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RISK FACTORS RELATED TO PESTICIDE EXPOSURE IN BANJAR HORTICULTURAL FARMERS

Dewa Ayu Eka Wahyuni, I Made Muliarta, Susy Purnawati
Udayana University, Indonesia
Email: ekawahyunii2202@gmail.com[1], made_muliarta@unud.ac.id[2], s_purnawati@yahoo.com[3]

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ABSTRACT

Agriculture in Indonesia is the driving force for the country's economy. Farmers in an effort to improve the quality and productivity of agricultural products use pesticides. The use of pesticides to control pests is growing rapidly. Banjar farmers from the Dasong Department are active pesticide users, so there is a potential for pesticide exposure. This study aims to determine the relationship between risk factors and complaints on horticultural farmers in Banjar Dinas Dasong, Pancasari Village, Sukasada District, Buleleng Regency. This study is an analytical observational study with a cross-sectional approach using 46 respondents. Data were analyzed by SPSS using chi-square test and logistic regression. The results of the Chi-Square test showed that there was no significant relationship between age, pesticide dose, duration of spraying, time of spraying, and frequency of spraying with complaints from farmers (p>0.05). While there is a significant relationship between the use of PPE with complaints to farmers (p <0.05). The results of the logistic regression test showed that the duration of spraying, spraying time, frequency of spraying, and use of PPE with complaints to farmers was not significant (p>0.05). This is due to other external factors. This research can be concluded that there is no correlation between the duration of spraying, spraying time, frequency of spraying, and the use of PPE with the complaints of farmers in Banjar Dinas Dasong, Pancasari Village, Sukasada District, Buleleng Regency.

KEYWORDS

Pesticide, Risk Factors; Horticultural Farmer

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INTRODUCTION

Agriculture in Indonesia has a very strategic role in the sector driving the country's economy. According to data (Central Statistics Agency, 2020) in February 2020 the number of workers in Indonesia was 137.91 million people. Employment that occupies the top rank is the agricultural sector with 38 million people (29.04%). The data above shows that most districts in Indonesia still rely on the agricultural sector as a source of Regional Original Income. In the agricultural sector, there are several sub-sectors in it, such as horticulture, plantations, and food crops. Efforts to optimize the quality and productivity of agricultural products use various technologies, one of which is the use of pesticides (Kiloes & Sulistyaningrum, 2019).

According to the Food and Agriculture Organization (FAO), a pesticide is any substance or mixture intended to prevent, destroy or control every pest, including vectors for humans or animal diseases, and unwanted plants or animals that causes damage during the production process. The use of pesticides in the agricultural sector in Indonesia is growing rapidly. Based on data from Agricultural Infrastructure and Facilities Statistics in 2016, the number of pesticide use was 3,930 people per year. Data from the World Health Organization (WHO) estimates that every year 1-5 million cases of pesticide poisoning occur in farmers with a mortality rate of 220,000 people.

Poisoning in Indonesia in the agricultural sector ranks second or third compared to other sectors (Tasmi, Lubis, & Mahayuni, 2015). The prevalence of pesticide poisoning was obtained from moderate to severe levels. Farmers in Indonesia use a lot of organophosphate and carbamate pesticides which are synthetic pesticides (Wudianto, 2007). Farmers in Bali show the same thing, especially in Pancasari Village. Pancasari Village is one of the villages in Sukasada District, the majority of the population works in the agricultural sector. Pancasari Village is the largest agricultural center in Bali, especially in the horticulture sub-sector. The commodities cultivated in Pancasari Village are, strawberries, tomatoes, chilies, and peppers. Based on the results of water quality inspections in Lake Buyan, Pancasari Village, it was found that environmental pollution was caused by residues from organochlorine, organophosphate, and carbamate pesticides (Yadnyawati et al., 2020).

Organophosphate and carbamate pesticides have a way of working by inhibiting the enzyme acetylcholinesterase (AChE) through a phosphorylation process at the ester anion and synapses causing disorders of the autonomic nervous system. Inhibition of AChE causes accumulation of acetylcholine and binds to muscarinic and nicotinic receptors in the central and peripheral nervous systems. This buildup causes symptoms of poisoning that affect all parts of the body (Neal, 2020). Based on the complaints felt by farmers using pesticides, 60.9% of farmers showed specific complaints (Minaka, Sawitri, & Wirawan, 2016).

