Determinant Factors Affecting Pesticide Poisoning, In Gisting Sub District, Tanggamus Regency

Bambang Murwanto[1], Yeni Rosita[1]
[1]Kesehatan Lingkungan, Poltekkes Kemenkes Tanjungkarang
Email: bambang_murwanto@poltekkes-tjk.ac.id, yenirosi74@gmail.com
Orcid: https://orcid.org/0000-0001-8108-352X, https://orcid.org/0000-0002-5363-5267

Abstract. The impact of horticultural agriculture on the welfare of farmers and the surrounding community is quite large, either directly or indirectly. Horticultural agriculture which is an agribusiness development in Lampung Province wich has horticultural centers, one of which is in Tanggamus District. However, the negative impact that is feared is pesticide poisoning. At this time in the world it is estimated that there are 1-5 million cases of pesticide poisoning, 80% of which are in developing countries.The purpose of this study was to determine the determinant factors that influence the occurrence of pesticide poisoning in one of the horticultural agricultural centers in Gisting District, Tanggamus Regency.The research design was cross sectional to determine pesticide exposure. With a total of 112 farmers' blood samples (56 cases and 56 controls) and Cholinestrase levels were examined to describe the tendency of poisoning and not poisoning. Data collection techniques and sources using questionnaires and blood sampling of farmers. Data processing using software applications by data, univariate and bivariate.The results of this study describe the determinants that affect the level of Cholinestrase, namely only the farmer's knowledge variable (p value = 0.019), while the other determinants are not related such as age, gender, education, income, service, attitude, behavior, temperature, humidity. The main recommendation is to ignore the spraying time, which is 16.00-17.00.

Keywords: pesticide, cholinestrase, horticulture.

1 Introduction

Lampung Province which is part of a country that implements programs in the agricultural industry (Agroindustry). The agro-industrial centers in Lampung are located in Central Lampung, East Lampung, West Lampung and Tanggamus Regency. Currently, most of the Indonesian population still relies on jobs in this sector, is 28.79%, while the trade sector is 18.61% and industry is 14.72% (Program et al., n.d.). Agroindustry is the activity of converting or processing raw materials into products that are ready to be produced and consumed to generate added value.

The positive impact of the agricultural sector will provide community welfare, especially farming communities. However, if it is not managed properly, it will have a negative impact on the health of the farmers concerned. One example is the bad use of pesticides that can cause poisoning, which is estimated at 1 to 5 million cases of pesticide poisoning that occur in the world and 80% of them occur in developing countries with a mortality rate of 20,000 cases [1] In today's world, pesticide poisoning reaches 18.2 per 100,000 workers, and 168,000 die a year. Thundiyil, JG., et. Al. (2008) in [2].

However, another negative impact that affects a greater degree of health is the impact that is acute or chronic. The acute impact of poisoning occurs immediately or shortly after using the pesticide directly at the time of application or immediately after the pesticide application. The effects of acute poisoning are divided into acute local effects and acute systemic effects [3]. Chronic impact is a cumulative poisoning that occurs over many years (long term) which causes damage to body tissues such as inducing neurological toxicity, dysfunction of lipid, protein and carbohydrate metabolism. The diagnosis is based on the exposure history, signs and symptoms and laboratory measurements. [2]. Exposure to pesticides that often occurs starts from preparing materials and spraying equipment, mixing and dispensing pesticides and removing residual spraying results (Yushananta, Melinda, Mahendra, Ahyanti, Angraini, et al., 2020). In addition, pesticide poisoning occurs at the time of spraying, namely by not using incomplete PPE, reaching 68.4% and causing 3.77 times the risk of anemia, occurring in hoticulture farmers in West Lampung Regency [4]. The direct effect of pesticide poisoning is that pesticides enter the body affecting nerve function through the action of the enzyme cholinestrase, which is a chemical that conducts impulses along nerve fibers.

