THE ASSOCIATION BETWEEN ORGANOPHOSPHATE PESTICIDE EXPOSURE AND ERYTHROCYTE SEDIMENTATION RATE AMONG FARMERS IN SUMBEREJO VILLAGE, MAGELANG, CENTRAL JAVA

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ABSTRACT

Background: The major occupation of Sumberejo villagers is a vegetable farmer. A lot of farmers use organophosphate pesticide spray. Improper use of spraying pesticide may cause harmful health impact in human. Organophosphate pesticide is poisonous and it affects the blood profile of farmers. This study aimed to examine the association between organophosphate pesticide exposure and erythrocyte sedimentation rate (ESR) among farmers in Sumberejo Village, Magelang, Central Java.
Subjects and Method: A cross-sectional study was conducted in Sumberejo Village, Magelang, Central Java, on April 2017. A total sample of 43 farmers was selected from a population of 110 farmers for this study by purposive sampling. The dependent variable was ESR. The independent variables were frequency of spraying (exposure/week), number of pesticide, dose of pesticide, length of work (exposure/day), work period (years of exposure), the use of personal protection equipment (PPE), and level of cholinesterase. The ESR data were collected by laboratory test. The other data were collected by questionnaire. The bivariate analysis used the chi-square test.
Results: Frequency of spraying, number of pesticides, length of work, work period, the use of PPE, and level of cholinesterase, were associated with ESR, but they were not statistically significant ($p>0.050$). The association between dose of pesticide and ESR was statistically significant ($p= 0.048$).
Conclusion: Dose of pesticide is associated with ESR. However, PPE usage, length of work, work period, number of pesticides, frequency of spraying, and level of cholinesterase, do not show statistically significant association with ESR in this study.

Keywords: exposure, organophosphate pesticide, erythrocyte sedimentation rate, farmer, level of cholinesterase

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BACKGROUND

Indonesia is an agricultural country that has natural wealth and biodiversity that has the potential to develop the agricultural sector. Some districts in Indonesia have superior agricultural commodities, including rice, crops, vegetables, medicinal plants, and ornamental plants. For example, Ngablak subdistrict, Magelang, Central Java, which has an area of 3.252 hectares of agricultural land, with 73 farmer groups spread in 16 villages. They grow horticultural crops such as cabbage, potatoes, carrots, tomatoes, chilies and so on. When the tobacco planting season arrives they plant tobacco with an intercropping system. Various efforts have been made to improve the quality and productivity of agricultural products.

Efforts to increase the production of agricultural products aim to prevent crops from being damaged by pests and diseases by using pesticides. The use of pesticides in vegetable crops in the highlands is classified as very intensive. This is mainly due to cool

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climatic conditions with high humidity and rainfall creating good conditions for breeding pests and plant diseases (Munarso et al., 2009).

One of the villages in Ngablak Subdistrict, Magelang Regency, namely Sumberejo Village, which has the majority of residents' livelihoods, is a vegetable farmer, such as chillies, tomatoes, potatoes, etc., there are some farmers who spray the plants by using organophosphate pesticides.

Spraying pesticides that do not meet the rules will cause many impacts, including health impacts on humans, namely the emergence of poisoning to farmers and affect the blood profile of farmers. Factors that influence the occurrence of pesticide poisoning are factors from the body (internal) and from outside the body (external). Factors from the body include age, gender, genetics, nutritional status, hemoglobin level, level of knowledge, and health status. While factors from outside the body also have a large role. These factors include the many types of pesticides used, types of pesticides, doses of pesticides, frequency of spraying, working period of spraying, duration of spraying, use of personal protective equipment, how to handle pesticides, the last contact with pesticides, plant height, ambient temperature, spraying time and action on wind direction (IARC, 1991).

Measurement of the level of poisoning based on the activity of the enzyme cholinesterase in the blood, the determination of the level of poisoning is as follows: 75% to 100% the normal category; 50% to <75% mild poisoning category; 25% to <50% moderate poisoning category; 0% to <25% category of severe poisoning (Dirjen PPM and PLP, 1992; Syarief, 2007). The results of a study with 68 samples in 2008 were examined showing blood cholinesterase levels of vegetable farmers in Sumberejo Village who were poisoned by 76.47% (Ngablak Health Center, 2006; Health Laboratory of Magelang District, 2006; Prihadi, 2008).

In addition, organophosphate pesticides may also affect the blood profile of farmers, one of them is the rate of blood sedimentation (LED).

Blood sedimentation rate is also called as erythrocyte sedimentation rate (ESR) or sedimentation rate which is one of the blood tests (Mubarok et al., 2018). Sedimentation rate is the rate of deposition of erythrocyte cells in a tube filled with blood that has been given anticoagulant within one hour (Bridgen, 1999; Desai and Isa-Pratt, 2000; Norderson, 2004).

