Eduvest – Journal of Universal Studies
Volume 4 Number 11, November, 2024
p- ISSN 2775-3735- e-ISSN 2775-3727

THE RELATIONSHIP OF CHOLLINESTERASE LEVELS TO COGNITIVE STATUS IN VILLAGE FARMERS PAKIS, JEMBER DISTRICT

I Made Putra Wira Negara[1], Kristianningrum Dian S[2], Alif Mardijana[3]
[1,2,3] Universits Jember, Indonesia
Email: putrawira2202@gmail.com[1], kdsofiana.fk@unej.ac.id[2],
Alif.mardijana05@icould.com[3]

ABSTRACT

This study aims to analyze the relationship between cholinesterase levels and cognitive status in farmers in Village, Panti District, Jember Regency. High use of pesticides in the agricultural sector can increase the risk of poisoning, which has an impact on health, especially the nervous system and cognitive function. The research method used was observational with a cross-sectional design, involving 30 farmers who used organophosphate and carbamate pesticides. Cognitive status was measured using the Mini Mental State Examination (MMSE). The results showed that there was a decrease in cholinesterase levels in some farmers, but the analysis with the Spearman correlation test showed no significant relationship between cholinesterase levels and cognitive status (p > 0.05). This research is expected to provide information about the impact of pesticides and the importance of using personal protective equipment for farmers.

KEYWORDS *Cholinesterase, cognitive status, farmers, pesticides, health*

INTRODUCTION

Indonesia is a country rich in natural resources, this wealth is divided into several sectors, such as the sea, forests, rice fields, and other biological resources. Indonesia is divided into maritime areas in the form of oceans and agrarian areas in the form of forestry, plantations, and large areas of rice fields geographically (East Java Agriculture Office, 2019). Agriculture is one of Indonesia's natural resources which is an important factor in economic development in Indonesia. Almost all of Indonesia's people need the results of this agricultural sector for food and most of the others depend on it as jobs (Widyawati, 2017). Jember is one of the areas dominated by agricultural areas in the form of forests and rice fields with a rice field area of 86,685.56 Ha (26.32%). In line with the working land of the people of Jember in the agricultural sector and the use of pesticides has increased (Oktavia et al., 2015). According to the National Poisoning Information Center (Sikernas) since

How to cite: I Made Putra Wira Negara, et al. (2024). The Relationship Of Chollinesterase Levels To Cognitive Status In Village Farmers Pakis, Jember District. *Journal Eduvest*. 4(11), 10114-10129
E-ISSN: 2775-3727
Published by: https://greenpublisher.id/

2016 until now, there have been 771 cases of poisoning that have occurred due to increasing pesticides (Okta, 2019).

Data from the Central Statistics Agency (BPS) of Jember Regency in 2019, Village, Panti District has a population of 7041 people with the majority of the population making a livelihood of rice farmers. We can see the increase in risk factors due to the high use of pesticides indirectly and the lack of habits of using Personal Protective Equipment (PPE) from farmers which causes the impact of pesticide exposure to increase.

Pesticides are one of the chemicals in the agricultural sector that are useful to help farmers repel pests so that they can maintain the yield of agricultural products (Arif, 2019). Pesticides have been used all over the world, according to Sebastian et al. (2017) the excessive use of pesticides and over a long period of time will cause several impacts on the human body. The impact is not only limited to farmers who are directly exposed but also indirectly but also to the surrounding living creatures and the environment. The impact on humans caused by pesticides can be of various types, ranging from the respiratory system, allergies or itching on the skin depending on how the pesticide enters the body. In addition, one of the disorders that can occur is abnormalities in the nervous system (Nicolopoulou et al., 2016).

The nervous system can be anatomically divided into two, namely the Central Nervous System (CNS) which consists of the brain and spinal cord and the Peripheral Nervous System (SST) which consists of cranial and spinal nerves (Bahrudin, 2016). The two nervous systems work together to maintain the human body to be able to run physiologically (Sherwood, 2014). The nervous system is very important and vital in the human body because the nervous system regulates motor and sensory stimuli in the human body physiologically. These two aspects, if not running normally, will cause disturbances in the human nervous system (Rohlman et al., 2012). One of the causes of the disorder is due to an imbalance in cholinesterase levels that interfere with the physiology of the nervous system (Wang A, 2014).

An imbalance in acetylcholinesterase (AChE) levels is one of the indicators that can be found in people who experience poisoning or exposure to pesticides. Decreased AChE levels can occur due to the long-term use of pesticides and the neurotoxin properties of substances in pesticides (Edward et al., 2015). Types of pesticides such as; organophosphates, organochlorines and carbamates can cause disturbances in the central nervous system and peripheral nervous system which can result in other disorders that are innervated by damaged nerves and can eventually cause a decrease in productivity of farmers (Muhammad et al., 2018).

One of the disorders that can occur in the human nervous system is cognitive impairment. In general, cognitive impairment is a disorder that often occurs with age and causes a decrease in brain function which is characterized by the onset of disorders in thinking, calculation, verbal communication, visual memory, and concentration (Sebastian et al., 2017). Another extrenal factor that can cause this disorder is chemical substances such as pesticides that interfere with cognitive functions regulated by the central nervous system. A person's cognitive status can be checked using the Mini Mental State Examination (MMSE) which is an examination to assess the cognitive function of a person and is widely used (Radolfo et al., 2009).

