



Association Of Pesticides Exposure With Leukocyte Level In Women Farmers In Bandungan Village, Bandungan Sub District, Semarang Regency

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Abstract- Leukocytes were one component of blood profile. Blood profile included leukocyte levels was one of the impacts of pesticide exposure. Bandungan village was a horticultural area that used pesticides. In this area, most women farmworkers of childbearing age which make them having great risk to have abnormalities of blood profile included leukocyte levels. Pesticide exposure among women farmworkers, and even less is known about the exposure associated with performing specific farm tasks. Using a random sample of 54 farmworkers in Bandungan Village, Semarang Regency. This study examined the association between pesticide exposure residues and leukocyte levels in blood samples of women farmworkers. This research was a type of observational analysis research. Research draft used cross-sectional study. This

research is conducted by conducting sampling and screening of blood samples, physical examinations, anthropometry measurements, interviews, and observations. Based on analyzed used chi square test and rank spearman test commonly reported farm tasks were length of work (p value=0,018 $r= 0,321$), spraying frequencies (p value= 0,034 $r= 0,289$), quantity and types of pesticides (p value= 0,049, CI 95%= 0,796-61,525), and using of personal protective equipment (p value= 0,008 CI 95%= 1,351-105,545), associated with increased of leukocytes differential count. The result of logistic regression analysis showed that using of PPE associated with increased of leukocytes differential count ($p=0,004$, RP=7,50, 95% CI=1,92 to 29,29). Conclusion of the findings showed relation between pesticides exposure and increased of leukocytes differential count. This study can be used to give information about pesticide reduction programs and health impacts of using pesticide in agricultural areas.

Keywords: pesticide, women farmworker, leukocytes.

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Introduction

According to WHO, worldwide, an estimated three million cases of pesticide poisoning occurred annually resulting in more than 250,000 deaths. Intentional and unintentional pesticide poisoning has been recognized as a serious problem in many farms of low-income communities and the middle countries, including China, India, Sri Lanka, and Vietnam (World Health Organization, 2004). Blood profile disorder is one of the Impacts of pesticide exposure. The health assessment Status of one person is determined from the blood profile which is an important component. Age, gender, nutritional status, and environment are factors that can affect a person's blood profile. Blood profile is one of the important components in health assessment, development of a treatment, infectious diseases, blood disorders and so forth. Pesticides are thought to be one of the environmental factors that also affect the blood profile. Some studies have shown the influence of pesticide exposure on blood profiles (Marinajati, 2012).

The influence of pesticide exposure to blood profiles is shown in some studies. According to the results of the study, the historical pesticide exposure associated with monocytes and neutrophil levels (Marinajati et al., 2012). The dominant factor against the number of leukocytes in the body mass index. As for neutrophil levels and lymphocytes levels, there is no dominant factor. In spraying, farmers acquired the influence of pesticide exposure to hematological parameters and obtained the results of research that showed a significant decrease in the increase in white blood cell levels (Nugraha et al., 2013).

High levels of white blood cells (leukocytes) in the body are indications of an increase in the production of cells to fight infections. The symptoms complained of are recurrent fever which is one of the signs of bacterial infection and also a marker of abnormalities from the white blood cells (Yang et al., 2016). When the bacterial infection process, leukocytes will automatically destroy the organism's Cause infections (phagocytosis). The increase in white blood cells is an indication of the presence of immune system disorders. The effects of high leukocytes include blood cancers (leukemia), bone marrow disorders, inflammation, recurrent fever, cramps, and spleen disorders, the onset of infectious diseases such as airway infections, typhoid, urinary tract infections, ears, typhoid, and skin infections can show the same thing (BPS (Badan Pusat Statistik), 2016).

Pesticides can cause abnormalities in blood profiles because suspected pesticides can disrupt the organs of the forming of blood cells, the process of forming blood cells and also the immune system. One of the risky groups is experiencing disruption to the profile Blood due to exposure to pesticides in agricultural areas are women of childbearing age (WUS) living in agricultural areas (Repetto R, 1996). This relates to their involvement in agricultural activities, such as planting, pesting, cultivating, watering, removing grass from crops, harvesting and helping to prepare pesticides. WUS involvement in agricultural activities was also found in Bandungan village as one of the horticultural centers in Bandungan district.

