Symptoms of Pesticide Intoxication Among Vegetable Farmers in Gowa Regency, Indonesia

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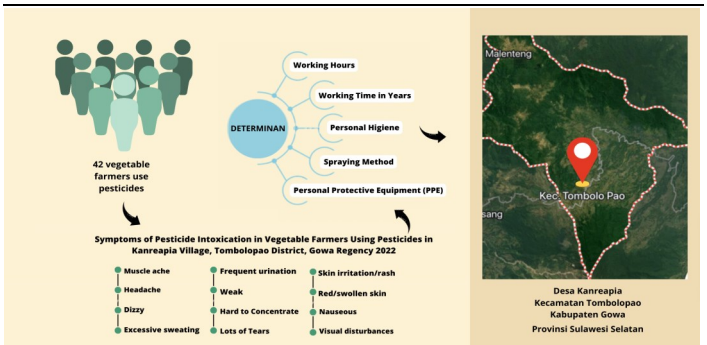
ABSTRACT

Farmers and pesticides are two inseparable things. Pesticides are one the toxic chemicals in the agricultural sector and use to control pests and weeds in the process of getting maximum yields. This study aimed to determine the symptoms of pesticide intoxication in vegetable farmers in Gowa Regency, Indonesia. This type of study was an analytical survey with a cross-sectional study design. The number of samples was 42 people consisting of vegetable farmers who were still actively working as pesticide sprayers and was determined by purposive sampling. For collecting data, it used interviews and screening for poisoning symptoms. Data were processed by tabulating (mentioning each participant in the study group) following the grouping of the variables examined and analyzed using the chi-square test. The results showed that the most common symptoms of pesticide intoxication were felt by farmers, namely muscle pain, headaches, and dizziness. This study found a relationship between spraying methods, personal hygiene, and personal protective equipment to symptoms of pesticide intoxication ($p<0.05$). This study recommends that vegetable farmers pay attention to the proper use of pesticides to minimize pesticide intoxication in the body.

ABSTRAK

Petani dan pestisida merupakan dua hal yang tidak bisa terpisahkan. Pestisida termasuk salah satu zat kimia beracun, pada sektor pertanian digunakan untuk mengendalikan hama dan gulma dalam proses mendapatkan hasil panen yang maksimal. Penelitian ini bertujuan untuk mengetahui gejala intoksikasi pestisida pada petani sayur di Kabupaten Gowa, Indonesia. Jenis penelitian ini adalah survei analitik dengan rancangan cross sectional study, jumlah sampel sebanyak 42 orang yang terdiri dari petani sayur yang masih aktif bekerja sebagai penyemprot pestisida yang ditentukan secara purposive sampling. Pengumpulan data dengan cara wawancara dan skrining gejala keracunan. Data diolah dengan cara tabulasi (menyebutkan masing-masing partisipan dalam kelompok belajar) sesuai dengan pengelompokan variabel yang diteliti dan dianalisis menggunakan uji chi-square. Hasil penelitian menunjukkan bahwa gejala intoksikasi pestisida paling banyak dirasakan oleh petani yaitu gejala nyeri otot, sakit kepala serta pusing. Penelitian ini menemukan hubungan antara cara penyemprotan, personal higiene, dan alat pelindung diri terhadap gejala intoksikasi pestisida ($p < 0.05$). Penelitian ini merekomendasikan kepada petani sayur memperhatikan cara penggunaan pestisida yang tepat untuk meminimalisir intoksikasi pestisida di dalam tubuh.

GRAPHICAL ABSTRACT



Keyword
intoxication among farmers
pesticide intoxication
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INTRODUCTION

Tropical Indonesia has fertile soil suited for agricultural production (Mehraban & Ickowitz, 2021). According to statistics, 38.97 million Indonesians, or around 34% of the country's total population, are employed in agricultural sectors. In order to boost crop yields, pesticides are a crucial component heavily relied upon by the agricultural sector (Jallow et al., 2017; Lechenet et al., 2014). It is impossible to avoid using pesticides because they are necessary for controlling weeds and pests on plants (Lengai et al., 2020; Sharma et al., 2018; Sinha et al., 2017). Using pesticides carelessly and excessively can have detrimental effects (Hughes et al., 2021). As a result of skin contamination, inhalation, and oral consumption, pesticides can enter the human body (Kim et al., 2017). One of the side effects of employing pesticides is farmer poisoning (Akter et al., 2018). Insecticides, fungicides, bactericides, herbicides, and other pesticide products are among the most harmful and are used by 75% of farmers in the food production process. The pesticide exposure markers cholinesterase, erythrocyte cholinesterase, and butyrylcholinesterase were all elevated in the plasma of these farmers (Miguel et al., 2022).

