SURABAYA INTERNATIONAL HEALTH CONFERENCE
"Empowering Community For Health Status Improvement"
Novotel Samator East Surabaya Hotel, July, 13-14 2019

The Effect Of Long Exposure To Pesticide Organophosphate On Cholinesterase Enzyme Activity In The Blood

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Abstract: The high use of pesticides increases the health risks faced, both for pesticide operators and the community at large. Synthetic group pesticides that are widely used by farmers in Indonesia are organophosphate groups. These organophosphate compounds are unstable in the environment but are more toxic to vertebrate animals because they can affect the nervous system by inhibiting cholinesterase enzyme activity in the body. The purpose of this study was to analyze the effect of exposure to organophosphate pesticides on the activity of cholinesterase enzymes in the blood of factory workers in fertilizer and pesticide industries. This study used an observational analytic study design with cross sectional design. The sample of this study was the pesticide production operator which amounted to 15 respondents who had different lengths of work taking blood for the examination of cholinesterase enzymes using the method of kinetic photometric test method recommended by the German Society of Clinical Chemistry (DGKC). Data analysis techniques with One Way Anova test. The results of the examination of the respondents cholinesterase levels showed a value between 5981 U/L - 12006 U/L which was categorized as mild and normal poisoning. The One Way Anova test results obtained the length of work of <10 years old work obtained an average value of 8798.5 U/L, working duration of 10-15 years obtained an average value of 7166.6 U/L, length of work > 15 years obtained an average value of 8264.0 U/L, with a p value (0.396) > 0.05 it can be concluded that there is no effect on the duration of exposure to organophosphate pesticides in the decrease in cholinesterase enzyme activity in the blood of pesticide production operators.

Keywords : Operators of Pesticide Production, Levels of Cholinesterase Enzymes, Organophosphates, Photometric Kinetic Tests.

1. Introduction

Pesticides are substances or chemical compounds that are growth regulating substances and growth stimulants, micro organisms, viruses and others that are used to protect plants or parts of plants [(1)]. The high use of pesticides adds to the health risks faced, both for pesticide operators and for the community at large. Health risks experienced by users of pesticides are usually related to ways of securing the use of these pesticides, while the health risks suffered by the wider community are generally due to pollution of pesticides entering the food chain and pesticide poisoning, either due to ingestion or inhalation or due to direct contact through skin [(2)].

Synthetic group pesticides that are widely used by farmers in Indonesia are organophosphate groups. These organophosphate compounds are unstable in the environment but are more toxic to vertebrate animals because they can affect the nervous system by inhibiting cholinesterase enzyme activity in the body [(3)]. Cholinesterase is an enzyme that is in the body's tissues which acts to keep the muscles, glands and nerve cells working harmoniously and regularly. If the cholinesterase activity of body tissues quickly reaches a low level, it will have an impact on the movement of conscious muscle fibers with smooth and rough movements [(4)].

According to the World Health Organization (WHO) at least 20,000 people died from pesticide poisoning and around 5,000-10,000 experienced very dangerous effects such as cancer, infertility, hepatitis, defects every year.

The workers in the production of pesticides are also not spared from exposure to pesticides for a long time. The time of exposure to pesticides can be seen based on the length of exposure that can be calculated based on the length of work time. The longer the working time, the more likely it is to be exposed to pesticides. While the length of work time is stated as the length of time someone works with pesticides. Someone who works in an environment containing pesticides is more likely to experience exposure to pesticides, so the greater the likelihood of poisoning, due to a lot of contact and inhalation [(5)].

This study aims to analyze the effect of exposure to organophosphate pesticides on the activity of cholinesterase enzymes in the blood of factory workers in fertilizer and pesticide industries.

2. Research Methodology

2.1. Research methods

This study uses observational analytic research with cross sectional design (cross section). The population in this study were factory workers in the fertilizer and pesticide industries at PT. X in the Gresik region.

