



Pesticide Exposure History As A Risk Factor for Preeclampsia in Pregnant Women in The Farming Area of The Bandungan District in Semarang Regency

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Abstract

Preeclampsia is a collection of symptoms that occur in pregnant women characterized by the onset of hypertension accompanied by proteinuria and edema in pregnancy after the age of 20 weeks or immediately after childbirth. About 50,000 women per year worldwide died of preeclampsia. Some studies

report that women who are exposed to pesticides or work in the agriculture sector have a risk of preeclampsia. The study used case-control, involving 30 case group respondents and 30 control group respondents in Bandungan district. The variables studied were a history of pesticide exposure (pesticide exposure level, pesticide type used, number of pesticide groups used, pesticide storage and farmer farming activity) with preeclampsia incidence. Analysis using the chi-square test. The results showed an association between the number of pesticide groups ($p = 0,020$), pesticide-type variables ($p = 0,010$) and pesticide storage variables ($p = 0,006$). The results of multivariate analysis with logistic regression analysis and variable of pesticide exposure are more dominant in the incidence of preeclampsia is storing of pesticide ($p = 0,049$ OR = 3,640 CI 95% = 1.007 – 13.159)

Keywords: preeclampsia incidence, history of pesticide exposure, Semarang

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Introduction

Preeclampsia is the main cause of maternal and infant morbidity and mortality. About 50.000 women per year worldwide died of preeclampsia. Preeclampsia is a collection of symptoms that occur in pregnant women characterized by the onset of hypertension accompanied by proteinuria and edema in pregnancy after the age of 20 weeks or immediately after childbirth. The uncontrolled development of preeclampsia contributes greatly to the high mortality rate of mothers during pregnancy or maternity mothers. Some risk factors for preeclampsia include the age of pregnant women who are too young or enter a high-risk age to conceive, high parity, gestational age, history of disease and fetal factors as well as from environmental factors such as Exposed by radical free.8i5 Ha of farmland from 4823.33 Ha area and majority of residents work as farmers.

(Badan Kependudukan dan Keluarga Berencana Nasional, Badan Pusat Statistik, & RI, 2017; Badan Pusat Statistik, 2018; Dinas Kesehatan Kabupaten Semarang, 2017; Tengah, 2016)

Methods

This type of research is analytic by using case control study that is suor research by comparing between case group and control group based on its exposure status (retrospective). This approach was chosen because it can provide information about the presence of pesticide exposure in the past before the outcome (the Preeclampsia event). Data retrieval is conducted by means of observation and interviews using questionnaires, which start from identifying subjects that experience preeclampsia (case groups) and subjects that do not undergo preeclampsia (control groups), Then both groups of subjects compared to know the impact of pesticide exposure to the incidence of preeclampsia.

This research is conducted in the Bandungan District in Semarang Regency, which includes two areas of the work of primary health care, namely Duren primary health care and Jimbaran primary health care. The population in this study consists of the target population of all pregnant mothers in the agricultural area of Bandungan district and the affordable population is divided into two groups. Case group (all pregnant women with preeclampsia history) and Control group (pregnant women who do not have preeclampsia history)

The samples in this study were expectant mothers residing in Bandungan sub-district. Calculation of sample quantities using a large sample formula and obtained the result $n = 26.72$ to avoid drop out then samples were added as much as 10% so the number of samples as much as 30 respondent group cases and 30 respondents of the control group.

Results

1) Respondent characteristics

Table 1 Characteristics of respondents

No	Characteristics	case	control
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	n (30)	%	n (30)	%
1. Education				
Primary school	15	25	17	28,3
Junior high school	7	11,7	8	13,3
Senior high school	8	13,3	5	8,3
2. Job				
Farmer	22	36,7	22	36,7
Not a farmer	8	13,3	8	13,3
3. Husband's job				
Farmer	28	46,7	25	41,7
Not a farmer	2	3,3	5	8,3
4. Agricultural activities				
Yes	30	100	30	100
No	0	0	0	0

Based on table 1 shows that the level of education in respondents was dominated by elementary school education, obtained the number of respondents with the least education of SD 15 (25%) In case groups and 17 (28.3%) In the control group. The main work of respondents as farmers in the case and control groups as many as 22 (36.7) respondents and 8 (13.3%) The respondents of both case groups and controls have the primary work not as farmers, But participating in agricultural activities. The work of husbands respondents is largely a farmer of 28 (46.7%) Respondents to the case group and 25 (41.7%) People of the control group and others have the main job of not the farmer is 2 (3.3%) Group of respondents to the case as well as 5 (8.3%) Respondents to the control group. All cases of group respondents and controls have involvement in agricultural activities.