Previous research by Sebastian et al. (2017), began to find abnormalities in the nervous system, especially in the cognitive function of farmers who were exposed to pesticides for a period of 5 years and began to be very obvious when the exposure was more than 10 years. Exposure to pesticides for a long period of time can have effects on farmers' health, especially on the nervous system. Acetylcholine (ACh) which should be broken down into choline and acetic acid by AChE cannot run properly because exposure to pesticides in the body can cause phosphorylation of AChE so that there is a buildup of ACh which later interferes with the flow of nerve excitation affected by exposure (Wang, 2014).

The data from the results of the study can find out that there is a possibility of an increase in the risk factors of pesticide poisoning in these areas and other areas with the majority of jobs as farmers who use pesticides (Edward et al., 2015). Village is one of the villages in Jember that has the majority of the community's work as farmers and is the largest rice producer in Panti District, making Village an active pesticide user so that it may have risk factors for exposure and the impact of the exposure. This attracted the attention of the author to research on the relationship between pesticide exposure seen from AChE levels and cognitive status in farmers, with the title "The Relationship of Cholinesterase Levels to Cognitive Status in Farmers in Village, Panti District, Jember Regency".

The general purpose of this study is to find out whether there is a relationship between cholinesterase levels and cognitive status in farmers in Village, Panti District, Jember Regency. The specific objectives of this study are:

a. Determine the level of cholinesterase in farmers.
b. Determine the cognitive status of farmers.
c. To determine the relationship between cholinesterase levels and cognitive status in farmers.

The researcher hopes that this study can provide benefits to several parties, including:

1. The results of this study can be used as a reference for medical personnel about the impact of pesticides on farmers and know the preventive actions that can be taken.
2. The results of this research can add to the literature and references as reference materials for future research.
3. The results of this study are expected to provide information to the community, especially farmers, about the impact of pesticide exposure, especially on the nervous system, so that it can help prevent the community from the impact of pesticide use and minimize risk factors that can be modified.

RESEARCH METHOD

Research Design

The type of research that will be carried out is observational analysis using *a cross sectional* research design. Cross *sectional* research is a non-experimental study that is used to measure several variables and is carried out at a certain time at once (*point time approach*) (Hidayat, 2019). The *cross sectional* research design used in this study was to find the relationship between cognitive function and cholinesterase levels in farmers in Village, Panti District, Jember Regency.

Place and Time of Research

This research was carried out in Village, Panti District, Jember Regency, while the measurement of cholinesterase levels was carried out in the Biochemistry Laboratory, Faculty of Medicine, University of Jember. The time for the data obtained in this study was taken during the months of May 2019 – February 2020.

Research Population

The population in this study is farmers who use organophosphate and carbamate pesticides in Village, Panti District, Jember Regency.

Research Sample

The samples taken were farmers who used organophosphate and carbamate pesticides in Village, Panti District, Jember Regency that met the inclusion and exclusion criteria

Research Instruments:

Questionnaire

The questionnaire contains data on the general characteristics of the subjects which include gender, working period, name, age, type of pesticide used based on brand, disease history, drug history, and at the same time a consent sheet in the form of informed consent and an MMSE questionnaire to measure cognitive status.

Research Tools

a. Lembar informed consent.
b. MMSE questionnaire to measure conitative function.
c. The blood lancet is 28 G to collect capillary blood from the farmers' fingers.
d. A 5 cc syringe with a 21 G needle to take a blood sample through the pinch fossa vein.
e. Alcohol swab for sterilization at the location where blood will be drawn.
f. Torniquet is used to stem venous blood in the upper arm.
g. Centrifuge is used to obtain supernatants in blood samples.
h. The blood collection is 5 cc.
i. Test tubes to hold supernatants, reagents, or a mixture of both.
j. Micropipettes to transfer reagents and supernatants into test tubes.
k. Cuvettes to accommodate the results of mixing supernatants with reagents before being assessed on a spectrophotometer.
l. Waterbaths are used to incubate either supernatant samples, reagents, or a mixture of both.
m. A spectrophotometer is used to assess cholinesterase levels in blood plasma.

Research Materials

a. Blood from the fossa cubiti vein to assess cholinesterase levels.
b. Cholinesterase reagents consist of 2 reagents (Wicaksono, 2016);

Reagent 1:
Pyrophosphate pH 7.6 75 mmol/L
Hexacyanoferrate(III) 2 mmol/L
Reagent 2:
Butyrylthiocholine 15 mmol/L

Research Procedure

Due Diligence

This research uses human subjects so that in its implementation it requires a feasibility test from the Ethics Commission of the Faculty of Medicine, University of Jember.

Licensing

The researcher took care of a letter of introduction from the Faculty of Medicine, University of Jember and asked for a research permit in Village, Jember Regency through the National and Political Health Agency (Bakesbangpol), as well as a permit to use the Biochemistry Laboratory of the Faculty of Medicine, University of Jember.

Informed Consent and Explanation

a. Providing informed consent to the sample
b. Provide an explanation sheet related to the data collection procedure.

Cognitive Function Measurement

a. Preparing MMSE Questionnaires and paper sheets
b. Conducting primary data collection by directly asking for samples to answer questions and follow instructions according to the questionnaire and test that will be given.

Venous blood sampling (Bastian et al., 2018) Blood sampling is carried out by:

a. Choose the part where the venipuncture will be performed, namely: the antecubitus of the arm, choose a vein that is large and not easy to move.
b. Disinfect the venipuncture area with an alcohol swab in a circular motion from center to edge, leave 30 seconds for alcohol to dry.
c. Placing a 7.5–10 cm tourniquet over the venipuncture area with a fist on the patient's hand helps with the appearance of the vein.
d. Inserting the needle into the vein, position the pinhole upwards at an angle of 15–300.
e. Remove the tourniquet after the blood has flowed (do not leave the tourniquet on for more than 1 minute).
f. Fill the tube until the vacuum is completely removed, remove the tube from the needle.
g. Rotate the contents of the tube 5–10 times.
h. Release the needle slowly. Immediately press with a cotton swab for 3–5 minutes, plaster the veni puncture part and remove after 15 minutes.
i. Label the tube (name, no.lab, needle & date of retrieval).