The research sample was The samples in this study were 15 serum samples taken from the venous blood of factory workers in the fertilizer and pesticide industry, part of the production operators at PT. X. Sampling was done by Purposive Sampling method using criteria in selecting samples, namely inclusion criteria and exclusion criteria and filling in questionnaire data. The inclusion criteria are male workers exposed to pesticides with a period of less than 10 years, 10 to 15 years, more than 15 years, ages 18-59 years, and experience symptoms of poisoning. While the exclusion criteria are workers who have a history of certain diseases such as anemia, the time of contact with pesticides is less than 2 weeks.

2.2. Time and Place

The location of sampling is carried out at a fertilizer and pesticide factory, PT. X in the Gresik region. The location of the study was conducted at the Surabaya Health Laboratory Center (BBLK) and the Immunology Laboratory of the Health Faculty of the Nahdlatul Ulama University in Surabaya. The study is from February to March 2019.

2.3. Tools and Materials

The tools used in this study were Tokyo Boeki 24i Prestige Chemistry Analyzer, tourniquet, centrifuge, separator gel tube, alcohol swab, label, serological tube rack, holder, vacutainner needle, plester.

The material in the study is serum taken of venous blood from the patient, Cholinesterase reagent is *R1 reagent (Pyrophosphate pH 7,6 and Potassium Hexacyanoferrate (III)), R2 reagent Butryrylthiocholine. buffer NaCl* solution.

2.4. Procedure

Sample preparation, processing of the test material is a sample taken in 3 cubic centimeters of cubic vein arms placed into a yellow tube containing a gel separator. Centrifuge samples at 3000 rpm for 10 minutes. 15 serum samples centrifuged were opened and then analyzed with the Tokyo Boeki Prestige 24 Chemistry Analyzer. Sample analysis using the cholinesterase kinetic type photometry (DGKC) method. To calculate cholinesterase levels can use the following calculation [(6)].

With Factors:

$$\Delta A / \text{min} \times 68500 = \text{ChE Activity (U/L)}$$

With Calibrator :

$$ChE\left({}^{U}/_{L}\right) = \frac{\Delta A/\min Sampel}{\Delta A/\min Calibrator}\ x\ Conc.Calibrator\ \left({}^{U}/_{L}\right)$$

The data obtained were analyzed first with a prerequisite test, namely the normality test and homogeneity test. Data were analyzed by One Way Anova test with a confidence level of α = 0.05.

3. Result And Discussion

The results of this study of measurements of cholinesterase levels in operators of pesticide production in PT.X were 15 samples. The process of collecting this data is done by using questionnaire data, interviewing and checking cholinesterase levels. The results of this measurement are characterized by age, length of work, cholinesterase level and level of poisoning. The length of work obtained varies, variations in the length of work that are grouped by length of work divided into 3 groups, namely <10 years, 10-15 years, and > 15 years. The results of the measurement of cholinesterase levels were used to categorize the level of worker poisoning which was divided into 3 categories, namely normal, mild and severe.

Based on the results of the study the age group characteristics of respondents in this study belong to the productive age category where according to Rahmawati [7] states that as a person ages, the average cholinesterase level will be lower, the condition is affected by declining organ function. According to the Ministry of Health's Data and Information Center in 2015, the age category was divided into two, namely productive working age, namely ages 15 to 64 years and non-productive working age, is over 64 years of age.

The percentage of age group characteristics in the respondents can be seen in Figure 3.1.

