Determination Of Risk Factors Of Musculoskeletal Disorders In Palm Oil Harvesting Workers In Batu Jong-Jong Village

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ARTICLE INFO

ABSTRACT (10PT)

Background : Musculoskeletal disorders (MSDs) describe disorders of the musculoskeletal system that arise from exposure to static position pressure that is repeated over a long period of time. This condition often causes complaints in the joints, ligaments, and tendons, a condition that is commonly experienced by workers who harvest oil palm fruit. The purpose of this study was to identify the determination of risk factors (work posture, work duration, age, physical fitness, work period and body mass index (BMI)) for the occurrence of musculoskeletal disorders in oil palm fruit harvesters in Batu Jong-Jong Village. **Methods**: This study applies a cross-sectional design with the use of primary data as the main source. A total of 68 oil palm harvesters were selected as respondents through a Stratified Sampling technique. Data were collected using a questionnaire distributed to respondents, as well as the Rapid Entire Body Assessment (REBA) and Nordic Body Map (NBM) assessment methods. The data obtained were then analyzed using the Chi-Square statistical test. **Results**: The results of the study showed that there was a relationship between work posture (p-value 0.003 and PR 2.172), age (p-value 0.000 and PR 3.095), physical fitness (p-value 0.009 and PR 2.160), length of service (p-value 0.009 and PR 2.160) with the incidence of musculoskeletal disorders. While there was no relationship between the duration of work (p-value 0.287 and PR 1.290) and body mass index (BMI) (p-value 0.936 and PR 1.076) with the incidence of musculoskeletal disorders. **Conclusion**: It can be concluded that there is a relationship between work posture, age, length of service and physical fitness with the incidence of musculoskeletal disorders in oil palm fruit harvesters.

1. Introduction

Musculoskeletal disorders (MSDs) are health disorders that affect the musculoskeletal system, including muscles, bones, joints, ligaments, and nerves. These disorders usually arise from repetitive work activities, non-ergonomic work postures, and physical stress over a long period of time. This condition not only reduces a person's work ability, but also has an impact on decreasing quality of life, increasing medical costs, and loss of work time due to absenteeism [1]. In the agricultural sector, especially for oil palm harvesters, the risk of MSDs is relatively high because it still relies on human physical strength in the harvesting process, without adequate mechanization support. [2].

Data from the World Health Organization (WHO) in 2021 showed that around 1.71 billion people in the world experience musculoskeletal disorders, with lower back pain being the most common

complaint affecting more than 568 million people [3]. In Indonesia, the prevalence of this disorder reached 11.9%, and as many as 24.7% of the population were reported to experience symptoms related to MSDs [4]. Meanwhile, in North Sumatra Province, the prevalence of musculoskeletal complaints was reported at 19.2%, and higher in the group of laborers, farmers, and fishermen, reaching 31.2% [5]. This high number reflects the urgency of handling MSDs, especially in informal sector work groups that have not been fully reached by the occupational health system.

One of the main causes of MSDs is an unergonomic work posture. Unnatural body positions, such as bending, lifting heavy loads, or working with raised arms for long periods of time, cause tension in muscles and joints [6]. In the context of oil palm harvesting, workers must cut fruit bunches using tools such as egrek or dodos, which is often done in an uncomfortable and forced body position [7]. This causes repeated pressure on certain body parts, especially the neck, shoulders, lower back, and wrists, which increases the risk of musculoskeletal injuries or disorders [8].

In addition to work factors, the risk of MSDs can also be influenced by individual characteristics such as age, level of physical fitness, length of service, and body mass index (BMI). The older a person is, the greater the likelihood of decreased muscle strength and body flexibility, thereby increasing the risk of developing musculoskeletal disorders [9]. Lack of physical fitness, such as insufficient rest or inadequate physical activity, also increases the body's susceptibility to muscle injuries [10]. Long working periods cause the accumulation of repetitive physical workloads, while high BMI increases stress on the muscular and skeletal systems, especially in the back and lower extremities [11,12].

