





# Factors Related to Cholinesterase Levels in Farmer's Blood at Bumiaji District, Batu City

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**Abstract.** Indonesia is an agricultural country. Most of the population works in agriculture. Farmers use pesticides when farming activities. Pesticides are needed for plants attacked by pests and diseases. Pesticides poison when they are to be used and when they are prepared or finished using. Pesticides have the effect of inhibiting the distribution of nerve impulses by binding them to the cholinesterase enzyme. This study aims to determine the relationship between age, education, knowledge, and action. The research design used observational analytics with a cross-sectional approach. The research population is a group of farmers in Bumiaji District. The research sample totaling 379 people was taken based on inclusion and exclusion criteria using the total sampling technique. Univariate analysis using characteristic frequency distribution and bivariate analysis using chi-square. The results of the bivariate analysis test using the chi-square statistical test, the age variable ( $p=0.669$ ), the education variable ( $p=0.034$ ), the knowledge variable ( $p=0.309$ ), and the action variable ( $p=0.938$ ). The value below ( $p=0.05$ ) indicates a relationship with cholinesterase levels. In conclusion, there is no relationship between age, knowledge, and action with cholinesterase levels, but for the education factor, there is a relationship with cholinesterase levels.

**Keywords:** Pesticides, Cholinesterase Levels, Farmers

## 1 Introduction

Indonesia is an agricultural country with the majority of people working in agriculture. The agricultural sector has a significant role because it is a food producer for people in a country. Data from the Central Bureau of Statistics showed that the number of farmers is around 33.4 million people spread across 34 provinces in Indonesia [1]. As an agricultural country, the use of inorganic and organic pesticides is very varied and diverse; this can lead to pesticide poisoning. Poisoning caused by pesticides is about 80% occurring in farming countries in all parts of the world. Cases of poisoning caused by the use of pesticides in China have reportedly reached 53,000 to 123,000 people. Bangladesh's death rate is relatively high due to pesticides for Cambodia from 23 [2].

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Most farmer fathers and mothers use pesticides when carrying out agricultural activities. These pesticides are very much needed when attacked by pests and diseases. The behavior of farmers in using pesticides contrary to regulations could have adverse effects on human health and the environment [3]. This was also conveyed by Yuantari et al. that the use of pesticides that are not appropriate can potentially be harmful to the health of these farmers and also buyers who buy these agricultural products, non-target microorganisms and will harm the environment so that it can be polluted both the water and the surrounding soil [4].

The use of organic and inorganic pesticides in all countries is around three and a half million tons annually. Pesticides poison the human body when applied and when prepared for or after spraying activities [5]. The entry of poison can be through the eyes, skin, breath, and mouth. Research by Herdianti suggests that pesticide poisoning, which has profound effects such as disease, infertility, cancer, liver, and defects in the body, is estimated at 5,000-10,000 farmers per year [6]. Signs of a person experiencing pesticide poisoning are speedy heart rate, dizziness, watery eyes, movement in specific muscles, vomiting, foaming at the mouth, narrowed pupils resulting in blurred vision, headaches, drooling, and nausea [7]. For the safety of farmers in using pesticides, it has been regulated by the Ministry of Health of the Republic of Indonesia [8]

In 2016 cases of poisoning caused by pesticides in Indonesia registered 711 points, while in 2017, cases of poisoning due to pesticides 2 died, and 124 cases of poisoning were recorded [9]. This pesticide has the effect of restraining the distribution of nerve impulses by binding to the cholinesterase enzyme. Cholinesterase is an enzyme present in cellular fluids, and its function is to stop the action of acetylcholinesterase by being hydrolyzed to choline and acetic acid. Cholinesterase is helpful as a regulator of nerve work in balancing the nervous system in the body [7]. Chronic poisoning from organophosphate pesticides has the potential to be carcinogenic [10]. The possibility of exposure to organophosphate pesticides in the body can be determined by carrying out a cholinesterase enzyme test [11].

Batu is a city in the middle of East Java Province, which is surrounded by mountains and has very high agricultural potential. The crops grown quite a lot by farmers are vegetables, fruits, flowers, and rice. Certain fruits and vegetables include apples, cauliflower, carrots, citrus fruits, and potatoes. These vegetables and fruits are suitable plants to be developed in the highlands. The Bumiaji sub-district is where most people work as farmers, fruit, flower, and vegetable farmers. In Batu City, there is the Bumiaji District. The Bumiaji sub-district is the area with the most livelihoods for farmers. The agricultural potential in Bumiaji District is very diverse. The variety is the abundance of flower, fruit, and vegetable farming.

