Individual and environmental factor analysis of musculosceletal disorders risk on lowland agricultural worker

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ABSTRACT

The agricultural sector is a type of work that has a high risk for workers. Activities carried out by farmers include hoeing, planting rice, drying rice, lifting and storing crops that have different levels of risk. The work posture of farmers who always bend over and work for long periods of time raises its own problems. Worker profile which includes age, gender, type of work, years of service, smoking habits, and psychosocial can be a risk factor for the occurrence of MSDS in farmers. Not only that, environmental factors such as working temperature can also be a factor that causes MSDS. MSDS complaints can be identified using the Nordic Body Map (NBM) method. Therefore, the aim of the research is to identify the influence of individual and environmental factors on MSDS complaints. This research was conducted on 20 farmers in Harapan Jaya Village. Statistical tests using the Chi-Square method were carried out to analyze the relationship between individual and environmental factors on the risk of MSDs complaints. The results obtained were from the bivariate Chi-Square test that there was a significant relationship between the independent variables and the risk factors for MSDs because they had a P-value of less than 0,05. These variables can be continued with a multivariate test provided that the P-value less than 0.25. The dominantly significant relationship between individual factors and risk factors for musculoskeletal disorders is the variable that has a P-value of less than 0.05 including gender and type of work with a P-value of 0.000. The right handler is to divide the work according to ability based on gender. If female workers are given work that is heavier than their capacity, the risk of MSDs will increase and have long-term effects.

1. INTRODUCTION

In 2013, the International Labor Organization (ILO) stated that every 15 seconds, 1 worker in the world dies as a result of a work accident and 160 workers experience work-related illness. In the previous year (2012), the number of deaths due to accidents and work-related diseases was recorded at 2 million cases every year. In this case, it indicates that occupational diseases need to be looked at further to find out the factors that cause these diseases to arise. One of the occupational diseases in general is complaints of pain in the body, namely Musculosceletal Disorders. This complaint arises due to an incorrect working position, which causes several complaints of pain in certain areas of the body. The agricultural sector is a type of work that has a high risk for workers. This type of work can cause complaints of pain in parts of the body due to several factors.

Jobs such as farming have a high level of risk when viewed from the work activities carried out and the work environment. Activities carried out by farmers include hoeing, planting rice, drying rice, lifting and storing harvests which have different levels of risk. One type of farmer activity that poses a high risk to health is when planting rice. Farmers' working posture, which is always bent and working for long periods of time, creates its own problems. Environmental conditions that often change and land management methods that are still manual are one of the factors. In general, farmers carry out their work activities all day in the fields and do this repeatedly as a routine for farmers. The environment in low-lying areas tends to have a higher temperature or air temperature (hot). This means that workers will feel more tired if they work for a long time under the hot sun. However, if you work when it is windy and tends to cause rain, workers will also have difficulty carrying out their activities. Apart from that, workers in the lowland agricultural sector generally work on other people's land, but there are some workers who also have their own land and work on that land. Workers who work on land owned by other people should continue to improve their work performance and have many other demands from land owners so that land productivity can increase. It cannot be denied that workers will feel pressured, causing psychological work stress.

Therefore, based on the background above regarding cases of pain complaints, namely musculoskeletal disorders (MSDs) in lowland agricultural sector workers, it is necessary to know the relationship between individual and environmental factors and risk factors for musculoskeletal disorders. This involves direct observation in Harapan Jaya Village to find out the factors that influence the risk of MSDs complaints among workers, especially rice farmers. Each factor needs to be divided into several categories to make it easier to determine the relationship between individual and environmental factors and risk factors. The goal is to find out the most dominant factors that cause pain in the body so that the treatment can be adjusted accordingly.

2. BASIC THEORY

2.1 Musculoskeletal Disorders (MSDs)

Musculoskeletal Disorders (MSDs) or generally known as injuries and disorders that affect the musculoskeletal system or body movement. MSDs that are felt usually start from mild disturbances or complaints to severe pain in the joints, nerves, muscles or spine due to unnatural work. If muscle contractions are used around 15% to 20% of the entire muscle capacity then there will be no muscle complaints. However, blood circulation to the muscles can decrease if the muscles contract by more than 20%. MSDs are a major concern for workers in the agricultural sector because they have a negative impact on worker health and productivity. This impact can be measured in terms of Health and safety costs, injury and illness rates, lost work time, duration of treatment, and worker welfare costs (Umima & Utami, 2022).

