Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences. 2022 Mar 29; 10(E):506-510.
https://doi.org/10.3889/oamjms.2022.8948
eISSN: 1857-9655
Category: *E - Public Health*
Section: *Public Health Epidemiology*

The Risk Factors and Pesticide Poisoning among Horticultural Farmers: A Pilot Study in Indonesia

Fitria Saftarina[1]*, Jamsari Jamsari[2], Masrul Masrul[3], Yuniar Lestari[4]

[1]Doctoral Program of Public Health, Faculty of Medicine, Universitas Andalas, Padang, Indonesia; [2]Department of Agrotechnology, Faculty of Agriculture, Universitas Andalas, Padang, Indonesia; [3]Department of Nutrition, Faculty of Medicine, Universitas Andalas, Padang, Indonesia; [4]Department of Public Health and Community Medicine, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

Edited by: Sasho Stoleski
Citation: Saftarina F, Jamsari J, Masrul M, Lestari Y. The Risk Factors and Pesticide Poisoning among Horticultural Farmers: A Pilot Study in Indonesia. Open Access Maced J Med Sci. 2022 Mar 29; 10(E):506-510. https://doi.org/10.3889/oamjms.2022.8948
Keywords: Risk factors; Poisoning pesticide; Horticultural farmer; Indonesia
***Correspondence:** Fitria Saftarina, Doctoral Program of Public Health, Faculty of Medicine, Universitas Andalas, Padang, Indonesia. E-mail: fitriamd7@gmail.com
Received: 09-Feb-2022
Revised: 26-Feb-2022
Accepted: 27-Mar-2022

Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: Pesticide usage has become more common, resulting in negative consequences for the environment and human health. Pesticide poisoning data are still difficult to come by in Indonesia. This is due to a poor health reporting system, and attention to the health state of farmers has gone unnoticed as well.

AIM: The aim of the study was to determine the risk factors and pesticide poisoning among horticultural farmers.

METHODS: A cross-sectional study among horticultural farmers in Sumber Rejo and Gisting Districts, Tanggamus Regency, Lampung, Indonesia. Data were collected from May to June 2021. The inclusion criteria were farmers who used organophosphate and carbamate pesticides, farmers who were still actively working using pesticides, and farmers who sprayed 1−7 days before taking blood. Data collection was carried out using questionnaires and taking respondent's blood to determine pesticide poisoning. Sampling of horticultural farmers is done by means of multistage random sampling. Bivariate analysis was assessed using the Chi-square test and multivariate analysis was used logistic binary regression. Data analysis used SPSS software version 18.0.

RESULTS: There were significant association between amount of pesticides, topography, Hb levels, knowledge, attitude, behavior, frequency of spraying, personal hygiene, and use of PPE for pesticide poisoning among horticultural farmers ($p < 0.05$). The usage of inadequate PPE as a dominant factor for pesticide poisoning among horticultural farmers was confirmed by multivariate analysis (OR = 27.448, 95% CI 7.352−10.474).

CONCLUSION: Pesticide poisoning among horticulture farmers is primarily caused by the use of inadequate PPE. As a result, relevant stakeholders must educate farmers on the need of utilizing excellent and standard personal protective equipment (PPE).

Introduction

Occupational safety and health are at risk in farming production activities such as cultivating land, planting, maintaining plants, fertilizing, managing pests and diseases, harvesting, and post-harvest procedures. For example, spraying pesticides for pest control poses a very high risk to the safety and health of workers [1], [2].

The usage of pesticides is on the rise all around the world. Pesticides are used by 53.2% of people in Asia and 29.3% of people in America [3]. Meanwhile, Indonesia uses 1,597 tons of pesticides every year. Pesticide usage has become more common, resulting in negative consequences for the environment and human health [4].

Pesticides such diazinon, paraquat, dichlorvos, metam sodium, and dimethoate have been reported to cause acute and chronic health risks to farmers in the past. Pesticide toxicity has also been linked to cancer risk, neurotoxicity, pulmotoxicity, toxicity to the reproductive system, growth and development, and metabolic toxicity, according to other research. Organochlorine, organophosphate, and carbamate insecticides are indeed the principal source of poisoning [5], [6].