In 2021 the Batu City Health Office will carry out an inspection of cholinesterase levels for farmers in the Batu City area spread over several villages/sub-districts, namely Punten Village, three respondents poisoned 26 examination respondents, Sumberbrantas Village has 50 examination respondents whom three respondents poisoned, Sidomulyo Village has 51 examination respondents one respondent was poisoned, Torongrejo Village had 53 examination respondents who were poisoned 0 respondents, Giripurno Village had 52 examination respondents whom one respondent poisoned.

Some plants often attacked by pests are oranges, apples, cauliflower, carrots, and potatoes. The most disturbing problems are insects. Therefore farmers use pesticides to eradicate insects. In carrying out pest control, farmers use spraying. Chemical spraying must follow the Standard Operating Procedure (SOP), namely wearing Personal Protective Equipment (PPE) such as long-sleeved shirts, gloves, goggles, masks, etc. This safety equipment is vital for the safety and health of farmers so they don't get poisoned. Threats that can occur during the application of pesticides on these plants are then capable of causing disturbances that can trigger disease. Diseases that trigger disruptions experienced by farmers are respiratory disorders, poisoning, blood disorders, and other disorders [12]. The variables to be studied are age, education, knowledge, and action. The age variable is studied because this age relates to years of service in agriculture. Field application. So, it is necessary to conduct further research on farmers' age, education, knowledge, and actions in using pesticides, especially in the Bumiaji area, to determine the number of farmers exposed to poisons. Farmer research aims to determine the relationship between age, knowledge, and education.

## 2 Methods

The type of research used is quantitative research. The research method uses an observational analytic design using a cross-sectional approach. The study analyzed the relationship between age, knowledge, education, and actions with cholinesterase levels in farmers in Bumiaji District, Batu City. The study has seven villages: Sumberbrantas, Giripurno, Bumiaji, and Tulungrejo. Punten, Bulukerto, and Sumbergondo. The sampling technique uses the total sampling method. The inclusion criteria are male/female, farmers in the Bumiaji sub-district, and willing to be respondents. The population is farmers in the Bumiaji sub-district, namely 379 farmers. The instrument used is a laboratory test (cholinesterase). To obtain other data using interviews, documentation, and questionnaires. This study used two analyses, namely univariate analysis and bivariate analysis. The characteristic frequency distribution was used for univariate analysis, while the Chi-Square test was used for bivariate analysis. The variables used are dependent and independent. Four independent variables are age, education, knowledge, and action. At the same time, the dependent variable is cholinesterase levels. The time for data collection was carried out in 2022 in the Bumiaji sub-district, Batu City.

## 3 Results

**Table 1.** Variables using univariate analysis of the characteristic frequency distribution

Variable	Frequency (n)	Percent (%)
Age		
<40 Years	116	30.6
>40 Years	263	69.4
Education		
No school	11	2.9

Variable	Frequency (n)	Percent (%)
Elementary / Junior High School	234	61.7
Senior High School	107	28.2
D1-D3	6	1.6
D4/S1	20	5.3
S2/S3	1	0.3
Knowledge		
Poor	22	5.8
Enough	285	75.2
Good	72	19.0
Action		
Poor	3	0.8
Enough	317	83.6
Good	59	15.6
Check up result		
No Poisoning	371	97.9
Poisoning	8	2.1

Table 1 shows that farmers aged less than 40 were 116 people (30.6%), and those aged more than 40 were 263 people (69.4%). For the education variable of farmers who did not attend school, 11 people (2.9%), elementary/junior high school education 234 people (61.7%), high school education 107 people (28.2%), D1-D3 education six people (1.6%) , D4/S1 education 20 people (5.3%) and Masters/S3 education one person (0.3%). The knowledge variable is divided into three, namely less, sufficient, and good, for those who are lacking 22 people (5.8%), enough 285 people (75.2%), and for good 72 people (19.0%). For the action variable, it is divided into three, namely less, adequate, and good. For those who are lacking three people (0.8%), 317 people (83.6%) are adequate, and for those who are good, 59 people (15.6%). The results of the cholinesterase examination showed that were not poisoned 371 people (97.9%), and those who were poisoned were eight people (2.1%).