Pesticide poisoning can happen suddenly or over time (Lushchak et al., 2018). Chronic toxicity is the ability of a substance to cause adverse health effects as a result of long-term exposure, as opposed to acute toxicity, which is the ability of a substance to cause adverse health effects that develop rapidly after exposure, specifically several hours or a day (Damalas & Koutroubas, 2016). Skin irritation, impaired vision, diarrhea, increased sweating, headaches, muscle aches, nausea, vomiting, shortness of breath, chest pain, and even death have all been reported as symptoms of pesticide poisoning (Joko et al., 2020; Kim et al., 2014; Loha et al., 2018).

Pesticide poisoning is a significant issue for global public health and accounts for about 300,000 fatalities annually (Sabarwal et al., 2018; Yuantari et al., 2015). The retrieved publications indicated that there were almost 740,000 annual cases of UAPP in 141 different countries, with 7446 fatalities and 733,921 non-fatal cases. Based on this, we project that there are around 385 million instances of UAPP per year, with 11,000 fatalities. Based on an estimated 860 million farmers worldwide, this indicates that 44% of farmers are poisoned by pesticides annually (Boedeker et al., 2020). According to information from the National Poisoning Information Center (SIKerNas), 625 cases of pesticide poisoning occurred in different Indonesian provinces in 2016 (Octiara & Saftarina, 2021). According to information from the 2019 Annual Report of the Center for Drug and Food Data and Information (BPOM), pesticide poisoning is the sixth-leading cause of poisoning in the country. Pesticide use in homes (178 incidents), then in agriculture (147 cases) (Badan Pengawas Obat dan Makanan, 2019).

According to Mrema et al. (2017) and Warra et al. (2020), pesticide poisoning is still a significant health issue in agricultural settings, particularly in horticultural agriculture (the production of garden crops. A highland region in Gowa Regency called Kanreapia Village grows a variety of crops (horticulture). Vegetables harvested the previous day are sold in Makassar and Kalimantan Island daily. Every day, Kanreapia Village is able to grow celery leaves, potatoes, mustard greens, carrots, chayote, and cabbage. Since there is no planting

season in this town, agricultural production is sustainable, necessitating ongoing pesticide use. By eliminating bothersome organisms (pests), pesticides help to increase vegetable production. Vegetable farmers' ongoing usage of pesticides has the potential to lead to issues with intoxication, so it is so interesting to study more. According to WHO data, roughly 20% of pesticides are used in emerging nations with increased human consumption. Pesticide use is rising quickly in developing countries, notably Southeast Asia (Sharma et al., 2019). Several studies have suggested an important relationship between the emergence of intoxication symptoms and the use of pesticides in low-economic and developing countries, namely Sankoh et al. (2016) in Sierra Leone, Nigatu et l. (2016) in Ethiopia, Khan & Damalas (2015) in Pakistan, and Marete et al. (2021) in Kenya. This study would complement the study above by conducting research in a country where farmers still depend on high pesticide use (Liu et al., 2015). This study aimed to determine the symptoms of pesticide intoxication in vegetable farmers in Gowa Regency, Indonesia.

