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FACTORS AFFECTING RESPIRATION COMPLAINTS IN PARAQUAT WORKERS IN PALM OIL PLANTATIONS IN KALIMANTAN, 2022

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KEYWORDS
paraquat, sprayer, respiratory complaint, 5-5 prevention pack model.

ABSTRACT
The study analyzed the relationship between the dependent variable (respiratory complaints) and the independent variables (worker characteristics, occupational characteristics, exposure intensity, and prevention of respiratory disorders) in paraquat sprayers in oil palm plantations in Kalimantan in 2022. The study design was a cross-sectional, analytical-descriptive quantitative study using a questionnaire instrument conducted online from August to October 2022. The total sample is 189 worker respondents and ten management respondents. The bivariate analysis was Chi-Square 2x2 for variables with p</=0.25 values, followed by multivariate logistic regression tests using the backward method. The study results found that 13.22% had respiratory complaints, 11.11% had complaints of cough, 3.17% coughed with phlegm, 2.11% had shortness of breath, and 1.05 had asthma. The results of the multivariate analysis show smoking habits have a risk of 4x (p 0.006), OR 4.12 (1.50-11.32)), permanent workers have a risk of 3x (p-value 0.022, OR 2.98 (1.16-7) .64)), and the use of inadequate PPE has a risk of 4.77x (p 0.002, OR 4.77 (1.78 - 12.80)). No significant relationship was found in the analysis of efforts to prevent respiratory disorders and respiratory complaints. This research implies that it can serve as a foundation for formulating better policies regarding the usage of paraquat in agriculture. It can also help raise awareness about the environmental impact of pesticide usage, such as paraquat.

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INTRODUCTION

National development has created jobs and expanded job opportunities for workers who will provide income to meet the necessities of life for themselves and their families (Djunaidi & Alfitri, 2022)—increasing workability and income, always facing health problems, accidents, disabilities, and even death (Iftitah, 2017). Therefore, promotive, preventive, curative, and rehabilitative occupational health services are needed to create healthy and productive workers (Agustina, 2016).

Ministry of Agriculture data for 2017-2021 shows that there has been an expansion of the area of oil palm plantations from 14,048,722 (Ha) in 2017 to 15,081,021 (Ha) with a 2018-2019 growth rate of 0.91%. The expansion of the plantation area was followed by an increase in palm oil production from 37,965,224 (tons) in 2017 to 49,710,345 (tons) in 2021, with a growth rate of oil palm production in 2018-2019 of 9.88%. Productivity (kg/ha) has also increased, with a growth rate of 8.42% in 2018-2019. The data above can describe the growth of the oil palm plantation sector in Indonesia, which is increasing rapidly and has made Indonesia one of the countries with the largest palm oil producers in the world (Indonesia, 2021).

From an economic perspective, palm oil is a foreign exchange earner for Indonesia; 80% of domestic palm oil production is exported to various countries. The palm oil industry can provide an

increase in foreign exchange which continues to increase from year to year; data for 2019-2020 shows an increase in the total value of exports (billions of USD) from 20.2 in 2019 to 23.0 in 2020 and 36.2 in 2021. Based on unit export value (USD/ton), there was also an increase from 541.1 in 2019 to 675.4 in 2020 and 1,046.9 in 2021 (Monitor, 2020).

Paraquat, as a non-selective pesticide, is one of the most widely used pesticides due to its affordable price. Paraquat is classified as a class I toxic substance, a class of bipyridyl (1,1-dimethyl-4, 4-bipyridinium) pesticides that impact humans through the respiratory, digestive, skin, and eye mucosa. In Indonesia, paraquat is classified as a limited pesticide in terms of its use; its use must have maximum efficiency with minimal impact on humans, living things, and the environment. Restricted pesticides require special requirements and safety equipment other than those listed on the label. They can only be used by certified users issued by the head of the service carrying out functions in the agricultural sector in the Regency/City (Fitriyani, 2019). Limited pesticide use must be explicitly regulated to minimize impacts on humans and the environment (Pertanian, 2013).