Cholinesterase Level Check

Used to test the solution whether it still meets the requirements or expires, how to test (Marissa, 2017):

a. The researcher took 3 cc of blood using a syringe and then put it into an eppendorf tube.
b. Blood in the centrifuge at 4000 rpm for 10 minutes to get blood plasma that is separated from the solid part of the blood.

c. The examiner mixed 20 µL of blood plasma and 1000 µL of reagent 1 into a sample tube and then incubated at 37 oC for 3 minutes.
d. The examiner added 2 reagent 2 as much as 250 µL. Mix incubated for 2 minutes.
e. The researchers put the mixture on a spectrophotometer with a wavelength of 405 nm and read the absorbance at minutes 1, 2, and 3.
f. Calculate the value of cholinesterase activity.

Cadre of cholinesterase (U/L) = ΔA/min x Factor
= |A1-A2|+|A2-A3| 68500 x
Normal values (Arif, Mansyur, 2015):
Man = 4620-11500 U/L Female = 3930-10800 U/L

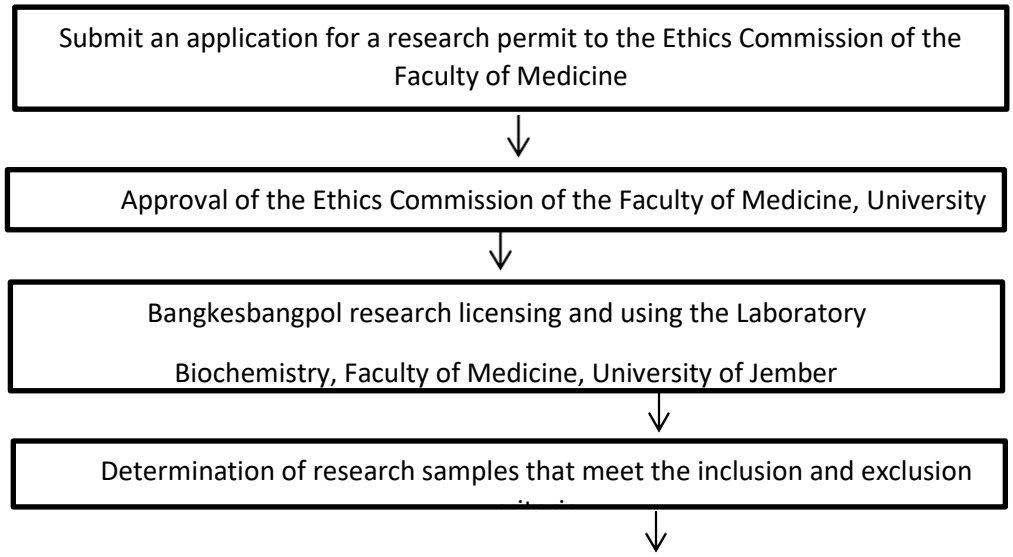
Data Collection

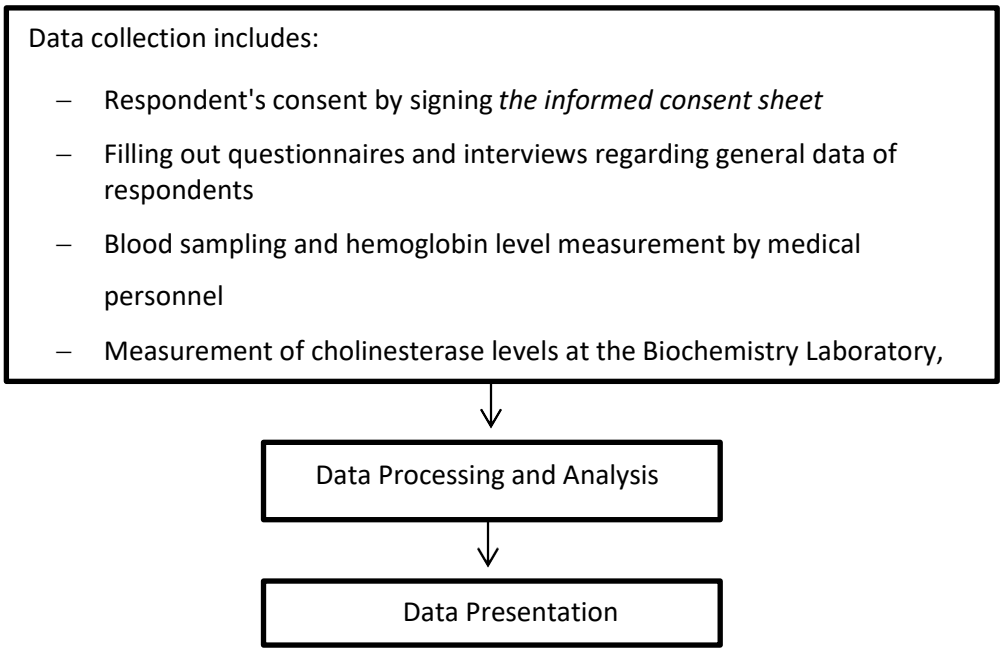
The data that has been collected is processed by means of interviews and filling in general data of farmers (name, gender, address, smoking, last time of spraying, disease history and history of medicines). Data collection was carried out by taking blood samples directly by medical personnel as materials to measure cholinesterase levels and conducting cognitive function tests using MMSE questionnaires.

