Analysis of risks factors on organophosphates poisoning on Chinese cabbage farmers in Semangat Village Kecamatan Merdeka Karo Regency

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Abstract

Pesticides of organophosphate type are mostly used on farming because they are easier to resolve in nature, but there was a possibility of high frequency that they were an agent that caused neurological diseases amongst farmers especially in developing countries. The factors influencing the occurrence of pesticide poisonings are internal and external factors, including age, knowledge level, work period as a sprayer, and spraying frequency. The purpose of this research is to analyze the risk factors that causes organophosphate pesticide poisonings on chinese cabbage farmers in Semangat Village Karo Regency. The methods that are used in this research are with observational method and *cross sectional* approach, with the population of all chinese cabbage farmers in Semangat Village Karo Regency. The taking of samples uses *simple random sampling* technique as much as 50 samples, the instruments that are used in this research is using Thermo Indiko for cholinesterase levels inspection and lists of questions for the farmers. The results show that there is no significant correlation between age and organophosphate pesticide poisoning on chinese cabbage farmers ($p > 0,05$). Meanwhile, for other factors such as relation between knowledge, relation between work period as a sprayer, and relation between spraying frequency with the level of pesticide poisoning show that there are significant correlation ($p < 0,05$). Research results also show that the most dominant variable related to organophosphate pesticide poisoning on chinese cabbage farmers is spraying frequency (p *value* = 0,000 dan *odds ratio* = 7,707), which means that spraying frequency > 2 times a week has the opportunity of 7,707 bigger risks of organophosphate pesticide poisoning abnormality on chinese cabbage farmers than with spraying frequency of ≤ 2 times a week.

Keyword: Cholinesterase, Organophosphate Pesticide, Chinese cabbage

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Background

Pesticides are poisons that are used to eliminate pests attack (plants or animals) that can cause harvest failure or decreasing harvest outcome. The use of pesticides even in small amount and size can cause poisoning on human. Organophosphate type is the kind of pesticides that are used the most in farming and there is a possibility of the higher frequency of it as an agent that causes neurological diseases amongst farming workers especially in developing countries. Organophosphates are absorbed by either inhalation, skin contact, and swallowing with the main method of exposure is through the skin. [1,2,4]

The factors that cause pesticide poisoning include internal and external factors. Internal factors includes: age, gender, genetic, nutrition status, hemoglobin level, knowledge level, and health status. Meanwhile, external factors includes: how many types of pesticides being used, the type of pesticides, the dose of pesticides, spraying frequency, work period as a sprayer, the period of spraying, the use of body shield, the handling of pesticide, last contact with pesticide, the height of the plants, ambient temperature, and the act towards wind direction. From those two factors, external factor is the one that has more effect in pesticide poisoning. [5]

From the preliminary survey that has been done, researchers found that almost all residents of Semangat Village, Karo Regency with the amount of ± 300 head of family as vegetable farmers. One of the vegetables that are planted a lot in the village is chinese cabbage. Chinese cabbage is chosen a lot because the relatively fast time of harvest. Chinese cabbage plant is very easy to be attacked by pests and diseases, and the most of them is many kinds of worm. So the chinese cabbage farmers do a lot of prevention to prevent the developing of that pests and diseases by doing pesticide spraying of organophosphate type with the spraying intensity of once a week until harvest. Generally the chinese cabbage farmers in the village only allow men with age more that 20 to do pesticide spraying. Because they are deemed as strong enough to pick up/carry the spray tank and are able to understand the right way to do the mixing and spraying.

The general purpose of this research is to analyze the risk factors that cause organophosphate pesticide poisoning on chinese cabbage farmers in Semangat Village Karo Regency. As of now the specific purpose of this research is: 1) To identify the characteristics (age, knowledge level, work period as a sprayer and the intensity of spraying) on chinese cabbage farmers in Semangat Village Karo Regency; 2) To measure the cholinesterase level on chinese cabbage farmer in Semangat Village Karo Regency 3) To analyze the relation between age and pesticide poisoning on chinese cabbage farmers in Semangat Village Karo Regency; 4) To analyze the relation between knowledge level and pesticide poisoning on chinese cabbage farmers in Semangat Village Karo Regency; 5) To analyze the relation between work period as a sprayer and pesticide poisoning on chinese cabbage farmer in Semangat Village Karo Regency; and 6) To analyze the relation between spraying frequency and pesticide poisoning on chinese cabbage farmers in Semangat Village Karo Regency.

