

Risk Factors of Pesticide Exposure against Pulmonary Function in Horticultural Farmers in Paal Merah Jambi City

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Abstract

The background of this research is initiated by the condition of Paal Merah Subdistrict Jambi City is a center of vegetable producers for the area of Jambi and surrounding areas. The excessive use of pesticides by farmers in Paal Merah Sub-district of Jambi City is an issue that needs attention, especially spraying practices that neglect aspects of farmers' safety and health that can lead to health problems either directly or indirectly to farmers. One of the long-term effects caused by exposure to pesticides is lung function disorders. So the purpose of this study aims to determine the risk factors of exposure to pesticides disruption of lung function in farmers in the District Paal Merah Jambi. The method of this study was observational analytic with cross sectional study design conducted in district Paal Merah with 80 people selected by purposive sampling. Data collection through interview, observation and measurement of lung function using spirometer. Data analysis used chi-square test and logistic regression. The results showed that there was significant correlation between work period (p value = 0,019), spraying frequency (p value = 0,002), use of PPE (p value = 0,012), pesticide amount (p value 0,016) and pesticide dose (p value = 0,001) to lung function disorders, no relationship between duration of work, pesticide management and spraying with lung function impairment. Farmers with a working period of > 5 years, spraying frequency > 2 times / week, incomplete APD usage and farmers who did not use pesticides unfit on labels had a 95% lung function impairment probability. So, Based on the research and spirometry measurement results found as many as 78.8% of respondents have impaired lung function obstruction and restriction. To prevent the negative impact of pesticide use, it is necessary to socialize for farmers to use pesticides properly and safely, it is suggested to farmers to use PPE starting from pesticide compounding activity up to spraying process and using dose in accordance with the use rules contained in pesticide packaging.

Keywords: Pesticide, Lung Function, Farmer

I. INTRODUCTION

Exposure to pesticides that occur in farmers with several factors namely internal factors, gender, nutritional status, hemoglobin levels, knowledge levels and health status. In addition, external factors also affect pesticides in farmers such as the number of pesticides that is, the dose of pesticides, the frequency of spraying, the working period of spraying, the duration of spraying, the use of personal protective equipment, pesticides control, plant height, environmental temperature, spraying time and wind direction (Pestisida:1992). Continuous use of pesticides over long periods and large doses and inconsistent with each pesticide at each growing season will cause various losses, such as pesticide residues will accumulate on agricultural produce and farmland. Animal poisoning and poisoning in humans that have an impact on their health. Horticultural farmers are one of the factors that have a great influence on exposure to pesticides with a long-term negative hazard, one of which is the keenness of togetherness in farmers in the form of acute diseases such as disturbance to lung function of farmers. This is issued by the activities undertaken by farmers using pesticides such as spraying activities, providing spray equipment, mixing pesticides, washing clothes that at the time of spraying, throwing grass, watering plants and harvesting activities. Research conducted by Beyene Negatu on farmers in Ethiopia that aims to find out whether exposure to pesticides in the workplace with health measures on farmers, which is done to improve the safety of pesticide-exposed plants. Pesticide surface effects occur in relatively young workers (27 years on average) and within a relatively short pesticide exposure period of 4 years (Negatu:2017). Research conducted by Listiawati in 2014 on farmers in Kepakisan Village Batur District Banjarnegara regency about the relationship of acetylcholinestrase content with lung function disorder in 31 farmers exposed to organophosphate pesticide. It is known that 64.52% of farmers have light poisoning. Spirometry measurement results showed that there were 35.48% of farmers with normal lung function category to mild decrease and 64.52% of farmers with lung function category decreased moderate to severe (Listiawati, 2014)