Batu Jong-Jong Village in Langkat Regency is one of the areas that has economic activities that are highly dependent on the oil palm plantation sector. Most of the local workforce is directly involved in the harvesting process, which requires high physical strength and is carried out in a work environment with high ergonomic risks. The average worker has a working period of more than five years, with a working duration of between 6 and 8 hours per day. Based on the results of observations and interviews, the majority of workers experience complaints in the neck, arms, wrists, back, and waist due to non-ergonomic work postures, the use of heavy equipment, and rocky, hilly, and slippery work terrain conditions.

The work of harvesting oil palm fruit bunches is carried out in several stages, starting from cutting the fronds and fruit bunches, transporting the harvest to the collection location, to loading it onto motorized vehicles. The tools used, such as egrek and dodos, weigh more than 5–7 kg and are used manually in a standing or bending position for a long time. This condition is exacerbated by the steep and challenging work terrain, as well as loads that exceed body capacity. The combination of improper posture, excessive workload, and long working hours greatly contributes to the emergence of musculoskeletal complaints in workers.

Therefore, considering the high risk and impact of musculoskeletal disorders on the productivity and welfare of oil palm harvesters, a comprehensive analysis of the causal factors is needed. This study aims to identify the relationship between determinants of risk factors such as work posture, work duration, age, physical fitness, length of service, and BMI with the incidence of musculoskeletal disorders in oil palm harvesters in Batu Jong-Jong Village.

2. Methods

This study is a quantitative study with a cross-sectional analytical observational design that aims to identify the relationship between independent variables (work posture, work duration, age, physical fitness, work period, and body mass index) and dependent variables, namely musculoskeletal disorders (MSDs) in oil palm fruit harvesters in Batu Jong-Jong Village. Conducted from February to April 2025, this study involved a population of 200 oil palm fruit harvesters, with a sample of 68 people determined using the Lemeshow formula and Stratified Sampling technique to ensure proportional representation. Primary data collection was carried out through interviews and questionnaires, utilizing instruments such as the Nordic Body Map (NBM) for MSDs and Rapid Entire Body Assessment (REBA) with the help of a camera for work posture, while secondary data were obtained from literature reviews. The data analysis method was carried out using univariate analysis and bivariate analysis using the Chi Square test.

3. Results and Discussion

3.1. Results

3.1.1. Univariat Analysis

Table 1. Risk Factors Distribution Oil Palm Fruit Harvesters

Risk Factors	Frequency (N)	%
Working Posture		
Tall	45	66,2%
Low	23	33,8%
Working Duration		
Abnormal > 8 Hours	25	36,8%
Normal ≤ 8 Hours	43	63,2%
Age		
Old ≥ 35 Years	42	61,8%
Young < 35 Years	26	38,2%
Physical fitness		
Not enough	50	73,5%
Good	18	26,5%
Years of service		
Old ≥ 5 Years	50	73,5%
New < 5 Years	18	26,5%
Body Mass Index (BMI)		
Abnormal	20	29,4%
Normal	48	70,6%
Total	**68**	**100**

Table 1 shows that the most dominant work posture is in the high work posture category of 66.2%, while the low work posture is 33.8%. The duration of work of respondents is generally in the category ≤8 hours of 63.2%, and only 36.8% work more than 8 hours. The age of respondents is mostly in the age group ≥35 years of 61.8%, while the age <35 years is 38.2%. The physical fitness of most respondents is in the less category of 73.5%, and only 26.5% have good physical fitness. The most dominant work period is ≥5 years of 73.5%, while the work period <5 years is 26.5%. Most respondents have a Body Mass Index (BMI) in the normal category of 70.6%, and 29.4% are in the abnormal category. The distribution of musculoskeletal disorders in oil palm fruit harvesters in Batu Jong-Jong Village is presented in Table 2.

Table 2. Distribution of Musculoskeletal Disorders Incidents Based on Complaint Level

Complaint	Frequency (N)	%
High	0	0,0
Medium	42	61,8
Low	26	38,2
Total	**68**	**100**

Referring to Table 2, it can be seen that oil palm harvesters experience musculoskeletal disorders that are categorized into moderate and low levels. The highest frequency is in the moderate category with 42 respondents (61.8%), while the low category has the lowest frequency, namely 26 respondents (38.2%).