Occupational lung disease is an artificial disease that can be prevented by preventing respiratory disorders (Halajur, 2019). Model 5-5 Prevention of workers' health problems is carried out through primary, secondary, and tertiary prevention. Primary prevention includes efforts to maintain and improve worker safety and health status and specific protection according to the hazards found in the workplace (Kurniawidjadja et al., 2021). Secondary prevention is done through early diagnosis and optimal treatment. Tertiary prevention with disability limitation and rehabilitation. (Kurniawidjadja et al., 2019) .

The results of a 2011 study on paraquat pesticide sprayers in South Kalimantan found a prevalence of restriction lung disorder of 7.24% (Dewi SK, 2011) and a prevalence of respiratory complaints of 15.22% (Dewi SK, 2011). A significant relationship was found between work period and restrictive lung disorder (95% CI 1.11 -- 73.12); respondents with a working period ≥13 months had nine times the risk of experiencing restrictive lung disorder compared to respondents with a working period <13 months, and there is exposure with high intensity in all respondents with a calculated score of exposure intensity of 24. This study aims to analyze the implementation of prevention efforts and the factors that influence respiratory complaints from paraquat exposure to sprayers in oil palm plantations in Kalimantan in 2022. Therefore, the benefits of this research include an increased awareness of worker safety, which can provide better insights into the health risks faced by workers in oil palm plantations exposed to paraquat. These findings can also assist in formulating and implementing improved and more effective workplace safety policies in oil palm plantations.

METHODS

This study used a cross-sectional design, a quantitative analytic study to examine the factors of Model 5-5 Control Efforts on paraquat sprayers against respiratory complaints. The research was conducted at the Kalimantan Oil Palm Plantation. Data collection was carried out through online instruments from August to October 2022. Validity and reliability tests were carried out on the instrument with valid and reliable results. The analysis was carried out as a univariate descriptive of the characteristics of the respondents and Control Efforts Model 5-5, bivariate on the factors Control Efforts Model 5-5 respondents to respiratory complaints using Chi-Square 2x2. The multivariate test was carried out on a bivariate test with a $p>0.25$ value. Factors with a p-value <0.05 in the multivariate test were found to be significantly related to respiratory complaints.

Based on the sample size formula used, the sample size for testing the hypothesis in the proportion of 2 populations obtained a sample size of 181 working respondents. The total sample was

189 worker respondents; 9 were excluded because the questionnaire data was incomplete. The sampling technique in this study used a non-probability technique, namely quota sampling; the inclusion criteria were workers spraying paraquats on oil palm plantations in Kalimantan with a minimum of 6 (six) months of work, the exclusion criteria were respondents who already had respiratory problems based on a doctor's diagnosis before working at the current company and are not willing to fill out the questionnaire completely. To get an overview of Control Efforts Model 5-5, a sample was taken from 10 management-level respondents in a palm oil company.

RESULTS AND DISCUSSION

This study involved 189 respondents; the analysis results show that Most of the respondents were female (50.3%). Most working age groups are between 26 - 35 years and 36 - 25 years. The majority of the respondents who participated were married (82.5%). Most of the respondents' physical activities did not exercise (53.4%). Most respondents did not smoke (83.1%), all female respondents did not smoke (100%), 34.0% of male respondents smoked, and 66.0% of male respondents did not smoke. History of the respondent's disease in the last three months, most of the respondents did not have a history of lung disease, heart and blood vessel disease, and bone disease in the thoracic cavity and spine. Most respondents' assessment of healthy work patterns on the indicators of knowledge related to procedures was good (76.2%). The indicators of work procedures were also primarily good (69.8%), but there were still quite a few that were not good enough. Almost all workers stated that they were aware of the potential hazards in the workplace as a sprayer.