One of the horticulture center areas in other areas in Lampung Province is Tanggamus Regency, where one of the sub-districts is a horticulture center area, namely corticulture such as vegetables with the largest horticultural agricultural land in Lampung Province (1,254 Ha), with vegetable crop production of 237,500 tons which dominated by shallots, potatoes, chilies and cabbage [5]. The state of health in Tanggamus district, especially related to the risk of pesticide poisoning in 2019, health status related to pesticides, one of which is the state of nutritional status such as the number of short toddlers reaching 2.2%, the number of underweight children reaching 2.1%, babies with weight Low Birth Body (LBW) reached 2.8% and underweight toddlers 1.2% [6]. According to HL. Blum the determinants of health status are a) the least heredity, b) the greater the health service factors c) the greater the health behavior factor and d) the largest is the health environment factor [7]. From the results of research in Brebes, Central Java, it shows that nutritional status is related to cholinesterase activity [8]. Thus, it can be said that the health status described by the nutritional status above is one of the causes of low cholinesterase levels. So it can also be said that the determinant of low levels of cholinesterase as according to the HL framework. Blum, namely a) heredity, b) health services c) health behavior and d) health environmental factors.

2. Method.

The design of this research is quantitative, i.e. analytic and observational study with a cross-sectional approach, to measure the effect between the independent variable (risk factors) and the dependent variable (incidence of pesticide poisoning). The case-control design was carried out by first determining the poisoned (case) and non-poisoned (control) groups and then looking back to look for risk factors.

The research location was carried out in Gisting Sub-District, Tanggamus Regency, Lampung Province, with an estimated time from April to December 2022.

The population of this study were all horticulture farmers in Gisting Sub-District, Tanggamus Regency. While the research sample is part of the population selected with inclusion and exclusion criteria for cases, both cases and controls.

1. Case.

Cases are horticultural farmers in the Gisting Sub-District, Tanggamus Regency and the results of blood tests are positive for cholinestrase deficiency, from the results of laboratory tests.

2. Control

The controls were horticultural farmers in the Gisting sub-district, Tanggamus Regency and the results of the blood test were negative for cholinestrase deficiency, from the results of laboratory tests.

Determination of the sample size for the case-control study is not matched using the following formula [9].

$$n = \frac{2pq(Z\alpha+Z\beta)2}{(p_1-p_0)}$$

p_0 = proportion of controls exposed to the exposure being studied

$$p_1 = p_0^{x}\frac{R}{1+p_0(R-1)}$$

$$\bar{p} = \frac{(p_1+p_0)}{2}$$

$$\bar{q} = 1-\bar{p}$$

Z = relative deviation between sample values and population (normal limits standards).

α = 0,05 ⟶ Z_α = 1,96 (both directions)

β = 0,2 ⟶ Z_β = 1,84 (both directions)

The sample size used is the largest, the result of the largest OR calculation in previous studies is 21.00, so the p taken is 0.013 above, then the sample size is 56, with a comparison of cases with controls 1: 1, then the number of control samples is 56.

The data collected is primary data, both case and control data.

Data Collection Procedure.

1) All horticultural farmers in the Gisting sub-district, adults (> 15 years old) were examined for cholinesteresis.

2) The results of the examination of cholesterol levels 75% including poisoning (although mild poisoning) and included in the group of cases. Meanwhile, the results of the examination of cholenestrase levels were 75% - 100% including normal (not poisoned) and included in the control group.

3) Then all cases and control groups were taken randomly.

The data is processed using a computer application for data processing, namely by processing data in univariate and bivariate ways.

2.1 Univariate Analysis.

Univariate data processing to obtain a descriptive picture of the frequency distribution.

2.2 Bivariate Analysis.

This analysis uses the Kai-Square test to test whether or not there is an effect between the dependent variable (risk factor) and the independent variable (cholenstrase level). The principle of the Kai-Square test is to compare the observed frequency with the expected frequency. If the value of the frequency of observations and the value of the frequency of expectations are the same, it is said that there is no significant difference (influence), and vice versa [10].