**Table 2.** Bivariate analysis

Variable	No Poisoning	Poisoning	p-value
Age			
<40 Years	113	3	0.669
>40 Years	258	5	
Education			0.034
No school	11	0	
Elementary / Junior High School	232	2	
Senior High School	102	5	
D1-D3	5	1	
D4/S1	20	0	
S2/S3	1	0	

Variable	No Poisoning	Poisoning	p-value
Knowledge			
Poor	21	1	0.309
Enough	278	7	
Good	72	0	
Action			
Poor	3	0	0.938
Enough	310	7	
Good	58	1	

Table 2 shows the results of the bivariate analysis test using the chi-square statistical test. There is no relationship between age, knowledge, and action with cholinesterase levels, but for the education factor (p-value=0.034), there is a relationship with cholinesterase levels.

## 4 Discussion

### 4.1 Relationship between Age and Cholinesterase Levels

For the age level of farmers, it is stated that farmers under forty have a one point ninety-nine times greater chance of experiencing pesticide poisoning, analogous to farmers over 40. However, the ratio value is 0.669. Of course, age and cholinesterase levels in the blood have no relationship [13]. Furthermore, Yuristi stated that the age that has entered the vulnerable age and then the age that is still productive at work cannot be used as a benchmark in pesticide poisoning because many factors influence poisoning apart from the age factor [14]. However, research result by Wicaksono suggests that the older a person is, the more they experience and the more exposure they experience. With the increasing age of a person, the metabolic function will decrease and result in a decrease in cholinesterase activity [15]. Therefore, it will facilitate the occurrence of poisoning caused by pesticides. Poisoning can be prevented by using pesticides according to the dosage and using personal protective equipment (PPE) according to regulations.

### 4.2 Relationship between Education and Cholinesterase Levels

For the farmer education category, there is a link between education and cholinesterase levels. Result Ratio of 0.034. The formal education gained will add insight into the knowledge of individuals, so with a higher level of education, it is hoped that insight into the understanding of the dangers of pesticides, how to use them properly, and their application is better when compared to those with a low level of education so that in the application of pesticides, the level of higher education will be much better [15]. A person's higher education level will affect how to receive new messages, and the level of education will ultimately influence behavior and attitudes [16]. Exposure to

pesticides also depends on the duration of exposure, measuring the capacity of these pesticides and aspects of exposure changes such as using personal protective equipment [17]. However, education is obtained from school benches and non-formal education such as training, courses, etc. Farmers in the Bumiaji District received pesticide guidance from the Agriculture Service and the Bumiaji Health Center.

### **4.3 Relationship between Knowledge and Cholinesterase Levels**

For the results of knowledge with cholinesterase levels, there is no relationship. The ratio value of 0.309. Maranata et al. stated that several aspects that can affect the occurrence of intoxication due to pesticides are external factors such as dose, duration of spraying pesticides, working period, correct spraying technique, spraying time and basic sanitation, type, use of proper personal protective equipment, action against wind direction, frequency of spraying and how to handle pesticides [18]. The level of knowledge is the main supporting component in behaving and doing work. This is because knowledge is one of the first components of behavior. Cognitive, as well as knowledge, is an essential domain for forming a person's actions [15]. A good level of knowledge is only sometimes followed by preventing farmers from pesticide poisoning, which can be seen by checking cholinesterase levels [19]. This is possible because not all owned knowledge ends in healthy behavior. In scoring this variable, most farmers' knowledge about pesticides is quite good. This can be seen in the table.

This level of knowledge is how farmers find out, learn, understand, and so on to get information related to agriculture, especially pesticides. Social media, the internet, books, agricultural service officers, and health workers exist. Higher knowledge will trigger appropriate action per the regulations to prevent poisoning. In scoring this variable, most farmers' knowledge about pesticides is quite good, as seen in the table.

### **4.4 Relationship of Action to Cholinesterase Levels**

For the results of the action with cholinesterase levels, there is no relationship—the ratio value of 0.506. From the results of multivariate analysis, the relationship between action and cholinesterase levels is very influential. By using personal protective equipment correctly and according to standards, there is no link between cholinesterase levels. This was also conveyed in research by Wicaksono, suggesting that farmers use pesticides well. This can be seen in attitudes, knowledge, and actions [15]. Action is an application that someone does. This action also approaches the direction of behavior. Health behavior is not solely influenced by insight but can also be affected by support from other parties, motivation, facilities, and actions [20]. Several factors influence poisoning, including temperature, humidity, and rainfall [21]. This research also aligns with Maranata, which states that several aspects that can influence pesticide poisoning are external, namely, from outside the body. Then the use of pesticides, most of the things are good. Therefore, this is what causes there to be no link between the action and poisoning in farmers. Another thing that causes poisoning is the large number of pesticides used [18].

