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Erythrocyte Sedimentation Rate and Hemoglobin Levels in Pesticide Poisoning-Farmers

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Abstract

Pesticides are chemicals used to control insects, fungi, weeds, and others. Unrestrained use of pesticides leads to poisoning that has an impact on inflammation and anemia. To provide evidence for this notion, acetylcholinesterase enzyme levels, blood sedimentation rates, and blood hemoglobin levels of farmers exposed to pesticides have been studied. The study design was quantitative in a cross-sectional manner. The participants of the study were all members of the Kurnia Makmur farmer group in Landasan Ulin Utara District, Banjarbaru with a total sample of 60 people. An examination of acetylcholinesterase, erythrocyte sedimentation rate (ESR), and hemoglobin enzyme levels was carried out at the Banjar Regency Health Lab. The blood sample was withdrawn from the cubital vein. Spectrophotometry was used to determine acetylcholinesterase enzyme levels, while ESR was determined by the automatic method. Hemoglobin levels are measured by the cyanmethemoglobin method. T-tests were used to compare acetylcholinesterase, ESR, and hemoglobin levels in the normal group and the poisoning group. The study concluded that exposure to a pesticide in farmers' pesticide poisoning may cause inflammation characterized by an increase in ERS. However, there was no decrease in hemoglobin levels.

Keyword: Anemia, Acetylcholinesterase, Erytrocyte Sedimentation Rate, Hemoglobin, Inflammation

Original Research Article

Laju Endap Darah dan Hemoglobin Pada Petani yang Keracunan Pestisida

Abstract

Pestisida merupakan bahan kimia yang digunakan untuk mengendalikan serangga, jamur, gulma dan lain-lain. Penggunaan pestisida yang tak terkendali menyebabkan keracunan yang berdampak pada inflamasi dan anemia. Untuk membuktikan hal tersebut telah diteliti kadar enzim asetilkolinesterase, laju endap darah, dan kadar hemoglobin darah petani yang terpajan pestisida. Penelitian ini bersifat kuantitatif secara cross sectional. Subjek penelitian adalah seluruh anggota kelompok tani Kurnia Makmur di Kecamatan Landasan Ulin Utara Banjarbaru dengan jumlah sampel sebesar 60 orang. Pemeriksaan kadar enzim asetilkolinesterase, LED, dan hemoglobin dilakukan di Labkesda Kabupaten Banjar. Darah petani diambil dari vena cubiti. Penentuan kadar enzim asetilkolinterase digunakan spektrofotometri, sedangkan LED ditentukan dengan metode automatic. Kadar hemoglobin diukur dengan metode sianmethemoglobin. Data yang diperoleh dilakukan uji-T untuk membandingkan kadar asetilkolinesterase, LED dan hemoglobin pada kelompok normal dan kelompok keracunan. Kesimpulan penelitian adalah pajanan pestida pada petani yang keracunan pestisida dapat menyebabkan inflamasi yang ditandai oleh peningkatan LED. Akan tetapi, belum terjadi penurunan kadar hemoglobin.

Kata kunci: *Anemia, Asetilkolinesterase, Hemoglobin, Inflamasi, Laju Endap Darah*

INTRODUCTION

Indonesia is an agricultural country where most of the population works as farmers. Farmers are one group of workers who are vulnerable to pesticide exposure. Thus, the use of pesticides should be expedient and according to the rules, since negligence in the utilization of pesticides can lead to poisoning. Pesticide poisoning is estimated at 1–5 million every year, with the mortality rate among farmers reaching 220,000 fatalities. Of these, about 80% of poisonings are reported to occur in developing countries (Rahman et al., 2020; Sodikin et al., 2020). Istianah and Yuniastuti (2017) found that out of 49 farmers, 27 of them (55.1%) suffered from pesticide poisoning, while 22 people did not (44.9%) in Brebes. Another study also reported that of the 75 respondents of pineapple farmers in Tangkit Baru Village, Muarojambi Regency, 47 (62.7%) experienced poisoning and 28 (37.3%) did not experience symptoms of poisoning (Herdianti, 2018).

Pesticide poisoning of farmers can be identified from the preparation of equipment, mixing pesticides, spraying, cleaning tools and work clothes, cleaning grass and pests, watering plants as well as harvesting (Mulyana et al., 2020). Furthermore, pesticides can enter the body through the skin (dermal), exhalation (inhalation), or mouth (oral). Pesticides that enter the body will inhibit acetylcholinesterase, which is an enzyme found in the central and peripheral nervous system (Suhartono et al., 2018).

