The Relationship between Pesticide Exposure and Impaired Lung Function in Horticultural Sprayer Farmers in Ngablak District, Magelang Regency

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Abstract: Pesticides can cause air pollution in farmers' workplaces. One of the effects of pesticide spraying is impaired lung function. This study aims to determine the relationship between pesticide exposure and impaired lung function of horticultural spraying farmers in Ngablak Magelang.The research design is an observational study using a Cross Sectional approach and 70 people as a sample. The population of this study is farmers who are members of the Sumberejo village farmer group. The research sample from this study is farmers in Sumberejo village who meet the inclusion criteria. The data collected used a questionnaire as an instrument, while the examination of pulmonary dysfunction used a spirometry. The data analysis used in this study is chi square and logistic regression.The findings of this study are related to lung function disorders, such as: length of work (p-value=0.004), duration of work (p-value=0.001), frequency of spraying (p-value=0.32)

Keywords: Pesticide exposure, Lung dysfunction, Central Java

INTRODUCTION

Pesticides are toxic substances used to kill bodies that interfere with plants, livestock and so on that humans strive for their well-being. Pest means pest, while cide means to kill. The use of pesticides is usually done with other ingredients such as mixing oil and water to dissolve them, there are also powders to facilitate the distribution and spraying of powders, powders that are mixed as diluents generally in dust formulations, attractants (e.g. pheromone materials) for feeders, as well as other synergistic ingredients to increase the toxicity.

According to World Health Organization (WHO) after that about three million pesticide poisonings occur every year, resulting in 220,000 deaths worldwide and about 500-1000 people per year of which experience very fatal effects such as cancer and impaired lung function. Agricultural conditions in Indonesia are currently directed to the interests of the agroindustry. One of the forms will lead to an increasingly monocultural agricultural pattern, both in land agriculture and aquaculture. Environmental problems caused by activities in the agricultural sector began with the green revolution movement which was marked by the use of fertilizers and pesticides as production factors. Pest control, disease and weed control with pesticides has been carried out by farmers in Indonesia for a long time, namely since pest control, disease and weed control was incorporated into the BIMAS and INMAS programs, to increase rice production around the 1970s.

In the water environment the half-life of DDT, more than 10 years, while the dieldrin is 20 years.5 Most of Magelang Regency is a fertile mountainous area, so many residents work in the agricultural sector. The percentage of the population who are farmers in Magelang Regency is 38.94% of the total employment rate of 361,799 people. Ngablak District is one of the sub-districts in Magelang Regency with a large agricultural area and the largest vegetable production, with a population of 40,888 people and 16 villages. The majority of residents in Ngablak District have a farmer livelihood, which is 26,341 people or 87.5% of the total population aged 10-64 years. Women farmers in Ngablak District have the same role as male farmers.

According to the report of the Ngablak District Health Center in the last 5 years, it is shown that the number of outpatient visits suffering from respiratory diseases is 3,058 people or 30% of the 40,879 patients who are treated at the Ngablak District Health Center. The results of the initial survey obtained a report at the Ngablak District Health Center, data was obtained that 30% of patients who were treated for diseases were respiratory tract infections and coughs. The use of pesticides by farmers in Ngablak District has been going on since the 1970s. Pesticides are used as the most important ingredient for farmers in the context of pest control. The use of pesticides is often disproportionate especially in the event of a pest attack and after rain, farmers will spray immediately after rain. This condition is often exacerbated by their indifference to the dangers of pesticides that can poison farmers, families and communities around their environment.

The area of agricultural land in Ngablak District, Magelang Regency covers an area of 4,391 hectares of the total amount of agricultural land in Ngablak District, Magelang Regency. Rice fields are 186,905 hectares and dry land is 4,204 hectares, the number of male farmers is 20510 and women are 20369. Commodities produced by agriculture in Ngablak District, Magelang Regency: Cabbage, Tomato, Carrot, Broccoli, Mustard, Cucumber and French Chickpeas.

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This is related to the involvement of farmers in agricultural activities, such as spraying, preparing equipment for spraying, mixing pesticides, washing the clothes used when spraying, removing grass from plants, looking for pests, watering plants and harvesting. Poisoning can also occur because of a lack of understanding of the dangers of pesticides by farmers' families and there are still many farmers using good and safe pesticides, thus having an impact on the health of the farmers themselves.