Table 1. Frequency of Worker Characteristics

Variable	n-189	%
Gender		
Woman	95	50,3
Man	94	49,7
Age group		
18-25 years	37	19,6
26-35 years	59	31,2
36-45 years	59	31,2
46-55 years	31	16,4
>55 years	3	1,6
Marital status		
Single	33	17.5
Marry	156	82.5
Formal education		
Tall	11	5,8
Intermediate	49	25,9
Base	129	68.3
Income		
>UMR	10	5,3
=UMR	141	74,6
<UMR	38	20,1
Nutritional status		
Good nutritional status	133	70,4
More nutritional status	42	22,2
Poor nutritional status	14	7,4
Sports Habits		
Yes	88	46,6
No	101	53,4
Smoking habit		
Do not smoke	157	83,1

Variable	n-189	%
Yes smoking	32	15,9
Lung disease		
No	188	99.5
Yes	1	0.5
Diseases of the heart and blood vessels		
No	189	100.0
Yes	0	0
Diseases of the thoracic cavity and spine		
No	188	99.5
Yes	1	0.5
Healthy Work Patterns		
Respondents' knowledge regarding procedures		
Good (≤4)	132	69.8
Less (>4)	57	30,2
Application of work procedures		
Good (≤5)	144	76,2
Less (>5)	45	23,8
Paraquat *Hazard* Knowledge		
Yes	185	97.9
No	4	2,1

The following is a table of the distribution of respiratory complaints for the last three months among workers in Kalimantan Oil Palm Plantations. Assessment of respiratory disorders using a modified questionnaire from The American Thoracic Society (ATS) respiratory disease questionnaire for adults ATS-DLD-78.

Table 2. Respiratory Complaints in Workers (n= 189)

Respiratory Complaints	Yes		No	
	n	%	n	%
Respondents who have respiratory complaints	25	13,22	164	86,78
Consultation with complaints of respiratory problems experienced by respondents in the last 3 (three) months	3	1.58	186	98.42
Cough nearly every day (4-7 days/week) for three months or more	21	11,11	168	88,89
Cough with phlegm from the chest cavity (not from the nasal cavity) occurring most days (4-7 days/week) for three consecutive months or more	6	3,17	183	96,83
Shortness of breath most days (4-7 days/week) for three months or more	4	2,11	185	97.89
Asthma disease ever diagnosed by a doctor while the respondent was working at the current workplace.	2	1.05	187	98.95
Chronic bronchitis ever diagnosed by a doctor while the respondent was working at the current workplace.	1	0.52	188	99.48

The study found that in the last three months, most respondents had no respiratory complaints (86.78%). However, 25 people (13.22%) experienced one or more complaints. The most common complaint was coughing, which occurred every day for the last three months, as much as 11.11%. The results of the analysis found that the average age of the workers who became respondents was 36 years, the youngest worker was 19 years old, and the oldest was 65 years old, the average respondent's BMI was 23.16 (good nutritional status), most of them were secondary education, the average income of respondents meet UMR standards. The healthy work pattern variable consists of indicators of respondents' knowledge regarding spraying work procedures and the application of work procedures; scoring is carried out, then divided into two excellent and poor categories based on the mean value.

Table 3. Job Characteristics

Variable	n=189	%
Type of work		
Foreman	6	3,2
Sprayer	183	96.8
Employment status		
Permanent worker/monthly salary	51	27.0
Casual Daily Worker (BHL)	138	73.0
Length of working		
>1 year	124	65,6
≤1 year	65	34,4

The job characteristics of the respondents showed that most of them were sprayers (96.8%), the majority (73%) were casual daily workers (BHL), and the majority of respondents (65.6%) had worked for > 1 year. The intensity of exposure can be seen from several variables, namely work assignments, use of PPE, and safe working methods. The results of the exposure intensity scoring showed that most of the respondents had carried out their duties well (60.3%), most of the respondents had used PPE properly (85.2%), and some of the respondents had worked well (59.3%).

Table 4. Exposure Intensity Scoring

Variable	n=189	%
Job Tasks		
Good (≤10)	114	60,3
Less (>10)	75	39,7
Using PPE		
Good (≤5)	161	85,2
Less (>5)	28	14,8
How to Work Safely		
Good (≤4)	158	83.6
Less (>4)	31	16,4

Prevention of Respiratory Disorders Model 5-5 results of the management questionnaire.

All respondents answered that they had carried out hazard communication, healthy work patterns, healthy lifestyles, training, work procedures, implementation supervision, availability of first aid kits, checking of first aid kits, trained first aid workers, company clinics, referral health facilities, checks before returning to work and treatment checks. Advanced. 30% of clinics can be reached within <15 minutes, 90% carry out MCU, 80% have pulmonary function examination (spirometry), 40% have chest X-ray examination, 90% have referral transportation, and a small proportion has carried out periodic job rotations (30%). Management respondents could not be researched by analyzing the relationship to respiratory complaints.

