International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR |Volume 9 | Issue 2 | Apr - Jun - 2021
www.ijamscr.com

Research Study Medical research

Influence factors of cholinesterase levels among farm workers in Cikaok Village, West Pakpak District, North Sumatra, Indonesia

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ABSTRACT

Objective: Was to find out the influence factors of cholinesterase levels among farm workers in Cikaok Village, West Pakpak District, North Sumatra, Indonesia.

Methods: Cross-sectional data were collected from farmers in Cikaok Village in 2020. Purposive sampling was employed and 30 farmers were willing to participate and met the criteria. Data were obtained using observation sheets, interview guidelines, and checking cholinesterase levels using blood sample tests in the laboratory. Spearman correlation and linear regression test were used for data analyses.

Results: The results indicated that the minimum level of cholinesterase among farm workers were 9,798U/L and maximum level was 19,092U/L means that the average cholinesterase levels was still normal. However, there was a positive effect of personal hygiene and use of PPE on cholinesterase levels among farm workers.

Conclusions: The farmers should pay more attention to their hygiene and use of PPE when preparing and spraying pesticides and those relevant agencies such as Ministry of Agriculture, Ministry of Health, and Cooperatives should provide more intensive counseling or information about the dangers of pesticide use to health. Having knowledge and understanding about personal hygiene and PPE gear during mixing and spraying pesticides, farm workers can reduce the health impact of pesticides use.

Keywords: farm workers, personal hygiene, personal protective equipment, cholinesterase, pesticides.

INTRODUCTION

The tropical climate in Indonesia causes Indonesia to have fertile land and is suitable for planting various types of plants. To improve the quality and productivity of agricultural products, the use of pesticides to eradicate plant pests is often unavoidable, so that the pesticides used are expected to help farmers to get maximum profits. Farmers are the largest working group in Indonesia, although there is a tendency to decline, the workforce working in the agricultural sector still amounts to 40% of the workforce[1].

Pesticide contamination in humans that enters the body can cause signs and symptoms that can be felt by patients and can be observed by other people. However, the community generally underestimates the symptoms that arise in themselves after applying for pesticides. They do not check to the hospital or health personnel related to the symptoms that arise which results in no detection of pesticide poisoning in the community thus chronic effects cannot be prevented[2]. Chemicals do not produce toxic effects or unwanted effects in biological systems unless these chemicals or their biotransformation products reach a suitable place in the body at sufficient concentration and a long time to produce toxic manifestations. The main factors that influence toxicity related to the situation of exposure to certain chemicals are an entry into the body, the duration, and frequency of exposure[1].

Most Indonesian farmers know the dangers of pesticides, but they do not care about the consequences. Many farmers are using pesticides without using personal protection equipment (PPE) such as masks, hats, clothing that cover the body, boots and others. Farmers, in general, assume that using personal protection when handling pesticides is impractical and considered troublesome. If the tool is not used, these pesticides can enter the body through the skin and respiratory tract[3]. International Pesticide Action Network (PAN) estimates that globally, between 1 and 41 million people each year experience the health effects of pesticides. World Health Organisation (WHO) estimated that at least 300,000 people die each year due to pesticide poisoning and United Nations Environment Program (UNEP) mentioned that 1-5 million cases of pesticide poisoning occur in workers working in the agricultural sector [1].In some countries, such as China and Sri Lanka,self-poisoning with pesticides is a particular problem. Studies from Sri Lanka regarding self-poisoning reveal an acute pesticide poisoning (APP) incidence rate of approximately 180 per 100,000.Studies from developing areas in Central America (El Salvador and Nicaragua) have indicated an overall incidence rate of 35 per 100,000 for APP in the general population and 17.8 per 100,000 occupationally-related APP in Thailand. In Belize, it has been estimated that 17 pesticide poisonings per 100,000 residents and 4,142 preventable poisonings occur each year. Previous research has demonstrated that reported occupational and non-intentional causes vary from 10% to 50% in developing countries[4].

One of the well-known pesticides that inhibit Cholinesterase enzymes is organophosphate group pesticides. Health problems occur due to the accumulation of acetylcholine (ACH) at the nerve endings. The organophosphate enters the body through the respiratory tract, digestive tract, and skin. The organophosphate binds to the acetyl cholinesterase (Ache) enzyme in the body and inhibits the action of this enzyme so that acetylcholine is not hydrolyzed into acetate and choline ions, resulting in accumulation of acetylcholine which causes health problems, paralysis, and death[5]. Review of studies showed there was association between chronic occupational exposure to organophosphate (OP) pesticides and neuropsychological effects[6]. A cross-sectional study conducted in North India also found that the unsafe occupational exposure of OP pesticides causes respiratory illness, decreased lung functions and hematological alterations among pesticide sprayers[7].