Paal Merah Sub-district is the center of agriculture that became the main supplier of vegetable commodity for Jambi and surrounding areas. The area of agricultural land in District Paal Merah is 503,5 Ha. Agricultural commodities in the area are chili, mustard greens, beans, cucumbers, tomatoes, spinach, basil, kale and beans. The use of pesticides in agricultural areas in Paal Merah subdistrict aims to control and eradicate pests, while the most widely used pesticides in the agricultural areas are Organophosphate, Carbamate and Organochlorine groups such as Diazinon, Curacron, Decis, Dursban, Lannate, Dithane, Amistar Top, Santa Cron, Matador, Yasitrin, Score, Ulate and Tamacron. The results of the initial survey by interviewing 20 peasants, obtained information that 12 people (60%) experienced respiratory symptoms such as shortness of breath and cough, while 8 people (40%) did not experience respiratory symptoms. Pesticide spraying activity is done every month with spraying frequency 2 to 3 times every week. The doses of pesticides used by farmers are only approximate and directly inserted into the spray tank. At the time of spraying activities farmers do not use self-protective equipment such as complete do not use a mask, do not use long-sleeved clothes and do not use goggles (goggles). Observations were also found by farmers who ate and drank in agricultural areas. Research on pesticide exposure to lung function disorder in farmers in urban areas has not been done by previous researchers. In Paal Merah sub district, there has been no research conducted on the impact of pesticide use on health problems to farmers, especially the impact on lung function impairment. So on that basis the authors do research on pesticide exposure to the risk of impaired lung function in farmers in the District Paal Merah Jambi.

II. RESEARCH METHODS

This was an observational analytic study with cross sectional design. The dependent variable in this study are pulmonary function disorder, the independent variable is the length of work / day, the working period, the frequency of spraying, the use of PPE, the number of pesticides, the doses of pesticides, the management of pesticides and the way of spraying. The population is all farmers doing pesticide spraying activity in Paal Merah Subdistrict, Jambi City. Sample in this research as many as 80 people taken by purposive sampling technique. By using inclusion criteria that is aged 20-45 years old, has been working as a farmer for at least 2 years and for female farmers not in pregnant condition, while exclusion criterion that is in the period of treatment of respiratory diseases and health condition of farmer which is not possible to be interviewed or examined at during the research. Data collection through interview, observation and spirometry examination. Data analysis used chi square test and logistic regression. This research has been stated to meet the ethical requirements by Health Research Ethics Commission of Public Health Faculty Diponegoro University of Semarang with ethics feasibility statement No.286 / EC / FKM / 2017

III. RESEARCH RESULT

A. Description of Research Variables

Based on the results of research known distribution of age of respondents ranged between 20 - 45 years, with the average age of respondents is 38 years. Minimum value is 20 years and the maximum value is 45 years with a standard deviation of 6.120 years. The sex of the respondents is mostly male which amounts to 48 people (60%). Most of the education of respondents who graduated from elementary school as much as 32 people (40%).

The results of the research in table 1 show that respondents who do spraying > 3 hours / day as many as 5 people (6.2%). Respondents mostly have a working period of > 5 years ie as many as 58 people (72.5%). Respondents who have frequency of spraying > 2 times / week as many as 47 people (58.8%). Respondents who did not use the complete APD were 38 people (47.5%). Respondents using mixed pesticide or > 2 types of pesticides were 62 people (77.5%).

Most of the respondents use pesticides not according to the doses listed on the label that is as many as 52 people (65%). Respondents who do poor management of pesticides are as many as 27 people (33.8%). Respondents who have a way of spraying the opposite direction of wind are as many as 12 people (15%).

Based on the results of lung function, spirometry is known from the total 80 respondents, most of them have lung function disruption which is 63 people (78,8%) while those who do not have lung function disorder are 17 people (21,2%). Detailed description of research variables can be seen in table 1 below:

Table 1. Distribution of Respondents' Answer Based on Aspect of Spray Practice

No	Variabel	n = 80	%
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1	a. Length of Work / day		
	b. > 3 hour/day	5	6,2
	c. ≤ 3 hour/day	75	93,8
2	Years of service		
	> 5 year	58	72,5
	≤ 5 year	22	27,5
3	Frequency of Spraying		
	a. > 2 time/week	47	58,8
	b. ≤ 2 time/week	33	41,2
4	Use of PPE		
	a. Not complete	38	47,5
	b. Complete	42	52,5
5	Number of Pesticides		
	a. > 2 type	62	77,5
	b. ≤ 2 type	18	25,5
6	Pesticide Dose		
	a. Not labeled	52	65
	b. labeled	28	35
7	Pesticide Management		
	a. bad	27	33,8
	b. good	53	66,2
8	Spray to method		
	a. Contrary to wind direction	12	15
	b. Following the wind	68	85
9	Lung Function Disorders		
	a. There is interference	63	78,8
	b. No interruption (normal)	17	21,2