2) Relationship of level exposure to the incidence of preeclampsia

Table 2 Relationship level exposure to the incidence of preeclampsia

Level exposure	case		control		Total		P-value	OR (95% CI)
	n	%	n	%	n	%		
1. High exposure	20	33,3	14	23,3	34	56,7	0,118	0,438
2. Low exposure	10	16,7	16	26,7	26	43,3		(0,154-1,243)

Base on table 2 The research results showed no meaningful link between the level of exposure of pesticides with preeclampsia incidence (P-value = 0.118). The proportion of high exposure levels in case groups is 33.3% higher than the 23.3% control group.

3) The relationship of pesticide type to preeclampsia

Table 4 The type of pesticide relationship to preeclampsia



Types of pesticide	case		control		Total		P-value	OR (95% CI)
	n	%	n	%	n	%		
>3 types of pesticide	21	35	11	18,3	32	53,3		4,030
≤3 types of pesticide	9	15	19	31,7	28	46,7	0,010	(1,372-11,839)

Base on table 4 the results of the study showed that there was a meaningful relationship between the types of pesticides used against the preeclampsia ($P = 0.010$ value). The proportion of respondents who use more than 3 types of pesticides from the case group is 35% higher than the control group 18.3%.

4) Storing of pesticide relationship to the incidence of preeclampsia

Table 5 Pesticide storage to the incidence of preeclampsia

Storing of pesticide	case		control		Total		P-value	OR (95% CI)
	n	%	n	%	n	%		
Bad	25	41,7	15	25	40	66,7		5,000
Good	5	8,3	15	25	20	33,3	0,006	(1,510-16,560)

Base on table 5 The study showed that there was a meaningful link between the storage of pesticides against the incidence of preeclampsia (value $P = 0.006$). The proportion of respondents who do the storage of pesticides in a bad way from a group of cases is 41.7% higher than the 25% control group.

5) The relationship of agricultural activity to the incidence of preeclampsia

Table 6 Agricultural activity relationships to the incidence of preeclampsia

Agricultural activity	case		control		Total		P-value	OR (95% CI)
	n	%	n	%	n	%		
> 8 activities	28	46,7	26	43,3	54	90		2,154
≤ 8 activities	2	3,3	4	6,7	6	10	0,389	(0,363-12,764)

Base on table 6 results showed that there was no meaningful relationship between agricultural activity on the preeclampsia (P - value = 0.389 value). The proportion of respondents who conducted more than eight types of farming activity from the case group was 46.7% higher than the control group 43.3%.

Tabel 7 Historical variable candidates for pesticide exposure of preeclampsia

No	Variables	p-value	OR	95%CI		Description
				Lower	Upper	
1.	Level exposure	0,118	0,438	0,154	1,243	Not significant
2.	Groups of pesticide	0,020	3,455	1,195	9,990	Significant
3.	Types of pesticide	0,010	4,030	1,372	11,839	Significant
4.	Storing of pesticide	0,006	5,000	1,510	16,560	Significant



The following are the results of a regression logistic analysis of variable candidate results as the dominant risk factor that affects the incidence of preeclampsia:

Tabel 8 Historical variable candidates for pesticide exposure are more dominant in the incidence of preeclampsia

No	Variable	B	Wald	Sig	Exp (B)	95% CI	
						Lower	Upper
1.	Storing of pesticide	1,761	7,536	0,006	5,816	1,655	20,445
2.	Level exposure	-1,045	3,280	0,075	0,352	0,111	1,109
	Constanta				-0,747		

Based on the table 8 results of multivariate analysis with logistic regression analysis showed that one of the four risk factors entered in the candidate model regression logistic and which can be calculated the forecast value probability (risk) against Preeclampsia is pesticide storage (P-value 0.006 OR = 5.000 CI 95% = 1.510 – 16, 560). Based on forecast results The probability of forecasted results amounted to 73%. The results showed that 73% of the incidence of preeclampsia in pregnant women in the agricultural area of Bandungan district was caused by the habit of performing poor pesticide storage.