In general, the risk of MSDs includes several factors including incorrect work posture, doing the same activity repeatedly, handling materials, vibrations in machines or other things, extreme temperature changes, inadequate lighting, and duration of exposure. The individual factors that influence the risk of MSDs include age, gender, physical activity and smoking habits (Maulana et al., 2021).

2.2 Individual Factors

There are many types of occupational factors related to musculoskeletal disorders recorded in the agricultural sector.

a) Age

In general, complaints of musculosceletal disorders begin to be felt when you enter the working age of 25 to 26 years. The first complaint of MSDs usually appears at the age of 35 years. Complaints will continue to increase as workers age. Usually the most painful complaints are due to doing activities that are too heavy at a young age so that the consequences are long term. This is because in middle age, muscle strength and endurance begin to decline so that the risk of muscle complaints increases (Maulana et al., 2021).

b) Gender

Women's muscle endurance is much lower than men's because women's muscle strength is only approximately two-thirds of men's muscle strength. Physiologically, women's muscle capacity is lower than men's. Many agricultural equipment is aimed at male workers with the assumption that they will automatically benefit women even though the ergonomic characteristics of women are different from those

of male workers. Women have anatomical and physiological differences that may place them at risk for agricultural injuries. Women are, on average, shorter than men and have more adipose tissue. Women also have narrower shoulders, wider hips, and have proportionally shorter legs and arms than their male counterparts (Singh & Arora, 2010).

c) Work Period

Pain complaints decrease in workers after working for 1-5 years. However, the workforce will increase after working for more than 5 years. The longer a person's working period, the longer they are exposed to work at work, so the higher the risk of occupational diseases (Maulana et al., 2021).

d) Smoking Habit

MSDs complaints can also be caused by workers' smoking habits. This is because the presence of nicotine in cigarettes prevents blood flow throughout the body from functioning properly. Apart from that, smoking also reduces the mineral content in the bones, resulting in pain due to cracks or damage to the bone area (Maulana et al., 2021).

e) Psychosocial Factors

Psychosocial is part of the individual factors that can influence MSDs complaints. This psychosocial is related to interactions that occur in the work environment, organizational or company conditions, excessive individual consideration of their work, which has an impact on health, performance and job satisfaction. Psychosocial factors in this are seen from the characteristics of working hours, rules and regulations in the workplace, injustice related to severance pay, the number of concurrent work activities, work stress, the consequences of work errors, short rest periods and other disturbances while working (Mayasari & Saftarina, 2016).

2.3 Environmental Factors

One of the environmental factors that influence workers' activities in rice fields is air temperature. Temperature or air temperature can influence farmers in carrying out their work. Farmers will feel dehydrated if they work in hot weather. Temperature is a quantity that shows the high and low temperature of a tool and object used to measure temperature, namely a thermometer. The temperature in the work space is a factor that needs to be considered by the management

of a company where they work so that employees can use all their abilities to achieve maximum results (Putra & Zetli, 2022).

2.4 Nordic Body Map

Nordic Body Map is a measurement and assessment technique for identifying and recognizing complaints of pain and skeletal muscle injuries due to disorders of the musculoskeletal system. The assessment uses a worksheet in the form of questions with a map of body parts which are categorized into nine main parts, namely shoulders, neck, elbows, wrists, upper and lower back, waist or buttocks, knees, and heels or feet (Kusmindari, 2014). Through this worksheet, risk levels will be identified and classified from the level of complaints of not being sick, slightly sick, sick, and very sick. From the NBM results, it can be identified which parts of the muscles are experiencing complaints or pain felt by workers by filling in the NBM questionnaire, ranging from discomfort to very painful. Based on the results of the NBM questionnaire information, individual values or scores are then calculated using a predetermined Likert scale (Rahdiana, 2018). The following is a Likert scale to show the risk level classification based on the individual's total NBM score which is shown in Table 1 and Table 2 (Rahmawati et al., 2023).