Data Analysis

The data analysis used in the study was using the statistical processing application Statistical Package for Social Science (SPSS). The data analysis needed is descriptive univariate analysis, then bivariate data to see the relationship between cholinesterase levels (independent variables) and cognitive status in farmers (dependent variables) using the Spearman correlation test (Dahlan, 2014).

Research Flow





RESULT AND DISCUSSION

The study on the relationship between cholinesterase levels and cognitive status in farmers in Village, Panti District, Jember Regency obtained the following results:

Characteristics of Research Sample

The research was conducted in Village, Panti District, Jember Regency from November 2019 to January 2020. The population of this study is all farmers in Village, Panti District, Jember Regency, the subjects and respondents in this study are 42 farmers, but as many as 12 farmers failed to become research samples due to damage to blood samples that have been taken and some did not enter the criteria for inclusion of data samples, so a sample of 30 farmers was obtained. Data processing and analysis in this study used the statistical processing computer program Statistical Package for the Social Science (SPSS) 24.0.

The enforcement of the inclusion and exclusion criteria of the sample by the researcher was carried out using interviews and filling out general data sheets. Some of the things that can affect cholinesterase levels and cognitive status in farmers include farmers with diseases such as dementia, Alzheimer's, neurological disorders and a history of head injuries, as well as other chronic diseases that need to be examined to minimize bias. In this study, no laboratory examinations or other examinations were carried out to enforce the exclusion criteria. This study has limitations in controlling factors that can affect cholinesterase levels and cognitive status in farmers such as; history of diseases and history of medications.

The characteristics of the sample were grouped by gender, age and educational status. The characteristics of the sample based on gender were 17 male samples (56.67%) and 13 female samples (43.33%). Sample characteristics based on educational status were obtained by each sample with the last education of elementary school (SD) as many as 24 samples (80%), as many as 3 sample (10%) is the first graduating from junior high school, as many as

2 samples (6.67%) were graduates of upper school (SMA), and 1 sample (3.33%) was graduates of Strata 1 (S1). The characteristics of the sample based on age were obtained 2 samples (6.67%) with a vulnerable age of 18-25, as many as 4 samples (13.33%) with a vulnerable age of 26-35, as many as 8 samples

(26.67%) with vulnerable age 36-45, as many as 12 samples (40%) with vulnerable

age 46-55, and as many as 4 samples (13.33%) with vulnerable age 55-60. Based on this study, samples with a history of disease were obtained as many as

5 samples (16.67%) while samples without a history of disease were 25 samples (83.33%). Sample characteristics based on drug history were obtained samples with drug history as many as 3 samples (10%) while samples without drug history were 27 samples (90%). The general characteristics data of the sample can be seen in Table 1.

Table 1. Distribution of Farmer Characteristics Data in Village, Panti District, Jember Regency

Characteristics of the farmer's sample	**Sum**	**Percentage (%)**
Gender		
Man	17	56,67
Woman	13	43,33
Age		
18 – 25	2	6,67
26 – 35	4	13,33
36 – 45	8	26,67
46 – 55	12	40
55 – 60	4	13,33
Educational Status		
SD	24	80
SMP	3	10
SMA	2	6,67
>SMA	1	3,33
History of disease		
Ada	5	16,67
No	25	83,33
History of medications		
Ada	3	10
No	27	90
Total	30	100

Distribution of Cholinesterase Level Data

The cholinesterase levels in this study were obtained in the range of 156.4-16,769.55 U/L. Men and women had different normal levels of cholinesterase, men had normal levels of 4620-11500 U/L and women 3930-10800 U/L. Based on the results of laboratory examinations, it was found that 8 male subjects and 6 female research subjects experienced a decrease in cholinesterase levels which is an indicator of pesticide poisoning. Data on cholinesterase levels can be seen in Table 2.

Table 2. Distribution of Cholinesterase Level Data

Man	**Woman**

Variable	Number (n)	Percentage (%)	Number (n)	Percentage (%)
< Normal	8	26,67%	6	20%
Normal	6	20%	6	20%
> Normal	3	10%	1	3,33%
Total	17	56,67%	13	43,33%

Distribution of Cognitive Status Data

A person's Cognitive Status can be known through the Mini Mental State Examination (MMSE) examination using the MMSE Questionnaire. Cognitive status or function is defined as one of the complex functions of the human brain consisting of several aspects such as visual perception and the construction of numeracy skills, perception and use of language, comprehension and use of language, information processing, memory, executive functions, and problem solving. Interpretation in the MMSE examination, a person will be assessed as having cognitive impairment with a score of 0-16, assessed as likely a disorder if the score is 17-23, and assessed as normal with a score of 24-30 (Nurjanah, 2012). In this study, based on the results of the examination, 7 respondents (23.33%) with normal MMSE scores, as many as 11 respondents (36.67%) had a possible impairment score, and 12 respondents (40%) with cognitive impairment scores. Data on cognitive status can be seen in Table 4.3.

Table 4.3 Distribution of Data on the Incidence of Cognitive Impairment in Farmers

Variable	Man		Woman	
	Number (n)	Percentage(%)	Number (n)	Percentage(%)
Normal	5	16,67%	2	6,67%
Possible Disruptions	7	23,33%	4	13,33%
Gangguan	5	16,67%	7	23,33%
Total	17	56,67%	13	43,33

Data Analysis of Research Results

In this study, before analyzing bivariate data to determine the relationship between variables, a normality test was carried out to find out whether the distribution of the data was distributed normally or not on the cholinesterase level data obtained from 30 research samples. In the normality test carried out, the significance value of AChE was obtained of 0.013. The significance value of the data is <0.05, which means that the data is not distributed normally, the correlation test used is the spearman correlation test because in the normality test it is not distributed normally.