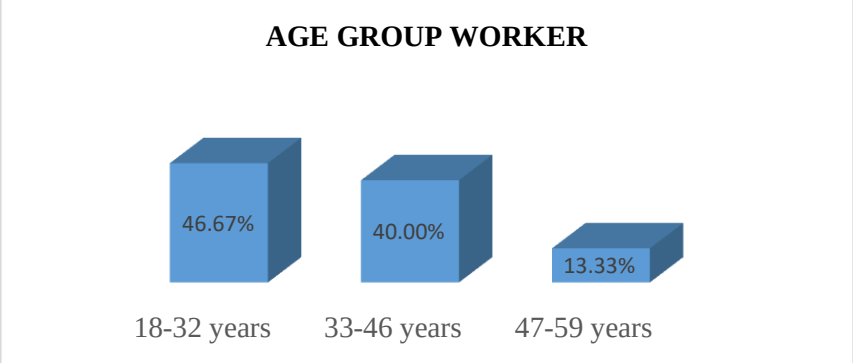

Figure 3.1 Percentage of Age Group characteristics in the respondents

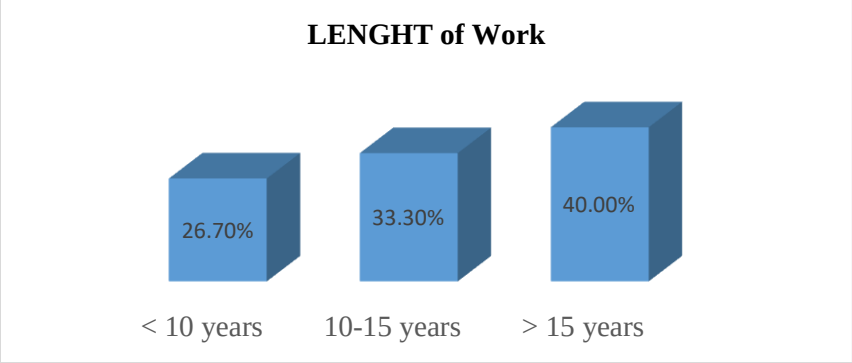

Figure 3.2 Percentage of Lenght of Work characteristics in the respondents

Poisoning Levels	Explaination	Respondents	Percentage
< 4.620 U/L	Heavy Poisoning	0	0,00%
4.620 – 11.500 U/L	Moderate Poisoning	14	93,33%
> 11500 U/L	Normal	1	6,67%
Total		15	100%

Tabel 3.1 Percentage of Poisoning Levels on Operators of Pesticide Production

Based on the results percentage of the study in accordance with the lenght of work obtained results as in the figure 3.2 above. Duration of work is a vulnerable time that has been passed by a worker or laborer to work in a particular industry or company. In this study, the length of work was grouped into 3, namely the duration of work <10 years, length of work 10 - 15 years, and work period > 15 years. The longer work with pesticides, the more direct contact with pesticides is more often so that the risk of poisoning is even higher [(7)].

According to poisoning levels on operators of pesticide production can be seen in the table 3.1 above. Data on the level of pesticide poisoning is obtained by measuring the levels of cholinesterase in the blood. Measuring the level of cholinesterase is done using an automatic tool and the sample used is serum. The reading of the results of blood serum was carried out with the principle of a photometer compared to the normal value of cholinesterase levels in men of 4,620 - 11,500 (U/L). Based on the provisions of the Clinical Pathology Specialist Association that cholinesterase activity in blood serum is said to be normal if the results of cholinesterase examination in the normal value range are 4600 - 11500 U/L. If the value of cholinesterase activity < 4600 U/L shows that the worker is poisoned so it must be rested for 2 weeks or more. According to a study conducted by Rahmawati [(7)] about grouping poisoning levels, namely heavy poisoning groups at cholinesterase levels < 5100 U/L, mild poisoning at levels between 5100 - 11700 U/L, and normally at levels > 11700 U/L.

Based on the results of a study long time of working with blood cholinesterase levels, it was found that respondents who had normal blood cholinesterase levels who worked < 10 years were as many as 5 respondents. The results of normal blood cholinesterase levels that work 10-15 years are as many as 4 respondents. normal blood cholinesterase levels that work > 15 years are as many as 5 respondents, and 1 respondent is abnormal because of the examination results > 11500 U/L. According to a statement from Sastrawijaya, [(8)] which states that the period of work or the length of one's work is one factor affect the degree of cholinesterase in the blood, where the longer the working period, the lower the level of cholinesterase in the blood becomes the risk of pesticide poisoning. The longer the mass of work means the more exposure is received and accumulates in the body and the lower the level of cholinesterase.