Pesticide poisoning has occurred in 500,000−1,000,000 people and has killed 5,000−20,000 people worldwide each year with two-thirds of these incidents occurring in developing countries [7]. Other data have shown an increasing trend of pesticide poisoning from 2011 to 2016. The poisoning occurs due to strong exposure and excessive and inappropriate use of pesticides [8]. Pesticide poisoning data are still difficult to come by in Indonesia. This is due to a poor health reporting system, and attention to the health state of farmers has gone unnoticed as well. The aim of the study was to determine the risk factors and pesticide poisoning among horticultural farmers.

Materials and Methods

Study design and research sample

This study was a cross-sectional study among horticultural farmers in Sumber Rejo and Gisting Districts, Tanggamus Regency, Lampung, Indonesia. Data were collected from May to June 2021. The inclusion criteria were farmers who used organophosphate and carbamate pesticides, farmers who were still actively working using pesticides, and farmers who sprayed 1−7 days before taking blood. The exclusion criteria were suffering from nocturnal hemoglobinuria, farmers with hypertension and diabetes mellitus, and refusing to take blood.

Data collection

Sampling of horticultural farmers is done by means of multistage random sampling. Farmers who met the inclusion criteria were given a history and examination of blood pressure, urine samples, and blood glucose at any time. Farmers were excluded from the study, if the results were an increase in blood pressure with 2× measurements at an interval of 15 min, urine found erythrocytes > 4−5 LPB, and GDS > 200 mg/dL. At the appointed time, farmers who have met the inclusion and exclusion criteria are gathered at the house of the head of the farmer group.

At the beginning, the researcher explained the aims and objectives and how to fill out the questionnaire and asked the farmers' willingness to become respondents by filling out the informed consent form. After farmers understand, the initial time, farmers are asked to fill out a questionnaire first. During filling out this questionnaire, two enumerators were accompanied by two people who understood how to fill out the questionnaire. The final check of the questionnaire before being collected by the enumerators was carried out to ensure that all questionnaires had been filled out completely and in accordance with the aims and objectives.

After the farmers had completed filling out the questionnaire, their weight, height, and blood pressure were measured. Furthermore, blood samples were taken using a tourniquet and injection syringe. The blood sample is put into the EDTA tube for the examination at the Duta Medika Laboratory in Bandar Lampung.

Ethical approval

This study was approved by the Faculty of Medicine, Universitas Lampung ethics committee (582/ UN26.18/PP.05.02.00/2020).

Operational definition

The dependent variable was pesticide poisoning status by measuring cholinesterase levels (poisoned, <4,620 IU/L; normal, 4,620−11,500 IU/L). The independent variables were the amount of pesticides (>1 pesticedes; 1 pesticide)), spatial/environmental characteristics; distance from land to settlements (<250 m; ≥250 m), distance from rivers to settlements (<250 m; ≥250 m), and topography (<600 meters above sea level (masl); ≥600 masl). Individual characteristics were as follows; age (<40 years; ≥40 years), nutritional status (underweight, 18.5 kg/m^2; normal, 18.5 kg/m^2; overweight, 23.0−24.9 kg/m^2; obese I, 25.0−30.0 kg/m^2; >30.0 kg/m^2), Hb levels (anemia, <13.00 gr/dL; normal, 13.0−17.5 gr/dL), smoking habits (heavy, >600 cigarretes/year; moderate, 200−599 cigarretes/year; mild, 0–199 cigarretes/year; and no smoking), and use of pesticides in the household (no exposed; and exposed). Occupational factors were as follows; length of work (≥5 years; <5 years), spraying time (>4 h/day; ≤4 h/day), and frequency of spraying (>2 times/week; ≤2 times/week). Factors of exposure behavior were as follows; knowledge, attitude, application behavior, post application, personal hygiene, and use of personal protective equipment (PPE).

Data analysis

Respondent characteristics were analyzed using frequency and percentage for categorical variables. Bivariate analysis hypotheses were assessed using the Chi-square test. Odd ratio values are interpreted as OR > 1 (risk factor), OR < 1 (preventive factor), and OR = 1 (reference). Multivariate analysis used logistic binary regression. $p < 0.05$ was considered statistically significant. Data analysis using SPSS software version 18.0.

Results

Respondent characteristics (Table 1).