The agricultural area of Bandungan District is the expansion of the district of Ambarawa and Jambu Sub District in Semarang Regency with a very broad vegetable and flower farming commodity (Pemerintah Kelurahan Bandungan, 2018). Agricultural land area reaches 1184500 m² and for vegetables 2500 Ha with a total area of 48233 Km² (5.08% of Semarang Regency). The agricultural Area of Bandungan district is dominated by vegetable



farming such as cabbage, tomatoes, chili peppers, carrots and onions with pesticide use which reaches 30 types of pesticides circulating in agricultural land (BPS, 2018).

Exposure to pesticides can occur through 4 (four) routes, i.e. oral or ingestion (through the mouth and digestive system), ocular (through the eyes), dermal (through the skin), or inhalation (through the nose and respiratory system). The most prevalent form of exposure is through inhalation and skin, while accidental poisoning, most commonly occurring via dermal exposure (Ester, 2006).

Preliminary study results showed that farmers in Bandungan sub-district used the most pesticides from dinitroaniline (70%), Carbamate (60%), and organophosphate (35%) With successive formulations Kocide 45 WG, Antracol 70 WP, and Akron 500 EC. Besides, some womens participated in spraying plants using pesticides. Personal Protective Equipment (PPE) also increases the potential for direct contact with pesticides. The objective of this study is to determine the relation of pesticide exposure to incidents in farmers in the agricultural area of Bandungan District, Semarang Regency. Contributions from this study are to improve understanding that exposure to contaminants in the environment, especially pesticides, may exacerbate health conditions including affecting white blood cell levels.

Methods

This research was a type of observational analysis research. Research draft used cross-sectional study. This research is conducted by conducting sampling and screening of blood samples, physical examinations, anthropometry measurements, interviews, and observations. The material of this study is the trugal U photometric system, digital body scales, microtoise, digital tensimeter, questionnaire, dispossible and bevel. The population in the research is WUS, which is a farmer of 54 people residing in Bandungan village, Bandungan District. The village was chosen purposively with the consideration of horticultural production as well as the level of pesticide usage.

Results

3.1 Respondent characteristics

In this study, respondents came from Bandungan Village Bandungan District Semarang Regency. The village was chosen based on the horticultural farming production area. The respondent's age interval is between 21-49 years old with an average age of 36.22 years. All respondents were farmers, both owners of farmers and farmers.

3.2 Pesticide use

In this study found dozens of pesticide brands used by farmers for the protection of horticultural crops. The type of pesticide used consists of fungicide, herbicide, insecticide, growth regulator, and adhesive substance. Fungicides used include Carbamate, Dinitroanilin, acetaldehyde, Chloronitile, blown, Morfolin, herbicides used include glycine, while the insecticide used includes organophosphate, Avermectin, neonicotinoid, Pyretroid, trifluoromethyl, and natural pesticides. The most widely used type of pesticide is a fungicide, and the most widely used pesticide group is 19.33% Dinitroanilin. Different types of activities ranging from planting



season to harvest. Activities involving many respondents include planting crops, cultivating, binding crops, pulling grass, cutting.

Based on the results of the Rank Spearman test conducted on 54 respondents of women of childbearing age, from the results of the test obtained $p = 0.018$ with the value $R = 0.321$ So it can be known that there is a positive relationship between the length of work with the levels of leukocytes In respondents, it can be concluded that the longer the respondent is exposed to pesticides in one day, the higher the level of its leucocytosis.

Based on the results of the Rank Spearman test conducted on 54 respondents of women of childbearing age, from the results of the test obtained $p = 0.336$ with the value $R = -0.133$ so that it can be known that there is no relationship between the working period with the rate of leukocytes on respondents.

Based on the results of the Rank Spearman test conducted on 54 respondents of women of childbearing age, from the results of the test obtained $p = 0.034$ with value $R = 0.289$ so that it can be known that there is a positive relationship between spraying frequency with Levels of leukocytes in respondents, it can be concluded that the more often the respondent spraying the pesticide in one day, the higher the level of its leukocyte.