The correlation test carried out in this study is a test used to determine the relationship between variables. with a confidence degree of 95% (α= 0.05). Two variables are said to have a meaningful relationship if the p-value is less than α ($p< 0.05$) while if the p-value is greater than α ($p>0.05$). The correlation strength is stronger when it approaches + 1 (Dahlan, 2014). The results of the bivariate test using the spearman correlation test did not find a correlation between cholinesterase levels and cognitive status, namely with p= 0.7 The p-value value of more than 0.05 showed that there was no meaningful relationship between cholinesterase levels and cognitive status. Data The relationship between cholinesterase levels and cognitive status can be seen in Table 4.4.

Table 4.4 Relationship between Cholinesterase Levels and Cognitive Status in Farmers

			Up to CHE	Status MMSE
Spearman	Up to CHE	Correlation coefficient	1,000	-,073
		Significance		,700
		Quantity(N)	30	30
	Status MMSE	Correlation Coefficient	-,073	1,000
		Significance	,700	
		Quantity(N)	30	30

Discussion

Sample Characteristics

In this study, characteristics by gender were obtained for 17 samples (56.67%) for men and 13 samples (43.33%) for women. This study is in line with the research conducted by Corral et al., (2018) which stated that the number of samples with male sex was 68 samples (66.7%) and female samples as many as 34 samples (33.3%). This happens because women's participation in several fields is still low when compared directly to men, and one of them is in the agricultural sector or several other fields that require high physical endurance (Luthfi, 2010). Some examples in agricultural activities such as carrying loads, one of which is a tank containing pesticides so that work, hoeing land, and other examples. For pesticide spraying, more men are done. According to research by Corral et al., (2017) and Manurung et al., (2016) this gender difference also has an impact in several ways, such as; differences in AChE levels and the presence of carcinogenic risks in pregnancy in women exposed to pesticides. According to Rasyid et al., (2017) if you look at the relationship between gender differences and cognitive status, there is no significant relationship, but it is still one of the risk factors for the occurrence of cognitive decline (Nur Aini, 2016).

In this study, the distribution of samples based on the age of the respondents showed an age range of 18 to 60 years which was grouped by age category according to the Ministry of Health (2018). The results of the analysis of the age of the respondents were known to be the most respondents with the age of 46-55 years as many as 40% of the respondents. This is in line with the research of Rahmawati (2017) which has the most respondents at the age of 45 and 50 years as much as 10%. This is because increasing age causes a decrease in cholinesterase levels in the blood due to a decrease in organ function, especially the liver and kidneys. The physiological function of the liver and kidneys is as a neutralizer of exposure to toxins and chemicals that enter the body, if there is a decrease in the function of this organ, it can cause the accumulation of toxins and chemicals that are harmful to the body either acutely or chronically (Rahmawati, 2017). These results are in accordance with the literature that says that increasing age results in anatomical changes, such as shrinking the brain and changes in neurotransmitters that result in a decline in cognitive function (Manurung, 2016).

In this study, the characteristics of the sample according to educational status were measured from the results of interviews and research questionnaires obtained variations in the level of education in the research sample, the minimum limit was elementary school education (SD) to the Strata 1 (S1) level. The results of this study are in line with the research conducted by Manururng et al., (2014) which stated

that the sample in the study was also dominated by the level of elementary school education (SD) with a total of 27 samples (50.9%) followed by junior high school (SMP) and high school (SMA) to the highest in college 1 sample, with a total sample of 53 samples. Research conducted by Rasyid et al., (2017) stated that there is a meaningful relationship between educational status and cognitive status or function in farmers. This happens because the lower a person's education, the less intellectual stimulation for the development of cognitive function will also be. According to Annida (2018) states that when a person has a good education, the person will have a broader knowledge of what is being lived and the impact it will have, in this study the statement is related to exposure to pesticides and their countermeasures, such as; pay attention to the direction of the wind, the use of Personal Protective Equipment (PPE).

In this study, the characteristics of the sample were found as many as 25 samples (83.33%) had no history of disease. low awareness of the community to check themselves at the local health center so that they do not know or forget that the sample has a history of disease. This is one of the shortcomings of this study.

The Relationship Between Cholinesterase Levels and Cognitive Status in Farmers

The data in this study obtained the results of cholinesterase levels from 30 research subjects which had varying values from the results of laboratory examinations. There is a difference in normal values in female and male samples, AChE levels in men are said to be normal if the level is 4620-11500 U/L and in women 3930-10800 U/L. AChE levels when experiencing a decrease are an indicator of a person experiencing pesticide poisoning (Ananto & Armunanto, 2017). The results of laboratory examinations found that 7 male subjects and 6 female subjects experienced decreased cholinesterase levels which are indicators of pesticide poisoning. The results of this study are in line with the research conducted by Rustia et al. (2010) which stated that there was a decrease in cholinesterase levels in 25 farmer subjects (86.2%) followed by the appearance of symptoms of pesticide poisoning. Research conducted by Islam and Malik (2018) stated that there was a relationship between a decrease in cholinesterase levels which is an indicator of pesticide poisoning and a decrease in cognitive function, but in contrast to the research conducted by Kim (2019) stated that from the 80 samples taken there was no significant relationship between a decrease in cholinesterase levels and changes in cognitive function. This may occur because several factors, both from the sample, such as lifestyle, disease history, duration of exposure to pesticides, can occur due to factors and errors from the research process itself, such as errors during the preparation of blood samples, storage, and when checking cholinesterase levels.