West Pakpak is an area with a large portion of the population working as farmers, so it is undeniable that the use of pesticides is very high to produce maximum yields. Based on the initial survey conducted, it was seen in the work process starting from the preparation and mixing pesticides carried out near the garden area to be sprayed. Pesticide preparations and mixing should be carried out where they have been provided and use the recommended PPE. Mixed pesticides are also not stirred to reduce the activity of pesticides in killing pests. When filling in pesticides that have been mixed into a sling sprayer, the pesticide mixture is foamy, and one of the workers immediately cleanses the foam with his hands without protective gloves so it can be ascertained that the worker has been exposed to pesticides through the skin. Then, the sprayer runs in a circular and irregular direction because at that time the workers sprayed the pests. Using circular and irregular spraying, it allows workers to be exposed to pesticides; spraying should be carried in the direction of the wind. Personal protective equipment such as long-sleeved clothes and trousers, hats, masks, glasses, gloves and boots should be worn when spraying pesticides. Apparently, after being seen in the field, almost all farm workers did not use PPE completely when spraying. Based on the description above, the researchers were interested in investigating what are the influence factors of cholinesterase levels among farm workers in Cikaok Village, West PakPak District, North Sumatra, Indonesia.

METHODS

Study design

This was analytical research with a cross-sectional approach to obtain the factors that affect cholinesterase levels among farmers using pesticides in Cikaok Village, West Pakpak District, North Sumatra. This study was conducted from March to December 2020.

Sample size and sampling technique

The study population was all farmers in Cikaok Village who working as local orange farmers. Manyfarmersgrowthe local orange because it is considered a mono-crop that can increasetheincome of the farmers who live in the area. Farmers in Cikaok Village have an average land area of ± 2 hectares for only this crops, thus farmers in the area use a lot of pesticides with spraying methods so that the plants are not damaged and the fruit is not infested with fruit worms and can improve the quality of these plants. A total of 98 farmers and 30 farmers were willing to participate and met the criteria. The sampling technique used purposive sampling with inclusión criteria being willing to participate in the study and take the blood sample, hadworked as a farmer >5 years, being active farmers are at least 25 yearsold, and finally spraying the orange plants between 1-7 days before blood was drawn to check cholinesterase levels.

Research instrumet and data analysis

In this study, the independent variables included age,length of work, duration of spray, personal hygiene and use of PPE, while the dependent variable was the cholinesterase levels. Primary and secondary data were collected in the study. Primary data were obtaine dusing observation sheets, interview guidelines, and checking cholinesterase levels using blood simple tests in the laboratory. Secondary data were obtained from villaje demographic data in SilimaKuta Village, West Pakpak Regency. Descriptive statistics, Spearman correlation and linear regression test were usedfor data analyses. Descriptive statistics were used to see the description or distribution of each dependent and independent variables. Spearman correlation was used to see the relationship between independent and dependent variables. Linear regression analysis was used to see the influence of the independent variables on the dependent. A requirement for linear regression analysis was normal data distribution. Therefore, each variable must first be tested for normality using the Kolmogorov Smirnov test. If p-value >0.05 was considered to normal distribution. Multicollinearity model was used to test the correlation between independent variables and the classical heteroscedasticity assumption model was used to test whether the variance of theresiduals from other observations was equal or not. SPSS for Windows version 20 was used for statistical analyses.

Ethical considerations

This study was approved by the Review Boards of the Ethical Committee of Prima Indonesia University (No. 003/KEPK/UNPRI/XII/2020).All respondents received the informed consent about the research before study being conducted.

RESULTS

Table 1: Respondents Characteristics

Variables	Min	Max	Mean	SD	N	(%)
Gender						
Male					15	50,0
Female					15	50,0
Education						
Primary School					10	33,3
Secondary School					6	20,0
High School					14	46,7
Age (yrs)	28	63	44.9	9.2		
Length of work (yrs)	7	40	18.9	9.0		
Duration of spray (hr)	1	7	4.4	1.8		
Personal hygiene (point)	3	8	5.5	1.7		
Use of PPE (point)	0	7	4.5	1.9		
Cholinesterase levels (units/L)	9,798	19,092	12,983	2,016		

Table 1 shown that the number of respondents was 30 farmers.Distribution by gender men and women, respectively 15 people (50.0%). The majority of respondents' education was high school (64.7%). The mean age of the farmers was 44.9 years; the mean length of work for current occupation was 18.9 years, the mean duration of spray was 4.4 hours, the mean personal hygiene was 5.5 points, the mean use of PPE was 4.5 points and farmer's cholinesterase levels mean was 12,983 U/L.

