acid in the body, especially muscles. One of the jobs at PT. X in Kampar Regency that can cause work fatigue is a palm oil harvester. This study is an observational study type with a cross-sectional study design. Data were obtained using interviews using a BMI questionnaire. Data collection was also carried out to obtain BMI measurement data, pulse measurements, blood pressure measurements, and lactic acid measurements with Accutrend Plus Roche Brand on 138 harvesters at PT. X Kampar Regency. In this study, the independent variable is the level of lactic acid and the dependent variable is work fatigue. The results of the study showed that the harvesters who experienced moderate work fatigue were 13 people (11.4%). The harvesters who experienced high work fatigue were 54 people (47.4%). The harvesters who experienced very high work fatigue were 47 people (41.2%). The high proportion of workers who experienced high and very high work fatigue (88.6%) reflects the significant physical workload that must be faced by oil palm harvesters at PT. X. Harvesters with lactic acid levels <2 mmol/l (not increasing) were 13 people (11.4%) and harvesters with lactic acid levels > 2 mmol/l (increasing/hyperlactatemia) were 101 people (88.6%). From the results obtained, a significant increase in lactic acid levels in 88.6% of respondents indicated that most workers experienced higher muscle fatigue conditions during work with increased lactic acid levels.

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

1. INTRODUCTION

According to the International Labour Organization (ILO) in 2016, around 32% of workers worldwide experience fatigue related to their work. The severity of fatigue in workers ranges from 18.3% to 27%, with the prevalence of fatigue in industry at 45%. In Indonesia, the agriculture, fisheries, plantations, and forestry sectors rank second in cases of work accidents, at 17.3% of 115,724 cases (Ministry of Manpower of the Republic of Indonesia, 2022). The number of work fatigue in Riau Province is considered high, namely in 2016 there were 6,768 cases or equivalent to 30.28%, then there was an increase to 9,628 cases or equivalent to 36.78%, and again increased to 12,528 cases or equivalent to 39.68% in 2018 (Rahmawati et al., 2019). Fatigue generally refers to a reduction in work ability and endurance characterized by the emergence of a feeling of fatigue and lack of motivation to work, which can interfere with the activities being carried out (Rozana et al., 2018). There are two components that cause work fatigue, namely: external components (work environment and among them workload, work shifts, and work periods) and internal components (individual components including gender, nutrition, sleep quality, age, and smoking habits) (Safira et al., 2020). In a study by

Arfan and Firdaus (2020) entitled "Factors Related to Work Fatigue in Production Workers in a Palm Oil Processing Factory", a significant relationship was found between workload, work shifts, and nutritional status with work fatigue. The Workplace Safety & Health Council in 2010 stated that work fatigue is divided into two types, namely mental fatigue and physical fatigue. Where for mental fatigue there is a decrease in the level of concentration and alertness in workers, while physical fatigue is a decrease in the ability to work manually. Ergonomic factors coupled with the influence of physical factors such as work climate, vibration, and noise have the potential to cause musculoskeletal fatigue/physical fatigue. One of the jobs that has high physical activity is working in the palm oil industry/factory (Utami et al., 2022). In workers in palm oil factories, the ergonomic factors found are bending the neck, back, and shoulders, lifting work aids for a long time. This condition can produce high levels of lactic acid as a metabolic product found in people who experience fatigue (Rahmawati et al., 2019). Research conducted by Irma (2018) regarding the increase in lactic acid levels after working on formwork workers for the Gunawangsa Tidar Superblock Apartment Project at PT. PP (Persero) Tbk. found a significant difference in the increase in lactic acid levels after working in workers who experienced fatigue. Increased lactic acid levels can also be found in workers who experience lower back pain. This is in accordance with research conducted by Siska (2022) which stated that there was a significant relationship between lactic acid levels and lower back pain in taxi driver X.