Pesticide Exposure Relation with Lung Function Disorders in Farmers In district Paal Merah Jambi city. Often occur unwittingly pesticides that enter the body can poison humans through the mouth, skin and breathing. These toxic chemicals enter into a person's body without causing sudden pain and resulting chronic poisoning. A person suffering from chronic toxicity will be caught after long intervals, after months or years (Sember, 2015:177-185). Pesticide poisoning due to pesticide particles sucked through the nose is the second highest after skin contamination. Very fine gases and particles can enter the lungs, while larger particles will stick to the mucous membranes of the nose or throat. Particles or droplets measuring less than 10 microns can reach the lungs, but droplets larger than 50 microns may not reach the lungs, but may cause interference with the mucous membranes of the nose and throat, and then cause respiratory system disruption (Djojsumarto, 2000)

Chi-square test results obtained significance value of 1,000, it shows that there is no relationship between the length of spraying work with lung function disorders in farmers in the District Paal Merah Jambi. Length of spraying work is not related to lung function disorder because most of the frequency of respondents doing pesticide spraying activity ≤ 3 hours / day that is equal to 78,7%. The results of this study are not in line with research conducted by Mohd. Fareed stating that the duration of exposure to pesticides can lead to various health problems. His research on farmers in northern India showed that the duration of pesticide exposure (p value = 0.001) had a significant effect on pulmonary function decline in pesticide spraying farmers (Fareed, Pathak, Bihari, Kamal, Srivastava, 2013:1-11).

The intensity of pesticide exposure can be illustrated by the length of time a farmer sprayed pesticides in a day. The longer the time of exposure to pesticides that occur then the more the amount of pesticides are absorbed into the body of farmers who perform spraying activities. Pesticide exposure to farmers is also affected by spraying time, spraying pesticides should be done in the morning or afternoon because if spraying is done during the day when the hot weather will contribute to pesticide poisoning. In hot weather it will facilitate the evaporation of water granules from sprayed pesticides which will increase the risk of poisoning (Suma'mur, 1994).

The result of chi-square statistic test obtained by significance value equal to 0,019 meaning p value <0,05, hence there is correlation between working period with lung function disorder at farmer in district Paal

Merah Kota Jambi. The result value of $RP = 1.459$ with Confidence Interval (CI) 95% = 1.015 - 2.097. So from the results it can be said that farmers with a working period > 5 years have a greater risk chances 1.5 times to experience lung function disorders compared with farmers with a working period of ≤ 5 years. The results of this study are in line with research conducted by Kim De Jong exposure to pesticides with decreased lung function over a period of time. The result of chi-square statistic test is known $p = 0,001$ which means that there is a high exposure relationship of pesticide with long intensity with decrease of lung function of farmer in Vlagtwedde-Vlaardingen Belanda (Jong, Boezen, Kromhout, Vermeulen, Postma, Vonk, 2014:1323-30)

This is because the exposure of pesticides to farmers is directly proportional to the peasants' working period of spraying. One of the adverse effects of exposure to pesticides to the body is a disruption to the central nervous system that can lead to one of them is the disruption of lung function because pesticides are accumulative in the body. The accumulation of pesticides in the body will be directly proportional to the working period of each farmer who pesticides spraying activities. Excessive levels of pesticides will be toxic to the body if it is in excessive amount. The result of chi-square statistic test obtained by significance value equal to 0,002 which mean value of $p < 0,05$, hence there is correlation between spraying frequency with lung function disorder at farmer in District of Paal Merah City of Jambi. The result value of $RP = 1.510$ with Confidence Interval (CI) 95% = 1,131 - 2,015. So from the results it can be said that farmers with spraying frequency > 2 times / week have a greater risk chances 1.5 times to experience lung function disorders compared with farmers with a working period ≤ 2 times / week. The results of this study in accordance with research conducted by Mahyuni in 2014, it is known that the average of pesticide spraying activities conducted by farmers as much as 3 hours / day. The result of statistical chi-square test obtained p value = 0,018 it shows that spraying frequency based on spraying duration (hour / day) has relationship with health complaints to farmers in District Berastagi Kabupaten Karo (Mahyuni, 2015:79-89)

The result of chi-square statistic test obtained by significance value equal to 0,012 meaning p value $< 0,05$, hence there is correlation between APD usage with impaired lung function at farmer in district Paal Merah Jambi city. The result value of $RP = 1.382$ with Confidence Interval (CI) 95% = 1.094 - 1.744. So from the results it can be said that farmers who do not use the complete PPE have a greater risk chances 1.4 times to experience lung function disorders compared with farmers who use the complete PPE. This happens because based on the results of interviews and observations in the field it is known that many farmers in spraying activities do not use a complete PPE, especially PPE that serves to protect the respiratory tract from exposure to pesticides. Of 80 respondents, 72.5% did not use mask during spraying activity, this became one of the causes of exposure of pesticides through the respiratory tract causing the impact of disruption on lung function of the map. In addition, farmers do not use PPE with uncomfortable reasons and some farmers think pesticides are not dangerous materials. Perception of farmers about pesticides is a dangerous substance to be one factor that can affect the use of PPE.