Table 1 showed most of the respondents with aged ≥ 40 years (78.3%). More than half of the respondents location at Gisting districts (56.6%) had low level of education (64.6%) and low income (60.3%).

The risk factors and pesticide poisoning among horticultural farmers (Table 2).

Table 2 found that there were significant association between amount of pesticides, topography,

Table 1: Respondent characteristics

Variables	Categories	n (%)
Age (years)	≥40	148 (78.3)
	<40	41 (21.7)
Location	Gisting district	107 (56.6)
	Sumber Rejo district	82 (43.4)
Educational level	Low	122 (64.6)
	Moderate	59 (31.2)
	High	8 (4.2)
Income	Low	114 (60.3)
	Moderate	58 (30.7)
	High	17 (9.0)

Table 2: The risk factors and pesticide poisoning among horticultural farmers

Variables	Poisoned, n (%)	Normal, n (%)	Total, n (%)	p	OR	95% CI
Amount of pesticides						
>1	43 (27.9)	111 (72.1)	154 (100)	0.042*[a]	3.002	1.000–9.012
1	4 (11.4)	31 (88.6)	35 (100)			
Distance from land to settlements (m)						
<250	11 (26.8)	30 (73.2)	41 (100)	0.743	1.141	0.520–2.504
>250	36 (24.3)	112 (75.7)	148 (100)			
Distance from rivers to settlements (m)						
<250	35 (26.5)	97 (73.5)	132 (100)	0.425	1.353	0.642–2.850
250	12 (21.1)	45 (78.9)	57 (100)			
Topography (masl)						
≥600	6 (9.4)	58 (90.6)	64 (100)	0.000*[a]	0.212	0.084–0.532
<600	41 (32.8)	84 (67.2)	125 (100)			
Age (years)						
≥40	3 (16.7)	15 (83.3)	18 (100)	0.569	0.577	0.160–2.089
<40	44 (25.7)	127 (74.3)	171 (100)			
Nutritional status						
Underweight	21 (28.0)	54 (72.0)	75 (100)	0.419	1.316	0.675–2.566
Normal	26 (22.8)	88 (77.2)	114 (100)			
Hemoglobin levels						
Anemia	13 (40.6)	19 (59.4)	32 (100)	0.024*[a]	2.475	1.111–5.515
Normal	34 (21.7)	123 (78.3)	157 (100)			
Smoking habits						
Smoking	36 (27.3)	96 (72.7)	132 (100)	0.244[a]	1.568	0.732–3.357
No smoking	11 (19.3)	46 (80.7)	57 (100)			
Length of work (years)						
≥5	46 (25.6)	134 (74.4)	180 (100)	0.455	2.746	0.334–22.554
<5	1 (11.1)	8 (88.9)	9 (100)			
Use pesticide in the household						
Exposed	15 (32.6)	31 (67.4)	46 (100)	0.163[a]	1.678	0.808–3.487
No exposed	32 (22.4)	111 (77.6)	143 (100)			
Knowledge						
Not good	28 (36.8)	48 (63.2)	76 (100)	0.002*[a]	2.886	1.464–5.688
Good	19 (16.8)	94 (83.2)	113 (100)			
Attitude						
Negative	31 (35.6)	56 (64.4)	87 (100)	0.002*[a]	2.975	1.491–5.937
Positive	16 (15.7)	86 (84.3)	102 (100)			
Behavior						
Not good	34 (36.6)	59 (63.4)	93 (100)	0.000*[a]	3.679	1.789–7.567
Good	13 (13.5)	83 (86.5)	96 (100)			
Frequency of spraying (times/week)						
>2	12 (48.0)	13 (52.0)	25 (100)	0.004*[a]	3.402	1.427–8.113
≤2	35 (21.3)	129 (78.7)	164 (100)			
Spraying time (h/day)						
>4	2 (20.0)	8 (80.0)	10 (100)	1.000	0.744	0.152–3.635
<4	45 (25.1)	134 (74.9)	179 (100)			
Personal hygiene						
Not good	35 (38.0)	57 (62.0)	92 (100)	0.000*[a]	4.349	2.082–9.084
Good	12 (12.4)	85 (87.6)	97 (100)			
Use of PPE						
Not good	44 (47.8)	48 (52.2)	92 (100)	0.000*[a]	28.722	8.479–97.299
Good	3 (3.1)	94 (96.9)	97 (100)			

*p < 0.05, considered significant; ap<0.25, multivariate analysis. PPE: Personal protective equipment, CI: Confidence interval, OR: Odds ratio

Hb levels, knowledge, attitude, behavior, frequency of spraying, personal hygiene, and use of PPE for pesticide poisoning among horticultural farmers ($p < 0.05$).