Lactic acid is produced from anaerobic metabolism or carbohydrate metabolism without oxygen. This occurs because there is not enough oxygen to support muscle energy production (Fitrianto et al., 2020). At rest, the level of lactic acid in the blood of a healthy person is around 0.5-2 mmol/L. The body usually removes lactic acid through the kidneys, liver, and muscles. However, because the body cannot produce the amount of lactic acid that is comparable to the rate of its synthesis, the muscle pH will drop, which inhibits glycolysis enzymes. As a result, chemical reactions that take place in cells will be inhibited, resulting in physical fatigue (Hidayah, 2018). Physical fatigue is the effect of increased levels of lactic acid in the body, especially muscles. Work fatigue is a physical condition that weakens workers, resulting in less than optimal work capacity and endurance (Utami et al., 2022).

Based on the results of an initial survey conducted through written interviews with 30 oil palm plantation harvesters of PT. X, it was found that 27 harvesters experienced physical fatigue with a very high classification. Data on work accidents due to fatigue also showed various incidents such as falling, slipping, cut hands, production errors, and operating tools. It can be seen that the activities carried out by oil palm harvesters can cause work fatigue, namely

cutting fruit bunches from trees using egrek or dodos. In addition, fruits that come off the bunches during cutting are also collected to ensure that no fruit is wasted. The bunches that have been cut are collected at a specific location before being transported to the processing site. The lifting uses a cart and is then transported to the palm oil processing plant using a truck or other means of transportation. Then the work environment which tends to be hot can be another factor that can cause fatigue.

Losses arising from work accidents include medical expenses, compensation for injured workers, and impacts on productivity and company reputation. This shows the need for more attention to work time management and fatigue risk mitigation in the palm oil mill work environment to improve worker welfare and operational efficiency.

Based on the background explained above, this study aims to study how "The Description between Lactic Acid Levels and Work Fatigue in Palm Oil Harvesters at PT. X in Kampar Regency"

2. RESEARCH METHODS

This study is an observational analytical study with a *cross-sectional design* where the study uses an observation design. The research instruments used are questionnaire sheets and *Accutrend Plus* Roche Brand. In this study, the data used is primary data, where the collection is carried out by accompanying respondents during the filling out of the questionnaire and if there is something that is not understood, respondents can ask the researcher about the questions in the questionnaire. The population used in this study were all harvesters at the PT. X Oil Palm Plantation in Kampar Regency, totaling 138 people. The sample used in this study were harvesters at the PT. X Oil Palm Plantation who had met the inclusion criteria. The inclusion criteria in this study were all harvesters registered at PT. X, cooperative, and present during the study. The exclusion criteria in this study were: Not willing to be respondents, Not present when the study was taking place, Having a history of diseases that can increase lactic acid, such as having a history of lactic acidosis, high blood pressure, heart disease, and kidney disorders, Other factors that cause fatigue other than at work, such as when the worker is sick.

This study uses a total sampling technique. The data source for this study was taken through primary data, which was selected by total sampling, namely oil palm harvesters at PT. X active in 2024 who met the inclusion and exclusion criteria. Secondary data of workers were obtained during the initial survey, data obtained from the administration section was used to synchronize with primary data. Univariate analysis was carried out to describe the distribution, frequency and percentage displayed in tabular form (Notoatmodjo, 2012). This study analyzed

the independent variable, namely lactic acid and the dependent variable, namely physical work fatigue in oil palm harvesters at PT. X.