Discussion

Based on statistical analysis test results proved several risk factors indicating a relationship to the event of preeclampsia (value p-value of < 0.05), among others: the number of pesticide groups used, the type of pesticides used and storage of pesticides, the two other risk factors that are the level of exposure of pesticides and agricultural activity has no meaningful relationship to the incidence of preeclampsia Variable exposure level of pesticides is determined based on the working period, length of work, frequency of spraying and use of personal protective equipment.

The results showed that the level of exposure of pesticides in pregnant women in agricultural areas, 34 respondents (56.7%) High exposure by pesticides and 26 respondents (43.3%) Low-exposure. The results of statistical test analysis showed there was no meaningful link between the level of exposure of the pesticides with the preeclampsia (P-value = 0.118 OR = 0.438 95% CI = 0,154-1,243) event that occurred because the majority of respondents in the farm area of the District The Bandungan works on farmland less than 5 hours per day. The majority of respondents have a working period of less than 12 years working in agricultural areas or as farmers and respondents often ignore the complete use of personal protective equipment when working in agricultural areas, this happens to all Respondents, so that when viewed based on statistical tests, the length of the respondent's work and the working period of the respondent as a farmer can be one factor in the absence of a meaningful relationship between levels of exposure to the incidence of preeclampsia. In Roshini's study that was conducted in 2008 showed that



someone whose work is related to pesticides would then be exposed by pesticide residues. The impact of women is a health disorder in the reproductive system, menstrual cycle disorders, spontaneous abortion, preeclampsia, fetus in the womb does not develop and early menopause, but the respondent is not entirely High exposure by pesticides this can occur because there are other factors that dominate such as the length of exposure every day (long working in the agricultural area) and the history factor of the disease that the respondent had before the pregnancy or before Working in agricultural areas as farmers.(J, Jhon, & Wickremasinghe, 2008)

From observations and interviews to the average research respondent using a mixture of two or more pesticides in each spraying, 36 respondents (60%) Using 3 pesticides in each spraying, 15 respondents (25%) Using 4 pesticide groups in each time of spraying, 8 respondents (13.3%) Using 2 pesticides in each spraying and other respondents did not mix several pesticides in each spraying.

Pesticide that commonly used respondents include Karbamat with active ingredient Propineb 70% and copper hydroxide 54% (equivalent to 35%) of copper, which works by inhibiting acetylcholinesterase but its effect does not last long because it is reversible, in general pesticide this group can persist in the body between 1 to 24 hours so rapidly in excretion. Organophosphate with active ingredient Profenofos 500 g/L and chlorpyrifos 200 g/L, which is generally the most toxic insect repellent poison on the vertebrate animals and has the effect of blocking the distribution of nerve impulses by binding to the enzyme acetylcholinesterase, in the event of pesticides poisoning Organophosphate group then potentially carcinogenic. Piretroid with active ingredient Sipermetrin 100 g/L that works very toxic and acute by attacking the nerve composition, the most immediate impact is to cause allergies to the body. Chloronitrile with active ingredient chlorotalonil 500 g/L. Dinitroanilin with active ingredient Etefon 100 g/L. acetaldehyde with the active ingredient sodium Orto nitrophenol 2 g/L, sodium para nitrophenol 3 G/L and sodium 5 Nutroguaiakol 1 g/L. Chloronitrile and Acetaldehyde basically have a common type of pesticide that is the same as a fungicide that attacks neurological damage and can impact death and is acute. Avermectin with active ingredient abamectin 18 g/L, residue settling on water and soil where it can potentially cause the death of soil and water biota and with the youth can enter the human body and is chronic and carcinogenic.

The results showed that there was a meaningful link between the number of pesticide groups used with preeclampsia in pregnant women in the agricultural area of Bandung District (P-value 0.020 OR = 3.455 95% CI = 1,195-9,990). This research is in line with the research conducted by Siti in 2018 shows that there is a connection between the dose of the use of the pesticide group to blood pressure (p-value 0.005). It is in line with the research of Marsaulina in 2017 which indicates that there is a link between the pesticide dose of poisoning incidence with a risk of 2.5 times greater in the use of inappropriate doses. Exposure to the most affected pesticides are organophosphate pesticides because the content of chlorpyrifos in organophosphate will inhibit the distribution of nerve impulses by binding cholinesterase so that there is no hydrolysis Acetylcholine and an increase in reactive oxygen species (ROS) as well as a stress oxidative and endothelial dysfunction then decreases the activity of the parasympathetic



nervous system but will increase the sympathetic nervous system characterized by heart rate The faster and increased blood pressure (hypertension), OR = 1.14 which means that the exposure to organophosphate pesticides has a risk of 1.14 times for the occurrence of hypertension. In the research of Garcia in 2003, stated that there is a significant link between the active ingredient contained in the pesticide organophosphate which is chlorpyrifos a risk factor for cancer.(Marsaulina & Wahyuni, 2005; Nurkhayati, Nurjazuli, & Joko, 2018)

