Risk of Pesticides on Anaemia Events in Horticulture Farmers

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Exposure to pesticides is thought to have an effect on anaemia, but the results are not consistent in various studies. The study was conducted on 155 women of childbearing age who worked on horticultural agriculture in three different regions, to determine the risk of pesticide exposure to anaemia. Measurements were made on the activity of the cholinesterase enzyme, haemoglobin, nutritional status, duration of exposure, and protective use. A total of 13 people experienced poisoning and 35 people suffered from anaemia. Statistical results showed that the risk of pesticide exposure to anaemia was 6.12 times (95% CI = 1.81 - 20.73), and with the use of protective equipment was 3.17 times (95% CI = 1.12 - 8.98). Exposure to pesticides will increase the risk of anaemia in women who work on horticultural agriculture. This research provides useful information regarding pesticide exposure in horticultural agriculture. Indiscriminate use of pesticides must be assessed regularly and agricultural workers must be trained for safe use of pesticides.

Keywords: *Anaemia, Pesticides, Cholinesterase, Horticulture.*

Introduction

The use of pesticides by farmers often causes health problems, both for farmers and people who consume these agricultural products. Each year it is estimated that there are up to 5 million cases of pesticide poisoning, with 220,000 deaths (Apoina Kartini, et. Al, 2019). The main effects of excessive exposure to organophosphates and organocarbamat are symptoms of the nervous system such as headaches, dizziness, paresthesia, tremors, discoordination and seizures. This type of pesticide inhibits the enzyme acetylcholinesterase, which leads to the accumulation of acetylcholine in nerve tissue and in vector organs. Chronic effects are weight loss, anaemia, anorexia, impaired liver function, and delayed neuropathy (Agustina & Norfai, 2018; Arwin & Suyud, 2016; Azmi, Naqvi, Azmi, & Aslam, 2006; Britt & Budinky A, 2000; Fauziyyah , Suhartono, & Astorina, 2017; Kartini et al., 2019; Nassar, Salim, & Malhat, 2016; Neghab, Jalilian, Taheri, Tatar, & Hajj Zadeh, 2018; Okvitasari, Anwar, & Suparmin, 2016; Patil, Patil , & Govindwar, 2003; Prasetyaningsih, Arisandi, & Retnosetiawati, 2017; Sihana, Dawson, & Buckley, 2019; Yusuf & Pratami, 2010).

The biggest user of pesticides is horticultural agriculture in which in large doses are used continuously during the growing season so that there is a risk of poisoning. Measurement of poisoning level is based on the activity of the enzyme cholinesterase in the blood (Britt & Budinky A, 2000).

Anaemia is marked by reduced color, number or size of red blood cells. In pesticide poisoning, *sulfhemoglobin* and *methemoglobin* are formed so that the function of haemoglobin in delivering oxygen will be disrupted (Britt & Budinky A, 2000; George, Shaikh, Thomas, & Kundavaram, 2014; GS Nutakki, Madhav Makineni, & Madhukiran, 2016; G. Nutakki, Siripurapu, Kumar, & SasiSekhar, 2017; Pinkhas & All, 1963; Sihana et al., 2019). Anaemia during pregnancy increases the risk of bleeding, premature birth, infant death in the womb, stunted foetal growth, giving birth to babies with low birth weight and stunting, perinatal death and reduced body defence (Eskenazi et al., 2004; Jaacks et al., 2019; Petit et al., 2012, 2010; Whyatt et al., 2004).

East Lampung Regency is the largest horticultural agriculture area in Lampung Province with the largest income from the food agriculture and horticulture sector (53.81% PDRB). Agricultural land horticulture ± 1,254 hectares with a production of vegetables amounted to 237,500 tonnes (CBS, 2017). The prevalence of anaemia in pregnant women in 2016 and 2017 was 7.7% and 5.8%; greater than for the province in the same year, amounting to 4.7% and 4.9%.