3.1.2 Bivariat Analysis

a. Relationship Between Work Posture with Musculoskeletal Disorders (MSDs)

Table 3. Relationship Between Work Posture with Musculoskeletal Disorders

Postur Kerja	MSDs				Total		P-Value	PR (95% CI)
	Sedang		Rendah					
	n	%	n	%	N	%		
Tinggi	34	75,6%	11	24,4%	45	100		
Rendah	8	34,8%	15	65,2%	23	100	0,003	2,172 (1,212-3,894)
Total	42	61,8%	26	38,2%	68	100		

Based on Table 3, it can be seen that workers who experience musculoskeletal disorders (MSDs) in the moderate category, the majority of them have a high level of work posture, namely 34 respondents (75.6%), while those with low work postures are 8 respondents (34.8%). Meanwhile, workers with low MSDs are more dominant in the group with low work postures, namely 15 respondents (65.2%), compared to high work postures which are 11 respondents (24.4%). The Chi-Square test produces a p-value of 0.003 (p <0.05), which indicates a relationship between work posture and the incidence of musculoskeletal disorders in oil palm fruit harvesters in Batu Jong-Jong Village.

b. Relationship Between Work Duration with Musculoskeletal Disorders (MSDs)

Table 4. Relationship between Work Duration with Musculoskeletal Disorders

Durasi Kerja	MSDs				Total		P-Value	PR (95% CI)
	Sedang		Rendah					
	n	%	n	%	N	%		
Tidak Normal >8 Jam	18	72,0%	7	28,0%	25	100		
Normal ≤8 Jam	24	55,8%	19	44,2%	43	100	0,287	1,290 (0,899-1,851)
Total	42	61,8%	26	38,2%	68	100		

Based on the data in Table 4, it can be seen that workers who experience moderate musculoskeletal disorders (MSDs) are more often found in the group with abnormal work duration (>8 hours), which is 18 respondents (72.0%), compared to the group with normal work duration (≤8 hours), which is 24 respondents (55.8%). Meanwhile, workers with low MSDs category were recorded as 7 respondents (28.0%) in the group with abnormal work duration and 19 respondents (44.2%) in the group with normal work duration. Based on the results of the Chi-Square test which produced a p-value of 0.287 (p>0.05), the results showed no significant relationship between work duration and musculoskeletal disorders in oil palm harvesters in Batu Jong-Jong Village.

c. Relationship Between Age with Musculoskeletal Disorders (MSDs)

Table 5. Relationship Between Age with Musculoskeletal Disorders

Usia	MSDs				Total		P-Value	PR (95% CI)
	Sedang		Rendah					
	n	%	n	%	N	%		
Tua ≥35 Tahun	35	83,3%	7	16,7%	42	100		
Muda <35 Tahun	7	26,9%	19	73,1%	26	100	0,000	3,095(1,620-5,915)
Total	42	61,8%	26	38,2%	68	100		

Based on the data in Table 5, it is known that workers who experience musculoskeletal disorders (MSDs) are mostly workers who experience moderate musculoskeletal disorders (MSDs) aged ≥35 years, which is 35 respondents (83.3%). Conversely, workers with low MSDs are more often found in the age group <35 years, as many as 19 respondents (73.1%). The results of the Chi-Square test showed a significant relationship between age and the incidence of MSDs (p-value = 0.000).

d. Relationship Between Physical Fitness with Musculoskeletal Disorders (MSDs)

Table 6. Relationship Between Physical Fitness with Musculoskeletal Disorders

Kesegaran Jasmani	MSDs				Total		P-Value	PR (95% CI)
	Sedang		Rendah					
	n	%	n	%	N	%		
Kurang	36	72,0%	14	28,0%	50	100		
Baik	6	33,3%	12	66,7%	18	100	0,009	2,160(1,099-4,246)
Total	42	61,8%	26	38,2%	68	100		

Based on the data in Table 6, it is known that workers with moderate musculoskeletal disorders (MSDs) mostly have a low level of physical fitness, which is 36 respondents (71.0%),

while workers with good physical fitness are only 6 respondents (33.3%). Meanwhile, in the low MSDs category, there are 14 respondents (28.0%) with low physical fitness and 12 respondents (66.7%) with good physical fitness. According to the results of the Chi-Squere test with a p-value of 0.009 (p <0.05), it can be concluded that the level of physical fitness is significantly related to the occurrence of musculoskeletal disorders in oil palm harvesters in Batu Jong-Jong Village.