The results of the cognitive status examination on 30 samples of this study obtained varying results. A person will be assessed as having cognitive impairment with a score of 0-16, assessed as likely to have a disorder if the score is 17-23, and assessed as normal with a score of 24-30 (Nurjanah, 2012). In this study, based on the results of the examination, 7 samples (23.33%) with normal MMSE scores, as many as 11 samples (36.67%) had a possible disorder score, and 12 samples (40%) with cognitive impairment scores. The highest number in respondents with MMSE values below 17, which means cognitive impairment, this can occur because the accumulation of organophosphate pesticide residues that are neurotoxins cause damage and cause disorders in the central nervous system resulting in a decrease in

cognitive function (Sauliyusta, 2016). According to Islam and Malik (2018) stated that one of the heavy impacts caused by long-term exposure to pesticides is that it interferes with the activity of the central nervous system and can damage cells in the brain, because the brain is more sensitive to toxicity. Processes such as replication, migration, differentiation, myelination of neurons, and synapse formation that occur in the nervous system are more susceptible to neurotoxic chemicals. Neurotoxic agents can cross the blood-brain barrier and manifest in disrupting the development of brain function.

A person's cognitive status can be influenced by several things, both from internal factors that come from oneself and are non-modifiable such as; age and genetics. Age is one of the factors that can affect a person's cognitive status because of the degenerative process that causes damage, death and decreased cell regeneration. One of the other factors is external factors that come from the environment, such as; Educational status and duration of exposure to pesticides, educational status is one of the factors that can affect cognitive status because according to Kim (2019) states that when a person has a high educational status, a person will get cognitive stimulation more often and this will cause better cognitive function than those who rarely get cognitive stimulation. Judging from other factors, namely the length of exposure, the longer exposure, the accumulation of neurotoxin pesticides will increase and cause more damage to the body, especially nerve cells.

The results of the bivariate test in this study showed that there was no meaningful relationship between cholinesterase levels and cognitive status in farmers. The results of this study are not in line with research conducted by Saulistya (2016) and Islam and Malik (2018) which stated that there is a relationship between cholinesterase levels and cognitive status in farmers exposed to pesticides. The difference between this study and the research conducted by Saulistya (2016) and Islam and Malik (2018) lies in the measurement of the treatment group, namely with farmers who are exposed to organophosphate pesticides and the existence of a control group, namely farmers who are not exposed to these pesticides and the large number of samples in the study. Research conducted by Corral (2017) states that there are symptoms and serious impacts caused by exposure to pesticides when the exposure has occurred for more than 5 years, and it will be more noticeable if the exposure occurs for more than 10 years, but besides that, cognitive function and cholinesterase levels can also be affected by several other things, both from the sample itself; such as genetics, age, and gender, as well as the external environment such as; lifestyle, education level, length of exposure, use of PPE, and others. This study only measured groups exposed to pesticides. This causes the effect of pesticides on the incidence of cognitive impairment when compared between farmers who are exposed to pesticides and those who are not exposed to pesticides in a certain working period.

One of the other factors that can cause differences in yields between farmers' samples is the use of Personal Protective Equipment (PPE), exposure to pesticides through inhalation is more vulnerable than through dermal. This happens because the inhalation route of pesticides enters the body by involving very small aerosol particles and a thin layer of alveoli so that it can accelerate and make it easier for pesticides to be absorbed in blood vessels, while through the dermal route pesticides enter the body involving larger pesticide particles; Its absorption is influenced by

various factors including the exposed body parts, the number of follicles, the thickness of the stratum corneum, the composition of sebum, and the distance of blood vessels to the surface of the skin; And the skin has xenobiotic metabolic enzymes that play a role in eliminating from pesticides. As a result, exposure to pesticides through dermal accumulates less in the body than through inhalation, so exposure to pesticides through inhalation is at risk of causing poisoning if with doses, the same type of pesticides and not using personal protective equipment that protects the body through inhalation and dermal (Kim, 2019). This study does not consider the factor of personal protective equipment in farmer subjects. The subjects in this study are not uniform in the use of personal protective equipment where there are farmers who use personal protective equipment and those who do not. This causes pesticides to enter the body more easily in farmers who do not use personal protective equipment than farmers who use these tools.

CONCLUSION

Based on research conducted to see the relationship between cholinesterase levels and cognitive status, it can be concluded that there is no significant relationship between cholinesterase levels and cognitive status. A decrease in ChE levels was obtained in 14 subjects (46.67%) and a decrease in cognitive function was obtained in 12 respondents in Village, Panti District, Jember Regency.

REFERENCES

Adrian, K. 2019. Brain and Spinal Tumors Information Page | National Institute of Neurological Disorders and Stroke. Ninds.nih.gov. Available at: https://www.ninds.nih.gov/Disorders/All-Disorders/Brain-and-Spinal-Tumors-Information-Page [Diakses pada 27 September 2019].

Aini, D. N., dan W. Puspitasari. 2017. The Correlation Between Cognitive Function with the Quality of Life in the Elderly in Barusari Village South Semarang District. Jurnal Keperawatan Volume 7, Nomor 1, Januari 2016: 2443-0900.

Ananto, A. D., dan R. Armunanto. 2017. Desain Senyawa Turunan Karbamat Sebagai Insektisida Baru Menggunakan Metoda In Silico.