## 5 Conclusion

There is no relationship between age, knowledge, and action with cholinesterase levels in farmers' blood in Bumiaji District, Batu City, while education has a relationship with cholinesterase levels.

## Author's Contribution

ASF: Concept this research, collect data, and analysis. AK and MAI: direct research, review the instrument, guide analysis and interpretation, and review article. AH: Monitoring and providing recommendations on the research and article draft. All authors write the manuscript.

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## References

1. Central Bureau of Statistics. Booklet 2018 National. Jakarta: Central Bureau of Statistics. Indonesian Statistics.
2. Ulva, F., Rizyana, NP, & Rahmi, A. Relationship between Knowledge Level and Symptoms of Pesticide Poisoning in Farmers Spraying Horticultural Plant Pesticide in Lembah Gumanti District, Solok Regency in 2019. 2019. STIKes Alifah Padang. Batanghari Jambi University Scientific Journal. 19(3), 501. <https://doi.org/10.33087/jiubj.v19i3.696>.
3. Rahmasari, DA, & Musfirah. Factors Associated with Farmers' Subjective Health Complaints Due to the Use of Pesticides in Gondosuli, Central Java. 2020. Faculty of Public Health. Ahmad Dahlan University. Yogyakarta. National Journal of Health Sciences. 3, 14–28. Retrieved From <https://journal.unhas.ac.id/index.php/jnik/article/view/10356>.
4. Yuantari, MGC, Widianarko, B., & Sunoko, HR Risk Analysis of Pesticide Exposure to Farmers' Health. 2015. Semarang State University. Semarang. Journal of Public Health. 10(2), 239. <https://doi.org/10.15294/kemas.v10i2.3387>.
5. Trianto, M., Marisa, F., & Siswandari, NP Relative Abundance, Frequency and Dominance of Flies in Several Traditional Markets in Martapura District. Tropical Biology. 2020. Faculty of Biology. Gadjah Mada University. Yogyakarta. Metamorphosis: Journal of Biological Sciences. 7(2), 21. <https://doi.org/10.24843/metamorphosa.2020.v07.i02.p04>.
6. Herdianti. Old Relationship, Spraying Actions, and Personal Hygiene with Symptoms of Pesticide Poisoning. 2020. Promotive: Journal of Public Health, 8(1), 72. Environmental Health Study Program, STIKES Ibnu Sina Batam. Batam. <https://doi.org/10.31934/promotive.v8i1.232>.
7. Fajriani, GN, Fadhilla, FR & Hutagaol, RR Relationship of Pesticide Spraying Intensity. 2019. Rajawali College of Health Sciences. Bandung Meditory, 7(1), 66–76. <http://ejournal.poltekkes-denpasar.ac.id/index.php/m>.