Research Methods

In this research, risk factors of organophosphate pesticide poisoning can be measured at the same time, so the type of research design that is used is analytic observational with *cross sectional* approach.

The instruments that are used in this research are :

1. Lists of questions/questionnaire for cabbage plants spraying farmers.
2. Thermo Indiko for cholinesterase level inspection.

Men normal value : 5.100 – 11.700 U/L
Women normal value : 4.000 – 12.600 U/L

Blood Cholinesterase Determination Procedure:
1) Spin the materials with 4000 rpm speed for 10 minutes.
2) Take the blood serum, then put it into the sample cup as much as 200 µl.
3) Take reagent R1 and R2, then combine with 1 : 4 comparison.
4) All of the reagents and samples then are put into the indiko tool.
5) Type in the name, lab and inspection code on the computer screen of the tool.
6) Press "START" on the tool and wait for the result to appear on the computer screen.

Measurement Methods

1. The result of Cholinesterase Examination Analysis.
   Measuring Tool: Thermo Indiko
   Unit : U/L
2. Age Measurement
   Measuring Tool : Questionnaire
   Unit : Age
   Scale : Ratio
3. Knowledge Level Measurement
   Measuring Tool: Questionnaire
   Unit : Good (score >75%) and Bad (score < 75%)
   Scale : Nominal
4. Work Period as a Sprayer Measurement
   Measuring Tool: Questionnaire
   Unit : Age
   Scale : Ratio
5. Frequency Measurement
   Measuring Tool: Questionnaire
   Unit : Times
   Scale : Ratio

Data Processing and Analysis

The data that are collected in this research are primary data and secondary data. Primary data are data that are obtained from cholinesterase inspection results and interviews with respondents using questionnaire, meanwhile secondary data are obtained from documentation/archiving results from Puskesmas, Dinas Kesehatan Karo Regency.

A. Data Processing

The stages on data processing are:
a. Verifying the results of the questionnaire that have been filled
b. Encoding respondents answers
c. Data tabulation and determination of the variables that are going to be analyzed
d. Inserting data to the computer with SPSS 16 program

B. Data Analysis

The stages on data analysis are:
a. Univariate Analysis
   Descriptive statistic to provide frequency distribution.
b. Bivariate Analysis
   To observe the relations between each variables towards dependent variables using Chi Square test.
c. Multivariate Analysis

To observe the influence of each variables together, using logistic regression statistic exam.

Results

Univariate Analysis

1. Farmer Age

Table 2 Respondents' Frequency Distribution According to Farmer Age Category in Semangat Village

Age	Frequency	Percentage
Young Farmers (≤ age 45)	21	42
Old Farmers (> age 45)	29	58
Total	100	50

2. Knowledge Level

Pesticide knowledge levels are categorized into two groups, which are good if respondents could answer more than or equal to 75% of the total score for knowledge level which is 40 (≥30) and less if they answer questions less than 75% of the total score for knowledge level which is 40 (<30). More can be seen on the following table :

Table 3. Respondents' Frequency Distribution According to Knowledge Level about Pesticide in Semangat Village

Knowledge Level	Frequency	Percentage
Less	29	58
Good	21	42
Total	50	100

3. Work Period as a Sprayer

The distribution of farmers' work period in this research are distinguished into two which are work period less than or equal to 10 years category and work period more than 10 years category. More can be seen on the following table.

Table 4. Respondents' Frequency Distribution According to Work Period as a Farmer Category in Semangat Village

Work Period	Frequency	Percentage
≤ 10 years	15	30
>10 years)	35	70
Total	50	100

4. Spraying Frequency

Research results for spraying intensity done by farmers are divided into two categories which are less than or equal to 2 times a week category and more than 2 times a week category. More can be seen on the following table.