Meanwhile, to find out the degree of influence between cases and controls, the Odds Ratio (OR) approach is used, which is to show the ratio of the dichotomous variable values, namely the ratio of case exposure and non-case exposure [11].

3. Results and Discussion.

3.1 Univariate Analysis.

To find out the frequency distribution of each research variable as a result of univariate analysis, simply can be seen in Table 1., below.

Table 1. : Description of Univariate Analysis Frequency Distribution

Variable	Frequency	
	n	%
Cholinstrase		
a. Abnormal	22	19,6
b. Normal	90	80,4
Age group		
a. <15 Year	1	0,9
b. >=15-49 Year	65	58,0
c. >50 Year	46	41,1
Gender		
a. Famale	29	25,9
b. Male	83	74,1
Education		
a. Ungraguated of Elementary School	12	10,7
b. Graduated of Elementary School	25	22,3
c. Graduated of Junior High School	36	32,1
d. Graduated of Sunior High School	36	32,1
e. Graduated of Collage	3	2,7
Income		
a. <Rp. 2.500.000,-	100	89,3
b. >=Rp.2.500.000,-	12	10,7
Health Service Delevery		
a. Bad	57	50,9
b. Good	55	49,1

Knowledge		
a. Bad	42	37,5
b. Good	70	62,5
Attitude		
a. Bad	44	39,3
b. Good	68	60,7
Behaviour		
a. Bad	50	44,6
b. Good	62	55,4
Humidity		
a. Not according to Threshold Value	56	50
b. According to Threshold Value	56	50
Temperatures		
a. Not according to Threshold Value	56	50
b. According to Threshold Value	56	50

From the results of the analysis, most of the Cholinestrase levels were normal at 80.4%, with the majority of the sexes being male, with most of them being in the productive age (15-49 years). The education level of most of the secondary schools (junior high school and senior high school), whereas, most of the income levels are low (< Rp. 2,500,000,-), with the perception of health services being mostly poor (50.9%). For knowledge, attitude and behavior Mostly good. While the influence of physical conditions (temparature, humidity, and are all good to meet thresshold value).

3.2 Bivariate Analysis.

While the description of the results of the bivariate analysis is illustrated in the cross table, in Table 2 as below. Most of the variables have no significant relationship/influence (p value > 0.05), only one variable has a significant relationship/influence, namely the knowledge variable (p value < 0.05), namely p value < 0.019, with OR = 3,038.

Table 2. : Overview of Bivariate Analysis of Cross Tables

Variable	Cholinstrase			*p value*	OR
	Abnormal	Normal	Total		
Age group					
a. <15 Year	0 (0%)	1 (100%)	1 (100%)	0,870	-
b. >=15-49 Year	12 (18,5%)	53 (81,5%)	65 (100%)		
a. >50 Year	10 (21,7%)	90 (78,3%)	100 (100%)		
Gender					
a. Famale	6 (20,7%)	23 (79,3%)	29 (100%)	0,320	0,915
b. Male	16 (19,3%)	60 (80,7%)	83 (100%)		
Education					
a. Ungraguated of Elementary School	5 (41,7%)	7 (58,3%)	12 (100%)		
b. Graduated of Elementary School	4 (16,0%)	21 (84,0%)	25 (100%)		
c. Graduated of Junior High School	10 (27,8%)	26 (72,2%)	36 (100%)	0,600	-
d. Graduated of Sunior High School	3 (8,3%)	33 (91,7%)	36 (100%)		
e. Graduated of Collage/University	0 (0%)	3 (100%)	3 (100%)		
Income					
a. <Rp. 2.500.000,-	20 (20,0%)	80 (80,0%)	100 (100%)	0,568	1,250
b. >=Rp.2.500.000,-	2 (16,7%)	10 (83,3%)	12 (100%)		
Health Service Delevery					
a. Bad	12 (21,1%)	45 (78,9%)	57 (100%)	0,443	1,200
b. Good	10 (18,2%)	45 (81,8%)	55 (100%)		