Table 2: Correlation Analysis

Variables	*r*	*p.*
Age (yrs)	-0.101	0.596
Length of work (yrs)	-0.049	0.796
Duration of spray (hr)	0.294	0.115
Personal hygiene (point)	0.795	0.000
Use of PPE (point)	0.556	0.001

Based on table 2 show that there was no correlation among age (p-value=0.596), length of work (p-value=0.796), duration of spray (p-value=0.115) and cholinesterase levels. However, there was a positive correlation between personal hygiene (p-value<0.000) and use of PPE (p-value<0.001) and cholinesterase levels among farm workers in Cikaok.

Table 3: Determination Analysis

R^2	F	*p.*
0.657	25.873	0.000

The regression coefficient of determination showed on table 3, a value of 0.657 indicating that the personal hygiene and the use of personal protective equipment variables were able to explain the variation in cholinesterase levels among farm workers by 65.7%.

Table 4: Influence of Personal Hygiene and Use of Personal Protective Equipment on Cholinesterase Levels among Farm Workers

Variables	B	*p-value*
Constant	7184.511	-
Personal Hygiene	731.280	0.000
Use of PPE	372.018	0.005

Based on the results of linear regression tests in table 4, there was an effect of personal hygiene (p-value<0.000) on cholinesterase levels among farmers and the effect given is positive. It means that the higher personal hygiene value, it is predicted that cholinesterase levels in the blood will increase the coefficient value of b1 = 731.280. There was also an effect of use of PPE (p-value<0.005) on cholinesterase levels among farmers and the effect given is positive. Meaning the higher use of PPE value, it is predicted that the cholinesterase level in the blood will increase the coefficient value of b1 = 372,018.

DISCUSSION

Based on the results in this study, the average of famers' cholinesterase levels was 12,893 U/L, by the minimum levels was 9,789 U/L and the maximum level was 19,092 U/L. It means that the average of cholinesterase levels among farmers in Cikaok Village was still normal. However, most of the farmers had the habit of spraying pesticide approximately 4 to 7 hours per day (66.7%) and the shortest exposure was 3 hours per day. This spraying habit was beyond the normal limits of pesticide use. A study found that when using organophosphate pesticides in hours, spraying with a frequency of weeks every week, the duration of spraying by farmers was still within the safe limit of 1-2 hours, so poisoning due to pesticides can be minimized because symptoms of pesticide poisoning can occur after 4 hours of contact, but the symptoms of poisoning disappear after 12 hours[8]. The danger of pesticide poisoning can result in acute poisoning (headache, dizziness, nausea, chest pain, difficulty breathing, etc.), sub-acute poisoning, and chronic poisoning (nervous system disorders, hormonal balance, and cancer)[9].

Personal hygiene also affects cholinesterase levels in farmers using pesticides. Good personal hygiene is if farmers who use pesticides wash their hands, face, feet with soap, change clothes after spraying, wash their hands before eating and drinking, clean utensils carefully and away from food and drink sources, and dispose of leftovers. Conversely, it is not good if the pesticide sprayer does not do either of these. If farmers using pesticides eat and drink during breaks and do not wash their hands and soap, the pesticides will enter through the mouth and digestive tract which can cause diarrhea and sore throat. This is also supported by the working period of the farmers who have an average experience of 15 years and the majority of farmers have an average spraying time of 4-7 hours per day. In this study, farmers generally always wash their hands with soap before eating and drinking, thus preventing pesticides from entering through the mouth. However, farmers do not immediately change clothes and take a shower because after spraying using pesticides, farmers usually choose to continue working in their gardens such as cleaning grass and hoeing so the exposure to pesticides remains on farmers' work clothes and there is a risk of pesticides entering the farmer's body. Farmers should have taken a shower and changed clothes immediately after use and expose to pesticides so the pesticides do not enter the body.

In this study, it was found that there was a significant relationship between farmers' personal hygiene and cholinesterase levels in farmers using pesticides in Cikaok Village. A research also found that there was a relationship between personal hygiene and the level of pesticide poisoning. These results indicated that individual hygiene is a factor in the occurrence of poisoning[10]. Personal hygiene is very influential on the health level of workers. Personal hygiene behavior related to disease prevention efforts that can be done in various ways such as bathing, washing hands and feet, and cleaning clothes[11]. Personal hygiene in farmers includes the habit of washing hands, bathing, washing equipment using water, changing work clothes every day, and changing work clothes after finishing their work. The action of farmers in washing their hands after spraying is the behavior of farmers in maintaining personal hygiene. Personal hygiene behaviors that can be carried out by farmers include washing hands using soap and water, showering immediately after spraying, not smoking when spraying or after finishing spraying, washing PPE using soap, storing PPE in a separate place, and changing clothes and PPE after spraying[12]. Storage and disposal of pesticides, as well as cleaning spraying equipment are also important things to avoid environmental pollution through air, soil, and water[9].

