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RESEARCH ARTICLE

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The Effect of Selenium Supplementation on Hemoglobin Among Farmers Working as Pesticide Sprayers

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Background: The symptom of organophosphate (OPs) poisoning develops when the activity of cholinesterase enzyme (ChE) at the nerves ending is obstructed, which caused accumulation of ACh in the nerve endings. The returning of ChE to the normal levels depends on the ability of Erythrocyte cell membrane to survive from lipid peroxidation, with the help of Glutathione peroxides enzyme (GPX), which is heavily depend on Selenium (Se). This study aimed to find out the benefits of Selenium and Vitamin C supplementation on Hemoglobin levels of the farmers working as pesticide sprayers. *Method*: This was an experimental study using Pre and post test Control Group Design. Ninety nine farmers lived in Pasuruan village, Temanggung, Central Java who fulfilled the inclusion and exclusion criteria were selected as the subjects. Se and Vit C supplementation were given for 7 consecutive days. *Results*: The hemoglobin levels in Selenium group increased by 2.66%, while in the control group and the group receiving Se + Vit C decreased by 1.96% ($p = 0.0001$). *Conclusion*: Supplementation of Selenium 200 μg for 7 consecutive days would increase the hemoglobin level of pesticide sprayers-farmers.

Keywords: Selenium, Vitamin C, Experimental Study, Level of Hemoglobin.

1. INTRODUCTION

World Health Organization (WHO) estimates that there are about 500,000 cases of acute pesticide poisoning world wide annually. Given the 1% case fatality rate in developed countries, the mortality rate due to poisoning is estimated to reach 5.000 persons annually.[1–4] In Indonesia, it is estimated that there are 150 million small scale farmers and workers who work in the agricultural sector. The population is exposed to the risk of the impact of pesticides.[5] The range of mild poisoning cases were 21.95% to 36.36%, medium poisoning were 3.63% to 4.88% and severe poisoning were 0.20% to 0.24% from the subjects investigated.[3–5]

It is also reported that in those poisoning cases, pesticides in the form of organophosphate and carbamate are the biggest culprits. One of the impacts of acute poisoning on health is the decrease in Cholinesterase or ChEA. ChEA-organophosphate bonding in the nervous synapses will trigger various clinical symptoms such as seizures, vomiting, foaming at the mouth, gasping and a low-dose long term poisoning like delayed neuropathy.[6–9]

The level of ChEA particularly ChEA in the red blood cells has been used as one of the parameters to asses the poisoning degree, particularly the acute poisoning and work-related poisoning such as among farmers.[6,10–13] Selenium (Se) is one of micronutrient element that forms GPX enzyme. Selenium deficiency results in red blood cells damages and shortened erythrocytes lifespan in the long run.[14] Anemia among people who were Se deficient is suspected to have an impact on blood ChEA levels.

The problem proposed in this study was: "Can Selenium supplementation with or without Vitamin C increase the hemoglobin level of pesticide sprayer farmers?"

2. METHOD

The study was an experimental study with a Pre-Post test Control Group Design. The treatment in this study was Selenium supplementation in the form of Sodium Selenite Pentahydrate ($NaSe_5H_2O$). Group I received Placebo, group II received Se, while group III received Se + Vit C. Prior to the treatment, the blood sample of every subject was taken and the levels of Hemoglobin (Hb) were checked. Then the treatment was given to each group for 7 days. On the 8th day, the blood of each subject was taken again for Hb level measurements.

The number of subjects were 33 in each group, based on minimal sample size calculation. This study required 3 groups,

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Table I. Characteristics of pesticides' sprayers.

Variables	Placebo group ($n=33$)			Se group ($n=33$)			Se+Vit C group ($n=33$)		
	Min	Max	Mean (SD)	Min	Max	Mean (SD)	Min	Max	Mean (SD)
Age (years)	25.0	44.7	32.9 (6.5)	25.0	45.1	34.6 (6.4)	25.0	43.0	34.0 (5.5)
BMI (kg/m^2)	17.0	24.2	20.4 (1.7)	16.9	25.6	20.1 (2.0)	17.1	23.4	19.8 (1.8)
Hb pretest (mg/dL)	13.3	17.3	15.3 (1.0)	12.8	16.3	15.0 (0.8)	13.5	16.7	15.3 (0.8)
ChEA pretest (U/L)	4042	12194	7525.1 (1818.8)	4704	12209	7733.6 (1608.3)	1704	10345	6697,1 (2243,3)
GPX pretest (U/gHb)	20.9	53.6	35.5 (8.5)	26.5	66.6	42.4 (12.1)	28.3	64.6	36.4 (8.1)
Hb posttest (mg/dL)	13.0	17.1	15.0 (1.1)	13.6	17.0	15.4 (0.8)	13.0	17.2	15.0 (0.9)
ChEA posttest (U/L)	2624	11594	7365.7 (1918.0)	2459	12580	7876.7 (1879.3)	1500	10213	6840.6 (2204.9)
GPX posttest (U/gHb)	23.8	56.9	36.4 (9.2)	22.0	62.3	37.0 (9.6)	23.8	56.8	36.4 (7.2)
Years as a pesticide sprayer	2	10	5.3 (1.8)	2	15	5.8 (2.4)	1	15	6.7 (2.8)
Numbers of pesticide	3	6	3.6 (0.8)	2	7	3.8 (1.0)	2	4	3.1 (0.3)
Duration/hours/days	4	7	5.7 (0.6)	2	7	4.4 (1.5)	2	10	4.1 (1.5)
Frequencies/week	1	3	1.6 (0.6)	1	3	1.7 (0.6)	1	3	2.1 (0.4)