Based on interviews and preliminary surveys with 10 spraying farmers in Ngablak District, Magelang Regency, 90% or 9 people experienced shortness of breath and cough during spraying and while 10% or 1 person did not experience shortness of breath and coughing during spraying. The frequency of spraying is more than 2 times a week or if it is rainy like this, spraying must be carried out frequently to eradicate pests, the use of incomplete PPE. As well as the many types of pesticides used and the behavior of farmers who mix themselves in Ngablak District, Magelang Regency.

Exposure to pesticides has been known to have adverse effects on health, especially the respiratory system. According to research by Hoppin et al. (2016), pesticides inhaled during spraying can cause a variety of lung function disorders, ranging from airway irritation to chronic obstructive pulmonary disease (COPD). Pesticides such as organophosphate and carbamate are known to have toxic effects on the human respiratory system. A study by Peiris-John et al. (2017) showed that farmers exposed to pesticides over the years experienced a significant decrease in lung capacity compared to the general population.

Ngablak District in Magelang Regency is one of the centers of horticultural production in Central Java. Horticulture, such as vegetables, fruits, and ornamental plants, plays an important role in the local economy. To maintain crop quality and crop yields, farmers in these areas rely heavily on pesticides to control pest and disease attacks. According to data from the Central Statistics Agency (2023), more than 70% of farmers in this region are involved in horticultural activities that require the regular use of pesticides. However, the increase in the intensity of pesticide use has raised concerns about its impact on the health of farmers, especially for those who spray directly.

Optimal lung function is indispensable for farmers, who often do heavy physical work. Disruption to lung function will reduce their working capacity, increase the risk of fatigue, and decrease the quality of life. Studies in various agrarian countries show a high prevalence of respiratory distress among sprayer farmers. For example, a study by Schenker (2010) in California showed that sprayer farmers have a higher risk of developing COPD compared to non-agricultural populations. This shows that pesticide spraying activities without adequate protection can lead to the accumulation of toxic effects that harm lung function. Although the health risks caused by pesticides have been recognized globally, many farmers in Ngablak District do not use adequate personal protective equipment (PPE) when spraying pesticides. A local study by Suharso et al. (2021) revealed that 60% of farmers in Ngablak District do not use masks, gloves, or protective clothing when spraying pesticides. Most farmers are unaware of the importance of PPE and tend to underestimate the risks associated with pesticide exposure, despite the fact that there have been occupational safety guidelines from the Ministry of Agriculture (2020) that advocate the strict use of PPE.

Research on the relationship between pesticide exposure and impaired lung function in farmers in Ngablak District is very important. This research is expected to provide a clear picture of the long-term health impacts of pesticide use on local farmers, as well as encourage increased awareness of the importance of PPE use. In addition, the results of this study can be used as a basis for policymakers to improve occupational health regulations and policies that better protect farmers from health risks faced on a daily basis. With the growing evidence about the dangers of pesticides to lung function, comprehensive preventive measures and education are urgently needed to mitigate these adverse effects in the future.

Although the adverse health impacts of pesticides are known, awareness about the use of PPE among farmers is still minimal. Research by Suharso et al. (2021) revealed that the majority of farmers in Ngablak District do not use PPE such as masks, gloves, or protective clothing when spraying pesticides. This increases the risk of direct exposure to pesticides, both through the respiratory tract and the skin. In fact, the consistent use of PPE can reduce pesticide exposure by up to 90%, according to a WHO report (2020). Pulmonary dysfunction experienced by farmers not only affects their health, but also quality of life and productivity. Farmers who experience respiratory problems tend to get tired more quickly and are not able to work optimally in the field. Conditions like this can also increase the cost of medical treatment and health care, as well as affect the welfare of farmer families. According to the Magelang Regency Health Office (2022), cases of respiratory disorders in pesticide spraying farmers in this region show an increasing trend, especially among horticultural farmers.

The purpose of this study is to analyze the relationship between pesticide exposure and impaired lung function in horticultural sprayer farmers in Ngablak District, Magelang Regency.

METHOD

This type of research is analytical observational research. This study is a study that explains the relationship between variables through hypothesis testing. The research design used uses a cross sectional research design because it is a research that emphasizes the measurement time or observation of independent variable and bound variable data carried out simultaneously at one time (point time approach).

The population in this study is farmers who spray and are members of the farmer group of Sumberejo Village, Ngablak District, Magelang Regency which totals 230 people. In determining the subject of the research.