Symptoms and signs of organophosphate and carbamate pesticide poisoning are often found with complaints of dizziness, nausea and increased fatigue. People are not aware and have the assumption that this does not require special attention (Puspitarani, 2016). Complaints felt by farmers can be influenced by internal and external factors. Insufficient information regarding exposure to organophosphate and carbamate pesticides on farmers. This study aims to determine the relationship between the variables of age, pesticide dose, duration of spraying, spraying frequency, and use of personal protective equipment with complaints to horticultural farmers who use pesticides in Banjar Dinas Dasong, Pancasari Village, Sukasada District, Buleleng Regency.

RESEARCH METHOD

This research is an observational analytic study with a cross-sectional approach in which the independent variable and the dependent variable are observed at one time. This research was conducted in Banjar Dinas Dasong, Pancasari Village, Sukasada District, Buleleng Regency in June – September 2021. This study included 46 samples that met the inclusion criteria. The affordable population in this study were horticultural farmers who were exposed to organophosphate and carbamate pesticides in Banjar Dinas Dasong, Pancasari Village, Sukasada District, Buleleng Regency for the period June - September 2021.

The data collection technique used was purposive sampling method. This study used primary data obtained from interviews using a self-identity questionnaire and a pesticide exposure questionnaire. During the Covid-19 pandemic, the research was conducted door to door at farmers' homes and plantations. Researchers and respondents when collecting data in the field completely use PPE to prevent dangerous risks.

The independent variables in this study were age, pesticide dose, duration of spraying, time of spraying, frequency of spraying and use of PPE. While the dependent variable is farmers' complaints. Data were processed univariate, bivariate and multivariate with SPSS version 26. Bivariate analysis used chi-square test on categorical data. The independent variables in the bivariate analysis with $p < 0.25$ were included in the multivariate analysis. Multivariate analysis using logistic regression method. This study obtained an ethical clearance from the Research Ethics Commission of the Faculty of Medicine, Udayana University with the number 165/UN14.2.2.VII.14/LT/2021.

RESULT AND DISCUSSION

A. Characteristics of Pesticide Use

Table 1. Characteristics of Pesticide Use in Banjar Dinas Dasong

No.	Merek Dagang	Jenis	Golongan
1	Acrobat	Fungisida	Morfolin
2	Antracol	Insektisida	Karbamat
3	Cabrio Top	Fungisida	Metoksi-karbamat
4	Callicron	Insektisida	Organofosfat
5	Curacron	Insektisida	Organofosfat
6	Confidor	Insektisida	Neonikotinoid
7	Daconil	Fungisida	Kloronitile
8	Dursban	Insektisida	Organofosfat
9	Decis	Insektisida	Poretroid dan Piretrin
10	Demolish	Insektisida	Avermectin
11	Endure	Insektisida	Spinosin
12	Fra-re	Insektisida	Pirol
13	Kanon	Insektisida	Organofosfat
14	Kocide	Fungisida	Inorganik
15	Sapporo	Insektisida	Avermektin Milbemisin
16	Sidacron	Insektisida	Organofosfat
17	Sidazeb	Fungisida	Ditiokarbamat

A total of 46 horticultural farmers in Banjar Dinas Dasong participated in this study. The use of pesticides on horticultural farmers in Banjar Dinas Dasong, Pancasari Village, Sukasada District, Buleleng Regency is listed in Table 1., indicating that the types of insecticides used by respondents, such as callicron, curacron, dursban, kanon, and sidacron brands. Fungicides used, such as morpholine, methoxy-carbamate, chloronitile, inorganic, and dithiocarbamate. Insecticides that are often used for spraying activities by horticultural farmers are organophosphates and carbamates.

B. Characteristics of Horticultural Farmers' Risk Factors in Banjar Dinas Dasong

Table 2. Characteristics of Horticultural Farmers' Risk Factors in Banjar Dinas Dasong

Risk factors	**Frequency**	**Percentage**
Age		
< 40	12	26,1
40	34	73,9
Pesticide Dosage		
It is not in accordance with	5	10,9
In accordance	41	89,1
Spraying Time		
> 4 hours	1	2,2
4 hours	45	97,8
Spraying Time		
Day dominant	1	2,2
Dominant morning/afternoon	45	97,8
Spraying frequency		
<1 time/week	33	71,7
>1 time/week	13	28,3
Use of PPE		
Incomplete < 5	30	65,2
Complete 5	16	34,8
Total	46	100,0

Based on the results of research conducted on 46 respondents, it is known that the distribution of risk factors is that the majority of farmers who carry out pesticide spraying activities are 40 years old as many as 34 people (73.9%). The majority of farmers in Banjar Dinas Dasong have used the dosage according to the recommendations listed on the package, a total of 41 people (89.1%). The dominant farmers spraying time 4 hours were 45 people (97.8%), 45 people (97.8%) were spraying in the morning or afternoon. Farmers mostly have a frequency of spraying less than 1 time per week as many as 33 people (71.7%) and there are still many farmers who use incomplete PPE <5 as many as 30 people (65.2%). A small number of farmers, amounting to 9 people (19.6%) felt complaints after carrying out pesticide spraying activities. The types of complaints that are felt include headaches, increased fatigue, itching, and nausea.