A study conducted by Damalas on 148 peasants in rural areas in North Pieria (Eginio and Methoni) in Northern Greece is known that the results of statistical tests obtained p value = 0.010, meaning there is a significant relationship between the perception of farmers about pesticides on the use of PPE at work (Damalas, Farmers, 2016:730-6). According to MarcFarlane the use of PPE can reduce exposure to pesticides for workers, in addition to the effectiveness of the use of PPE also varies according to the type of PPE itself and how to use by workers such as care and use of the correct PPE.13. The result of chi-square statistic test obtained by significance value 0,016 which means p value $< 0,05$, this means that there is correlation between amount of pesticide with lung function disorder at farmer in District Paal Merah Jambi City. The result value of $RP = 1.539$ with Confidence Interval (CI) 95% = 1.005 - 2,355. So from the results it can be said that farmers with the number of pesticides > 2 species have a greater risk chances 1.5 times to experience lung function disorders compared with farmers using ≤ 2 types of pesticides. The results of this study are in line with research conducted by Miah on farmers in Burichong Upazila Bangladesh, indicating that farmers who use various types of pesticides, especially groups of organophosphates and carbamates experience some health problems, such as short-term illnesses such as physical weakness, nausea, dizziness, chest pain and muscle pain, then long-term illnesses such as respiratory problems, excessive sweating and fatigue. besides that 47% of farmers experience physical fatigue and discomfort after using pesticide (Miah, Hoque, Paul, Rahman, 2014:57-67)

The result of chi-square statistic test obtained significance value equal to 0,001 which mean p value $< 0,05$, hence there is correlation between dose of pesticide with lung function disorder at farmer in District Paal Merah Jambi City. The result value $RP = 1.582$ with Confidence Interval (CI) 95% = 1,134 - 2,206. So

from the results it can be said that farmers who use doses do not match the label has a greater risk opportunities 1.6 times to experience lung function disorder compared with farmers who dose according to the label. Based on the information from the farmers at the time of the study, most farmers used doses with the estimation and intensity of pest attacks without looking at the usage instructions contained on the pesticide packing label, in addition there are farmers who assume that the doses on the label are not effective to eradicate pests. Another thing that became the consideration of farmers in determining the dosage in the use of pesticides is in terms of economic, where the price of pesticides are quite expensive, causing the farmers to determine their own doses used. The use of pesticides such as these can lead to the doses used can be excess or less than the dosage contained on the packaging label so that the use of pesticides to be not optimal and a negative impact for farmers. Doses of pesticides used in spraying pesticides can affect the level of pesticide poisoning in farmers. The higher the dose used to eat will be the higher the risk for pesticide poisoning in farmers (Dosemeci, Alavanja, Rowland, Mage, Zahm, 2002).

Based on the results of research undertaken Dalvie advocated in the use of pesticides need to consider some things related to the dosage used include the use of pesticides at the recommended doses when the pest is found or the necessary preventive care, optimization of pesticide use for economic savings through doses tailored to the density of pest populations and minimizing the need for pesticides by altering the cultivation system to reduce the risk of pests (Dalvie, White, Raine, Myers, 1999:391-6)/. The result of chi-square statistic test obtained by significance value 0,474 which mean $p > 0,05$, hence there is no correlation between management of pesticide with impaired lung function at farmer in District Paal Merah Jambi City.