METHODS

A cross-sectional analytic design was used to carry out observational research utilizing the survey method. Length of work, duration of work, spraying technique, personal cleanliness, and use of personal protection equipment were the parameters that were observed (PPE). After receiving approval from the medical faculty of Hasanuddin University's health research ethics committee, this study was conducted in Kanreapia Village, Buttonopao District, Gowa Regency, beginning in August and continuing through September 2022. A total of 375 pesticide-using vegetable growers from Kanreapia Village, Buttonopao District, Gowa Regency, made up the study's population. Using a purposive sampling strategy, a sample based on the Lemeshow formula was selected to represent the population under investigation in this study. Forty-two persons met the criteria set by the researchers, which included being male, between the ages of 25 and 55, not already experiencing a significant illness, working part-time as pesticide sprayers, and being willing to participate in the study.

In this study, the sprayed farmers were asked about their experiences with intoxication. Farmers' work hours were counted and classified as eligible if they exceeded 8 hours per day. If the farmer has worked for more than five years, the working duration will be as lengthy. Farmers who immediately took a shower with soap after spraying, no later than an hour later, were considered to have good personal hygiene. If the method of spraying was not against the wind when it was being used, it was concluded to meet the standards. If all PPE was worn while farming, the use of PPE was deemed suitable.

The study started with questionnaire-based interviews and fieldwork with vegetable farmers. The behavioral and technical aspects of applying pesticides during farming, as well as analyzing symptoms and subjective complaints experienced while working as a pesticide sprayer in the previous three months. The local health center's medical staff examined any signs of intoxication. The acquired data was then processed using the the computerized SPSS program by tabulating (mentioning each participant in the study group), by grouping the variables examined and analyzed using the chi-square test. The data was displayed in tabular form with a narrative providing context. Hasanuddin University RSPTN, RSUP Dr. Wahidin

Table 1
The Characteristics of Respondents

Characteristics	n=42	Percentage
Nutrition status (IMT)		
<18.5	1	2.38
18.5-24.5	27	64.29
25.0-27	8	19.05
>27.0	6	14.29
Age (Years)		
25-29	8	19.05
30-34	7	16.67
35-39	5	11.90
40-44	6	14.29
45-49	6	14.29
50-54	6	14.29
55-59	4	9.52
Educational Background		
Bachelor	1	2.38
Diploma III	3	7.14
Diploma II	1	2.38
High School	9	21.43
Islamic High School	2	4.76
Junior high school	7	16.67
Elementary	18	42.86
No educational background	1	2.38

Sudirohusodo health research Makassar's ethics Commission conducted a feasibility study on this project under the grant of No. 270/ Um4.6.4.5.31/PP36/2021.

RESULTS

The respondents' age, current educational level, and nutritional status were among their characteristics in this study. The most common age range was 25-29 years, represented by eight respondents (19.05%) and the most recent educational level is an elementary school (SD), represented by 18 respondents (42.86%), while the nutritional status of respondents was predominately normal, as indicated by a BMI value of 18.5-24.5, which was equivalent to 27 respondents (64.29%) in the normal category (see table 1).

According to figure 1, the most prevalent signs of poisoning included muscle pain in 33 people (78.57%), headaches in 30 people (71.43%), dizziness in 27 people (64.28%), excessive sweating in 23 people (54.76%), frequent urination in 17 people (40.48%), weakness in 15 people (35.71%), trouble concentrating in 14 people (33.33%), skin redness in 14 people (33.33%), skin irritation/rash in 14 people (33.33%), crying a lot in 13 people (30.95%), five people (11.90%), five people (11.90%) had breathing problems. And only one person (2.38%) frequently drooled and experienced seizures.

There was no correlation between length of work, and symptoms of pesticide intoxication experienced by vegetable farmers who used pesticides, as shown in table 2 by the respondents who reported experiencing poisoning symptoms in the long working group who met and did not meet the requirements were 12 people (29%) with statistical tests

Table 2
The Results of Bivariate Analysis

Variable	Symptoms of Pesticide Intoxication				Total		P-*Value*
	Symptoms		Non-Symptoms				
	n	%	n	%	N	%	
Length of work							
Normal	12	28.57	11	26.19	23	54.76	0.542
Abnormal	12	28.57	7	16.67	19	45.24	
Period of work							
Old	23	54.76	16	38.10	39	92.86	0.567
New	1	2.38	2	4.76	3	7.14	
Spraying Method							
Eligible	2	4.76	8	19.05	39	23.81	0.01
Diseligible	22	52.38	10	23.81	32	76.19	
Personan Hygiene							
Eligible	3	7.14	9	21.43	12	28.57	0.014
Diseligible	21	50.00	9	21.43	20	71.43	
Personal protective equipment							
Complete	18	42.86	6	14.29	24	57.14	0.012
Uncomplete	6	14.29	12	28.57	29	42.86	