Table 5. Respondents' Frequency Distribution According to Spraying Frequency Done by Farmers in Semangat Village

Spraying Intensity	Frequency	Percentage
≤ 2 times a week	20	40
> 2 times a week	30	60
Total	50	100

5. Cholinesterase Examination Results

The distributions of farmers' cholinesterase examination results in this research are distinguished into 2 which are normal category and abnormal category. More can be seen on the following table.

Table 6. Respondents' Frequency Distribution According to Poisoning Happenings from Farmers' Cholinesterase Examination Results in Semangat Village

Poisoning Level	Frequency	Percentage
Normal	19	38
Abnormal	31	62
Total	50	100

Bivariate Analysis

1. The Relation Between Age and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

Table 7. Cross Tabulation of Relation Between Age and Organophosphate Pesticide Poisoning Level on Cabbage Farmers in Semangat Village Karo Regency

No	Age	Poisoning Level				Total		*p* value
		Normal		Tidak Normal				
		n	%	n	%	n	%	
1	≤ 45 tahun	11	22	10	20	21	42	0,137
2	>45 tahun	8	16	21	42	29	58	
	Total	**19**	**38**	**31**	**62**	**50**	**100**	

According to *chi square* exam results there is no significant relation between age and organophosphate pesticide poisoning level on cabbage farmers (p > 0,05).

2. The Relation Between Knowledge Level and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

Table 8. Cross Tabulation of Relation Between Knowledge Level and Organophosphate Pesticide Poisoning Level on Cabbage Farmers in Semangat Village Karo Regency

No	Knowledge	Poisoning Level				Total		95% CI for Exp (B)	*p* value
		Normal		Tidak Normal					
		n	%	n	%	n	%		
1	Baik	13	26	8	16	21	42	1.770 – 21.920	0,008
2	Kurang	8	12	23	23	29	58	6.229	
	Total	**19**	**38**	**31**	**62**	**50**	**100**		

This research also shows the value of *odds ratio* = 6,229, which means that respondents' less knowledge has the chance of risking the abnormality of organophosphate

pesticide poisoning level on cabbage farmers 6,229 times more than respondents' good knowledge. According to *chi square* exam result there is a significant realtion between knowledge and organophosphate pesticide poisoning on cabbage farmers (p < 0,05).

1. The Relation Between Work Period as a Sprayer and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

Table 9. Cross Tabulation of Relation Between Work Period as a Sprayer and Organophosphate Pesticide Poisoning Level on Cabbage Farmers in Semangat Village Karo Regency

No	Work Period	Poisoning Level				Total		95% CI for Exp (B)	*p* value
		Normal		Tidak Normal					
		n	%	n	%	n	%		
1	≤10 tahun	10	20	5	10	15	30	1,552 – 21.503	0,016
2	>10 tahun	9	18	26	52	35	70	5,778	
	Total	**19**	**38**	**31**	**62**	**50**	**100**		

This research also shows the value of *odds ratio* = 5,778, which means that work period as a sprayer for > 10 years has the chance of risking the abnormality of organophosphate poisoning level on cabbage farmers 5,778 times more than the work period as a sprayer for ≤ 10 years. According to *chi square* exam result there is a significant relation between work period as a sprayer and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05).

2. The Relation Between Spraying Frequency and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

Table 10. Cross Tabulation of Relation Between Spraying Frequency and Organophosphate Pesticide Poisoning Level on Cabbage Farmers in Semangat Village Karo Regency

No	Frequency	Poisoning Level				Total		95% CI for Exp (B)	*p* value
		Normal		Tidak Normal					
		n	%	n	%	n	%		
1	≤2 kali seminggu	14	28	6	12	20	40	3,009 – 45,238	0,000
2	>2 kali seminggu	5	19	25	50	30	60	11,667	
	Total	**19**	**38**	**31**	**62**	**50**	**100**		

This research also shows the value of *odds ratio* = 11,667, which means that spraying frequency of > 2 times a week has the chance of risking the abnormality of organophosphate poisoning level on cabbage farmers 11,667 times more than spraying frequency of ≤2 times a week. According to *chi square* exam result there is a significant

relation between spraying frequency and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05).

