Pesticide Exposure, Cholinesterase Level and Hypertension among Farmers

Fitria Saftarina[1], Dian Isti Angraini[2], Johns Fatriyadi Suwandi[3]

[1,2,3] Fakultas Kedokteran Universitas Lampung, Bandar Lampung, Indonesia
*fitria.saftarina@fk.unila.ac.id

Abstract. Prevalence of Hypertension Among Farmers is 28.6% and Excessive Use of Pesticides Can Cause Poisoning by Decreasing Cholinesterase Activity, Potentially Leading to Hypertension. This Study Aims to Analyze the Relationship Between Pesticide Exposure and Cholinesterase Levels with Hypertension Among Farmers in Gisting District, Tanggamus Regency. The Study Design is Cross-Sectional, with a Sample Size of 189 Individuals Selected Using Purposive Sampling Technique. Data were Collected Through Interviews with Questionnaires and Examination of Cholinesterase Levels and Blood Pressure. Data were Analyzed Using Chi-Square Test. From the 189 farmers, 53 individuals (28%) had hypertension and 61 individuals (32.3%) experienced pesticide poisoning. The chi-square test results indicated that nutritional status ($p = 0.021$), smoking ($p = 0.04$), the amount of pesticide used ($p = 0.028$), and cholinesterase levels ($p = 0.024$) were associated with hypertension. In contrast, working duration ($p = 0.7$), working hours ($p = 0.3$), frequency of spraying ($p = 0.7$), and household pesticides ($p = 0.9$) were not associated with hypertension. Logistic regression analysis revealed that cholinesterase levels had the most significant influence on hypertension (OR = 8.956). Farmers are advised to consider the impact of pesticide use by adopting safe pesticide use practices and healthy dietary patterns to reduce the risk of poisoning and hypertension.

Keywords: Pesticide, Cholinesterase, Hypertension, Farmers

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INTRODUCTION

Non-communicable diseases represent a major health challenge in Indonesia. These diseases continue to be a key public health concern in the country, with hypertension being one of the most serious non-communicable conditions.[1] Based on World Health Organization (WHO) data, it is estimated that in 2019, 22% of the global population was affected by hypertension. Of those individuals, fewer than 20% have taken steps to manage their blood pressure. Africa has the highest rate of hypertension at 27%, with Southeast Asia ranking third at 25% of its population. A global health objective for non-communicable diseases aims to reduce hypertension prevalence by 25% by 2025.

The incidence of hypertension in Indonesia remains high. According to data from the 2018 Basic Health Research (Riskesdas), the prevalence in Indonesia, measured among individuals over 18 years old, is 34.1%.[1]

Indonesia is an agricultural nation where a large portion of the population depends on farming for their livelihood. As a result, the agricultural sector plays a crucial role in supporting the national economy and serves as a primary source of employment for many Indonesians, helping them meet their daily needs and sustain their lives.[2] Farmers and pesticides are two things that cannot be separated. Farmers are directly exposed to pesticides, making them the group most at risk of poisoning. Excessive use of pesticides can affect environmental quality and lead to both short-term and long-term health problems. [3] Pesticide exposure can occur through inhalation, ingestion, or skin contact. [4] Pesticide poisoning is detectable via cholinesterase testing, as cholinesterase levels are influenced by organophosphate and carbamate pesticides.[5] The active ingredients in pesticides act as anticholinesterase agents (inhibiting cholinesterase enzyme function), which prevents the breakdown of acetylcholine, leading to its accumulation.[6]

A study conducted in Gisting District, Tanggamus Regency, reported a prevalence of 28.6% for hypertension among farmers. This was attributed to excessive pesticide use, which can cause poisoning by decreasing cholinesterase activity, potentially leading to hypertension

Pesticide exposure may also impact blood pressure, as pesticides enter the body through the skin, mouth, or nose. Once inside, the active components disrupt acetylcholine breakdown Acetylcholine binds to muscarinic and nicotinic receptors in both the peripheral and central nervous systems, interfering with cholinesterase enzyme activity in nerve tissues and cells. This acetylcholine buildup causes irregular blood flow in blood vessels. Acetylcholine binds to nicotinic cholinergic receptors, leading to inhibition of the sympathetic ganglia, which increases sympathetic stimulation, clinically manifesting as mydriasis (pupil dilation) and increased cardiac output. The rise in cardiac output and peripheral resistance will affect blood pressure, leading to hypertension.[3]

Another study found that hypertension in farmers has been widely researched, including examinations of the roles of obesity, smoking, alcohol consumption, unhealthy diets, and sedentary lifestyles. [7,8,9] In addition to behavioral and lifestyle risk factors, occupation is another risk factor that may be associated with hypertension. Previous studies have found that hypertension is linked to physical workload, shift work, and long working hours. [10]

Based on this background, researchers interested to analyze the relationship between pesticide exposure, cholinesterase levels, and hypertension among farmers in Gisting District, Tanggamus Regency