Prevention of Respiratory Disorders Model 5-5 results of workers' questionnaires

Efforts to control the prevention of PAK Model 5-5 have been going well, where 99.5% have received PPE, 87% have received spirometry examination facilities, 98% have received health facilities if they have a work accident, and 91% have received compensation for PAK. Respondents who received spirometry examination facilities had lower respiratory complaints (11.5%) than respondents who did not have spirometry examination facilities (25%). Respondents who received compensation guarantees had lower respiratory complaints (11%) than respondents who did not have compensation guarantees (37.5%). Multivariate analysis was performed on the spirometry examination facility variable (p=0.1)

and compensation guarantee variable (p=0.009); the results of the multivariate analysis found no significant relationship between the spirometry examination facility variable and the compensation guarantee variable on respiratory complaints.

Table 5. Prevention of AIDs Prevention Model 5-5 of Management (n=10)

Variable	Yes		No	
	n	%	n	%
Health Promotion				
Hazard Communication	10	100	0	0
Healthy Work Patterns	10	100	0	0
Healthy lifestyles	10	100	0	0
Training	10	100	0	0
Specific Protection				
Fit Work Program				
MCU check	9	90	1	10
Lung Function Examination	8	80	2	20
X-ray examination	4	40	6	60
Work procedures	10	100	0	0
Executor Supervision	10	100	0	0
Supervision Sanctions	6	60	4	40
Job Rotation	3	30	7	70
PPE				
PPE Use Practices	8	80	2	20
Availability of PPE	7	70	3	30
PPE cleaning	8	80	2	20
Early Diagnosis and Optimal Treatment				
First Aid at Work				
Availability of first aid	10	100	0	0
First aid affordability	7	70	3	30
Periodic First Aid Examination/ Checking	10	100	0	0
Availability of First Aid Officers	9	90	1	10
Trained First Aid Officer	10	100	0	0
Medical Facility				
Clinic Availability	10	100	0	0
Clinic Affordability				
○ <15 minutes	3	30	7	70
○ 15-30 minutes	7	70	3	30
Defect Prevention				
Health Facilities and Referrals	10	100	0	0
Referral Transportation	9	90	1	10
Return to Work Program				
Post Accident Recovery Service Facility	9	90	1	10
Post-Illness Service Facility	9	90	1	10
Doctor Examination Before Returning to Work	10	100	0	0
Continuing Care Physician Examination	10	100	0	0

Table 6. Prevention of CAH Model 5-5 from Workers (n = 189)

Variable	Yes		No	
	n	%	n	%
Obtain PPE to avoid hazards as a sprayer	188	99.5	1	0.5
There is a spirometry examination facility related to the dangers of working as a sprayer	165	87.3	24	12,7
There are health facilities when there is a work accident	186	98.4	3	1,6
There is a guarantee of compensation if there is a respiratory disorder as a result of working as a sprayer	173	91.5	16	8,5

Table 7 is a bivariate test. A multivariate test was carried out on 14 variables which in the bivariate analysis had p<=0.25 with the logistic regression test of the predictive model. In the final step of the multivariate analysis, three variables related to respiratory complaints were obtained: smoking habits, employment status, and use of PPE. The group with smoking habits has a risk factor of 4.12x exposure to respiratory complaints than the non-smoker group. In employment status as permanent workers/monthly salary, the risk is 2.98x exposure to respiratory complaints compared to the Casual Daily Workers (BHL) group. The employment status is interesting because permanent employees/monthly salaries are more at risk than casual daily workers. This can be seen in the condition of permanent workers/monthly salary; the percentage of cases of respiratory complaints is high for employees with >1 year of service (23.5%) compared to employees with >1 year of service in the Casual Daily Workers group (10%). In the group of workers lacking in using PPE, there is a 4.77x risk of exposure to respiratory complaints compared to the group that uses PPE properly.