Multivariate Analysis

After bivariate analysis is done, which was to ascertain the influence between each independent variables and organophosphate pesticide poisoning level on cabbage farmers, then multivariate analysis will be done next to discover the most dominant variable that influences the level of organophosphate pesticide poisoning on cabbage farmers using Logistic Regression Exam. The followings are the examination results to select the variables that are included in logistic regression model.

1. Variable Selection for Logistic Regression Exam

Table 11. The Variable Selection Results That Can Be Included in Logistic Regression Model With *Chi Square* Exam

Independent Variable	P	Info
Age	0,137	All of the variable have value p< 0,25
Knowledge	0,008	
Work period	0,016	
Frequency	0,000	

2. Logistic Regression Model Towards Organophosphate Pesticide Poisoning Level on Cabbage Farmers

Table 12. The Result of Multivariate Analysis of Independent Variables Influence and Organophosphate Pesticide Poisoning Level on Cabbage Farmers in Semangat Village Karo Regency

Variabel independen	B	SE	Sig	OR	95% CI for Exp (B)	
					Lower	*Upper*
Umur	.823	.800	.303	2.278	.475	10.918
Pengetahuan	1.448	.792	.068	4.253	.900	20.100
Masa kerja sebagai penyemprot	1.448	.850	.089	4.255	.804	22.517
Frekuensi penyemprotan	2.042	.778	.009	7.707	1.679	35.376
Constant	-8.620	2.737	.002	.000		

Table 12. shows that three independent variables have no significant relation with organophosphate pesticide poisoning level on cabbage farmers (p>0,05), which are age variable (p *value* = 0,303), knowledge (p *value* = 0,068), and work period as a sprayer (p *value* = 0,089). So the most dominant variable related with organophosphate pesticide poisoning level on cabbage farmers is spraying frequency (p *value* = 0,000 and *odds ratio* = 7,707) which means that spraying frequency of >2 times a week has the chance of risking the abnormality of organophosphate poisoning level on cabbage farmers 7,707 times more than spraying frequency of ≤2 times a week.

Discussion

1. The Relation Between Age and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

According to research results, it is possible to see that the normal organophosphate pesticide poisoning level on cabbage farmers is seen more on respondents aging ≤ 45 year

(22%) than respondents aging > 45 year (16%). Meanwhile the abnormal organophosphate pesticide poisoning level on cabbage farmers is seen more on respondents aging > 45 year (42%).

According to the results of bivariate analysis with *chi square* exam, there is no significant relation between age and organophosphate pesticide poisoning level on cabbage farmers (p > 0,05). This thing can happen because young and old age both have the opportunity of risking the happening of organophosphate pesticide poisoning. Only, on cholinesterase activity there is a difference between children and adults over 20 years old, either in the state of being exposed to organophosphate pesticide or as long as working with organophosphate. Age less than 20 years old can be a contra indication for workers with organophosphate because to lessen the cholinesterase activity then aggravate the poisoning that already happened.

2. The Relation Between Knowledge Level and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

According to the results of bivariate analysis with *chi square* exam, there is a significant relation between knowledge and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05). This research also shows the value of *odds ratio* = 6,229, which means that respondents' less knowledge has the chance of risking the abnormality of organophosphate pesticide poisoning level on cabbage farmers 6,229 times more than respondents' good knowledge. This research is supported by research results by Teguh (2009) that stated that there is a relation between respondents' knowledge level and pesticide poisoning. Respondents' less knowledge related to types of pesticides and chronic effects of poisoning such as simple aids for if poisoning happens, how to compose, how to spray, and how to clean the tools can have risk poisoning more than the ones with good knowledge. This statement is supported by research results done by Prihadi (2008) that farmers with low knowledge level can have poisoning risk as much as 4,27 times more than farmers with good knowledge.