The analysis of research data was carried out univariate, bivariate and multivariate. Univariate data analysis was carried out to describe the characteristics of the respondents. Bivariate analysis was

carried out to determine the relationship between pesticide exposure and the incidence of BBLR and other supporting variables using a non-parametric Chi-Square statistical test (α=0.05). Meanwhile, multivariate analysis to determine the most dominant influence of independent variables with bound variables using the Logistic Regression Test. The variable tested was a variable that had a p-< value of 0.25 as a result of the bivariate test. All variables will be analyzed together.

RESULT

Ngablak District is located in the north of the capital city of Magelang Regency. The North is bordered by Banyubiru District and Getasan District, Semarang Regency. The East is bordered by Ngampel District and Selo District, Boyolali Regency. The South is bordered by District, Magelang Regency and the West is bordered by Grabag District. Table 1.1 shows that the proportion of respondents who experience pulmonary dysfunction is 81.8% or 30 respondents more in the group with a working time of ≥5 hours per day, when compared to the group with a working time of < 5 hours per day, which is 48.5% or 16 respondents. Statistical test results Chi-Square The value of p = 0.004 was obtained less than α (0.05). This shows that there is a relationship between the length of spraying work per day and the impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang. Result RP = 1.672 with Confidence Interval (CI) 95% (1,138-2,457), so from these results, it can be said that farmers who work for ≥ 5 hours per day have a risk of experiencing lung dysfunction at risk of more than 1.6 times compared to farmers whose working period is < 5 hours per day.

Table 1.2 shows that the proportion of respondents who experience pulmonary dysfunction is 83.7% or 36 respondents are more in the ≥ 5-year working age group, when compared to the 5-year < working age group, which is 37.0% (10 respondents). Statistical test results Chi-Square The value of p = 0.001 is obtained less than α (0.05). This shows that there is a relationship between the working period and the impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang. Result RP = 2,260 with Confidence Interval (CI) 95% = 1,359-3,761, so from these results, it can be said that farmers whose working period is ≥ 5 years have a risk of experiencing lung dysfunction, the chance is more than 2.2 times more risky compared to farmers whose working period is < 5 years.

Table 1.3 shows that the proportion of respondents who experience impaired lung function with a frequency of ≥3 spraying/week is 61.3% or 19 respondents, while the frequency of spraying <3 times/week with impaired lung function is 69.2% or 27 respondents. Statistical test results Chi-Square obtained a value of p = 0.329. This shows that there is no relationship between spraying frequency and impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang.

Table 1.4 shows that the proportion of respondents who experience impaired lung function of 86.4% or 38 respondents is more in the group with incomplete PPE use, when compared to the complete PPE use ability, which is 30.8% or 8 respondents. Statistical test results Chi-Square The value of p = 0.001 is obtained less than α (0.05). This shows that there is a relationship between the ability to use PPE and impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang. Result RP = 2.807 with Confidence Interval (CI) 95% = 1,558-5,055, so from these results it can be said that the ability to use PPE for incomplete horticultural farmers has a risk of experiencing impaired lung function is more than 2.8 times more risky than farmers who are able to use complete PPE.

Table 1.5 shows that the proportion of respondents who experience impaired lung function is 73.3% or 22 respondents are more in the Insecticide category, when compared to the fungicide category, which is 60.0% or 24 respondents. Statistical test results Chi-Square obtained a value of p = 0.182 greater than α (0.05). This shows that there is no relationship between spraying frequency and impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang.

Table 1.6 shows that the proportion of respondents who experienced impaired lung function was 72.1% or 31 respondents more in the number of mixed pesticides, when compared to the number of single pesticides, which was 55.6% or 15 respondents. Statistical test results Chi-Square The value of p = 0.123 was obtained greater than α (0.05). This shows that there is no relationship between the number of pesticides and impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang.

Table 1.7 shows that the proportion of respondents who experience impaired lung function of 62.5% or 30 respondents is more in poor pesticide management, when compared to the number of good pesticide management, which is 72.7% or 16 respondents. Statistical test results Chi-Square obtained a value of p = 0.289 greater than α (0.05). This shows that there is no relationship between pesticide management and impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang.

Table 1.8 shows that the proportion of respondents who experience impaired lung function of 63.0% or 29 respondents is more in bad spraying methods (against the wind direction), when compared to the number of good spraying methods (according to the wind direction) which is 70.8% or 17

respondents. Statistical test results Chi-Square obtained a value of p = 0.353 greater than α (0.05). This shows that there is no relationship between the method of spraying pesticides and the lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang.