Table 7. Bivariate Test

	Respiratory Complaints				p-value	OR	95% CI
	No		Yes				
	n	%	n	%			
Gender							
Woman	86	90.5	9	9,5	0.12*	1,960	0.819 – 4.689
Man	78	83.0	16	17.0		1	
Age							
≤36 years old	80	83.3	16	16,7	0.15*	0.536	0.224 – 1.281
>36 years	84	90.3	9	9,7		1	
Marital status							
Single	25	75.8	8	24,2	0.05*	0.382	0.149 – 0.98
Marry	139	89.1	17	10,9		1	
Education							
High-Intermediate	48	80.0	12	20	0.061*	0.448	0.191 – 1.053
Base	116	89.9	13	10,1		1	
Income							
≥UMR	130	86.1	21	13,9	0.58	0.728	0.234 – 2.263
<UMR	34	89.5	4	10.5		1	
Nutritional status							
Normal Nutrition	118	88.7	15	11,3	0.22*	1,710	0.717 – 4.081
Abnormal Nutrition	46	82,1	10	17,9		1	
Sports Habits							
Yes	73	83.0	15	17.0	0.14*	0.535	0.227 – 1.260
No	91	90,1	10	9,9		1	
Smoking habit							
No	141	89.8	16	10,2	0.01*	3,448	1.262 – 8.722
Yes	23	71.9	9	28,1		1	

	Respiratory Complaints				p-value	OR	95% CI
	No		Yes				
	n	%	n	%			
Lung Disease							
No	164	87,2	24	12,8	0.13*	0.128	0.88 – 0.185
Yes	0	0	1	100		1	
Heart							
No	164	86.8	25	13,2	-	-	
Yes	0	0	0	0		1	
Chest Bone Abnormalities							
No	164	87,2	24	12,8	0.13*	0.128	0.88 – 0.185
Yes	0	0	1	100.0		1	
Knowledge Healthy Work Patterns							
Good (≤4)	114	86.4	18	13,6	0.80	0.887	0.348 – 2.257
Less (>4)	50	87.7	7	12,3		1	
Procedure							
Good (≤5)	127	88.2	17	11,8	0.30	1.615	0.656 – 4.040
Less (>5)	37	82,2	8	17,8		1	
Paraquat Hazard Knowledge							
Yes	161	87.0	24	13.0	0.43	2,236	0.223 – 22.380
No	3	75.0	1	25.0	1		
Type of work							
Foreman	4	66,7	2	33,3	0.18*	0.288	0.55 – 1.659
Sprayer	160	87.4	23	12,6		1	
Employment status							
Permanent Worker/Monthly	39	76.5	12	23.5	0.01*	0.338	0.143 – 0.801
Salary	125	90.6	13	9,4		1	
Casual Daily Worker (BHL)							
Length of working							
>1 year	107	86.3	17	13,7	0.78	0.883	0.359 – 2.172
≤1 year	57	87.7	8	12,3		1	
Job Tasks							
Good	100	87.7	14	12,3	0.63	1.228	0.525 – 2.872
Not enough	64	85,3	11	14,7		1	
Using PPE							
Good	146	90.7	15	9,3	0.00*	1	2.116 – 13.816
Not enough	18	64,3	10	35,7		5,407	
How to Work Safely							
Good	140	88.6	18	11,4	0.14*	1	0.856 – 6.011
Not enough	24	77,4	7	22,6	1	2,269	

*significantly related

Table 8 . Logistic Regression Multivariate Test

	Coefficient	SE	Wald	Df	p-value	OR	95% CI
Habit							
Smoke	1.41	0.51	7.55	1	0.006*	4,12	1.50 - 11.32
Do not smoke						1	
Employment status							
Permanent Labor	1.09	0.47	5,21	1	0.022*	2.98	1.16 - 7.64
BHL						1	
Use PPE							
Not enough	1.56	0.50	9.67	1	0.002*	4.77	1.78 - 12.80
Good						1	
Constant	-2.98	0.40	55,51	1	0.0	0.15	

*significantly related

For significant values of p <0.25, a multivariate test was performed. Gender in this study was followed by a multivariate test (p = 0.12); it was seen that women had a 1.96x chance of not experiencing respiratory complaints from men. Of female workers, 50.3% were respondents for the gender with many respiratory complaints, namely men (64%). In Santosa WRB's research, Gayatri PR, 2020 stated that gender differences affect lung capacity and respiratory performance. Women have a smaller diffusion area than men with the same lung size, which can lead to poor respiratory performance and lung function (Santosa & Gayatri, 2020).