Table 3.2 Results of Mean ± SD from Measurement of Cholinesterase Levels

Cholinesterase Levels			
Length of Working	**TOTAL**	**Mean ± SD**	**P *Value***
< 10 years	4	8798,5 U/L ± 1655,69	
10 – 15 years	5	7166,6 U/L ± 1240,95	0,396
> 15 years	6	8264,0 U/L ± 2191,62	
Total	15	8040,7 U/L ± 1789,18	

The analysis of the results in this study can seen in the table 3.2 above. The result this study used the One Way Anova statistical test which showed a significant value of 0.396 so that the results showed that there was no significant effect on the duration of exposure to organophosphate pesticides in the decrease in cholinesterase enzyme activity in the blood of factory workers in the fertilizer and pesticide industries.

The results of this study are in line with the research conducted by Hastuti, [(9)] that there was no significant effect between the length of pesticide exposure to the levels of cholinesterase enzymes in the blood of farmers in the village of Ndari Plupuh Sragen. Based on previous research conducted by Rahmawati [(7)] that the old working factor has no effect there is a cholinesterase level, this can be because as long as there are other factors, the pesticides used are not too toxic, the cholinesterase levels in workers are not affected. In a study conducted by Rustia [(5)], it was also stated that there was no significant relationship between the length of work and the level of poisoning.

The factors that influence the occurrence of pesticide poisoning on the activity of cholinesterase enzymes in workers producing pesticides are among others, derived from factors in the body and external factors. Factors in the body that can affect are age, sex, nutritional status, anemia or body condition, knowledge of attitudes, and level of education. While external factors that can affect the environment temperature, the use of PPE (Personal Protective Equipment), mass work or length of work, how to handle pesticides. Based on the results of data filling in questionnaires and interviews with workers of production operators at PT. X this is all the workers while working using a complete Personal Protective Equipment (PPE) such as a helmet / head protector, boots, protective clothing, masks and gloves. Clothing that is used even with long sleeves and trousers, it can reduce the risk of exposure to pesticides. According to research conducted by Suroso, [(10)] states that there is a significant relationship between the incidence of pesticide poisoning in pest control officers who use Personal Protective Equipment (PPE) in complete and incomplete. This is in accordance with what was stated by Febriansyah, [(11)] where pest control officers who use long sleeves and trousers get lower effects than officers who dress minimum. According to the Ministry of Health of the Republic of Indonesia regarding the use of protective clothing for the management of pesticides, based on the Decree of the Minister of Health of the Republic of Indonesia No. 1350 / MENKES / SK / XII / 2001 that to protect the surface of the skin using shoes, long sleeves, trousers, hats, gloves, face shields and masks. Article 5 paragraph (1) and (3) explain that the handler, technician or operator must meet the health requirements and in carrying out their duties must use safe protective equipment. Pesticide protective equipment consists of head protectors (caps), eye protection, respiratory protection (masks), body armor (apron / overalls), gloves, and footwear (shoes).

The high level of poisoning can be seen based on the measurement of cholinesterase enzyme activity in the blood which can be an indicator of the high exposure of organophosphate pesticides to someone who works with pesticides. These organophosphate pesticide can enter the body through various pathways, namely inhalation, ingestion, and absorption, distributed into the body and work to inhibit the activity of the cholinesterase enzyme in the body. To recover cholinesterase levels can be done by way, workers who are exposed to pesticides are rested for several weeks so that the body can synthesize again the

cholinesterase enzyme so that its activity returns to rise. Cholesteresterase in plasma takes 3 weeks to return to normal, while in red blood cells it takes 2 weeks to return to normal [(5)].

4. Conclusion

Based on the results and discussion on this research can be concluded that there was no effect on the length of exposure to organophosphate pesticides in the decrease in cholinesterase enzyme activity in the blood of pesticide production operators.

5. Thank You Note

Acknowledgments I told Staff Laboratory of Nahdlatul Ulama Surabaya University, Faculty of Health who helped in the research process and to the respondents who participated in the study so that the research can proceed smoothly.

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