2.5 Chi-square Test

The Chi-square test is a type of non-parametric comparative test carried out on two variables, where the data scale for both variables is nominal. This test was carried out to test the descriptive hypothesis of one sample and also test the comparative hypothesis of two independent samples (Nursalam, 2015). In the Chi-Square test, a hypothesis needs to be made, namely for H0 indicating that there is no significant influence between two variables, while H1 indicates that there is a significant influence between two variables. The testing criteria for the Chi-Square method are if Sig. more than equal to 0.05 then H0 can be accepted, but if Sig. less than 0.05 then H0 can be rejected (Negara & Prabowo, 2018).

3. METHODOLOGY

A flowchart is a diagram that describes the stages of a research such as the process and work flow carried out. In general, flowcharts are composed of graphic symbols such as work processes, input and output obtained, and decisions taken. The flow between processes that occur is connected using arrow symbols as a link.
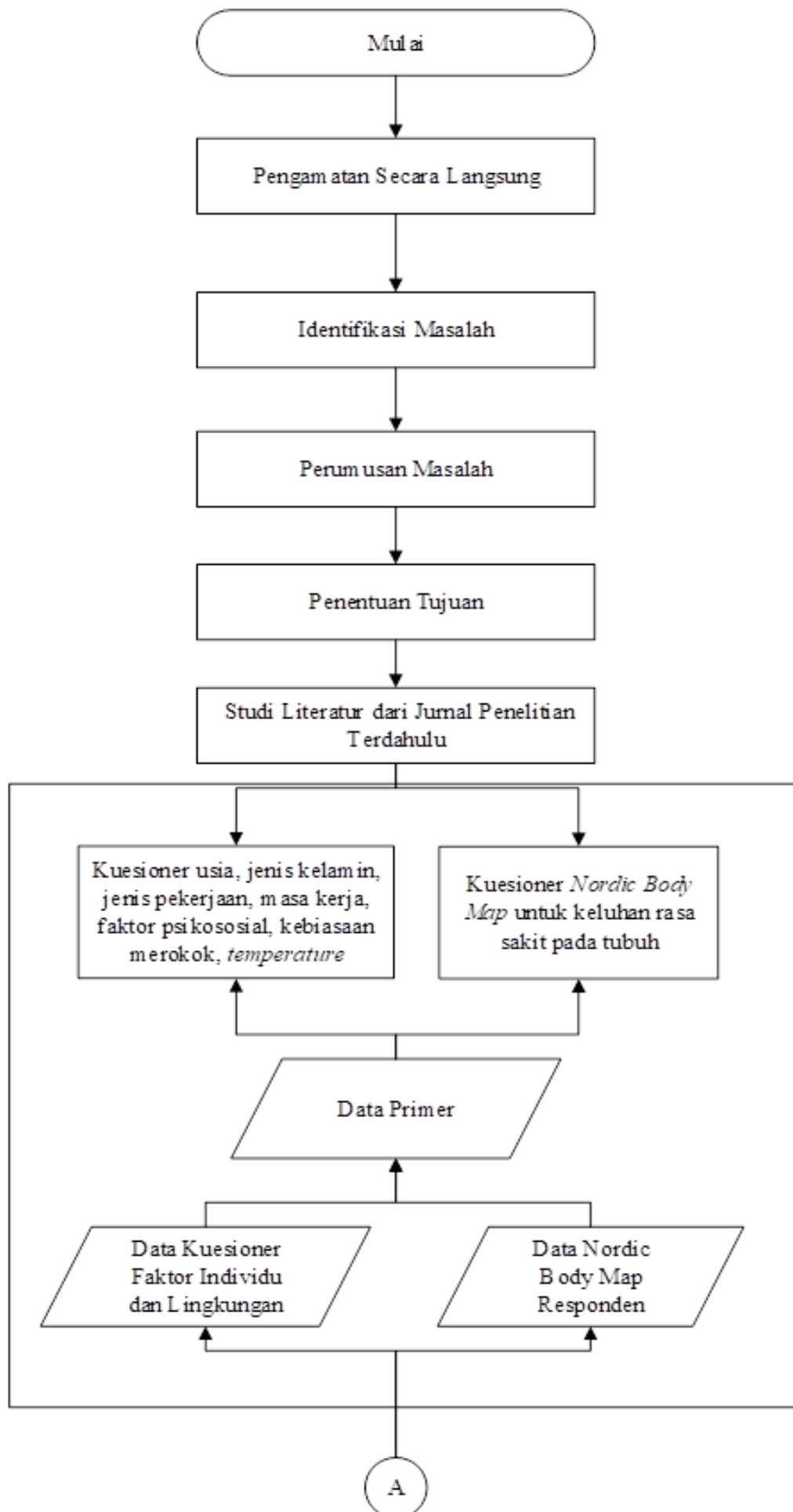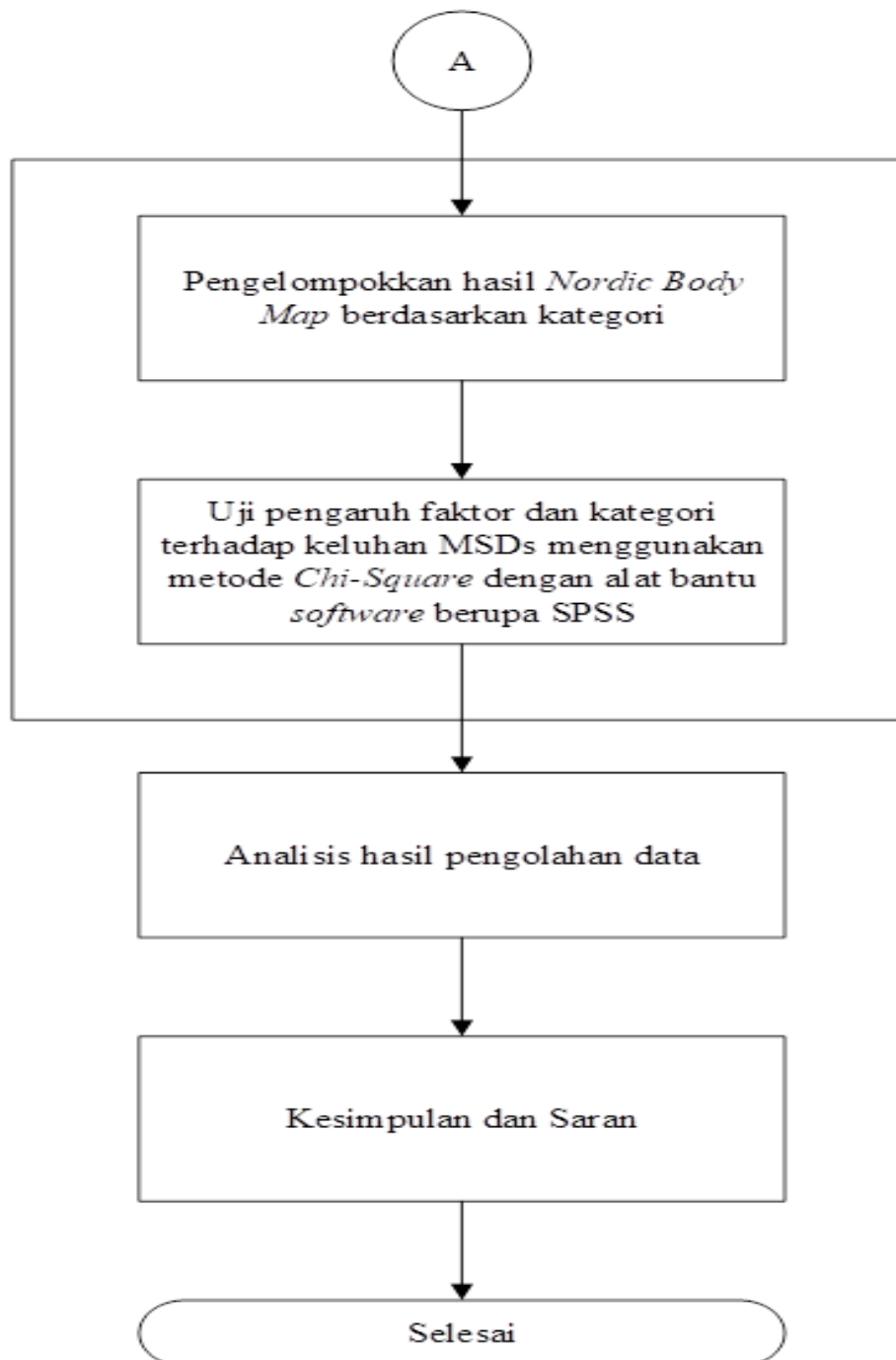
Figure 1. Data Collection Flowchart