The multivariate test was continued for the age group with respiratory complaints (p=0.15). The age group ≤36 years has a protection factor of 0.53x for not experiencing respiratory complaints compared to the age group >36 years. The age group that experienced the most respiratory problems was ≤36 years old (64%). In Moon's 2015 study, there was no significant relationship between age and paraquat poisoning, p = 0.980 (Moon & Chun, 2015).

Only a small proportion of respondents had the habit of smoking (15.9%); there were no female respondents who had the habit of smoking, and 34.0% of the male respondents had the habit of smoking. The prevalence of smoking habits in this study was lower compared to the research (Ahmad, 2021) ; (Profiles, 2017). Smoking habits were followed by a multivariate test (p=0.006). The group with smoking habits has a 4.12x chance of experiencing respiratory complaints compared to the non-smoker group. Smokers risk 2.6x asthma, 1.7x chronic bronchitis, 4.0x chronic cough, 1.4x persistent wheezing, and 2.2x shortness of breath (Schenker et al., 2013). There is no significant relationship between age and paraquat poisoning p=0.98. There is no significant relationship between cardiovascular disease and paraquat poisoning p = 0.377

Bivariate analysis for variables with a p </ =0.25 value was followed by a multivariate logistic regression test using the *backward method*. Based on the multivariate test results, there are variables related to respiratory complaints, namely smoking habits, type of work, and use of PPE. Smoking habits have a risk of 4x (*p* 0.006), OR 4.12 (1.50-11.32), permanent workers have a risk of 3x (*p-value* 0.022, OR 2.98 (1.16-7.64)), and the use of PPE is not good has a risk of 4.77x (*p* 0.002, OR 4.77 (1.78 - 12.80). No significant relationship was found in the variable efforts to prevent respiratory disorders and complaints.

CONCLUSION

In conclusion, the analysis of respiratory complaints among workers in oil palm plantations over the past three months reveals several key findings. The majority of respondents (86.78%) reported no complaints, while the most prevalent issue was coughing, affecting 84% of respondents on a daily basis during the specified period. The characteristics of the workers indicated a relatively equal distribution of male and female respondents (50.3% each), with the age group of 26-45 years constituting the largest portion (62.4%). Additionally, 68.3% of respondents had primary education, 53.4% lacked regular exercise habits, 29.6% exhibited poor nutritional status, and 20.1% had income below the UMR.

The analysis identified prominent risk factors influencing the relationship between independent and dependent variables. Smoking habits, employment status, and the utilization of personal protective equipment (PPE) emerged as dominant risk factors, whereas not smoking and properly using PPE at work were protective factors.

Based on these findings, recommendations can be directed to both workers and companies. Workers are advised to take proactive steps to prevent respiratory issues by enhancing their knowledge, adopting healthy lifestyles involving regular exercise, balanced nutrition, adequate rest, stress management, and avoiding smoking and alcohol. They are also encouraged to establish healthy work

patterns, acquaint themselves with potential workplace hazards, adhere to proper work procedures, and consistently use appropriate PPE. Smokers among the employees are encouraged to quit smoking through various methods, with the support of occupational health services.

For companies, it is recommended to improve efforts in preventing respiratory disorders by implementing a comprehensive strategy, including environmental assessments, a fit-to-work program, enhanced health education, educational programs on healthy living and work practices, improved PPE usage, periodic job rotation, reporting systems for respiratory complaints, and health surveillance. The provision of health facilities, smoking cessation clinics, high-protein meals, and strong management-worker collaboration in prevention programs are also emphasized. Implementing the RAPKPIEK method in Health Promotion at Work (PKDTK) and engaging with the principles of Indonesian Sustainable Palm Oil (ISPO) are suggested. Furthermore, the registration of all workers in the Employment Social Security Administration Agency (BPJS-TK) program is recommended to ensure protection against occupational diseases. Lastly, it is advised to enhance the competency of occupational health service personnel in diagnosing and reporting occupational diseases, while maintaining consistent engagement from management.

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