The sedimentation rate of blood is also defined as the rate of precipitation of erythrocyte cells in the plasma (Burns, 2004). The more red blood cells that precipitate, the higher the rate of blood sedimentation (Mubarok et al., 2018). An increase in the value of ESR indicates an inflammatory process in a person's body, both acute and chronic inflammation, or the presence of tissue damage (Norderson, 2004; Estridge et al., 2000). There are several ESR inspection methods including the Westergren and Wintrobe methods. The Westergren method is the method suggested by the International Committee for Standardization in Hematology (ICSH) (Liswanti, 2014).

Sumberejo village with an area of 209 hectares of agricultural land and there are 10 groups of farmer spread over 8 areas, most of the sources of income come from the agricultural sector. A preliminary survey at the beginning of January 2017 with interviews of 25 spraying farmers in Sumberejo Village found 9 spraying farmers to experience complaints such as dizziness, fatigue, and dizzy eyes. This is a symptom of an indication of health problems, especially disorders of blood profile.

This study aims to determine the relationship between exposure to organophos-

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phate pesticides with blood sedimentation rate (ESR) among farmers in Sumberejo Village, Ngablak District, Magelang District.

SUBJECTS AND METHOD

1. Study Design

This study used a cross sectional approach. This study was conducted in April 2017 and the place of the study was in Sumberejo Village, Ngablak District, Magelang Regency.

2. Population and Sample

The study population was 110 farmers and a sample of 43 people were taken by purposive sampling.

3. Study Variables

The independent variables of this study were the history of organophosphate pesticide exposure, including length of service, the use of PPE, length of work, number of pesticides, frequency of spraying, levels of cholinesterase and pesticide doses. The dependent variable was the blood sedimentation rate (ESR) of farmers who spray organophosphate pesticides.

4. Study Instruments

Data collection was using a questionnaire that contained informed consent as evidence that farmers have agreed to become respondents and participate in this series of research. There was a laboratory examination to determine the rate of blood sedimentation and cholinesterase levels.

5. Data Analysis

Data were analyzed univariately on all independent variables, namely work period, PPE usage, length of work, number of pesticides, frequency of spraying, levels of cholinesterase, and pesticide doses. The dependent variable was sedimentation rate. To test the relationship between the independent variables and the dependent variable, the Chi-square test was used.

RESULTS

1. Work Period

The respondent's working period as a spraying farmer in this study revealed an average value of 18 years. The shortest working period was 1.5 years and the longest was 48 years.

The respondent's working period as a spraying farmer was divided into two categories, which were long if the respondent has been a spraying farmer for> 10 years and new if they have been a spraying farmer for ≤10 years. Chi-Square test showed that p= 0.368. Therefore, the relationship between work period and ESR was not statistically significant.

Different results shown by the research of Istianah and Yuniastuti (2017) on farmers in Brebes obtained p= 0.049 which mean that there was a significant relationship between work period as a spraying farmer and the incidence of poisoning to farmers (Istianah and Yuniastuti, 2017).

2. The Use of PPE

The use of PPE when spraying the pesticides is very influential on the entry of the number of pesticide particles into the body of the farmer. Personal protective equipment that should be used by farmers were hats or headgear, masks, gloves, boots, clothes and trousers, and glasses.

The use of PPE was said to be incomeplete if using PPE that can only protect from exposure through 1 contact which was skin, if they only wear PPE clothes, trousers, gloves, and hats, but did not wear masks or glasses that can prevent exposure to pesticides through the eyes, respiratory tract and digestive tract and was said to be complete if using PPE that can protect from exposure through ≥2 contacts.

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The Chi-Square test showed that p= 0.138, so the relationship between PPE and ESR was not statistically significant.

Different results shown by the research of Irnawati and Wahyuni (2017) which obtained the results (OR= 5.30; p= 0.001) which mean that there was a relationship between PPE and pesticide poisoning. The results of the statistical test explained that farmers who use incomplete PPE would be at risk of experiencing pesticide poisoning by 5.30 times higher compared to farmers who use complete PPE (Irnawati and Wahyuni, 2017).

3. Length of Work

The length of work also has a huge influence on the amount of exposure to pesticides that enter the body of the farmer. The longer the working time, the greater the exposure of pesticides to farmers. Length of work is categorized as bad if ≥ 8 hours/day and good if <8 hours/day. The Chi-Square test obtained p= 0.243, so the relationship between work time and ESR which was statistically insignificant.

The results of this study were in line with research by Lucki et al. (2018) which showed no significant relationship between length of work per day and levels of cholinesterase in farmers (p= 0.154). A study done by Mahyuni (2015) got p= 0.018 which mean that there was a statistically significant relationship between the length of work or spraying with health complaints (Mahyuni, 2015).