Materials and How

The study aims to determine the risk of pesticide exposure to the incidence of anaemia in women aged 15-49 years who work in horticultural agriculture. The total sample was 155 WUS people spread in 3 districts of horticultural farming centres, namely Balik Bukit, Sukau, and Sekincau. The sample selection is done purposively. Data is collected by interviewing and measuring blood samples to assess haemoglobin and cholinesterase. Hb measurements were carried out in-situ, while Cholinesterase enzyme levels were measured at the Poltekkes Tanjung Karang Laboratory. The results of data collection were then analysed using SPSS 20.0 statistical software. The analysis technique used is the mean, proportion, chi-square, and logistic regression. This research has received Ethical Clearance from the Poltekkes Kemenkes of Tanjung Karang.

Results

The results of the study found that 42.6% of respondents were of poor nutritional status and the majority worked more than 5 hours per day (95.5%). Most respondents (87.1%) have worked more than 5 years in horticultural agriculture, and as many as 82.6% work in risky ways. APD is a tool to protect against exposure to pesticides. As a result, as many as 68.4% of respondents work with incomplete APD. This study found as many as 13 people (8.4%) showed poisoning status, marked by the level of the enzyme cholinesterase <3990 μ / L, while those who have low Hb are 35 people (33.6%) (Table 1).

We performed Chi-square analysis to determine the relationship of each independent variable with anaemia. The results of the analysis did not show a significant relationship on the nutritional status variables (p-value = 0.535), length of work (p-value = 0.228), years of service (p-value = 0.398), and ways of working (p-value = 0.477). Whereas the variables that showed a significant relationship with anaemia were APD (p-value = 0.022), and pesticide poisoning (p-value = 0.002).

Multivariate analysis is performed to determine the valid relationship and dominant variables between the independent variables and anaemia. The analysis found that the most dominant variable related to the incidence of anaemia in the study population was pesticide poisoning. The chances of anaemia in WUS who suffer poisoning are 6.12 times greater than those who are not poisoned, after being controlled by the variable APD use (95% CI = 1.81 - 20.73). While the use of incomplete personal protective equipment increases risk 3.17 times, after being controlled by the variable poisoning (95% CI = 1.12 - 8.98).

Discussion

APD is work equipment consisting of hats, goggles, masks, long sleeve clothes, gloves, trousers, and boots so that they are protected from exposure to pesticides. The results of the multivariate analysis found that the odds of having anaemia in WUS who worked not using APD completely were 3.17 times greater than those using complete APD, after being controlled by poisoning variables (95% CI = 1.12 - 9.89). The results of this study are in accordance with (Istianah. Yuniastuti, Ari. (2017), which has a significant relationship (p-value = 0.0001) between the use of APD and pesticide poisoning. Other studies also convey the same results (Arwin & Suyud, 2016 Azmi et al., 2006; Del Prado-Lu, 2007; Istianah. & Yuniastuti, 2017; Kapeleka, Sauli, Sadik, & Ndakidemi, 2019; Kurniasih, Setiani, & Nugraheni, 2013; Okvitasari et al., 2016; Prasetyaningsih et al., 2017)

In this study, it was seen that the majority of farmers worked without using a complete APD, namely clothes and trousers, and hats; the habit of not using APD at work was carried out continuously, including in mixing pesticides (Arwin & Suyud, 2016). Even when they wear

APD, they do not meet the requirements (Istianah. Yuniastuti, Ari. (2017). The low use of APD showed a lack of knowledge and understanding by farmers about the risks of exposure to pesticides (Fauziyyah et al., 2017).

The use of APD influences strongly the entry of pesticides into the body. There are several ways for pesticide entry into the body based on the Portal of Entry, which is through the skin, breathing, and digestion. The most common way is through the skin, and absorption will be more effective if there are skin disorders or sweat. Nasal poisoning is the second most common cause after skin contamination, with a proportion of 10% and 90% (Kurniasih et al., 2013).