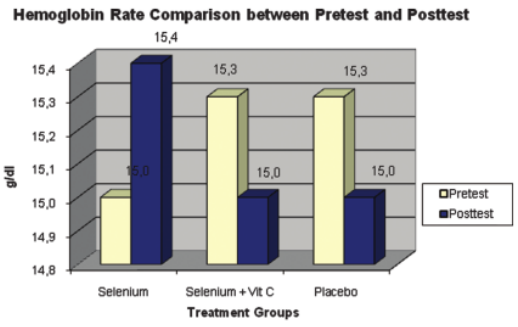
Table II. Mancova analysis.

	Hb post test		ChE post test		GPX post test	
	p	95%CI	p	95%CI	p	95%CI
Se versus Placebo	0.000	0.362–0.995	0.060	−19.080–691,571	0.201	−5.959–1.276
Se+Vit C versus Placbo	0.534	−0.239–0.459	0.14	104.471–887.871	0.511	−2.664–5.311

therefore 99 subjects were randomly selected from the population in Pasuruan village, Temanggung District, Central Java in 2008. The inclusion criteria include: Farmers aged 25–45 years old; did not suffering from neither haemmorhoid nor spontaneous bleeding problem; having a normal nutritional status based on their height and weight; males and free from jaundice. The exclusion criteria include: not permanently living at the research location; had a reaction allergy or side effect to treatment. Ethical Clearance No: 26/EC/FK/RSDK/2008 conducted by Ethical Clearance committee of Medical Faculty of Diponegoro University.

3. RESULTS

Table I shows the characteristics of the subject, the levels of hemoglobin, ChEA, GPX at pre and posttest, and the pesticide exposures. Table II shows the results of mancova analysis.



Graph 1. Comparison between the average level of hemoglobin (Hb) in three groups of respondents before and after the treatment ($n=33$ per group).

The average Hb level of the Control group and of the group treated with Se + vit C decreased by 0.3 g/dl (1.96%) from the average Hb level at the pretest 15.3 g/dl to the average level 15.0 g/dl at the posttest. On the contrary, the average Hb level of the group which was treated with Se increased by 0.4 g/dl (2.66%) from before receiving the treatment at 15.0 g/dl to 15.4 g/dl after the treatment.

4. DISCUSSION

The average Hb level of the farmers who received Se treatment increased by 2.66% from pretest to post test. On the contrary, the hemoglobin levels of the group who received Se + Vit C were decreased by 1.96% from pretest to post test, and the control group were decreased by 1.96% from pretest to post test. Se supplementation increased the level of GPX enzyme that prevent erythrocyte from lipid peroxidation, which was caused by organophosphate pesticide. Therefore, the hemoglobin levels of the group received Se increased.

Vitamin C acted as a pro-oxidant on the complex of vit C with active redox Fe that induced lipid peroxidation of erythrocyte membrane[15,16] therefore the hemoglobin level decreased. Until now, there is no research related to the effect of Selenium supplementation on Hemoglobin among organophosphate sprayers.

The paired sample t tests were used to compare the mean difference of hemoglobin levels between pretest and post test. The results showed that in the group receiving Se supplementation, there was a significant different ($p=0.000$) between pre test and post test. The same result was also found in Se + vit C group and in the control group ($p=0.000$).

Mancova tests on the average Hb level, controlled for the covariants variables were conducted to find out whether there was a difference in the average Hb level between the group who received Se supplementation and the group received Se + vit C against the control group. The result indicates a significant difference ($p=0.0001$) between the average Hb level of the group receiving Se and the average Hb level of the control group. These

results showed that Se supplementation increased the hemoglobin levels of the farmers spraying OPs, while in the control group the hemoglobin level decreased.

There was no difference between the group who received Se + vit C supplementation and the control group ($p = 0.534$). Thus Se + vit C supplementation did not show any effect on Hb level of the farmers who are pesticide sprayers. Increasing Hb will increase choline Esterase Enzyme, which would protect pesticide sprayers from acute OP poisoning, because ChE has a role as the catalysator on the reaction of Ach conversion to Choline and Acetic Acid. Thus, there were no accumulation of Ach in the nerves ending.

It can be concluded that the impact on Hb level between the group who received Se and Se + vitamin C was mainly due to the addition of vitamin C, as it showed that the average Hb level of the group who received Se increased, while the group who received Se + vit C decreased.

5. CONCLUSION

Selenium supplementation of 200 μg for 7 days, might increase Hemoglobin levels of the organophosphate sprayers farmers.

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