SUBJECT AND METHODS

This study employed an analytical observational design using a cross-sectional approach and was conducted in Gisting District, Tanggamus Regency. The population comprised farmers actively engaged in agricultural activities who resided in the nearby agricultural areas. Participants included farmers from Gisting District in Tanggamus Regency. A purposive sampling technique was utilized to determine the sample size, which consisted of 189 participants. Data collection involved interviews and physical examinations, including the measurement of cholinesterase levels and blood pressure. Blood pressure measurements were taken using a calibrated

sphygmomanometer on the right arm. These measurements were conducted after a 10-minute rest period. The subject was seated with their antecubital fossa positioned at heart level and legs uncrossed. The arm needed to be supported at heart level, resting on a cushion, pillow, or armrest, and it was important to ensure that no tight clothing restricted the arm. The cuff was applied snugly 2 cm above the brachial artery, aligning it with the 'artery mark'. The bladder of the cuff should encircle at least 80% of the arm but no more than 100%, and the appropriate cuff size recommended by the monitor's manufacturer was used.

To estimate systolic pressure, the brachial artery was palpated, and the cuff was inflated until the pulsation disappeared. The cuff was then deflated to re-estimate the systolic pressure. The cuff was subsequently inflated to 30 mmHg above the estimated systolic level to occlude the pulse. The diaphragm of the stethoscope was placed over the brachial artery, and the cuff was deflated at a rate of 2-3 mm/sec until regular tapping sounds were heard. The systolic pressure (first sound) and diastolic pressure (disappearance of sound) were recorded to the nearest 2 mmHg.[11]

Statistical Analysis using chi-square test was used to assess the relationships between variables, while logistic regression was applied to identify the most significant predictors of hypertension.

RESULTS

Table 1. Bivariat Analysis

Variabel	Blood Pressure				P Value
	High		**Normal**		
Cholinesterase Level	n	%	n	%	
Poisoning	23	39	36	61	0.02
Normal	30	23.1	100	76.9	
Nutritional Status					
Overweight/Obese	25	38.5	40	61.5	0.02
Normal	28	22.6	96	77.4	
Smoking Habits					
Smoking	46	31.7	99	68.3	0.04
Not Smoking	7	15.9	37	84.1	
Pesticide Household					

Expose	13	27.7	34	72.3	0.94
Not Expose	40	28.2	102	71.8	
Amount of Pesticide					
≥ 2 type	51	30.7	115	69.3	0.02
1 type	2	8.7	21	91.3	
Frequency of Spraying					
> 2x/week	8	7.3	18	69.2	0.73
≤ 2x/week	45	27.6	118	72.4	
Duration					
>4 hr	4	40	6	60	0.38
≤4 hr	49	27.4	130	76.4	
Working Period					
> 5 yr	50	27.8	130	72.2	0.71
≤ 5 yr	3	33.3	6.5	66.7	
PPE					
Bad	24	25.8	69	74.2	0.51
Good	29	30.2	67	69.8	
Personal Hygiene					
Bad	22	23.9	70	76.1	0.21
Good	31	32	66	68	

DISCUSSION

Farmers with decreased cholinesterase activity due to pesticide poisoning had a higher prevalence of hypertension compared to those with normal cholinesterase levels (p= 0.02). the neurotoxic effects of pesticides, which inhibit cholinesterase activity and potentially lead to increased blood pressure.[12]

Overweight or obese farmers had a higher prevalence of hypertension compared to those with normal weight (p=0.02), obesity is a well-established risk factor for hypertension due to its impact on cardiovascular health and metabolic processes. [13]

Smoking habits prevalence of smoking compared to non-smoking (p = 0.04). Smoking contributes to endothelial dysfunction and arterial stiffness, which are critical pathways leading to increased blood pressure.[14]

Farmers using two or more types of pesticides had a higher prevalence of hypertension (30.7%) compared to those using only one type (8.7%) (p=0.02). This finding underscores the cumulative toxic effect of multiple pesticide exposures on blood pressure.[15]

Frequency of spraying (p = 0.73) and duration of exposure (p = 0.38) did not show significant associations with hypertension. This might be due to the relatively homogenous exposure patterns among the study population or other confounding factors not accounted for in this analysis.[16]

Working periode did not show a significant association with hypertension (p = 0.71). This suggests that while chronic exposure to pesticides is harmful, other factors such as lifestyle and genetic predisposition might play more significant roles in the development of hypertension over time.[17]

The use of PPE (p = 0.51) and personal hygiene (p = 0.21) did not show significant associations with hypertension. This might indicate that the current use of PPE among farmers is inadequate to provide full protection against pesticide exposure or that other unmeasured factors are contributing to hypertension risk.[18]

CONCLUSION

Pesticides exposure and decreased cholinesterase activity are important risk factors for hypertension in farmers. Consequently, it is crucial to implement interventions aimed at minimizing pesticide exposure and encouraging safe agricultural practices to prevent hypertension in this group. Future studies should investigate the long-term impacts of pesticide exposure on cardiovascular health and assess the effectiveness of different preventive strategies. Such initiatives will not only benefit farmers' health but also help improve environmental quality and promote sustainable agricultural practices.

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