Based on the results of interviews and observations of pesticide types commonly used by respondents are a fungicide, herbicide, insecticide, plant growth regulator and adhesive substance. A number of 32 respondents (53.3%) Use more than 3 types of pesticides, compared to respondents who use less than 3 types of pesticides 28 people (46.7%). The results showed a meaningful link between the type of pesticide used with the preeclampsia (P-value 0.010 OR = 4.030 95% CI = 1,372-11,839).

Based on Radjeep research that has been conducted in 2018, exposure to pesticides can induce oxidative stress by increasing free radicals that accumulate in cells and weaken antioxidant defenses in the body, where the process Cell metabolism in the body is catalyzed by the cytochrome P450 enzyme (CYP450), but the exposure of toxins contained in pesticides will weaken the working of the cytochrome P450 enzyme, so that it will increase the reactive of oxygen species and enable oxidative stress As a result of lipid peroxidation that will cause health problems in the body's organs or the bad impact is the death of cells. Exposure to pesticides with the active ingredient chlorpyrifos can increase neurotoxicity (toxic binding Proteins in the body) through increased oxidative biotransformation (changes in cells in the body catalyzed by the enzyme CYP2B6 and enzymes CYP3A4), CYP2B6 enzymes and enzymes CYP3A4 is included in the group of cytochrome P450 enzymes that can trigger the occurrence of Lipid peroxidation and carcinogenic.(Abass et al., 2012; Kaur & Thakur, 2018)

Based on the results of the study of 40 respondents (66.7%). Respondents in this study are still many who do storage of pesticides in the home or not in a special room for pesticides (warehouse pesticides) and some other 20 respondents (33.3%). Do pesticide storage is good that does not store pesticides in the house or already have a special room for pesticide storage, statistical test analysis results show that the existence of the connection between pesticide storage with Occurrence of preeclampsia in pregnant women in the agricultural area of Bandung District (P-value 0.006 OR = 5.000 95% CI = 1,510-16,560). The level of exposure to indoor pesticides is higher when compared with outdoor exposure. Pesticide storage should be stored in the original place or container, if not stored in the original packaging it could harm the user.(Garcia, 2003)

There are various kinds of agricultural activities related to pesticides such as planting crop seeds, preparing pesticides, mixing pesticides, doing pesticide mixing by using special places, mixing pesticides close to Water source or water shelter, mixing pesticides using special tools (stirrer), spray crops with pesticides, eradicate pests, harvest crops, move crops, wash clothes that have been used for activities Agriculture, washing agricultural equipment, eating and



drinking in the agricultural area and washing hands with soap after activities in the agricultural area.

The results of observations and interviews conducted by researchers showed that respondents will continue to be spraying since after planting until the harvest, spraying done approximately 1 to 3 times in one week. If the weather is rainy season then spraying will be more often done after the raindrops. The majority of respondents did the activity of preparing pesticides as many as 54 respondents (90%) Doing so, as many as 40 respondents (66.7%) Pesticide mixing activities that will be used to spray. Mixing pesticides using a special container or place in its mixing process and 54 respondents (90%) Use it, 58 respondents (96.7%) Also use the mixer for pesticide mixing process as well as in the process of mixing pesticide 5 people (8.3%) Do it close to the water source, it has an impact on water pollution that comes from pesticide or pesticide residue directly about the water source. As many as 50 respondents (83.3%) Planting seeds or crop seedlings, as many as 37 respondents (61.7%) Also conducting spraying activities, 33 respondents (55%) Eradication of pests and 51 respondents (85%) Harvesting activities as well as 56 people (93.3%) The sorting process. A number of 47 respondents (78.3%) Doing the rest of the time work is eating and drinking in the farm area and without regard to cleanliness around it.