e. Relationship between Working Period with Musculoskeletal Events Disorders (MSDs)

Table 7. Relationship between Working Period with Musculoskeletal Disorders

Masa Kerja	MSDs				Total		P-Value	PR (95% CI)
	Sedang		Rendah					
	n	%	n	%	N	%		
Lama ≥5 Tahun	36	72,0%	14	28,0%	50	100		
Baru <5 Tahun	6	33,3%	12	66,7%	18	100	0,009	2,160(1,099-4,246)
Total	42	61,8%	26	38,2%	68	100		

Based on Table 7, it is known that workers with moderate musculoskeletal disorders (MSDs) mostly have a long working period (≥5 years), which is 36 respondents (72.0%), while workers with new working periods (<5 years) are 6 respondents (33.3%). Meanwhile, in the low MSDs category, there are 14 respondents (28.0%) with long working periods and 12 respondents (66.7%) with new working periods. The Chi-Square test produces a p-value of 0.009 (p<0.05), which indicates a significant relationship between length of work and the incidence of musculoskeletal disorders in oil palm fruit harvesters in Batu Jong-Jong Village.

f. Relationship of Body Mass Index (BMI) with Musculoskeletal Disorders (MSDs)

Table 8. Relationship Between Body Mass Index (BMI) with Musculoskeletal Disorders

BMI	MSDs				Total		P-Value	PR (95% CI)
	Sedang		Rendah					
	n	%	n	%	N	%		
Tidak Normal	13	65,0%	7	35,0%	20	100		
Normal	29	60,4%	19	39,6%	48	100	0,936	1,076(0,725-1,597)
Total	42	61,8%	26	38,2%	68	100		

Based on the measurement results in Table 8, it is known that workers who experience moderate musculoskeletal disorders (MSDs) are more often found in the group with an abnormal body mass index (BMI), namely 13 respondents (65.0%), compared to the group with a normal BMI of 29 respondents (60.4%). Meanwhile, workers with low levels of MSDs were recorded as many as 7 respondents (35.0%) in the abnormal BMI category and 19 respondents (39.6%) in the normal BMI category. Based on the results of the Chi-Square test with a p-value of 0.936 (p>0.05), which shows that body mass index (BMI) does not have a significant relationship with the incidence of musculoskeletal disorders in oil palm harvesting workers in Batu Jong-Jong Village

3.2. Discussion

This study shows that several factors such as work posture, age, physical fitness, and length of service have a significant relationship with the incidence of musculoskeletal disorders (MSDs), while work duration and body mass index (BMI) are not significantly related. This indicates that the risk of muscle and skeletal complaints is more influenced by work ergonomics, physical conditions, and work experience than by length of work time or nutritional status based on BMI.

Unnatural and non-ergonomic working postures have been shown to be significantly associated with MSDs. Oil palm fruit harvesters generally work in a bent position, tilting their heads back, lifting heavy loads, and performing repetitive movements for long periods of time. The work posture assessment was carried out using the Rapid Entire Body Assessment (REBA) method, which showed that most respondents were at moderate to high risk levels. Non-neutral posture causes excessive

stress on muscles and joints, especially if done repeatedly every day. The uphill, uneven, and slippery working environment also worsens the body's position while working. This condition triggers excessive pressure on the musculoskeletal structure, thereby increasing muscle complaints. These results are in line with the research of Teresia and Indah (2022) which states that non-ergonomic body posture during harvesting is directly related to the increased risk of MSDs. 2 Likewise, research by Akbar et al. (2021) on rice farmers showed that work posture has a significant relationship to musculoskeletal disorders [13].