3. RESULT AND DISCUSSION

Respondent Characteristics Based on Age, Nutritional Status, Length of Service, and Smoking Habits of Oil Palm Harvesters at PT. X

Based on Table 1 regarding the age of respondents, it was found that the majority Respondent aged 30-40 year with amount 59 Respondent (51.8%), age 20-30 years old amounted to 31 respondents (27.2%), and age >40 years old amounted to 24 respondents (21.1%). Based on nutritional status, it can be seen that most of the respondents own status nutrition normal with amount 99 Respondent (86.8%), nutritional status thin amount to 9 Respondent (7.9%), And status nutrition fat amount to 6 respondents (5.3%). Based on the length of service, it can be seen that most respondents have a length of service > 5 years with a total of 100 respondents (87.7%) and a length of service \leq 5 years totaling 14 respondents (12.3%). Based on Smoking habits can be seen that the majority of respondents have a smoking habit with a total of 105 respondents (92.1%) and non-smokers totaling 9 respondents (7.9%).

Table 1. Description of Respondent Characteristics Based on Age, Nutritional Status, Length of Service, and Smoking Habits

Sample Characteristics	Frequency	Percentage (%)
Age		
20-30 years	31	27.2%
30-40 years	59	51.8%
>40 years	24	21.1%
Nutritional status		
Thin	9	7.9%
Normal	99	86.8%
Fat	6	5.3%
Years of service		
\leq 5 years	14	12.3%
> 5 years	100	87.7%
Smoking Habit		
Do not smoke	9	7.9%
Smoke	105	92.1%
Total	114	100%

Respondent Characteristics Based on Work Fatigue

Based on Table 2 regarding work fatigue, it was found that most respondents experience fatigue Work tall with amount 54 Respondent (47.4%), work fatigue was very high at 47 respondents (41.2%), and moderate work fatigue amounted to 13 respondents (11.4%).

Table 2. Description of Respondent Characteristics Based on Work Fatigue

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

Based on the results of the study, 114 respondents were obtained with 13 respondents (11.4%) experiencing moderate work fatigue, 54 respondents (47.4%) experiencing high work fatigue, and 47 respondents (41.2%) experiencing very high work fatigue. This is in line with previous studies showing that work in the plantation sector, especially oil palm harvesting, has a high risk of work fatigue. This work requires heavy physical activity and takes place in challenging environmental conditions, such as exposure to hot sun, high humidity, and difficult terrain. These conditions cumulatively contribute to the high levels of fatigue experienced by workers, especially those who work for long periods without sufficient rest (Melvira et al., 2024).

The high proportion of workers experiencing high and very high levels of fatigue (88.6%) reflects the significant physical workload that oil palm harvesters at PT. X have to deal with. Fatigue at this level not only impacts workers' physical health, but can also affect their mental and emotional health. Workers who experience high levels of fatigue tend to experience impaired concentration, decreased motivation, and increased risk of stress and burnout. This is very dangerous because it can reduce workers' quality of life and, in the long term, can result in a decrease in overall company productivity. This study underlines the importance of better workload management and improved working conditions to minimize the negative impacts of high levels of fatigue.

Factors such as nutritional status, age, length of service, and smoking habits can also affect the level of work fatigue experienced by workers (Pratiwi et al., 2021). Respondents with poor or excessive nutritional status may experience fatigue more quickly than those with normal nutritional status. Likewise, workers who are older or have heavy smoking habits may be more susceptible to work fatigue due to decreased physical capacity or pre-existing health problems. Therefore, managing work fatigue needs to be focused not only on the workload itself, but also on efforts to improve the overall health and well-being of workers.

Workers who experience very high levels of work fatigue are at risk of developing serious health problems, including musculoskeletal disorders, respiratory disorders, and cardiovascular diseases, all of which can be exacerbated by heavy physical activity and harsh working environments (Pratiwi et al., 2021). This condition requires special attention from company management in the form of a comprehensive occupational health program, including the provision of health services, regular health monitoring, and physical training programs aimed at improving workers' endurance and physical fitness. In addition, adjusting the workload and increasing adequate rest time are important steps to prevent excessive fatigue accumulation.