On the other hand, pesticides that enter the body can cause cellular inflammation that triggers chronic diseases such as cancer, diabetes, neurodegenerative diseases, birth defects in babies, reproductive diseases, and problems in the respiratory and cardiovascular systems (Cahyadi et al., 2020). Inflammation caused by these pesticides can be assessed by the erythrocyte sedimentation rate (ESR). ESR values indicate the presence of both acute and chronic inflammation that is not specific to tissue damage and is a clue to the presence of the disease. Utami et al. (2017) have proven that there is a meaningful relationship between organophosphate pesticide doses and ESR farmers in Sumberejo Village, Ngablak District, Magelang Regency.

Besides having an impact on ESR, farmers who are exposed to pesticides are at risk of anemia due to a decrease in hemoglobin levels. Aldeeb et al. (2022) mentioned that pesticide exposure in rabbits for 12 weeks can reduce hemoglobin levels, leukocyte counts, and erythrocytes. Fauziyyah et al. (2017) found that 2 people out of 23 pesticide sprayers in Tunggak Village, Toroh District, Grobogan Regency, had anemia. Meanwhile, Yusuf and Pratami (2016) stated that pesticide poisoning had an impact on the incidence of anemia in shallot farmers in Pamengger Jatibarang Brebes Village.

As an agricultural country, the majority of Indonesia's population, including in South Kalimantan, works by farming. Thus, this group of people is a group that is prone to poisoning due to pesticides that have an impact on cellular inflammation and anemia. However, there have not been many studies that reveal this. Therefore, it is necessary to conduct a study to analyze farmers who are poisoned and their impacts on ESR and hemoglobin levels.

MATERIAL AND METHODS

The study design applied was a quantitative analytical cross-sectional observation. The subjects of the study were all members of the Kurnia Makmur farmer group in Landasan Ulin Utara District, Banjarbaru, using a minimum sample number of 60 people.

Sample examinations of acetylcholinesterase, ESR, and hemoglobin enzyme levels were carried out at the Banjar Regency health laboratory. The farmer's blood was taken from the cubital vein. Spectrophotometry was used for the determination of acetylcholinesterase enzyme levels, while ESR was determined by the automatic method. Hemoglobin levels were measured by the Cyanmethemoglobin method.

The farmer's group was divided into 2 groups, namely the normal group and the poisoning group. When the activity of the cholinesterase enzyme of 3.5 – 11.5 U/L is categorized as a normal group (Suhartono et al., 2018). In addition to that group, it is called the poisoning group. The results obtained were analyzed using an independent *t-test* to compare levels of acetylcholinesterase, ESR, and hemoglobin.

RESULT

The results showed that the baseline data of farmers of the female sex were more than men. Meanwhile, the oldest age is 90 years old and the youngest is 21 years old. A detailed description can be seen in table 1. of this article.

Table 1. Gender and age of the control and poisoning groups

Parameters	Control group	Poisoning group
Gender (%)		
• Male	45	57,5
• Female	55	42,5
Age (year)		
• Male		
Average	58.22 ± 20.58	43.52 ± 12.10
Modus	60	50
Median	60	45.5
Maximum	90	67
Minimum	28	22
• Female		
Average	41.82 ± 8.63	40.43 ± 13.59
Modus	-	45
Median	44	40.5
Maximum	55	72
Minimum	25	21

Measurements of levels of the acetylcholinesterase enzyme, ESR, and hemoglobin are presented in table 2. The levels of the acetylcholinesterase enzyme, ESR, and hemoglobin of the normal group are still within the normal range.

Table 2. Levels of the acetylcholinesterase enzyme, ESR, and hemoglobin in the control and poisoning groups

Parameters	Control group	Poisoning group	*p*
Acetylcholinesterase enzyme levels (U/L)			
• Average	8.59 ± 1.84	19.52 ± 8.03*	*p*=0.022
• Modus	9.08	-	
• Median	9,00	17.925	
• Maximum	10,02	41.33	
• Minimum	4,90	10.11	
Erythrocyte sedimentation rate (mm/hour)			
• Average	7.53 ± 4.52*	11.35 ± 4.51	*p*=0.037
• Modus	2.00	8.00	
• Median	9.00	8.00	
• Maximum	19.00	26.00	
• Minimum	1.00	3.00	
Hemoglobin (g/dL)			
• Average	14.08 ± 8.03	14.32 ± 1.78	*p*=0.063
• Modus	-	13.93	
• Median	13.96	13.91	
• Maximum	18.24	14.33	
• Minimum	8.19	10.11	