The duration of work in this study did not show a significant relationship with the incidence of MSDs. This is likely due to the oil palm harvesting work system in Batu Jong-Jong Village which is not carried out every day, but rather follows a harvest rotation schedule of about once every two weeks. This condition gives workers' bodies enough time to rest and recover from muscle fatigue. In addition, workers also have rest time during working hours and do a variety of activities, so that the workload does not accumulate continuously on the same muscles. These results are reinforced by research by Hermin et al. (2024) which shows that the duration of work does not have a significant relationship with MSDs complaints, because most workers have relatively balanced work and rest times [14]. Similar research by Olivya et al. (2020) also concluded that the duration of work is not a dominant factor causing muscle and skeletal disorders [15].

The age of workers in this study showed a significant relationship to the incidence of MSDs. As age increases, body functions, including muscle strength, joint elasticity, and the capacity of the body's supporting tissues, will decrease. Tissue degeneration begins to occur from the age of 30, where bone and muscle structures begin to lose their stability. Elderly workers tend to be exposed to physical work activities for longer, and because the body's cell regeneration process is increasingly slow, then they are more susceptible to fatigue and muscle injuries. Repetitive activities such as bending, lifting, or standing for long periods of time become more difficult for older age groups to tolerate. Research by Alisha et al. (2021) supports this finding, that workers aged ≥35 years have a higher risk of experiencing MSDs complaints than younger age groups [16].

Physical fitness was also found to be significantly related to the incidence of MSDs. Workers who do not have a routine of exercise or gymnastics tend to have less fit physical conditions. A less active body causes muscles to become stiff, inflexible, and fatigue more quickly when used for heavy physical activity. Lack of physical activity also has an impact on suboptimal blood flow to muscle tissue, thus disrupting the distribution of oxygen and nutrients that are important in muscle cell recovery. In conditions like this, the risk of muscle pain will increase when doing heavy work such as oil palm harvesting. Research by Marcilin and Decy (2020) shows that exercise habits have a significant effect on the level of MSD complaints, where workers who routinely do physical activities experience milder complaints [17]. This is also reinforced by Goalbetrus et al. (2022) which indicates a relationship between exercise and the incidence of MSDs, although not as strong as work ergonomics factors [18].

The longer a person works in heavy and repetitive activities, the greater the possibility of gradual soft tissue damage. The same work activities carried out continuously every day cause micro-stress that can accumulate into muscle and joint injuries. Workers with long working periods also tend to experience physical and mental fatigue, so that decreased alertness and consistency of work techniques can exacerbate the risk of injury. Research by Perry et al. (2022) and Aprilia & Rifai (2022) support these results, where workers with a working period of ≥5 years are more likely to experience musculoskeletal complaints than those who are new to work [19,20].

Unlike other variables, body mass index did not show a significant relationship with the incidence of MSDs in this study. The majority of respondents had a BMI in the normal category, so that the variation between groups very small and does not reflect a significant difference in risk. In addition, in the context of palm oil harvesters, MSDs complaints are more influenced by work positions and repetitive physical activities, not solely by body weight. Workers with normal BMI can still experience muscle disorders if they work in the wrong position or lift heavy loads for a long time. This finding is in line with the results of a study by Alfiani et al. (2023) which stated that there was no relationship between BMI and musculoskeletal complaints in tailor workers [21]. However, this is different from the study by Laksana and Triana (2020) which found that in heavy work such as welding, an abnormal BMI increases the risk of MSDs [12].

4. Conclusion

A study of 68 oil palm fruit harvesters in Batu Jong-Jong Village showed that the majority of workers experienced musculoskeletal disorders (MSDs) in the moderate category (61.8%) and most had a high-risk work posture (66.2%). Most respondents worked no more than 8 hours per day, were ≥35 years old, had a work period of ≥5 years, were not used to exercising regularly, and had a normal body mass index. The results of the analysis showed that there was a significant relationship between work posture,

age, physical fitness, and work period with the incidence of MSDs, while work duration and body mass index did not show a significant relationship. Based on these findings, it is recommended that oil palm fruit harvesters maintain an ergonomic body position while working and not push themselves when they feel tired, especially for workers aged ≥35 years so that they can make optimal use of their rest time. Workers with long working hours are advised to manage their working hours effectively to reduce the risk of musculoskeletal disorders and increase productivity. In addition, it is important for workers to do light exercise or warm-up before working to improve physical fitness and reduce muscle fatigue.

Declaration

Conflicts of Interest: "The authors declare no conflict of interest."

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