8. Directorate of Occupational Health and Sports Directorate General of Public Health, Ministry of Health of the Republic of Indonesia. Guidelines for Safe and Healthy Pesticides in the Workplace of the Agricultural Sector (For Health Workers). 2019. Director of Occupational Health and Sports. Ministry of Health. Jakarta. [https://www.researchgate.net/publication/332528454\\_pedoman\\_pestisida\\_aman\\_dan\\_sehat\\_di\\_place\\_kerja\\_sector\\_pertanian](https://www.researchgate.net/publication/332528454_pedoman_pestisida_aman_dan_sehat_di_place_kerja_sector_pertanian).
9. Oktaviani, R. & Pajuang, ET Symptoms of Pesticide Poisoning in Greenhouse Farmers. 2020. Department of Public Health, Faculty of Sports Science, Semarang State University. Semarang. *Higeia Journal of Public Health Research and Development*, 4(2), 178–188. Retrieved from <http://journal.unnes.ac.id/sju/index.php/higeiahttps://doi.org/10.15294/higeia/v4i2/33544>.
10. Syahda, IA, Damayanti, I., & Imanudin, I. Relationship of Lung Vital Capacity with Cardiorespiratory Endurance in Football. 2016. Faculty of Sports and Health Education, Indonesian University of Education. Bandung. *Journal of Applied Sports Science*. 1(1), 24. <https://doi.org/10.17509/jtikor.v1i1.1549>.
11. Arif, MI, Suhartono, & Dewanti, NAY Study of the Prevalence of Pesticide Poisoning in Vegetable Spraying Farmers in Mendongan Village, Sumowono District, Semarang Regency. 2016. *Journal of Public Health (E-Journal)*, 4(5), 35–43. Faculty of Public Health. Diponegoro University. <http://ejournal-s1.undip.ac.id/index.php/jkm>.
12. Rahmawati, YD Effect of Farmer Characteristics and Spraying Methods on Cholinesterase Levels. 2018. Faculty of Public Health, Airlangga University. Surabaya. *The Indonesian Journal of Occupational Safety and Health*. 6(3), 343. <https://doi.org/10.20473/ijosh.v6i3.2017.343-35>.
13. Annida, S. The Correlation Between Frequency and Duration of Spraying with Pesticide Poisoning in Farmers in Srikaton Village, Adiluwih District, Pringsewu Regency. 2016. Thesis. Bandar Lampung: Medical Faculty Medical Education Study Program. Lampung University. <http://digilib.unila.ac.id/31082/3/kripsi%20tak%20pemandingan.pdf>.
14. Yuristi, I. Relationship between Characteristics, Spraying Techniques, and Use of PPE (Personal Protective Equipment) with Cholinesterase Levels and Hemoglobin Levels in Farmers in Juhar Ginting Sadanioga Village, Karo District, 2018. 2019. Public Health Study Program. Faculty of Public Health. The University of Northern Sumatra. Medan.
15. Wicaksono, AB Internal Factors Cholinesterase Levels in the Blood of Potato Farmers in Gapoktan Al-Farruq Patak Banteng Village, Kejajar District, Wonosobo Regency in 2016. Department of Environmental Health, Health Polytechnic of the Ministry of Health Semarang. Semarang. <https://ejournal.poltekkessmg.ac.id/ojs/index.php/keslingmas/article/view/2985>.
16. Hermawan, I., Widjasena, B., & Kurniawan, B. Factors Associated with Blood Cholinesterase Activity in Guava Farmers in Pesaren Village, Sukorejo District, Kendal Regency. 2018. Occupational Safety and Health Section, Faculty of Public Health. Diponegoro University. Semarang. *Journal of Public Health (E-Journal)*, 6(4), 309-320. <http://ejournal3.undip.ac.id/index.php/jkm>.
17. Hohenadel, K, et al. Exposure to Multiple Pesticides and Risk of Non-Hodgkin Lymphoma in Men from Six Canadian Provinces. 2011. *International Journal of Environmental Research and Public Health*. 2320-2330. <https://doi.org/10.3390/ijerph8062320>.
18. Maranata R, Chahaya I, Santi DN. Farmers' Behavior in Using Pesticides and Personal Protective Equipment and Farmers' Health Complaints in Suka Julu Village, Barus Jahe District, Karo District in 2014. Environmental Health Faculty of Public Health. North Sumatra University. <https://www.neliti.com/en/publications/14526/>.
19. Indrianti, K., Susanto, BH, & Yohanani, A. The Relationship Between Farmer's Behavior in the Use of Organophosphate Pesticide with Cholinesterase Levels. 2021. STIKES



- Widyagama Husada Malang. *Poor. Media Husada Journal of Environmental Health* Volume 1, Number 1. 66–73. <https://mhjeh.widyagamahusada.ac.id/index.php/mhjeh/article/download/10/7>.
20. Ridwan, M. *The Relationship between Knowledge, Attitudes, and Actions with Symptoms of Poisoning in Pesticide Sprayers in Pematang Cermai Village, Serdang Bedagai Regency, 2017*. Thesis. Public Health Study Program. Faculty of Public Health. University of Northern Sumatra. Medan. <https://repositori.usu.ac.id/handle/123456789/1491>.
  21. Kurniawan, R. *Relationship between Knowledge, Attitudes, and Actions on Using Pesticide with Complaints of Pesticide Poisoning among Pest Control Workers in Central Java and Yogyakarta, 2019*. Thesis. Public Health Study Program. Health faculty. Muhammadiyah Surakarta university. <http://eprints.ums.ac.id/73448/12/naskah%20publikasi%20fix.pdf>.

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