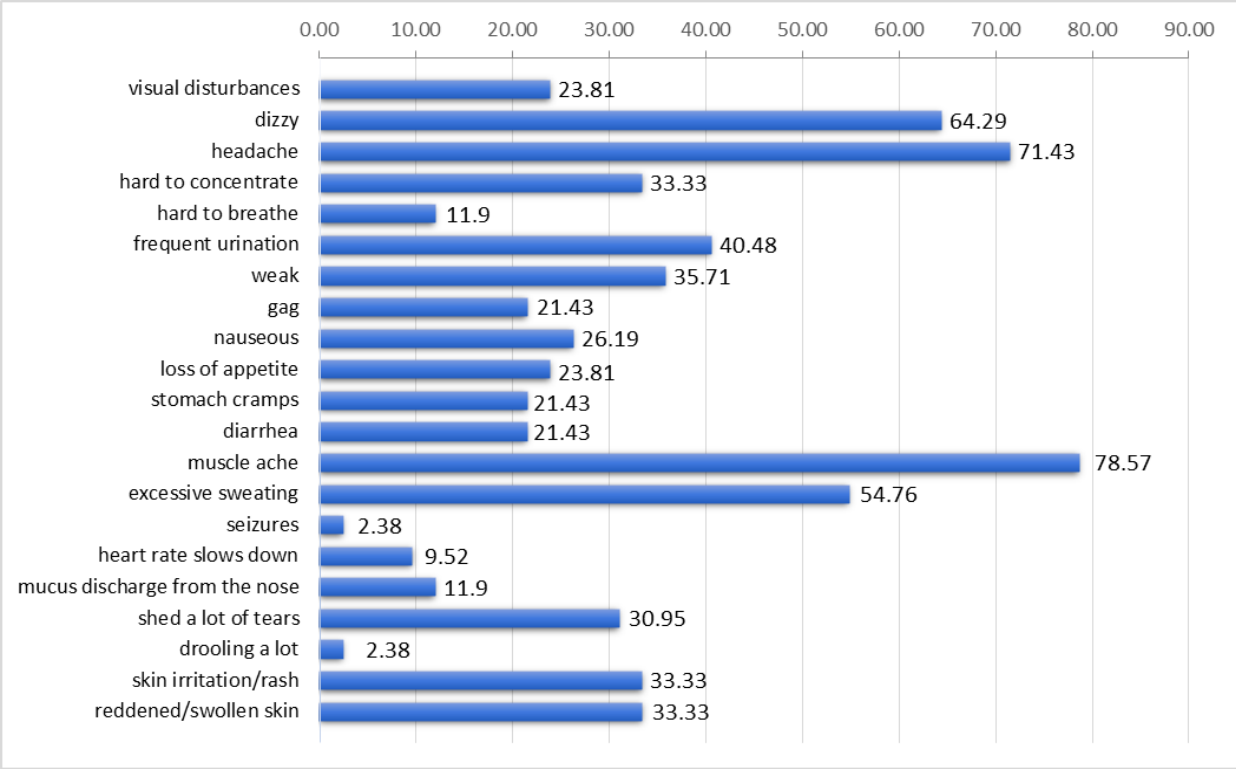
obtaining a p-value of 0.542 > 0.05. There was no significant link between years of service and signs of intoxication since the respondents with symptoms of intoxication were mainly in the older category (more than five years), which included 23 people (55%) with statistical test results that got a p-value of 0.567 > 0.05. Most respondents experienced symptoms of intoxication in the spraying method variable, namely the spraying category that did not meet the requirements of 22 people (52%) based on statistical tests between spraying methods and symptoms of intoxication with a p-value of 0.0100.05, indicating that there was a significant relationship between spraying method and signs of intoxication. The respondents who experienced the most intoxication were in the personal hygiene category and did not meet the requirements of 21 people (50%) based on statistical tests obtained a p-value of 0.0140.05, indicating that there was a relationship between personal hygiene and symptoms of intoxication. Based on statistical test results, the respondents who experienced the most symptoms of poisoning were in the category of using incomplete personal protective equipment, namely 18 people (43%), indicating that there is a relationship between personal protective equipment and symptoms of intoxication in vegetable farmers who use pesticides in Kanreapia Village, Buttonopao District, Gowa Regency.