Cross Tabulation and Chi-Square . Significance Test

Table 3. Cross Tabulation and Chi-Square Significance Test for Risk Factors with Complaints

No	**Variabel**	**Farmer's Complaint**				***p-value***
		Ada	**%**	**Tidak**	**%**	

		ada				
1	Age					
	40 years	8	23,5	26	76,5	0,409
	< 40 years old	1	8,3	11	91,7	
2	Pesticide Dosage					
	It is not in accordance with	1	20,0	4	80,0	1,000
	In accordance	8	19,5	33	80,5	
3	Spraying Time					
	> 4 hours	1	100	0	0,0	0,196+
	4 hours	8	17,8	37	82,2	
4	Spraying Time					
	Day dominant	1	100	0	0,0	0,196+
	Dominant morning/afternoon	8	17,8	37	82,2	
5	Spraying Frequency					
	More than 1 time/week	5	38,5	8	61,5	0,092+
	Less than 1 time/week	4	12,1	29	87,9	
6	Use of PPE					
	Incomplete < 5	9	30,3	21	70,0	0,018*+
	Complete 5	0	0,0	16	100	

*p<0,05 + included in the multivariate analysis

The results of the chi-square analysis to see the relationship between the independent variable and the dependent variable. Based on Table 3, it shows that there is no significant relationship between age, pesticide dose, duration of spraying, time of spraying and frequency of spraying with farmer complaints (p>0.05). However, other risk factors such as the use of PPE have a significant relationship with farmer complaints after spraying activities (p <0.05).

Logistics Regression Multivariate Analysis

Table 4. Results of Multivariate Logistics Regression Analysis

Variabel	*Pseudo R-Square*	Koefisien Regresi (B)	OR (Exp. B)	P *value*
Spraying Time	0,481	22,877	86158662969	1,000
Spraying Time		21,426	2019343159	1,000
Spraying Frequency		1,451	4,267	0,115
Use of PPE		19,953	26305255 9,6	0,998
constant		-44,080	0,000	0,999

Multivariate analysis used binary logistic regression method with independent variables in bivariate analysis with p < 0.25. Variables such as duration of spraying, time of spraying, frequency of spraying, and use of PPE were analyzed simultaneously. The results of the multivariate analysis are presented in the form of Table 4, it is known that the pseudo R-Square value obtained through the logistic regression test is 0.481 or 48.1%

(Nagelkerke). Based on these results, it indicates that the variables of spraying time, spraying time, frequency of spraying, and the use of PPE to explain complaints to farmers are 48.1%, of which 51.9% are explained by external factors.

Table 4 shows that the duration of spraying, time of spraying, frequency of spraying, and use of PPE have no effect on farmer complaints because this multivariate analysis will compete with other variables.

Discussion

This study shows that from a total of 46 respondents, 9 (19.6%) horticultural farmers from Banjar Dinas Dasong had specific complaints due to pesticide poisoning. Research conducted on farmers in Gondosuli, Central Java by 93.8%, farmers in Jember by 60% found specific complaints due to pesticides (Rahmasari & Musfirah, 2020). The difference in the results was caused by the sampling technique and the instrument used.

The results of the bivariate analysis showed that there was no significant relationship between age and farmer complaints (p = 0.409). This study is in line with previous research conducted on farmers in Karo Regency which found no relationship between age and health complaints. The results of this study are supported by Ipmawati's research, spraying activities are classified as productive age, capable, and ready to increase income to the maximum (Ipmawati, Setiani, & Darundiati, 2016)

There was no significant relationship between pesticide doses and farmers' complaints (p=1,000). These results are in line with research conducted in Pancasari Village which found no significant relationship between pesticide doses and farmers' health complaints (Minaka et al., 2016). The results of this study are not in accordance with the theory. Because the larger the dose used, the risk of pesticide poisoning will increase. This discrepancy in results is caused by farmers carrying out spraying activities on land that is not too large and the exposure time is not long (Mardiyah et al, 2019).