Personal protective equipment is an obligation where usually farm workers or construction workers are required to use them. Such tools must meet the requirements and not interfere with work and provide effective protection against

work hazards. The use of personal protective equipment aims to protect oneself from certain sources of danger, both from work and the work environment[13]. Based on the results in Cikaok Village, the majority of respondents are less aware of the importance of using personal protective equipment such as hats, masks, gloves, long sleeves, trousers, glasses and shoes. Farmers who use pesticides tend to think that using personal protective equipment will interfere and slow down their work. Farmers only wear hats, long sleeves, trousers and boots, but some farmers only wear shirts and shorts, and don't wear shoes. This indicated that the farm workers in Cikaok Village did not know the impact of not using PPE when working with pesticides.

The habit of wearing personal protective equipment is one of the factors that could affect the activity of the cholinesterase enzyme. Cholinesterase is an enzyme found in cellular fluids, whose function is to stop the action of achethilcholin by hydrolyzing it into choline and acetic acid. Achethilcholin is a neuro hormone that present between nerve endings and muscles, as a chemical medium whose function is to transmit nerve stimuli or impulses to receptors for muscle and glandular cells[14].

In this study, the results showed that 96.7% of respondents did not wear complete personal protective equipment. In general, almost all farmers did not use a mask when spraying pesticides. The use of masks is very important in preventing exposure to pesticides entering through inhalation[15]. It was also found that almost all farmers did not use PPE when mixing pesticides with solvents and spraying the pesticide. This is an important thing that must be considered, because it is a way to avoid exposure to pesticides entering the body and causing cholinesterase levels to increase and lead to poisoning[16].

This study results found that there was a significant correlation between use of personal protective equipment and cholinesterase levels among farmers using pesticides in Cikaok Village. The finding in this study is in line with a research conducted in Pasirhalang Village that found there was a significant correlation between use of complete PPE and cholinesterase level among farmers[17]. A study investigated among red onion farmers in NgurensitiPatialso found that there was a significant relationship between use of PPE and cholinesterase levels in the farmers' blood[18]. Research conducted in Brebes, Indonesia found that that there was a correlation between the use of personal protective equipment and the health problems among farmers such as excessive fatigue, excessive saliva, hard breathing, frequent urination, blurred vision, dizziness, and finger pain[19]. This study also supported the research investigated in Bumen Village, Sumowono District, Semarang Regency that found the PPE usage had an positive influence with diastolic blood pressure[20].A research found that not using PPE completely has a 4.54 times (OR = 4.54; 95% CI 2.09-9.83) higher risk of experiencing pesticide poisoning in famers in West Lampung[21]. Therefore, most studies showed that the use of proper PPE and in adequate conditions is proven to reduce the risk of pesticide exposure[22]. Personal protective equipment is a tool capable of protecting workers because it is able to protect and isolate workers from possible risks and potential hazards in the workplace. Personal protective equipment such as hats, glasses, gloves, masks, boots, long clothes and trousers must be used among farmers using pesticides in Cikaok Village because it can avoid pesticides exposure on the skin and bodies of farmers. Improper use of PPE can be dangerous because chemicals from pesticides can be absorbed by the skin and cause poisoning.

CONCLUSION

In conclusion, there was an effect of personal hygiene and use of PPE on cholinesterase levels among farmers using pesticides. The farmer's personal hygiene in Cikaok Village was not good and they did not use complete PPE gear, thus it affects the farmers' cholinesterase levels in the body. Therefore, farmers who use pesticides in Cikaok Village are suggested to increase their knowledge by participating in counseling on the impact and risks of using pesticides on farmers' health and having to wear complete personal protective equipment while mixing and spraying the pesticides. Wash hands; take shower using soap and change clothes are recommended for farmers after coming from the farm field. The community health center in the working area of Cikaok Village must be more active in conducting blood checks among farmers at least once a year so that their health is monitored and the village chairperson or community leaders can also choose health volunteers so they can monitor the clean and healthy behavior of farmers and become promoters in the use of PPE for farmers. The local government such as department of agriculture, department of health and cooperative should provide protection efforts to farmers in Cikaok Village in the form of assistance for personal protective equipment to farmers who use pesticides.

ACKNOWLEDGMENT

The authors would like to thank all the respondents for their participation in this research especially to the farmers in Cikaok Village, West Pakpak District, North Sumatra.

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How to cite this article: Agnes Ferusgel, Safrina Ramadhani, Rosmidah Simanjuntak, Cut SauraSalmira, Ivan Elisabeth Purba, Yenni Gustiani Tarigan. Influence factors of cholinesterase levels among farm workers in CikaokVillage, West Pakpak District, North Sumatra, Indonesia..Int J of Allied Med Sci and Clin Res 2021; 9(2): 186-191.

Source of Support: Nil. **Conflict of Interest:** None declared.