Spraying pesticides is not based on indicative control, which is control based on the presence or absence of pests. Generally, spraying is carried out in a "Cover Blanket System", ie spraying is done even though there are no pests (Prasetyaningsih et al., 2017). This condition is exacerbated by spraying techniques, which sometimes go against the direction of the wind so that the farmer has a position as a perpetrator and a poisoner. As a perpetrator due to poor management and spraying methods, which endangers others. As sufferers, because they have high exposure to poisoning. Pesticide poisoning is also caused by unprotected body contact with pesticides (Kurniasih et al., 2013; Prasetyaningsih et al., 2017).

The entry of pesticide toxins through the skin, mouth, and respiratory tract will disrupt the work of the cholinesterase enzyme in the blood, which plays a role in delivering impulses along nerve fibres. Anaemia occurs in people with pesticide poisoning due to the formation of *sulfhemoglobin* and *methemoglobin* in red blood cells. *Sulfhemoglobin* occurs because of the high sulfur content in pesticides, thus forming bonds. Whereas *Methemoglobin* is formed when the iron in Hb is oxidised from Ferro to ferric; but it also can be caused by the bond between nitrite and Hb. *Sulfhemoglobin* and *methemoglobin* in red blood cells are irreversible and their presence causes a decrease in hemoglobin levels in red blood cells, resulting in hemolytic anaemia (Britt & Budinky A, 2000; George et al., 2014; GS Nutakki et al., 2016; Pinkhas & All, 1963; Sihana et al., 2019; Tarun, George, et al., 2014; Nutakki G, Sai, et al., 2016; Prasetyaningsih Y, et al., 2017).

The assessment of pesticide poisoning in the blood was measured using a kinetic method which was characterised by the reaction of potassium ferrocyanide to potassium ferithacide due to a reduction reaction, the reading of the results using a spectrophotometer at a wavelength of 405 nm. The results of the multivariate analysis found that the chance of anaemia in WUS who experienced poisoning was 6.12 times greater than those who did not experience poisoning, after being controlled by variable APD use (95% CI = 1.81 - 20.73).

Although it does not show a meaningful relationship, it is indicated that pesticide poisoning is also caused by working time, years of service, as well as poor working methods. The results found that the majority (95.48%) of workers in the horticultural agriculture sector worked more than 5 hours per day. In fact, the group of sharecroAPDrs (farm laborers) works up to 8 hours per day. The length of work time is related to the risk of poisoning. The longer the working time, the longer contact with pesticides, so the greater the risk of pesticide poisoning (Agustina & Norfai, 2018; Arwin & Suyud, 2016; Istianah. & Yuniastuti, 2017; Kapeleka et al., 2019; Kurniasih et al. ., 2013; Okvitasari et al., 2016; Rustia, Wispriyono, Susana, & Luthfiah, 2010).

The government has set a time to avoid poisoning due to pesticide exposure, through Permenaker No. Per-03 / Men / 1996 article 2 paragraph 21, which states that to maintain undesirable effects, it is recommended that workers who manage pesticides should not experience exposure > 5 hours a day and 30 hours a week. However, this regulation is very difficult in its implementation. Short work time will have an impact of a reduced income. Efforts should be made to increase farmers' knowledge and awareness of the risk of acute and chronic pesticide poisoning.

In line with the working time, the working period of farmers also looks homogeneous, that is, 87.5% have worked more than 5 years. This long working period in the agricultural sector is the main source of income for the family. This also indicates a high risk of chronic poisoning. The longer the work period, the higher the risk of poisoning (Agustina & Norfai, 2018; Arwin & Suyud, 2016; Istianah. & Yuniastuti, 2017; Kapeleka et al., 2019; Kurniasih et al., 2013; Okvitasari et al. , 2016; Rustia et al., 2010). Apart from anaemia, the effects of poisoning due to prolonged exposure are slow foetal growth and smaller baby head circumferences (Eskenazi et al., 2004; Petit et al., 2012, 2010).

Most horticultural farmers (82.58%) work with a high risk of exposure – spraying without paying attention to the direction of the wind, working near the area being sprayed, working without using APD in full, eating and drinking while working, and throwing away the packaging in any place. Poor work methods will increase the risk of pesticide poisoning (Del Prado-Lu, 2007; Istianah. & Yuniastuti, 2017; Kapeleka et al., 2019; Kurniasih et al., 2013). Increasing knowledge about the dangers of pesticides, pesticide management, and how to work well, is an effort that can be done to reduce the risk of pesticide toxicity.