Knowledge					
a. Bad	13 (31,0%)	29 (69,0%)	42 (100%)	0,019	3,038
b. Good	9 (12,9%)	61 (67,1%)	70 (100%)		
Attitude					
a. Bad	7 (15,9%)	37 (84,1%)	44 (100%)	0,292	0,688
b. Good	15 (22,1%)	53 (77,9%)	68 (100%)		
Behaviour					
a. Bad	12 (24,0%)	38 (76,0%)	50 (100%)	0,211	1,642
b. Good	20 (16,1%)	52 (83,9%)	72 (100%)		
Humidity					
a. Not according to Threshold Value	10 (17,9%)	46 (82,1%)	56 (100%)	0,406	0,797
b. According to Threshold Value	12 (21,4%)	44 (78,6%)	56 (100%)		
Temperatures					
a. Not according to Threshold Value	11 (19,6%)	45 (80,4%)	56 (100%)	0,544	1,000
b. According to Threshold Value	11 (19,6%)	45 (80,4%)	56 (100%)		

3.3 Discussion.

Blood cholinestrase levels of horticultural farmers in Gisting Sub-District, Tanggamus Regency is mostly normal 80.4% or still most of the farmers are horticultural farmers in Gisting Sub-District is not yet an indication of pesticide poisoning, the same thing happened in West Lampung, Lampung Province also mostly not poisoned (75.4%) [12], in Kutai Kertanegara, East Kalimantan (55.1%) [13], unlike what happened in Sumowono, Semarang, which is mostly low at 57.9% or there is a tendency for pesticide poisoning to occur [14], in Tomohon, North Sulawesi (71.4%) [15]. However, 19.6% of cholinestrase levels are abnormal or have indications of pesticide poisoning, although the numbers are relatively smaller, but we are still wary of especially having an impact on women of childbearing age (WUS) [4], both directly (as farmers) or indirectly (the impact of pesticide pollution).

The age variable was dominated by the group, namely between the ages of 15-49 years, is 58% then the age over 50 years, 41.1% and there was no significant relationship with the Cholinestrase level (p value = 0.870), as well as in North Sulawesi [16], in Tegal [17], in Semarang [18] (p value = 0.18), ([19]. However, most of the productive age also occurs in Maharatu Village, Pekanbaru City [20]. The older a person is, the more at risk of pesticide poisoning [21].

Most of the gender of farmers are male (74.1%), as also happened in Buleleng Bali (100%) [22], [23], this gender group has no significant relationship with Cholinestrase levels (p value = 0.320), [24]. Although there was no significant relationship, male sex was more at risk of pesticide poisoning [21].

Similarly, the education level of farmers is mostly junior and senior high school graduates (32.1%), and there is no significant relationship (p value = 0.600), as well as in Semarang [18] (p value = 0.546) . Most of the junior and senior high school education levels also occur in Maharatu Village, Pekanbaru City [20]. The higher the education level of the community group, the lower the risk of pesticide poisoning (Organophosphate et al., 2008).

The income level of farmers is mostly in the low category (< Rp. 2,500,000, -) i.e. 89.3%, and there is no significant relationship with Kholinestrase levels (p value = 0.568), as well as in West Lampung [4], as well as in Kab. Tapin, Kalimantan [19], Most income < Rp. 2.500.000,- also occurred in Maharatu Village, Pekanbaru City [20], as well as in Larangan, Brebes [25].

The role of health services for farmers is mostly perceived as bad (not good) 50.9% and there is no significant relationship with Cholenistrase levels (p value = 0.443), [26].