Furthermore, amount of pesticides, topography, Hb levels, smoking habits, use pesticide in the household knowledge, attitude, behavior, frequency of spraying, personal hygiene, and use of PPE continued to multivariate analysis to known dominant factor for pesticide poisoning among horticultural farmers.

The dominant factor for pesticide poisoning among horticultural farmers (Table 3).

Table 3 showed use of PPE as dominant factor for pesticide poisoning among horticultural farmer (OR = 27.448, 95% CI 7.352-10.474).

Discussion

There were significant association between amount of pesticides, topography, Hb levels, knowledge, attitude, behavior, frequency of spraying, personal hygiene, and use of PPE for pesticide poisoning among horticultural farmers. Pesticide poisoning among horticulture farmers is primarily caused by the use of inadequate PPE. As a result, relevant stakeholders must educate farmers on the need of utilizing excellent and standard personal protective equipment (PPE).

Pesticide exposure has become a growing environmental health concern across the world. Farmers are more vulnerable to pesticide poisoning due

Table 3: The dominant factor for pesticide poisoning among horticultural farmers

Variables	B	SE	Wald	df	p	Exp(B)	95% CI	
							Lower	Upper
Amount of pesticide	1.138	0.777	2.145	1	0.143	3.121	0.680	14.318
Topography	−1.473	0.620	5.634	1	0.018	0.229	0.068	0.774
Hemoglobin levels	0.057	0.617	0.009	1	0.926	1.059	0.316	3.549
Smoking habits	0.113	0.559	0.041	1	0.840	1.119	0.374	3.349
Use of pesticide in the household	0.173	0.521	0.110	1	0.740	1.189	0.428	3.304
Knowledge	0.104	0.472	0.048	1	0.826	1.109	0.440	2.798
Attitude	1.262	0.493	6.561	1	0.010	3.534	1.345	9.285
Behavior	0.629	0.603	1.086	1	0.297	1.876	0.575	6.121
Frequency of spraying	0.780	0.637	1.497	1	0.221	2.181	0.625	7.604
Personal hygiene	0.642	0.551	1.359	1	0.244	1.901	0.646	5.595
Use of PPE	3.312	0.672	2.288	1	0.000	27.448	7.352	10.474
Constant	−7.383	2.651	7.759	1	0.005	0.001		

PPE: Personal protective equipment, CI: Confidence interval, SE: Standard error to a lack of understanding about how to use pesticides safely and effectively [1], [9]. Pesticide poisoning is also one of the world's most serious issues.

According to a research, the WHO classifications I and II pesticides accounted for 50% of the pesticides applied. According to the findings of the study, 88% of respondents experienced acute poisoning, which was found to be substantially connected to the length of employment [6]. In a research conducted in Yogyakarta, Indonesia, farmers poisoned with organophosphate insecticides had health issues such as tremors [10]. Poisoning from organophosphate pesticides can be both acute and chronic. Pesticide poisoning can result in a variety of health issues. Headache, impaired vision, chest discomfort, increased perspiration, and other muscarinic symptoms are among them [6].

The gap between Indonesian farmers' understanding and application of good agricultural practices (GAP) for safe pesticide use has been infrequently mentioned in the scientific literature, and empirical data are missing; the present study intends to fill that gap. An examination of the knowledge-practice gap, on the other hand, may not be adequate to generate suggestions for improving GAP implementation at the farmer level. To add to the topic, this study uses an importance–performance analysis (IPA) method. IPA can reveal crucial issues that need greater attention and discover prospective resources that may be used more efficiently. The IPA model can assist in identifying areas where resources should be wisely allocated [11], [12].