In the long term, companies need to consider implementing technologies or innovations that can reduce the physical burden on workers, such as the use of mechanical aids or automation in the harvesting process. Although this requires a significant initial investment, the long-term benefits, both in terms of worker health and productivity, can outweigh the costs. By reducing the physical burden that workers have to endure, companies can create a healthier and more sustainable work environment, which will ultimately improve worker well-being and overall company performance. This study confirms that addressing work fatigue should be a top priority in workforce management in the palm oil plantation industry.

Respondent Characteristics Based on Lactic Acid Levels

Based on Table 3 related to lactic acid levels, it was found that most 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) totaled 13 respondents (11.4%).

Table 3. Description of Respondent Characteristics Based on Lactic Acid Levels

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

Based on the research results, 114 respondents were obtained with 13 respondents (11.4%) having lactic acid values < 2 mmol/l (not increased) and 101 respondents (88.6%) having lactic acid values > 2 mmol/l (increased). This is in line with the physiological theory which states that intensive and prolonged physical activity can cause lactic acid accumulation in muscles. When oil palm harvesters do heavy work such as harvesting oil palm fruit bunches, their bodies experience increased energy demand that exceeds aerobic metabolic capacity, so that lactic acid accumulates as a by-product of anaerobic metabolism.

The significant increase in lactic acid levels in 88.6% of respondents indicated that most workers experienced higher muscle fatigue conditions during work. Lactic acid is a commonly used indicator to measure work intensity and muscle fatigue (Yudisianto et al., 2021). When lactic acid levels increase, this indicates that the body is working in anaerobic conditions, where the muscles do not get enough oxygen for normal metabolic processes. This increase in lactic acid levels can cause feelings of fatigue, muscle pain, and decreased physical performance, which further affect the work efficiency and well-being of workers. These results indicate that heavy physical workloads in oil palm harvesters can result in substantial muscle fatigue, which requires attention in work planning and management. These results are also consistent with research by Yudisianto et al. (2021) which shows that high-intensity work can cause lactic acid accumulation and muscle fatigue. Physical work that requires continuous effort for a long time,

such as harvesting oil palm, can cause the body to be unable to remove lactic acid quickly, thereby increasing the concentration of lactic acid in the blood. This highlights the importance of effective fatigue management strategies to prevent excessive lactic acid accumulation and reduce the negative impact on workers' health. Physical exercise programs, adequate rest periods, and better workload management can help manage lactic acid levels and reduce the effects of fatigue. On the other hand, only 11.4% of respondents had lactic acid levels below 2 mmol/l, suggesting that a small proportion of workers may have better physical fitness or be better adapted to high physical workloads. Workers with lower lactic acid levels may have better aerobic capacity, allowing them to work at high intensity without accumulating significant lactic acid. This could be related to factors such as optimal nutritional status, good fitness levels, or longer work experience in handling heavy physical workloads.

To address the issues related to elevated lactic acid levels and fatigue, companies need to consider implementing policies and practices that support employee health and well-being. This includes setting work schedules that allow for adequate rest periods, providing facilities that support recovery such as access to isotonic drinks, and training on efficient work techniques to reduce physical stress. Additionally, promoting physical fitness through training and fitness programs can help improve workers' aerobic capacity and reduce the accumulation of lactic acid during work. By taking a holistic approach to health and fatigue management, companies can improve work productivity while maintaining employee well-being.

4. CONCLUSION

Harvesters who experienced moderate work fatigue numbered 13 people (11.4%). Harvesters who experienced high work fatigue numbered 54 people (47.4%). Harvesters who experienced very high work fatigue numbered 47 people (41.2%). The high proportion of workers experiencing high and very high work fatigue (88.6%) reflects the significant physical workload that oil palm harvesters must face at PT. X. Harvesters with lactic acid levels <2 mmol/l (not increasing) numbered 13 people (11.4%) and harvesters with lactic acid levels > 2 mmol/l (increasing/hyperlactatemia) numbered 101 people (88.6%). The significant increase in lactic acid levels in 88.6% of respondents indicates that most workers experience higher muscle fatigue conditions during work.

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