DISCUSSION

Pesticides are toxic chemicals used to control the development or growth of pests and weeds to help control various disease vectors and protect various agricultural products (Andarini & Rosanti, 2018; Baghel et al., 2022; Oktaviani & Pagawa, 2020). Pesticides are a significant issue that harms society (Xiao et al., 2022). Whereas most pesticides are potentially toxic to humans, resulting in serious health consequences (Wallace & Djordjevic, 2020), and large amounts of pesticides can cause DNA damage (Isah et al., 2020). Pesticide contamination can cause a variety of carcinogenic, oncogenic, genotoxic, and teratogenic effects in humans, both acute and chronic (Singh et al., 2018).

This study was conducted in Kanreapia

Figure 1
Symptoms of Pesticides Intoxication



Village, Buttonopao District, Gowa Regency, using various nutritional status characteristics, age characteristics (25-55 years), and educational level characteristics. The process of observing intoxication symptoms by paying attention to the presence or absence of symptoms on the skin (reddening/swelling), skin irritation/rash, profuse salivation, profuse tears, nasal mucus discharge, slowed heart rate, convulsions, excessive sweating, muscle aches, diarrhea, stomach cramps, loss of appetite, nausea, vomiting, weakness, frequent urination, shortness of breath, difficulty concentrating, headaches, dizziness, visual disturbance.

According to the findings of a study on farmer length of work using the chi-square test on farmers in Kanrepia Village, Buttonopao District, Gowa Regency, farmer length of work is not related to symptoms of pesticide intoxication. This is consistent with the research (Helepciuc & Todor, 2021). The length of work is the amount of time a worker spends using pesticides (Hotang et al., 2020), which is the average amount of time farmers spend spraying pesticides which can be measured in time units (hours). Paying attention to the duration of action is becoming a common approach to limiting pesticide toxicity.

According to the findings of a statistical analysis of a study on years of service conducted on farmers in Kanrepia Village, Buttonopao District, Gowa Regency, the years of service pesticide intoxication symptoms are unrelated. According to Dwiyanti et al. (2018) observed the relationship between tenure, duration of spraying, length of work, and frequency of spraying on farmer blood cholinesterase level and statistical tests revealed that neither duration of action (p=0.526) nor duration of spraying (p=0.678) had any association with blood cholinesterase level. This is consistent with research findings that have a p

-value greater than 0.05.

The work period is the length of time that employees work in an environment where they are exposed to chemicals for an extended period of time (Mesnage & Séralini, 2018). It will increase the risk of pesticide poisoning (Andarini & Rosanti, 2018). According to the study by Octiara and Safari (2017) that analysed the relationship between ownership and pesticide poisoning by Farmers with Measuring Blood Cholinesterase Levels, it found results that there was no relationship between work experience and pesticide poisoning in the blood of farmers in Pekon Srikaton, Adiluwih District, Pringsewu Regency. This was also consistent with research findings with a P value greater than 0.05.

Pesticide poisoning is determined by the method of spraying. Pesticide applicators employ a variety of methods in pesticide application (Afshari et al., 2018). Farmers can become pesticide-contaminated while storing and handlining pesticides, preparing pesticide solutions, applying pesticides, and cleaning application equipment (Yarpuz-Bozdogan, 2018). The recommended spraying position must take into account the wind and weather conditions (Linhart et al., 2019). Spraying in the opposite direction of the wind is prohibited under RI Menaker Regulation No. Per/03/ MEN/1986. Using the IPM concept via the six right principles (6T) Pesticide application (as presented by the Directorate General of Horticultural Production Development, name-ly, (1) the right on target, (2) the right quality, (3)the right type of pesticide, (4) the right time, (5) the right dose or concentration, and (6) the right method of use to minimize the use of chemical pesticides and chemical residue in the environment (A'yunin et al., 2020).