Annida, S. 2018. Hubungan Antara Frekuensi Dan Lama Penyemprotan Dengan Keracunan Pestisida pada Petani di Desa Srikaton Kecamatan Adiluwih Kabupaten Pringsewu. Skripsi. Bandar Lampung: Program Sarjana Fakultas Kedokteran Universitas Lampung.

Arif, A. 2019. Pengaruh Bahan Kimia Terhadap Penggunaan Pestisida Lingkungan. Journal.uin-alauddin.ac.id. Available at: http://journal.uin-alauddin.ac.id/index.php/jurnal_farmasi/article/view/2218 [Diakses pada 10 September 2019].

Arif, M. 2015. Penuntun Praktikum Hematologi. Makassar. Makasar:Unhas. Astuti, E. P., dan R. Juliawati. 2010. Toxicity of Organophosphate and Carbamate

Insecticide Against Aedes aegypti Mosquitoes.

Bahrudin, M., 2013. Neurologi Klinis. Edisi Pertama, Malang, Universitas Muhammadiyah Malang Press. Hal 53-55

Bastian, F. D., A. Marson, Asmarani, dan Pariyana. 2018. The Differences Application Technique of Tourniquet to Potassium Level in Serum. Jurnal kesehatan vol 11 no 2 tahun 2018.

Cahyaninggrum, D., H. Denny dan M. Sakundarmo. 2018. Kandungan Pestisida

Organoklorin dalam Air Susu Ibu di Daerah Pertanian Bawang Merah Kabupaten Brebe.

Dinas Pertanian. 2019. 14. Kab. Jember. Pertanian.jatimprov.go.id. Available at: http://pertanian.jatimprov.go.id/index.php/komoditas/sentra-hortikultura/14-kab-jember [Diakses pada 10 September 2019].

Edwards, J.W., S. Suratman, K. Babina. .2015. Organophosphate pesticides exposure among farmworkers: pathways and risk of adverse health effects. Rev Environ Health 2015; 30(1):65-79.

Gernauli, I. 2009. Analisis Faktor-faktor yang Berhubungan dengan Kadar Kolinesterase pada Perempuan Usia Subur di Daerah Pertanian.

Ghiffari, A., H. Fatimi, dan C. Anwar. 2013. Detection of Insecticide Synthetic Pyrethroid Resistance on Dengue Vector Aedes aegypti (L.) in Palembang using Polymerase Chain Reaction.

Guyton, A. C., dan J. E. Hall. 2014. 2014. Buku Ajar Fisiologi Kedeokteran. Edisi 12. Penerjemah: Ermita I, Ibrahim I. Singapura: Elsivier

Hidayat, A. 2019. Captcha. Statistikian.com. Available at: https://www.statistikian.com/2012/10/pengertian-populasi-dan-sampel.html [Diakses pada 18 September 2019].

Hudaya, D. 2016. Keracunan Organofosfat. IDAI. Available at: http://www.idai.or.id/artikel/seputar-kesehatan-anak/keracunan-organofosfat [Diakses pada 30 September 2019].

Horimu, C. E., O. R. Pinontoan, dan R. H. Akili. 2017. Analisis Kadar Cholinesterase Darah Pada Petani Penyemprot Pestisida Tanaman Hortikultura Di Perkebunan Wawo Matani Kota Tomohon.

Islam, A. dan Malik, F., M. 2018. Toxicity of Pesticides on CNS. Journal of Toxicological Analysis, Volume 1, Nomer 1.7, 27 Juli 2018.

Jemberkab.bps.go.id. 2019. BPS Kabupaten Jember. Available at: https://jemberkab.bps.go.id/ [Diakses pada 1 November 2019].

Kementrian Pertanian, R. 2016. Psp.pertanian.go.id. Available at: http://psp.pertanian.go.id/assets/file/2016/Pestisida%20Pertanian%20dan%20Kehutanan%20Tahun%202016.pdf [Diakses pada 24 September 2019].

Kusuma, A. W., dan I. Budiono. 2017. Media Modul Gizi Braille terhadap Pengetahuan, Sikap, dan Praktik Makan Pagi Anak Tunanetra.

Komalasari, R. 2014. Domain Fungsi Kognitif Setelah Terapi Stimulasi Kognitif.

Manurung , C. H., W. Karema, dan J. Maja. 2016. Gambaran Fungsi Kognitif pada Lansia di Desa Koka Kecamatan Tombulu. Jurnal e-Clinic (eCl), Volume 4, Nomor 2, Juli-Desember 2016.

Marisa., Arrasyid, A.S. 2017. Pemeriksaan Kadar Pestisida dalam Darah Petani Bawang Merah di Nagari Alahan Panjang. Journal of Sainstek 9(1): 14-18.

Muhammad, N. 2018. Blood cholinesterase level and its association with neurobehavioral performance due to insecticide exposure among male cocoa farmers in Pahang and Perak, Malaysia.

Neupane, D., L. London, dan E. Jørs. 2018. Pesticide poisoning: A response to Eddleston.

Nurjanah, F. 2012. Gambaran Status Kognitif Lanjut Usia Menurut Jenis Pekerjaan Di Wilayah Puskesmas Masaran II.

Narwanti, I., E. Sugiharto dan C. Anwar. 2012. Residu Pestisida Piretroid pada Bawang Merah di Desa Srigading Kecamatan Sanden Kabupaten Bantul.

Netter, F., Kelly, C., Landman, J. and Netter, F. 2012. The Netter collection of medical illustrations. Philadelphia, Pa.: Elsevier Saunders.