Farmers who work for a long time in contact with pesticides can get chronic poisoning, meaning that the longer they work, the more the number of pesticides absorbed would increase and lead to decreased cholinesterase activity (Rustia, 2009).

4. Total Type of Pesticide

Mixed pesticides used for spraying have greater toxicity compared to single pesticides so that the impact of exposure to farmers was also greater. The number of pesticides was categorized as a mixture if> 1 type of pesticide is used for one spraying. Categorized not mixed if only 1 type of pesticide was used for one spraying.

Chi-Square test was obtained p= 0.523, so the relationship between the number of pesticides and ESR was not statistically significant.

These results were quite in contrary to the theory of using pesticides > 1 type when spraying would cause greater poisoning effects than using 1 type of pesticide (Ban and Hawkins, 2005). Istianah and Yuniastuti's research (2017) showed that p <0.001 which showed a statistically significant relationship between the number of pesticides and the incidence of poisoning (Istianah and Yuniastuti, 2017).

5. Spraying Frequency

The more frequent the spraying, the greater the exposure to pesticides obtained by farmers. The frequency of spraying was categorized often if ≥2 times spraying a week and rarely if <2 spraying times a week. The Chi-Square test showed a statistically insignificant relationship between spraying frequency and ESR (p= 0.590).

Research by Simbolon (2004) regarding the relationship of spraying frequency with poisoning found that the time of last contact with a long time pesticide had an influence on the decrease in cholinesterase activity (p= 0.021) (Simbolon, 2004).

6. Cholinesterase Levels

The level of exposure or pesticide poisoning to farmers can be seen from the level of cholinesterase. Cholinesterase levels are considered abnormal in men with <4,620 or> 11,500 U/ L, in women with <3,930 or > 10,800 U/ L. Cholinesterase levels are considered normal in men if it is 4,620-11,500 U / L, in women if it is 3,930-10,800 U/ L.

The Chi-Square test obtained p= 0.186, so the relationship between cholinesterase levels and ESR was not statistically significant.

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Reduction in cholinesterase activity to below 75% was a biomarker poisoning of organophosphate compounds. Organophosphate compounds enter through various channels (inhalation, ingestion, and absorption) distributed and work to inhibit the activity of the enzyme cholinesterase in the body that is an enzyme that functioned as the destruction and termination of biological activity in the neurotransmitter acetylcholine (Klaassen and Watkins, 2003).

7. Pesticide Dosage

Doses of pesticides are also very influential on the incidence of poisoning due to pesticides. The greater the dose, the greater the poison power so that the risk of poisoning due to pesticides was also greater. The Chi-Square test showed p= 0.048, so the relationship between Pesticide Doses and ESR was statistically significant.

These results were in line with research done by Irnawati and Wahyuni (2017) which found a relationship between the dose of pesticides and the incidence of pesticide poisoning (p= 0.005) (Irnawati and Wahyuni, 2017).

Table 2. showed that there was no significant relationship between work period, PPE usage, length of work, number of pesticides, frequency of spraying, levels of cholinesterase with ESR on spraying farmers in Sumberejo Village. Table 2. showed a significant relationship between the dosage of pesticides with ESR on spraying farmers in Sumberejo Village.

Table 1. Frequency distribution of research variables

Variables	Frequency (people)	Percentage (%)
Work Period		
Long (>10 years)	31	72.09
Short (≤10 years)	12	27.91
The Use of PPE		
Incomplete	21	48.84
Complete	22	51.16
Length of Work		
Poor (>8 hours)	8	18.6
Good (≤8 hours)	35	81.4
Total Type of Pesticide		
Mixture (>1 types)	36	83.72
Not Mixed (1 type)	7	16.28
Spraying Frequency		
Often (≥2 times)	29	67.44
Rarely (<2 time)	14	32.56
Cholinesterase Levels		
Abnormal	7	16.28
Normal	36	83.72
Pesticide Dosage		
> dose on the label of pesticide	15	34.88
According to the dose on the pesticide label	28	65.12
ESR		
Above Normal (>10 mm/hours)	2	4.65
Normal (≤10 mm/hours)	41	95.35

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Table 2. The results of bivariate analysis of the relationship of independent variables and the dependent variable

Independent Variables	OR	95%CI	p
Work Period			0.368
The Use of PPE			0.138
Length of Work	4.38	0.31 to 62.75	0.243
Total Type of Pesticide			0.523
Spraying Frequency	0.48	0.03 to 7.17	0.590
Cholinesterase Levels	5.14	0.36 to 72.86	0.186
Pesticide Dosage			0.048

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