Research conducted by Lekei on farmers in Tanzania shows that the use of pesticides and unsafe pesticide management practices (home pesticide storage, washing equipment close to water sources, safety practices, especially the disposal of pesticide packaging and not using PPE at work) potential for high pesticide exposure to farmers and causing adverse health effects for farmers (Lekei, Ngowi, 2014:1-13). Good pesticide management is an important way to prevent pesticide poisoning such as avoiding hot weather and wind direction while spraying, full PPE use, correct mixing practices and not polluting water, changing clothing after spraying, using special equipment when mixing pesticides , washing hands after using pesticides, not eating and drinking when using pesticides and not storing food near pesticide containers. The result of chi-square statistic test obtained by significance value 0,422 which mean $p > 0,05$, hence no relation between spraying of pesticide with lung function disorder at farmer in District Paal Merah Jambi city. The results of this study are not in accordance with the research conducted by Yuantari in 2009, from the results of statistical tests Chi-square note that the value of $p = 0.001$ this means there is a relationship between the method of spraying with pesticide poisoning in farmers in Sumber Rejo District Ngablak District Magelang Central Java (Yantari, 2009)

Spraying is an aspect that farmers need to pay attention to avoid the negative impact of pesticide use. One of the factors to watch out for during spraying is the weather. If the wind is blowing fast, the drift of the pesticide can be flown and the wind can be flown elsewhere and about the person or animal that is close to where the pesticide is applied. Another thing to note also is that do not spray opposite to the direction of the wind because spray fluid can affect farmers (Djojsumarto, 2008).

Table 2. Results of statistical analysis of the relationship of independent variables with impaired lung function in farmers in District Paal Merah 2018

No	Variabel	Pulmonary function	<i>p-value</i>	IDR	95 % CI
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	interruptions	No interruptions		Lower	Upper
1. Length of working					
> 3 hours / day	4 (6,3%)	1 (5,9%)	1,000	1,017	0,646
≤ 3 hours / day	59 (93,7%)	16(94,1%)			1,601
2. Years of service					
> 5 years	50 (79,4%)	8 (47,1%)	0,019*	1,459	1,015
≤ 5 years	13 (20,6%)	9 (52,9%)			2,097
3. Frequency of Spraying					
> 2 times / week	43 (68,3%)	4 (23,5%)	0,002*	1,510	1,131
≤ 2 times / week	20 (31,7%)	13 (76,5%)			2,015
4. Use of PPE					
Incomplete	35 (55,6%)	3 (17,6%)	0,012*	1,382	1,094
Complete	28 (44,4%)	14 (82,4%)			1,744
5. Number of Pesticides					
> 2 types	53 (84,1%)	9 (52,9%)	0,016*	1,539	1,005
≤ 2 types	10 (15,9%)	8 (47,1%)			2,355
6. Pesticide Dose					
No Match label	47 (74,6%)	5 (29,4%)	0,001*	1,582	1,134
Corresponding label	16 (25,4%)	12 (70,6%)			2,206
7. Pesticide Management					
Bad	23 (36,5%)	4 (23,5%)	0,474	1,129	0,906
Good	40 (63,5%)	13 (76,5%)			1,406
8. How to Spray					
Contrary to wind direction	11 (17,5%)	1 (5,9%)	0,422	1,199	0,966
Appropriate wind direction	52 (82,5%)	16 (94,1%)			1,487

information: * (signifikan)

Based on table 3 of multivariate test results logistic regression is known that the variables that affect pulmonary function disruption that is the working period, spraying frequency, the use of PPE and doses of pesticides pesticides. Based on the calculation of probabilitias that aims to see the effect together between variables affecting lung function disorder can be seen that farmers with a working period > 5 years, spraying frequency > 2 times / week and incomplete APD usage and farmers who use the doses of pesticides are not according to the packaging on the label has a probability of having a lung function disorder of 95%.

Table 3 Results of logistic regression analysis between pesticide exposure with impaired lung function in farmers in District Paal Merah Jambi city

Variabel	B	Sig	Exp (B) /OR	value 95% CI	
				Lower	Upper
Years of service	2,085	0,020	8,045	1,390	46,561
Frequency of Spraying	2,583	0,006	13,236	2,111	82,974
Use of PPE	2,323	0,014	10,211	1,614	64,607
Pesticide Dose	2,135	0,013	8,549	1,574	45,476
Constants	-6,462				

IV. CONCLUSION

This study concludes: 1) Of 80 farmers who measured the capacity of lung function there are 78.8% of farmers have impaired lung function, while 21.2% of farmers do not experience impaired lung function. 2). (P-value = 0.012), number of pesticides (p-value = 0.016), pesticide dose (p-value = 0,019) 0.001) with lung function disorder at farmers in District Paal Merah Kota Jambi. 3) Farmers with a working period of > 5 years, spraying frequency > 2 times / week and incomplete APD usage and farmers using pesticide doses not on the label on the packaging have a probability of having lung function disorder of 95%

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