The limitations of this study extrapolated to characterize the pesticide-related behavior of all Indonesian farmers due to the small sample size and the selective sampling approach utilized. Other farmers who were not sampled in this study may behave differently. Furthermore, memory-related side-holding was a restriction in this study, beccause respondents had to rely on their recollections to recall their pesticide-use practices from the previous planting season.

Farmers may become acutely poisoned if they use pesticides without wearing the proper PPE. Uncomfortable bodily issues are a warning indication that the body is not in excellent shape. As a result, pesticide exposure must be closely managed to avoid the harmful effects of poisoning.

Conclusion

There were significant association between amount of pesticides, topography, Hb levels, knowledge, attitude, behavior, frequency of spraying, personal hygiene, and use of PPE for pesticide poisoning among horticultural farmers. Pesticide poisoning among horticulture farmers is primarily caused by the use of inadequate PPE. As a result, relevant stakeholders must educate farmers on the need of utilizing excellent and standard personal protective equipment (PPE).

Acknowledgments

The authors would like to thank the participants who have participated in this research.

References

1. Zhang X, Wu M, Yao H, Yang Y, Cui M, Tu Z, *et al*. Pesticide poisoning and neurobehavioral function among farm workers in Jiangsu, People's Republic of China. *Cortex*. 2016;74:396-404. https://doi.org/10.1016/j.cortex.2015.09.006
PMid:26475098
2. Thundiyil J, Stober J, Besbelli N, Pronczuk J. Acute pesticide poisoning: A proposed classification tool. Bull World Health Organ. 2008;86(3):205-9. https://doi.org/10.2471/blt.08.041814
PMid:18368207
3. Zhang Y, Dong T, Hu W, Wang X, Xu B, Lin Z, *et al*. Association between exposure to a mixture of phenols, pesticides, and phthalates and obesity: Comparison of three statistical models. Environ Int. 2019;123:325-36. https://doi.org/10.1016/j.envint.2018.11.076
PMid:30557812
4. Joko T, Dewanti NA, Dangiran HL. Pesticide poisoning and the use of personal protective equipment (PPE) in Indonesian farmers. J Environ Public Health. 2020;2020:5379619. https://doi.org/10.1155/2020/5379619
PMid:32405302
5. Nabih Z, Amiar L, Abidli Z, Windy M, Soulaymani A, Mokhtari A, *et al*. Epidemiology and risk factors of voluntary pesticide poisoning in Morocco (2008-2014). Epidemiol Health. 2017;39:e2017040. https://doi.org/10.4178/epih.e2017040
PMid:28882026
6. Jensen HK, Konradsen F, Jørs E, Petersen JH, Dalsgaard A. Pesticide use and self-reported symptoms of acute pesticide poisoning pesticide use and self-reported symptoms of acute pesticide poisoning among aquatic farmers in Phnom Penh, Cambodia. J Toxicol. 2011;2011:639814. https://doi.org/10.1155/2011/639814
PMid:21234245
7. Hadian Z, Samira S, Yazdanpanah H. Pesticide residues analysis in Iranian fruits and vegetables by gas chromatography-mass spectrometry. Iran J Pharm Res. 2019;18(1):275-85. PMid:31089362
8. Mostafalou S, Abdollahi M. Pesticides: An update of human exposure and toxicity. Arch Toxicol. 2017;91(2):549-99. https://doi.org/10.1007/s00204-016-1849-x
PMid:27722929
9. Okoffo ED, Mensah M, Fosu-Mensah BY. Pesticides exposure and the use of personal protective equipment by cocoa farmers

in Ghana. Environ Syst Res. 2016;5(17):1-15.

10. Perwitasari DA, Prasasti D, Supadmi W, Amelia S, Jaikishin D, Wiraagni IA. Impact of organophosphate exposure on farmers' health in Kulon Progo, Yogyakarta: Perspectives of physical, emotional and social health. *SAGE Open Med*. 2017;5:1-6. https://doi.org/10.1177/2050312117719092 PMid:28839934
11. Matthews GA. Attitudes and behaviours regarding use of crop protection products – A survey of more than 8500 smallholders in 26 countries. Crop Protect. 2008;27:834-46.
12. McLeay F, Robson A, Yusoff M. New applications for importance-performance analysis (IPA) in higher education: Understanding student satisfaction. J Manag Dev. 2017;36(6):780-800.