* $p < 0,05$ (significant different)

DISCUSSION

Acetylcholinesterase (AChE, EC 3.1.1.7) belongs to the enzyme cholinesterase, which is found in the central nervous system, platelets and erythrocyte membranes. Acetylcholinesterase plays a role in the hydrolysis of the neurotransmitter acetylcholine into acetate and choline so that if it is inhibited, acetylcholine will accumulate in the receptors. This will prolong the excitatory effect of the cholinergic nerve before and after ganglion (Thetkathuek et al., 2017). In this study, acetylcholinesterase levels were used as a marker of pesticide poisoning due to the stability of the enzyme-pesticide inhibition bond (Nganchamung et al. 2017; Kusumawati et al., 2019). Therefore, high levels of blood acetylcholinesterase indicate a degree of pesticide poisoning (Santoso et al, 2019; Sine et al, 2019). This is supported by research by Sombatsawat et al (2021) which states pesticides can induce changes in the activity of the acetylcholinesterase enzyme of farmers in the Nakhon Ratchasima region of Thailand. The study also revealed that pesticides can inhibit acetylcholinesterase activity which further impacts impaired kidney function. Hansen et al., (2020) found that organophosphate and carbamate pesticides can inhibit the acetylcholinesterase activity of farmers in Uganda, causing blood glucose to increase significantly. Various factors cause farmers pesticide poisoning, including the use of personal protective equipment, service life, length of spraying, type of pesticide, and pesticide management (Istianah and Yuniastuti, 2017; Santoso et al., 2019; Yogisutanti et al, 2020).

Sustained exposure to pesticides can lead to bioaccumulation of pesticides in the liver. Such bioaccumulation causes an imbalance of activation and detoxification of xenobiotic metabolic processes. Pesticide activation occurs through an oxidative desulfuration reaction facilitated by several cytochrome P-450 enzymes (CYP450) forming an active metabolite of oxon to then cause an inhibitory effect on AChE as the main target of pesticide toxicity. On the other hand, the detoxification process can take place through metabolic pathways mediated by some enzymes including CYP450, paraoxonase (PON)-1, acetylcholinesterase (AChE), and Butyrylcholinesterase (BChE). Thus, the more pesticides enter the body, the more ACheE levels increase as a metabolic response. This can be seen in table 2, which shows that the AChE levels of the control group were lower than those of the poisoning group.

The increase in AChE levels in the poisoning group also indicates that pesticide levels are also increasing. This increase can also lead to the binding of pesticides-erythrocyte cell membranes resulting in cellular injury. This injury results in changes in structure and morphology to cause erythrocyte damage. This circumstance will cause a change in the ESR value. Erythrocyte sedimentation rate (ESR) or sedimentation rate (SED rate) is the rate at which erythrocyte cells settle in a tube filled with blood that has been given an anticoagulant within an hour. The rate of blood precipitate is also defined as the speed of deposition of erythrocyte cells in plasma. The normal ESR value is less than 10 mm/hour so if there is an increase in ESR values, there is an inflammatory process in a person's body, both acute and chronic inflammation, or the presence of tissue damage (Utami et al., 2017). The results of this study supported by the research of Hayat et al (2018) have proven that led sprayers of higher insecticides are meaningful. Another study also mentioned that the ESR of pesticide sprayers in Brebes was higher in meaning (Utami et al., 2017).

In addition, cell membrane damage can also cause hemoglobin leakage which results in anemia. In this study, the hemoglobin levels of the control group and the poisoning did not differ. Various factors that cause hemoglobin levels are not different, including the completeness of personal protective equipment from mixing to spraying pesticides, sanitation and hygiene while working, nutritional adequacy and a healthy lifestyle, and others. The results of this study are in accordance with the study of Arwin and Suyud (2016) which showed that horticultural farmers spraying pesticides in Cikajang, Sukabumi Regency did not experience anemia. This study is different from previous studies which stated that pesticide exposure can significantly reduce farmers' hemoglobin levels (Hendrayana et al., 2020; Sine et al., 2021).

CONCLUSION

Based on the results of the study, it was concluded that pesticide exposure in farmers who are poisoned by pesticides can cause inflammation characterized by an increase in ESR. However, it has not affected hemoglobin levels.

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