Figure 2. Data Processing Flowchart

4. RESULTS AND DISCUSSION

4.1 Data Collection

The working position of workers in Harapan Jaya Village agriculture is the main problem in this research. There are errors in work position in several activities such as planting, hoeing, and so on

Figure 3. Farmer work position

Figure 3 shows one of the work activities carried out by farmers, namely barrowing. The picture clearly shows that a bent position like this will cause pain in the back and lower back. Apart from that, farmers have been doing this for quite a long time.

Table 1. Questionnaire results

Name	Gender	Age	Type of Work	Work Period (years)	Psychosocial	Smoking habit	*Temperature* (°C)
Ahmad Basori	Man	31	farmer	15	Moderate	smoker	> 30
Ersi	Woman	45	planter	25	Low	do not smoke	< 30
Fatoha	Man	60	farmer	30	Moderate	smoker	< 30
Hasim	Man	40	farmer	10	Low	smoker	> 30
Ismail	Man	51	farmer	20	Moderate	smoker	> 30
Jamal	Mam	41	farmer	20	Moderate	smoker	> 30
Jemin Alam	Man	51	farmer	20	Moderate	smoker	> 30
Kadung	Man	39	farmer	20	Moderate	smoker	> 30
Kobin	Man	65	farmer	30	Moderate	smoker	> 30
Limah	Woman	70	planter	50	Low	do not smoke	< 30
Mada	Man	45	farmer	20	Moderate	smoker	> 30
Marcha	Man	44	farmer	20	Moderate	smoker	> 30
Nabri	Man	46	farmer	20	Moderate	smoker	> 30
Nia Danianti	Woman	27	planter	5	Low	do not smoke	> 30
Omsih	Woman	60	planter	25	Moderate	do not smoke	< 30
Ririn	Woman	25	planter	10	Low	do not smoke	> 30
Ropiah	Woman	30	planter	15	Moderate	do not smoke	< 30
Sapin	Mam	60	farmer	20	Low	smoker	> 30
Umah	Woman	25	planter	5	Moderate	do not smoke	> 30
Zamhari	Man	49	farmer	35	Moderate	smoker	> 30

Table 1 is a data table resulting from a questionnaire filled in by 20 respondents who work in the highland agricultural sector in Harapan Jaya Village. For psychosocial factors, a psychological risk measurement questionnaire based on Permenaker 05 of 2018 in the form of an excel file was used. The questionnaire consists of 30 questions with answers on a scale of 1 (never), 2 (rarely), 3 (rarely), 4 (sometimes), 5 (often), 6 (very often), 7 (always causes stress). If you enter the scale number in Excel, the stress level results will be automatically displayed.

4.2 Nordic Body Map Data Processing

From the results of the Nordic Body Map calculations for each category, the risk level of the 20 respondents was obtained which was divided into several factors. The following is a table of risk level results based on the Nordic Body Map.