Based on research results shows that the normal organophosphate pesticide poisoning level on cabbage farmers can be seen more on respondents with good knowledge (26%) than with the ones with less knowledge (12%). Meanwhile the abnormal organophosphate pesticide poisoning level on cabbage farmers can be seen more on respondents with low knowledge (23%).

Corresponding with the theory of Lawrence Green that states that knowledge does not relate directly with health status, but has to be through gesture or practice. Knowledge will affect someone's manner to act. Knowledge is the most important domain for shaping someone's practice. Respondents whose knowledge is relatively isn't good about pesticide reflects that there is an indifference about health, either for themselves or the environment.

3. The Relation Between Work Period as A Sprayer and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

According to the results of bivariate analysis with *chi square* exam, there is a significant relation between work period as a sprayer and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05). This research also shows the value of *odds ratio* = 5,778, which means that work period as a sprayer for >10 years has the chance of risking the abnormality of organophosphate pesticide poisoning level on cabbage farmers 5,778 times more than work period as a sprayer for ≤10 years. This research is supported by

a research (Dolfie dkk, 2013) that stated that there is a relation between work period and cholinesterase blood level on farmers (p < 0,05).

This relation shows that the higher work period then the lower cholinesterase level become. According to (Sastrawijaya, 2002) someone's work period is one of the factors that affect cholinesterase degree on blood to decrease, wherein the longer work period, cholinesterase level on respondent's blood will decrease and risking to be exposed to pesticide poisoning. Work periods of cabbage farmers with the lowest being 10 years and the highest being >20 years that have been under the category of being poisoned show that the longer being exposed or in contact with pesticide then the negative effect that will appear is poisoning. Research results show that the longer farmers' work period is, the lower cholinesterase enzyme's activity becomes; clarifying that farmers that have been exposed for a long time or continuously are at the utmost risk to experience poisoning on the next level.

4. The Relation Between Spraying Frequency and Organophosphate Pesticide Poisoning Level on Cabbage Farmers

According to the results of bivariate analysis with *chi square* exam, there is a significant relation between spraying frequency and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05). This research also shows the value of *odds ratio* = 11,667, which means that spraying frequency of >2 times a week has the chance of risking the abnormality of organophosphate pesticide poisoning level on cabbage farmers 11,667 times more than spraying frequency of ≤2 times a week. This happens because spraying frequency in Semangat Village is often more than 2 times a week so people that actively sprays mustard seed plants is easily exposed and can create health risks.

Based on multivariate analysis also shows that the most dominant variable relating to organophosphate pesticide poisoning level on cabbage farmers is spraying frequency (p *value* = 0,000 and *odds ratio* = 7,707) which means that spraying frequency of >2 times a week has the chance of risking the abnormality of organophosphate pesticide poisoning level on cabbage farmers 7,707 times more than spraying frequency of ≤2 times a week. This means that if spraying frequency done >2 times then there is a chance of people doing the spraying to experience pesticide poisoning easier. Pesticide poisoning because the particles of pesticide being inhaled through nose is the second most after skin. The spraying gas and particles that are very fine (less than 10 micron) can enter the lungs; meanwhile the biggest particles (more than 50 micron) will stick to mucous membrane or esophagus.

Conclusion

Based on research results about risk factors related to organophosphate pesticide poisoning level on cabbage farmers in Semangat Village, Karo Regency, the following conclusions then can be taken:

1. There is no significant relation between age and organophosphate pesticide poisoning level on cabbage farmers (p > 0,05).
2. There is a significant relation between knowledge and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05).
3. There is a significant relation between work period as a sprayer and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05).
4. There is a significant relation between spraying frequency and organophosphate pesticide poisoning level on cabbage farmers (p < 0,05).
5. The most dominant variable on organophosphate pesticide poisoning level on cabbage farmers is spraying frequency (p *value* = 0,000 and *odds ratio* = 7,707) which means that

spraying frequency of >2 times a week has the chance of risking the abnormality of organophosphate pesticide poisoning level on cabbage farmers 7,707 times more than spraying frequency of ≤2 times a week.

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