Table 3.1 Association of using PPE with leukocyte levels

PPE	Leukocyte levels			p	RP (95% CI)
	Abnormal n (%)	Normal n (%)	Total n (%)		
Incomplete	7 (29,16)	17 (71,84)	24 (100)	0,008	11,94 (1,351-105,545)
Complete	1 (3,33)	29 (97,67)	30 (100)		

From the test results of Chi-Square obtained the value $P = 0.008$ So it can be noted that there is a relationship between the use of APD with the rate of leukocytes. The relationship between the number of types of pesticides with the level of leukocytes from Chi-Square test results obtained the value $P = 0.049$ so it can be known that there is a relationship between the use of PPE with the rate of leukocytes From the test results of Chi-Square obtained the value $P = 0.049$ so it can be noted that there is a relationship between the use of PPE with the rate of leukocytes.

Table 3.2 Association between qount and type of pesticides with leukocyte level

Qount and type of pesticides	Leucocyte level			P	RP (95% CI)
	Abnormal n (%)	Normal n (%)	Total n (%)		
≥ 3	7 (23,33)	23 (77,67)	30 (100)	0,049	7,000 (0,796-61,525)
< 3	1 (2,44)	23 (98,56)	24 (100)		

From the test results of Chi-Square obtained the value $P = 0.054$ so it can be noted that there is no link between agricultural activity and the rate of the respondent leukocytes.



Table 3.3 Association between agricultural activity with leukocyte levels

Agricultural Activity	Leucocytes level			P	RP (95% CI)
	Abnormal	Normal	Total		
	n (%)	n (%)	n (%)		
Risk	5 (20,83)	19 (80,17)	24 (100)	0,54	2,368 (0,504-11,125)
No Risk	3 (10)	27 (90)	30 (100)		

Based on the results of bivariate analysis indicates that statistically meaningful variables will be selected into the next model which will be analyzed jointly by multivariate analysis to determine the factors that The most dominant or influential variable of free variables to the bound variable i.e. the levels of white blood cells. Use of logistic regression test with the enter method. Variable free meaning of the results of a bivariate analysis of the variable bound to be used as a candidate in the logistic regression test, among others, the use of APD and the number of pesticides.

Table 3.4 Exposure of pesticides to the level of leukocytes in women farmers in the fertile age of Bandungan Sub District, Semarang Regency

No	Variable	B	Wald	Sig	Exp (B)	95% CI
1.	PPE	2,409	4,683	0,03	0,9	0,01-0,797
2.	Qount and type of pesticide	17,907	0,000	0,999	0,00	0,00-0,000
	Constante	19,428	0,000	0,069	0,999	

Discussion

Exposure to pesticides in the study consisted of working time, length of work, frequency of spraying of crops, number of types of pesticides, use of PPE, and agricultural activities. The length of work states the amount of time per week used by respondents to work in paddy fields. Besides the standard of the International Labour Organization (ILO), which is for workers who work for 6 (six) days, the duration of the daily work is 40 long work/week. Based on the information from respondents, the average of them began working in the rice fields from 7 am to 12 noon and resumed from 2 to 5 pm. The results of this study indicate there is a relationship between the length of work with the level of white blood cells $P = 0.018$ with the value $R = 0.321$.

The results of this study were in line with the research conducted by Del Pradou-Lu in Trinidad on floral farmers. The results showed that farmers who were exposed to an average of 3 hours per day had significant connections to the number of leukocytes (p -value = 0,025) (Saftarina & Suwarni, 2010). In the study the farmers exposed 30 minutes to 4 hours per day, with an average of 3 hours. They are exposed to about 1 to 4 days per week or an average of a half day exposed to pesticide exposure. While the research is based on the results of the study of 54 respondents, obtained an average length of work respondents 7 hours, at least 3 hours and a maximum of 8 hours in a day. So it can be concluded that the average length of work per day on this research is more so that in line with the research.



The longer the exposure of pesticides increasingly, the higher the amount of pesticides that are absorbed into the body. In research conducted by Fitria in Bandar Lampung shows that there is no relationship between the length of work with the levels of leukocytes (Lebailly, 2003). This is due to pesticides used are organophosphate and carbamate so that at intensity High will be degraded, while the research uses dozens of different types of pesticides such as Avermectin, Mancozeb, and Profenofos so that these types of pesticides are not easily described by the body. This is in line with the study conducted by Pradou-Lu, because the type of pesticide used is also the same.