Table 2. NBM Score Results

Name	NBM score	risk level
Ahmad Basori	73	high
Fatoha	76	high
Hasim	62	moderate
Ismail	65	moderate
Jamal	82	high
Jemin Alam	66	moderate
Kadung	59	moderate
Kobin	67	moderate
Mada	66	moderate
Marcha	65	moderate
Nabri	74	high
Sapin	75	high
Zamhari	67	moderate
Ersi	78	high
Limah	68	moderate
Nia Danianti	69	moderate
Omsih	82	high
Ririn	48	low
Rofiah	73	high
Umah	81	high

Table 3. NBM Score Classification Results

Factors	Number of Workers	Risk level			
		low	**moderate**	**high**	**very high**
Individual					
Age					
>50	7	1	6	0	0
<50	13	0	4	9	0
Gender					
Man	13	1	10	2	0
Woman	7	0	0	7	0
Type of Work					
farmer	13	1	10	2	0
planter	7	0	0	7	0
Work Period					
≥25	6	1	5	0	0
<25	14	1	5	9	0
Psychosocial					
low	5	1	4	0	0
Moderate	15	0	6	0	0
Heavy	0	0	0	0	0
Smoking Habit					
smoker	13	1	10	2	0
Do not smoke	7	0	0	7	0
Environmental					
Temperature					
>30°C	15	1	10	4	0
<30°C	5	1	0	5	0

Table 3 is the result of the risk level obtained based on the Nordic Body Map calculation for each individual. Each individual is then categorized based on individual factors and environmental factors. This is to find out the factors that significantly influence the risk level.

4.3 Chi-square Test

Testing individual and environmental factors on the risk of MSDs can be carried out using the Chi-Square method using tools in the form of SPSS software. This method consists of 3 stages, namely univariate tests, bivariate tests and multivariate tests. The aim is to determine the most significant factors influencing the risk of MSDs. The data tested is data on risk levels for each factor and category based on the Nordic Body Map.

4.3.1 Univariate Test

In the univariate test, it was possible to determine the frequency distribution of the risk of MSDs from 20 respondents based on predetermined factors and categories.

Table 4. Univariate Risk Factor Test Results

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Age	> 50 Tahun	7	35.0	35.0	35.0
	< 50 Tahun	13	65.0	65.0	100.0
	Total	20	100.0	100.0	
Gender	Laki-Laki	13	65.0	65.0	65.0
	Perempuan	7	35.0	35.0	100.0
	Total	20	100.0	100.0	
Type of Work	Petani	13	65.0	65.0	65.0
	Penandur	7	35.0	35.0	100.0
	Total	20	100.0	100.0	
Work Period	≥25 year	6	30.0	30.0	30.0
	< 25 year	14	70.0	70.0	100.0
	Total	20	100.0	100.0	
Psikososial	low	5	25.0	25.0	25.0
	moderate	15	75.0	75.0	100.0
	Total	20	100.0	100.0	

Table 4. Univariate Risk Factor Test Results

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Smoking Habit	smoker	13	65.0	65.0	65.0
	do not smoke	7	35.0	35.0	100.0
Total		20	100.0	100.0	
Temperature	>30°C	15	75.0	75.0	75.0
	<30°C	5	25.0	25.0	100.0
Total		20	100.0	100.0	
MSDs Risk	low	1	5.0	5.0	5.0
	moderate	10	50.0	50.0	55.0
	high	9	45.0	45.0	100.0
Total		20	100.0	100.0	

Table 4 above shows the frequency distribution results regarding factors related to MSDs complaints from 20 respondents who work in the lowland agricultural sector, especially rice farming. After knowing the frequency distribution results, a bivariate test was then carried out to determine the factors that influence the risk of MSDs complaints.

4.3.2   Bivariate Test

Bivariate tests were carried out to determine which independent variables were significant in the risk factors for MSDs complaints (dependent variable). An independent variable can be said to be significant provided that the P-value does not exceed 0.05 (<0.05). The results of the bivariate test for MSDs risk factors are presented in the following table.

Table 5. Bivariate Risk Factor Test Results

Variable Independent	Category	Risk Level			Test	P-value
		low	moderate	high		
Age	> 50 year	1	6	0	9.451[a]	0.009
	< 50 year	0	4	9		
Gender	Man	1	10	2	13.162[a]	0.001
	Woman	0	0	7		
Type od Work	farmer	1	10	2	13.162[a]	0.001
	planter	0	0	7		
Work Period	≥25 year	1	10	2	8.095[a]	0.017
	< 25 year	0	0	7		
Psychosocial	Low	1	4	0	7.200[a]	0.027
	Stress Sedang	0	6	9		
Smoking Habit	Smoker	1	10	2	13.162[a]	0.001
	do not smoke	0	0	7		
Temperature	>30°C	1	10	4	8.148[a]	0.017
	<30°C	0	0	5		

Table 5 shows that there is a significant relationship between independent variables and MSDs risk factors because they have a P-value <0.05. These variables can be continued with a multivariate test provided that the P-value does not exceed 0.25 (<0.25) to determine the variable that has the most dominant relationship to MSDs risk factors.