The risk factor for spraying time did not have a significant relationship with farmers' complaints (p = 0.196). These results are in accordance with research in Tejosari Village, it is known that there is no significant relationship between the duration of spraying and the health complaints of farmers (Runia, 1993). These results are in line with previous research in Balik Bukit District, West Lampung Regency, which found that there was no relationship between the duration of spraying and the health complaints of farmers (Yushananta, Melinda, Mahendra, Ahyanti, & Anggraini, 2020). According to the Minister of Manpower Regulation No. Per-03/Men/1986, it is stated that you should not be exposed to pesticides more than 5 hours a day and 20 hours a week in order to avoid unwanted effects.

This study stated that there was no relationship between the time of spraying and the complaints felt by farmers (p = 0.196). This research is in line with research conducted in Canada which states that farmers carry out spraying activities in the morning or evening (Maybank, Yoshida, & Grover, 1978). The study in Mendongan Village, Sumowono District, Semarang Regency obtained the same results showing that there was no significant relationship between spraying time and cholinesterase levels (Pradananingrum, Setyaningsih, & Suwondo, 2021). The time of applying pesticides will determine the effectiveness of the pesticides that are sprayed. If the time of spraying is done properly, then pest control will be optimal.

Spraying frequency did not have a significant relationship with farmers' complaints (p=0.092). These results are similar to research conducted in Candi Village, Bandungan District, which showed that there was no significant relationship between spraying frequency and farmer complaints. The more often farmers carry out spraying

activities, the higher the risk of poisoning due to pesticides. So that the level of the enzyme cholinesterase decreases. The frequency of spraying should be carried out according to the established rules, a maximum of 2 times a week (Samosir et al, 2017). In fact, farmers carry out spraying activities according to the needs in the field. If plants are attacked by pests, farmers will spray more often without paying attention to the rules that have been set.

The use of PPE has a significant relationship with farmers' complaints (p=0.018). Research in Gondosuli Magelang Village is in accordance with this study, where a significant relationship was found between the use of PPE and farmer complaints (Rahmasari & Musfirah, 2020). A similar study conducted in Rurukan Regency showed the results (p = 0.002) that there was a relationship between the use of PPE and cholinesterase enzymes (Tutu, Manapiring, & Umboh, 2020).

The results of the multivariate analysis showed different results on the use of PPE, the p-value was 0.998, meaning that there was no significant relationship between the use of PPE and the complaints felt by farmers in Banjar Dinas Dasong, Pancasari Village, Sukasada District, Buleleng Regency. This causes there to be no significant relationship between these two variables, such as the number of samples, the lack of instruments, and the sampling technique used.

Farmers feel unfamiliar and uncomfortable when they have to use full PPE. The majority of farmers who spray pesticides only use long clothes, head coverings, and boots. Based on the theory, the use of PPE when spraying activities will protect farmers in the area from direct exposure to pesticides. The risk of poisoning will be reduced if used completely. According to (Ministry of Health of the Republic of Indonesia, 2016) the recommended PPE for farmers who spray pesticides is obliged to use (1) head protection in the form of a hat/helmet; (2) eye and face protection in the form of goggle glass/face shield; (3) respiratory protection in the form of masks; (4) latex gloves/handscoons; (5) protective clothing in the form of long-sleeved shirts and long-sleeved pants; (6) gaiters/boots.

Based on the results of interviews, respondents stated that most of them did not use complete PPE because they were used to and uncomfortable when spraying. Most farmers do not use PPE in the form of masks and gloves. Pesticide contamination that ranks first occurs through the skin. Poisoning due to pesticide particles entering through inhalation ranks second. If farmers do not use PPE completely, it will make pesticides easy to absorb into the body.

Organophosphate pesticides are very dangerous because the pesticide and cholinesterase bonds are irreversible. Other health impacts that will result from long-term use of organophosphate pesticides, such as neurobehavioral or neurotoxic symptoms. Interaction with other enzymes can occur in some organophosphates called esterase target neuropathy (NTE) which is found in the brain and spinal cord (Dhamayanti & Saftarina, 2018).

CONCLUSION

Based on the results of bivariate analysis, the risk factor for the use of PPE has a significant relationship with farmer complaints (p = 0.018). In multivariate analysis, it was found that risk factors, such as duration of spraying, time of spraying, frequency of spraying and use of PPE had no effect on farmer complaints (p>0.05).

Suggestions to farmers during spraying activities should use complete PPE to minimize direct exposure to pesticides. Further research can be done to examine the poisoning of farmers to determine blood cholinesterase levels using the Tintometer Kit.

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