Nuraini, dan I. Ardian. 2018. The Effectiveness of Brain Gym And Brain Vitalization Gym In Increasing Cognitive Function of The Elderly In Pucang Gading Social Rehabilitation Unit of Semarang.

Nicolopoulou, S. P., S. Maipas, C. Kotampasi. 2016. Chemical Pesticides and Human Health: The Urgent Need for a New Concept in Agriculture. Front. Public Health 4:148. doi: 10.3389/fpubh.2016.00148.

Oktavia, E.2015. Penggunaan Pestisida dan Kandungan Residu Pada Tanah dan Buah Semangka (Citrullus vulgaris, Schard) (Studi di Kelompok Tani Subur Jaya Desa Mojosari Kecamatan Puger Kabupaten Jember).

Okta S., w. 2019. Sentra Informasi Keracunan Nasional - BPOM RI. Ik.pom.go.id. Available at: http://ik.pom.go.id/v2016/ [Diakses pada 15 September 2019].

Puspitarani, D. 2016. Gambaran Perilaku Penggunaan Pestisida Dan Gejala Keracunan Yang Ditimbulkan Pada Petani Penyemprot Sayur Di Desa Sidomukti Kecamatan Bandungan Kabupaten Semarang. Skripsi. Semarang: Program Sarjana Fakultas Ilmu Keolahragaan Universitas Negeri Semarang.

Prijanto, B,. 2013. Analisis Faktor Risiko Keracunan Pestisida Organofosfat Pada Keluarga Petani Hortikultura Di Kecamatan Ngablak Kabupaten Magelang.

Radolfo, B. L.. 2009. Combining Cognitive Screening Tests for the Evaluation of Mild Cognitive Impairment in the Elderly.

Rahmawati, Y., D. 2014. Affect Between Characteristic Factors And Method Of Spraying On Cholinesterase Levels. The Indonesian Journal of Occupational Safety and Health Vol. 6, No. 3 Sept-Des 2017: 345–354.

Rasyid, I. A., Y.Syafrita dan S. Sastri. 2019. Hubungan Faktor Risiko dengan Fungsi Kognitif pada Lanjut Usia Kecamatan Padang Panjang Timur Kota Padang Panjang.

Rustia, H. N., B. Wispriyono, D. Susanna, N. Fitra, dan Luthfiah. 2010. Lama Pajanan Organofosfat Terhadap Penurunan Aktivitas Enzim Kolinesterase Dalam Darah Petani Sayuran.

Rini, Z.N, 2016. Fungsi Kognitif menjadi indicator Perkembangan otak anak.

Rohlman, D., A A Ismail, T E Bodner,2012. Neurobehavioral Performance among Agricultural Workers and Pesticide Applicators: A Meta-analytic study. Occup Environ Med. 2012 July ; 69(7): 457–464. doi:10.1136/oemed-2011-100204.

Rosita, M. D. 2012. Hubungan Antara Fungsi Kognitif Dengan Kemampuan Interaksi Sosial Pada Lansia di Kelurahan Mandan Wilayah Kerja Puskesmas Sukoharjo.

Sebastián, A. Corral, Valeria de Angel, Natalia Salas, Liliana Zúñiga-Venegas, Pablo A. Gaspar, Floria Pancetti. 2017. Cognitive impairment in agricultural workers and nearby residents exposed to pesticides in the Coquimbo Region of Chile, Neurotoxicology and Teratology. doi: 10.1016/j.ntt.2017.05.003.

Sherwood, L. 2014. Fisiologi Manusia: dari Sel ke Sistem. Edisi 8. Jakarta: EGC Sopiyudin, M.D. 2014. Statistik untuk kedokteran dan kesehatan. Jakarta.

Epidemiologi Indonesia: 165-173 dan 238-240.

Sobotta, J., Paulsen, F. and Waschke, J. 2011. Sobotta Atlas of human anatomy. München: Elsevier.

Sauliyusta, M. 2016. Aktivitas Fisik Memengaruhi Fungsi Kognitif Lansia.

Sugiyono, S. 2012. Metode Penelitian Kuantitatif Kualitatif dan R&D. Bandung:

Alfabeta.

Tonny, K. Moekasan dan L. Prabaningrum. 2011. Penggunaan Pestisida Berdasarkan Konsepsi Pengendalian Hama Terpadu (PHT). Edisi 1. Bandung: Yayasan Bina Tani Sejahtera.

Wang, A, Cockburn M, Ly TT, Bronstein JM, Ritz B. The association between ambient exposure to organophosphates and Parkinson's disease risk. Occup Environ Med 2014; 71(4):275-81.

Widyawati, R. 2017. Analisis keterkaitan sektor pertanian dan pengaruhnya terhadap perekonomian indonesia (analisis input ouput). Jurnal Economia, 13(1), p.14.

Wispriyono, B., A. Yanuar dan L. Fitria. 2013. Safe Level Consumption of Carbamate Residues in Fruits and Vegetables Based in Post Column High Performance Liquid Chromatography Analysis.

Wicaksono, A. B., T. Widiyanto, dan A. Subagiyo. 2016. Faktor Internal Yang Berhubungan Dengan Kadar Enzim Cholinesterase Pada Darah Petani Kentang di Gapoktan Al-Farruq Desa Patak Banteng Kecamatan Kejajar Kabupaten Wonosobo Tahun 2016. Thesis. Semarang: Jurusan Kesehatan Lingkungan Politeknik Kesehatan Kemenkes Semarang.

Yuantari, C. 2011. Dampak Pestisida Organoklorin Terhadap Kesehatan Manusia Dan Lingkungan Serta Penanggulangannya.