4.3.3   Multivariate Test

Multivariate tests can be carried out if the bivariate test results have a P-value <0.25. Based on the results of bivariate tests, all independent variables were indicated to have a relationship with risk factors for musculoskeletal disorders (MSDs). To find out the most dominant factor, a multivariate test is carried out with the condition that the P-value does not exceed 0.05 (<0.05). The results of the multivariate test for MSDs risk factors are presented in the following table.

Table 6. Univariate Risk Factor Test Results

Model	Unstandardized	Coefficients	Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.600	0.39		1.537	0.147
Age	0.333	0.422	0.273	0.791	0.442
Work Period	3.30E-15	0.552	0.000	0.000	1.000
Psychosocial	0.200	0.428	0.149	0.468	0.647
Smoking Habit	0.667	0.319	0.545	2.092	0.055
Temperature	-5.980E-16	0.327	0.000	0.000	1.000

Table 6 is the result of a multivariate test of independent variables that have a relationship with risk factors for MSDs complaints but are not dominant because all P-value results for the variables age, length of service, psychosocial, smoking habits and temperature produce a P-value of more than 0.05 (>0.05).

Table 7. Dominant Univariate Test Results

Model	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
Gender	.b	.	.	.	0.000
Type of Work	.b	.	.	.	0.000

Table 7 is the result of a multivariate test of independent variables that have a dominant relationship with risk factors for MSDs complaints. The variables gender and type of work have a P-value of 0.000. These results indicate that the variables gender and type of work have a more dominant relationship compared to the variables in Table 27, producing a P-value of less than 0.05 (<0.05).

Table 8. Influential Factor Results

Model	Risk Level of MSDs	
	t	Sig.
Age	0.791	0.442
Work Period	0.000	1.000
Psychosocial	0.468	0.647
Smoking Habit	2.092	0.055
Temperature	0.000	1.000
Gender	0.000	0.000
Type of Work	0.000	0.000

From the SPSS data processing results of the Multivariate Chi-Square test in Table 8, it is known that all respondents had complaints regarding the risk of MSDs. Judging from individual and environmental factors, the variables gender and type of work have the

most significant dominant influence/relationship on the emergence of the risk of MSDs. The right treatment is to divide work according to ability based on gender. This is because the physique of women and men is very different. If female workers are given work that is heavier than their capacity, the risk of MSDs will increase and have long-term effects.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the results of the analysis of data collection and processing from 20 worker respondents in the lowland agricultural sector, several conclusions were obtained, including:

1. In the Bivariate Chiq-Square Test, there is a significant relationship between the independent variables and the risk factors for MSDs because they have a P-value <0.05. These variables can be continued with a multivariate test provided that the P-value does not exceed 0.25 (<0.25) to determine the variable that has the most dominant relationship to MSDs risk factors.
2. There is a dominantly significant relationship between individual factors and risk factors for musculoskeletal disorders, namely variables that have a P-value < 0.005, including the variables gender and type of work with a P-value of 0.000.
3. The right treatment is to divide work according to ability based on gender. This is because the physique of women and men is very different. If female workers are given work that is heavier than their capacity, the risk of MSDs will increase and have long-term effects

5.2 Recommendations

Based on the results of the conclusions above, several suggestions that can be given include:

1. Managers of rice farming sector worker associations/organizations should divide tasks by considering all factors related to the risk of MSDs complaints.
2. Agricultural sector workers should carry out work activities by adopting good work posture. You can also use adequate work aids to carry out your work.
3. 3. Future researchers can make work equipment used in farming activities in lowland agriculture, especially rice and provide information regarding work attitudes/postures that must be applied to minimize the risk of MSDs complaints.

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