The work period indicates the amount of time in a person's unit is working as a farmer. The longer a person works as a farmer and followed by his activity at risk of being exposed to pesticides then this can be said to be a chronic exposure. The results of this study showed no relationship between the length of work with white blood cell levels ($P = 0.336$ with a value of $R = -0.133$). These results can be possible because in women of childbearing age there is recovery from exposure to pesticides such as in the study of exposure to sublethal doses of cypermethrin and carbofuran in fish *Labeo rohita*. White blood cells undergo recovery from cypermethrin on days to 60, 62.7 and 63.3 with a dose of cypermethrin as much as 0.16, 0.4, and 0.8 MI/L, whereas in carbofuran white blood cells undergo recovery on a day to 77, 77.6 and 79.3 at a dose of carbofuran As much as 0.06, 0.15, and 0.3 MI/L.

The results of this study in line with the research conducted by Del Prado Lu, Research conducted in Trinidad on the farmer's interest that has an average working period of more than 12 years has no meaningful relationship with the level of white blood cells (Lebailly, 2003). This research is also in line with the research of Fitria in Bandar Lampung where there is no working time relationship with leukocytes ($P\text{-value} > 0.05$). The exposure to the pesticides of the organophosphate group and Carbamat is easily described by the body. The two groups will be relegated several hours to several hours to several hours to several weeks, and only a certain type lasts for 3 months. Thus, although the workforce has long been exposed to pesticide organophosphate and carbamate, it is not detected in blood specimen examination. But the research done by Lu et al, the blood has the smallest accumulation, the biggest accumulation is the tissue of fat, brain, and kidneys. According to Lebailly et al, on farmers exposed to pesticides, it has a normal number of leukocytes but DNA damage to the nucleus of white blood cells (Brown et al., 1990). Thia research conducted in Lowa and Minnesota indicates the value of OR is not related to the length of work. The value $OR = 1.3$ is in the lifetime of 1-9 years, while the lowest risk is shown the value of $OR = 0.9$ in respondents with a working period of more than 45 years (De Roos et al., 2003).

The number of pesticide types is the number of pesticides used by respondents in every spraying plant. Farmers in Bandungan Village average mix 2 to 6 types of pesticides which is a mixture of fungicide, Insectida, and adhesive. In a single spraying plant, farmers can mix 2 types of insecticide and or 2 types of fungicide added with adhesive. The results showed there was a link between the number of pesticide types used with leukocyte levels. This is in line with the research conducted by De Roos shows the more pesticides used, the greater the exposure on farmers (Suwarni, 1997). This can result in a change in the amount on the blood component including white blood cells. In the study, the mixture used more than 4 types of pesticides and the types of pesticides used among others carbofuran and carbaryl are equally kind on this research.



Pesticides used by farmers in Bandungan village consist of several mixtures of different groups, for example, Organophosphate or pyrethroid mixed with Carbamate. The active ingredient pesticide used by farmers in Bandungan subdistrict Bandungan District is propineb 70%, copper hydroxide 54%, sodium Ortho nitrophenol 2 g/L, sodium para nitrophenol 3 G/L, sodium 5 Nitroguaiacol 1 g/L, chlorothalonil 500 g/L, Asibenzolar S-Methyl 1%, Mankozeb 48%, Dimetomorf 50%, Profenofos 500 g/L, abamectin 18 g/L, imidacloprid 100 g/L, imidacloprid 200 g/L, chlorpyrifos 200 g/L, Deltamethrin 25 g/L, Chlorantraniliprol 50 g/L, cypermethrin 100 g/L, Etefon 100 g/L, and Rodhapex LSB 90%. The active ingredients are from the Karbamat group, Dinitroanilin, Anilide acetaldehyde, Chloronitrile, Raviocarbat, Organomangan, Morfolin, glycine, organophosphate, Avermectin, neonicotinoid, organophosphate, Piretroid, and Trifluoromtil. The number of pesticides used, causing varied exposure to the body, with the consequences of synergically reactions that can cause interference or disease induced by pesticides (Carey, 2013).

Exposure to pesticides can be seen from the frequency of spraying plants performed by respondents. Farmers who often spray plants using pesticides have the possibility of direct contact with pesticides higher than those who do not spray crops. Based on the observation that has been done shows that before spraying the plant, farmers will prepare pesticides, take them to the rice fields, and mix and blend pesticides. The results showed there was a meaningful link between the frequency of spraying plants with white blood cell levels $P = 0.034$ with a value of $R = 0.289$.