According to spraying method research conducted in Kanreapia Village, Buttonopao District, Gowa Regency, there is a link between the spraying method and pesticide intoxication symptoms. This is consistent with Herdianti (2018) study on the relationship between pesticide spraying and poisoning symptoms in pineapple farmers. The p-value for the statistical test discovered was 0.028 < 0.05, indicating a significant correlation between spraying and pesticide poisoning symptoms experienced by pineapple farmers. This corresponds to the research findings obtained with a p-value of 0.05.

Personal hygiene plays an important role in reducing pesticide use's harmful effects on farmers (Saftarina et al., 2022). Farmers who use pesticides must ensure that there are no pesticide residues on their bodies, clothing, or other farm equipment. This knowledge improves awareness of official pesticide handling recommendations and attitudes toward preventive action (Riccò et al., 2018). Based on research (Herdianti, 2018) on pineapple growers' hygiene and signs of pesticide toxicity. The statistical test results indicate that there is a difference between the proportion of personal hygiene and symptoms of pesticide poisoning. As a result, there is a strong link between personal hygiene and pesticide poisoning symptoms.

Because of the minimal use of PPE, personal protective equipment (PPE) is privileged in many countries' safety interventions (Garrigou et al., 2020; Sombatsawat et al., 2022). Personal protective equipment (PPE) is a collection of tools workers use to protect all or part of their bodies from potential workplace hazards (Joko et al., 2020). Concerning proper personal

protective equipment, the government issued government regulation No.7 of 1973 and Minister of Agriculture Regulation No.429 of 1973.

A significant result was obtained based on the statistical analysis of the assessment of personal protective equipment performed by vegetable farmers in Kanreapia Village, Buttonopao District, Gowa Regency. This demonstrates that personal protective equipment is associated with pesticide intoxication symptoms, implying that if farmers spray using PPE that meets the requirements, they can avoid pesticide intoxication symptoms. This study employed a cross-sectional analytical survey based on Oktaviani and Pawira's (2020) research for observing the Risk to Greenhouse Farmers of Pesticide Poisoning Symptoms. They found a connection between pesticide poisoning and the use of personal protective equipment and the significance of the relationship between PPE use. This corresponds to the research findings obtained with a p-value greater than 0.05. In theory, the longer a farmer is exposed to pesticides, the greater the possibility of pesticide residues in his blood and the more severe the symptoms of intoxication.

CONCLUSIONS

The study found that there was a relationship between pesticide intoxication symptoms and spraying methods, personal hygiene, and personal protective equipment (PPE) in vegetable farmers who use pesticides. This study also did not find a link between the length of work, years of service, and symptoms of intoxication experienced by pesticide-using vegetable farmers. Muscle aches, headaches, and dizziness were the most common symptoms of pesticide intoxication. This study revealed symptoms of intoxication in vegetable farmers who use pesticides, which served as the foundation for farmer health interventions. The study's limitation is that it did not measure the level of toxicity in the blood or the bioavailability of the poison in the body. The findings of this study recommend that farmers pay attention to wind direction when spraying, i.e., do not spray against the wind; farmers must pay attention to personal hygiene, i.e., clean themselves (using soap) from pesticides that come into contact with the body for no more than 1 hour after finishing spraying. Farmers must use personal protective equipment (PPE) in accordance with the provisions that have been set. Farmers should use community health services and obtain enough rest if they experience emotional issues after spraying. To reduce pesticide poisoning in the body, vegetable farmers must pay close attention to the correct application of pesticides.

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AUTHORS' CONTRIBUTIONS

Habibi Habibi: Design of study, formulated research questions, wrote and edited drafts, collected and analyzed data. Agussalim Bukhari collected, reviewed and edited of manuscript drafts. Muhammad F. Naiem designed statistical methods, and analyzed. The author(s) read and approved the final manuscript.

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COMPETING INTERESTS

The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

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