Farmers' knowledge of pesticides is mostly good, namely 62.5%, as well as in Buleleng, Bali [27], in Maharatu Village, Pekanbaru City [20], and there is a significant relationship with farmers' Cholinestrase levels (p value = 0.019, with OR = 3.038) or an increase in farmers' knowledge affects 3,038 times the increase in Cholinestrase levels. The role of this knowledge related to cholinestrase levels also occurs in Kabanjahe, North Sumatra [28], [29], in Kerinci, Jambi (p value = 0.012) [30], (Pest, n.d.). Through the GAP (Good Agriculture Practice) program in Thailand to monitor the implementation of farmers doing their jobs well (according to procedures) [31]. While in Nigeria the pesticides used are in traditional forms such as wood ash, extracts and seeds of Mimda leaves, such as goat and cow dung as pest control [32]. In Maputo, Mozambiq, even though they know there are other pesticides that are not harmful, they still use chemical pesticides that are more dangerous because these pesticides are considered more effective [33].

The attitude factor was mostly good at 60.7% and there was no significant relationship with the Cholinestrase level (p value = 0.292), it also occurred in Maharatu Village, Pekanbaru City [20], [26].

The behavior referred to in this study is the behavior of using Personal Protective Equipment (PPE) such as masks, glasses, hats, long-sleeved clothes (t-shirts), boots, gloves, etc. Although most of them were good but only

55.4% and there was no significant relationship with Cholinestase levels (p value = 0.211) or > 0.05, the same thing happened in Sumowono, Semarang (p value = 0.147) [14], [29], in Tegal [17]. In Kabanjahe, North Sumatra, to change unhealthy behavior in the use of pesticides as a reinforcing factor is the role of community leaders, partners, agricultural officers and health workers [34]. The use of rubber gloves (gloves) is highly recommended [35] to protect the skin from pesticide poisoning. In addition to avoiding the level of pesticide poisoning, it is recommended that farmers use mixed pesticides with organic pesticides [36] and handlers using the Integrated Pesticide Management (IPM) method.

The situation of inertia is in accordance with the workload of horticultural farmers which is assumed to be a moderate workload with working hours every hour between 75%-100%, so the Threshold Value is 65%-95% according to the Regulation of the Minister of Manpower and Transmigration Number Per.13/Men /X/2011 Year 2011 Regarding Threshold Values for Physical and Chemical Factors in the Workplace [37], which is in accordance with the Threshold Value (NAV) of 50% and there is no significant relationship with Cholinestrase levels, namely (p value = 0.406).

Temperature Codition In accordance with the workload of horticultural farmers who are assumed to be medium workloads with working hours every hour between 75%-100%, the Threshold Value is 28^{o} C according to the Regulation of the Minister of Manpower and Transmigration Number Per.13/Men/X/ 2011 Year 2011 Regarding Threshold Values for Physical and Chemical Factors in the Workplace, which is in accordance with the Threshold Value of 50% and there is no significant relationship with Cholinestrase levels, is (p value = 0.544).

Temperature and humidity are mutually influencing each other. The air temperature is getting higher, the air humidity is getting lower, and conversely the air temperature is getting lower, the air humidity is getting higher [38]. The role of temperature and humidity on the occurrence of poisoning and the effectiveness of pesticides, avoid spraying during the day because there will be movement of air from cooler air temperatures on the surface, moving upwards (turbulence) to air with higher temperatures, which will reduce the effectiveness of spraying and increased exposure to the skin [39]. Therefore, it is recommended to spray in the afternoon at 16.00-17.00, when the temperature is less than 30^{o} C, and the humidity is between 50%-80% [12].

4. Conclution.

From the results of research and discussion, it is only the Knowledge variable that has an influence on Blood Chlolinestrase levels or the possibility of pesticide poisoning. While the ten variables that do not have a significant effect. Therefore, it is necessary to increase the knowledge of pesticides both in terms of health and in terms of agriculture. In the field of Health, counseling on the use of complete PPE must continue to be delivered. While in agriculture itself, the role of temperature and humidity is very important, so that the time for spraying the plants is attempted in the afternoon at around 11 am. 16.00-18.00.

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