Another variable that is thought to have contributed to anaemia in women of childbearing age who work in horticultural agriculture is nutritional status. Nutritional status is a measure of the condition of a person's body that can be seen from the food consumed and the use of nutrients in the body (Almatsier, 2010 in Pramesti, Andiyanti, & Effendi, 2017; Yogyakarta, 2011). The results found that almost half (42.6%) of respondents had poor nutritional status.

Nutritional status is related to protein-energy intake. Anaemia is the most common nutritional problem found in women of childbearing age due to Chronic Energy Deficiency (Azwar, 2004; Umisah & Puspitasari, 2017). Short-term impacts of KEK include anaemia, organ development is not optimal and physical growth is lacking, resulting in a less productive person. While the long term is a negative impact on the mother and foetus, which results in the process of foetal growth and can cause miscarriage, abortion, stillbirth, neonatal death, congenital defects, infant anaemia, intrapartum asphyxia and babies born with low birth weight (Umisah & Puspitasari, 2017).

Two intervention strategies can be undertaken to reduce the risk of anaemia in women of childbearing age who work on horticultural agriculture, namely the prevention of exposure and improving nutritional status. Prevention of pesticide exposure involves using complete APD so that the entry of pesticides into the body can be prevented. Nutritional interventions can be done by increasing the consumption of nutritious foods by consuming foods that contain lots of iron, vitamin C; increased iron intake by taking blood-boosting tablets; as well as checking and monitoring nutritional status to prevent the risk of KEK on WUS.

Conclusion

The results of the study show a strong indication that exposure to pesticides will increase the risk of anaemia in women who work on horticultural agriculture. This research provides useful information regarding the health effects of pesticide exposure in horticultural agriculture. Indiscriminate use of pesticides must be assessed regularly and agricultural workers must be trained for safe use of pesticides.

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Table 1. Distribution of Respondents by Research

Variable Variables		n	%
Nutritional Status	Poor	66	42.58
	Good	89	57.42
Length of Work	Poor	148	148.4
	Good	7	4.52
Long Work	Period	135	87.10
	New	20	12.90
Ways of Working	Poor	128	82.58
	Good	27	17.42
Use of APD	Less Complete	106	68.39
	Complete	49	31.61
Pesticide	Poisoning	13	8.339
	Normal	142	91.61
Anaemia Status	Anaemia	35	22.58
	Normal	120	77.42

Table 2. Relationship Between Variables

Variable			Anaemia		Normal		p-value	OR (95% CI)
			n	%	n	%		
Nutritional Status	1	Not Good	17	25.8	49	74.2	0.535	1.37
	2	Good	18	20.2	71	79.8		0.64 - 2.92
Long Working	1	Poor Good	31	21.2	115	78.8	0.117	0.34
	2	Good	4	44.4	5	55.6		0.09 - 1.33
Working Period	1	Length	29	21.5	106	78.5	0.573	0.64
	2	New	6	30.0	14	70.0		0.23 - 1.80
How it Works	1	Not Good	27	21.1	101	78.9	0.477	0.64
	2	Good	8	29.6	19	70.4		0.25 - 1,860
Use of APD	1	Not Good	30	30.3	76	71.7	0.022	3.47
	2	Good	5	10.2	44	89.8		1.26 - 9.20
Poisoning	1	Poisoning	85	81.5	27	38.5	0.002	6.82
	2	Normal	27	19.0	115	81.0		2.07 - 22.48

Table 3. Multivariate analysis results

ANAEMIA	B	SE	p-wald	OR	95% CI
APD Usage	1.155	22.666	0.030	3.17	1.12 - 8.98
Pesticide Poisoning	1.812	22.663	0.004	6.12	1.81 - 20.73
Constant	-2.310	22.663	0.000	0.10	

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