The results showed no meaningful link between agricultural activities and preeclampsia in pregnant women in the agricultural area of Bandung District (P-value 0.389 OR = 2.154 95% CI = 0,363-12,764). This research is in line with research conducted by Marinajati in 2012 that there is no meaningful link between the involvement of women of childbearing age in agricultural activities with levels of leukocytes (P-value 0.574), it is known that increased The number of leukocytes in pregnant women in the first trimester pregnancy becomes the risk for the occurrence of hypertension in pregnancy or preeclampsia.(Marinajati, W, & Suhartono, 2012)

Conclusion

Conclusions based on research conducted a history of pesticide exposure is a risk factor of preeclampsia in pregnant women in the agricultural area of Bandung district. It is recommended for peasant women or pregnant mothers residing in agricultural areas to reduce involvement in agriculture, taking into account the importance of the complete use of personal protective equipment and reducing the intensity of activities Associated with the Pesticide (mixing pesticides and spraying pesticides) as well as carrying out pesticide storage properly and appropriately. For the Agriculture Department, it is expected to educate the full use of the personal protective equipment, the rules regarding the impact of pesticide use and storage. Health service is expected to provide health services such as women farmers ' health screening and intensive monitoring of peasant women during pregnancy.



References

- Abass, K., Lämsä, V., Reponen, P., Küblbeck, J., Honkakoski, P., Mattila, S., ... Hakkola, J. (2012). Characterization Of Human Cytochrome P450 Induction by Pesticides. *Toxicology*, 294(1), 17–26. <https://doi.org/10.1016/j.tox.2012.01.010>
- Badan Kependudukan dan Keluarga Berencana Nasional, Badan Pusat Statistik, & RI, K. K. (2017). Survei Demografi dan Kesehatan 2017.
- Badan Pusat Statistik. (2018). *Kecamatan Bandungan Dalam Angka 2018*.
- Dewi, N. A. (2016). *Patologi dan Patofisiologi Kebidanan*. Yogyakarta: Nuha Medika.
- Dinas Kesehatan Kabupaten Semarang. (2017). *Profil Kesehatan Kabupaten Semarang*.
- Fatkhayah, N., Kodiyah, & Masturi. (2016). Determinan Maternal Kejadian Preeklampsia (Studi Kasus Di Kabupaten Tegal, Jawa Tengah). *The Soedirman Journal Of Nursing*, 11(1), 53–61.
- Garcia, A. M. (2003). Pesticide Exposure and Women ' s Health. *American Journal Of Industrial Medicine*, 44, 584–594. <https://doi.org/10.1002/ajim.10256>.
- Icesmi Sukarni, S. (2014). *Patologi Kehamilan, Persalinan, Nifas dan Neonatus Resiko Tinggi*. Yogyakarta: Nuha Medika.
- J, R., Jhon, P., & Wickremasinghe, R. (2008). Impact of Low-Level Exposure to Organophosphates on Human Reproduction and Survival. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 102(3), 239–245. <https://doi.org/10.1016/j.trstmh.2007.11.012>
- Kaur, R., & Thakur, Y. (2018). Diseases Caused By Pesticide Induce Oxidative Stress – A Review. *Journal of Emerging Technologies and Innovative Research*, 5(August), 325–331.
- Marinajati, D., W, N. E., & Suhartono. (2012). Hubungan Riwayat Paparan Pestisida Dengan Profil Darah Pada Wanita Usia Subur di Daerah Pertanian Cabai Dan Bawang Merah Pesticides Exposure and Blood Profile on Women Childbearing Age in Chili and Shallot Agriculture Area (Study in Subdistrict Kersana ,. *Jurnal Kesehatan Lingkungan Indonesia*, 11(1), 61–67.
- Marsaulina, I., & Wahyuni, A. S. (2005). Faktor-Faktor Yang Berhubungan Dengan Keracunan Pestisida Pada Petani Hortikultura Di Kecamatan Jorlang Hataran Kabupaten Simalungun Tahun 2005. *Media Litbang Kesehatan*, 17(1 Mar), 18–25. <https://doi.org/10.22435/mpk.v17i1Mar.803>.
- Nurkhayati, S., Nurjazuli, & Joko, T. (2018). Hubungan Paparan Pestisida Dengan Tekanan Darah Diastolik Pada Petani Hortikultura Desa Kapuhan Kecamatan Sawangan Kabupaten Magelang. *Jurnal Kesehatan Masyarakat*, 6(10), 335–343.
- Pipkin, F. B. (2001). Risk Factors For Preeclampsia. *The New England Journal Of Medicine*, 344(12), 925–926.
- Tengah, D. K. P. J. (2016). *Profil Kesehatan Provinsi Jawa Tengah Tahun 2016* (Vol. 3511351).