Table 1.9 shows that the proportion of respondents who experienced impaired lung function was 69.4% or 25 more respondents had pesticide doses that were not in accordance with the rules on the packaging label, when compared to the pesticide doses according to the rules on the packaging label, which was 61.8% or 21 respondents. The results of the Chi-Square statistical test obtained a value of p = 0.336 greater than α (0.05). This shows that there is no relationship between pesticide dose and impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang.

Table 1.10 shows that the proportion of respondents who experienced pulmonary dysfunction was 86.7% or 26 respondents had more symptoms of pulmonary dysfunction, when compared to no history of lung disease, which was 50.0% or 20 respondents. Statistical test results Chi-Square The value of p = 0.001 is obtained less than α (0.05). This shows that there is a relationship between symptoms of pulmonary dysfunction and pulmonary dysfunction of horticultural farmers in Sumberejo village, Ngablak District, Magelang. Result RP = 1.733 with Confidence Interval (CI) 95% = 1,233-2,436 so from these results it can be said that the symptoms of lung disease in horticultural farmers have a risk of more than 1.7 times compared to not experiencing symptoms of lung disease

Table 1.11 shows that the proportion of respondents who experience impaired lung function of 75.5% or 40 respondents is more in smoking habits, when compared to not smoking, which is 35.3% or 6 respondents. Statistical test results Chi-Square The value of p = 0.003 was obtained less than α (0.05). This shows that there is a relationship between smoking ability and impaired lung function of horticultural farmers in Sumberejo village, Ngablak District, Magelang. Result RP = 2.138 with Confidence Interval (CI) 95% = 1,103-4,144 then from these results it can be said that smoking habits in horticultural farmers. risk risk of more than 2.1 times by not smoking

Table 2.1 Summary of Bivariate Analysis of Pesticide Exposure with Impaired Lung Function in Horticultural Sprayer Farmers

Table 2.2 Results of Logistic Regression Analysis

No.	Variable	P	RP	95% CI	Information
1.	Length of work	0,004	1,672	1,138-2,457	**Significant**
2.	Working period	0,001	2,260	1,359-3,761	**Significant**
3.	Spraying frequency	0,329	0,885	0,624-1,255	Insignificant
4.	PPE Usage Habits	0,001	2,807	1,558-5,055	**Significant**
5.	Types of pesticides	0,182	1,222	0,876-1,704	Insignificant
6.	Number of pesticides	0,123	1,298	0,883-1,908	Insignificant
7.	Pesticide management	0,289	0,859	0,614-1,204	Insignificant
8.	Spraying methods	0,353	0,890	0,634-1,249	Insignificant
9.	Pesticide dosage	0,336	0,889	0,632-1,252	Insignificant
10.	Symptoms of pulmonary dysfunction	0,001	1,733	1,233-2,436	**Significant**
11.	Smoking Habits	0,003	2,138	1,103-4,144	**Significant**

Between Exposure to Pesticides and Lung Function Disorders in Horticultural Spraying Farmers in Sumberejo Village, Ngablak District, Magelang

It	Variable	B	Sig	Exp (B)	Value 95% Cl	
					Lower	Upper
1.	Working period	2,494	0,005	12,112	2,106	69,649
2.	PPE Habits	4,295	0,001	73,311	6,466	831,170
3.	Symptoms of pulmonary dysfunction	4,067	0,002	58,406	4,215	809,278
	Constant	-4,354				

CONCLUSION

There were disorders, namely 46 people (65.7%), no lung function disorders, 24 people (34.4%)

There is a relationship between the length of work per day and the incidence of pulmonary dysfunction

There is a relationship between working life and the incidence of pulmonary dysfunction

There is a relationship between the ability to use PPE and the incidence of pulmonary dysfunction

There is a relationship between the symptoms of pulmonary dysfunction and the incidence of pulmonary dysfunction

There is a relationship between smoking ability and the incidence of pulmonary dysfunction

There was no significant relationship between spraying frequency, type of pesticide, amount of pesticide, pesticide management, spraying method, and pesticide dosage with the occurrence of pulmonary dysfunction in horticultural sprayer farmers in Ngablak District, Magelang Regency.

The variables that most affected the impaired lung function of horticultural farmers in Ngablak District, Magelang Regency were working period (p value = 0.005 with Exp (B) = 12.112), PPE use habits (p value = 0.001 with Exp (B) = 73.311), Symptoms of pulmonary dysfunction (p value = 0.002 with Exp (B) = 58.406) with a probability value of 98%

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