These results are consistent with the research conducted by Fitria indicating the frequency of spraying has a significant relationship ($P < 0.05$) (Suwarni, 2010). The more often the spraying frequency than the greater the exposure. Based on the results of the research, farmers will be spraying more often during the rainy season. This is because in the rainy season the pest attack will be more. Besides, rainwater will soften the pesticides so that pesticides will be used more by increasing its intensity as well. Pesticides that are sprayed with high frequencies will pollute the environment because of the hoarding of pesticide residues in the soil. The more often the pesticides are applied hence the development of resistance will be faster, as well as more pesticides that enter the body.

The use of APD when spraying is very influential in the number of entry of pesticide particles into the farmer's body. Pesticides can be absorbed into the body through the epidermis. The average skin cells measuring 25-40 μm . Absorption rate can also be affected by higher skin temperature. Higher temperatures will also increase the blood flow of the skin, which causes the circulation of pesticides in the body (Kim, 2017). The level of relative absorption of palms. The skin has a certain metabolic capacity as well as contains a very active enzyme especially against exposure to chemical substances in the environment (Damalas & Koutroubas, 2016).

The results of the Chi-Square statistical test obtained the value of $P\text{-value} = 0,014$, proven that there is a meaningful relationship between the use of APD with white blood cell levels. Various types of APD can be used in the handling of pesticides to limit dermal exposure. The type of APD that can be used to restrict the exposure to dermal pesticides such as gloves, boots, long sleeve shirts, and headgear (Caps/caping). Use of gloves and boots to be a minimum PPE that can be used to prevent exposure to pesticides.



A study reported that gloves were found to be the most effective method of protection against exposure of pesticides on citrus farmers in the United States. The use of gloves is shown to reduce exposure to pesticides through the skin by 27% and can reduce dermal exposure by 65% when used with long-sleeved shirts and trousers.

Of the 54 respondents, amounting to 40.7% of the plant spraying. Usually, women farmers in this research area spray crops directly if their husbands do other jobs like helping other farmers, or other jobs outside their area. The results of this study showed no link between agricultural activity and levels of leukocytes (p -value = 0.265). This is due to the farming activities performed by respondents tend to be uniform. That is, all respondents do the same activity except in preparing and making pesticides and spraying plants using pesticides. Spraying plants done by peasant women does not indicate that any time spraying the plant is done by women. Women farmers sprayed crops when their husbands could not or were unable to spray due to illness, work in other areas, or other activities. However, respondents had the same potential exposure because as husbands sprayed crops, women farmers still went to the rice fields to perform other farming activities such as plucking the grass, cutting leaves and plant stalks, and tying Crop on the chase.

Based on the logistic regression test shows the most influential variables on the incidence of type 2 diabetes in women farmers in the Bandungan sub-district of Semarang Regency, the use of APD (P -value = 0.03). This analysis acquired the relationship between the free variables and the bound variable indicating a value-2 log likelihood of 37.743, the value of Cox & Snell R Square by 0.131, and the overall percentage value of 85.2%. The value indicates that there are 14.8% of cases due to other risk factors. Ability to predict increased leukocytes incidence of 85.2%.

Women farmers actively work in agricultural areas and have a high potential for pesticide exposure. One of them is due to the incomplete use of personal protective equipment (PPE). The APDS are routinely used by women farmers namely head coverings (hoods and capping), long-sleeved shirts, trousers, and boots and some use gloves and masks.

Conclusion and Recommendation

Based on the results of research and discussion that has been done to analyse the relationship between exposure of pesticides to the level of white blood cells to women farmers in the village Bandungan sub district Bandungan Semarang District, then it can be concluded As that there is a meaningful relationship between the length of work with the level of white blood cells, the amount of pesticide used with white blood cell levels, the frequency of spraying plants with white blood cell levels, the use of APD with the rate of cells White blood on women farmers in the horticultural farm area Bandungan Sub district Bandungan District Semarang. From the results of multivariate analysis, the use of APD is the most influential variable with the level of white blood cells in women farmers in the horticultural farming area of Bandungan subdistrict of the district of Semarang. Overall percentage value indicates that there are 14.8% of cases due to other risk factors. Ability to predict increased leukocytes incidence of 85.2%.



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