

Relationship of Pesticide Exposure with Hypertension for Farmers in Juhar District, Karo Regency in 2019

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Abstract: Hypertension or high blood pressure is an increase in abnormal blood pressure in the arteries, also known as "silent killer", risk factors for hypertension is sex, gen, smoking, obesity, cholinesterase, excessive use of pesticides can cause poisoning that is decreased cholinesterase activity which can cause hypertension. In 2018, hypertension is the third highest disease in the Juhar, where the majority of the population works as farmers (88.54%). The purpose of this study was to analyze the relationship pesticide exposure with hypertension in farmers in Juhar District, Karo District in 2019. This study was quantitative study with cross sectional research design. Data obtained through interviews with questionnaires and blood pressure checked. The results of the study of 35 farmers sampled were 14 people (40%) had hypertension. Chi-square test results showed that there was a relationship between the duration of spraying ($p=0.094$), spraying techniques ($p=0.034$), the use of personal protective equipment Self ($p=0.041$) with hypertension, while years of service ($p=0.685$) had no relationship with hypertension. The public health center has an active role in providing counseling, periodic hypertension checks. It is suggested to Ministry of Agriculture to monitor and supervise the use of pesticides in farmers, and for the farmers to pay attention in using personal protective equipment, spraying techniques, and not spray more than 4 hours/day.

1 INTRODUCTION

Based on World Health Organization (2015), there are around 1.13 billion people in the world suffering from hypertension, it is estimated that 1.5 billion people will be affected by hypertension in 2025, and every year 9.4 million people die from hypertension and complications (Ministry of Health, 2018).

In Indonesia, based on Riskesdas data (2018), the prevalence of hypertension in the population aged ≥ 18 years was 34.1% and an increase of 8.3% from 2013. The highest prevalence occurred in South Kalimantan (44.1%) and the lowest in Papua (22.2%). Data from Riskesdas (2013), hypertension in North Sumatra, the highest hypertension sufferers were in Karo District at 37.5%, afterwards Humbang Hasundutan and Gunung Sitoli.

Profile of the Karo District Health Office, the number of cases of hypertension were ranked third with the highest incidence in the Karo District Health Center with a total of 13,689 cases (11.84%). The Juhar public health center report found that in October 2018 hypertension was the 3rd highest

disease out of the 10 highest disease lists in the Juhar public health center with 135 cases. In 2013 the prevalence of hypertension in Indonesia was recorded at 25% occurred in the group of farmers / fishermen (Riskesdas, 2013).

Hypertension is also known as a silent killer (silent killer) because patients suffering from hypertension are usually not accompanied by complaints or symptoms. In general, people who suffer from hypertension just know that they suffer from hypertension after complications occur (Ministry of Health, 2013).

The risk factors for hypertension are gender, obesity, smoking habits, diabetes mellitus, and cholesterol levels in the body.

In general it is estimated that hypertension is found twice as much in the diabetic population compared to non-diabetics. Hypertension is known to accelerate and aggravate complications due to diabetes such as coronary heart disease, stroke, diabetic nephropathy, diabetic retinopathy, and cardiovascular disease due to diabetes, which doubles when accompanied by hypertension.

Hypertension is a major factor in life expectancy and complications in diabetic patients and determines the evaluation of nephropathy and retinopathy of diabetics in particular.

One of the causes of hypertension is insulin resistance/hyperinsulinemia. The association of primary hypertension with insulin resistance has been known for several years, especially in obese patients. Insulin is a suppressor because it increases levels of ketekolamin and sodium reabsorption. The relationship between diabetes and hypertension is more complex and is not related to nephropathy. In diabetic patients, hypertension is often part of the metabolic syndrome of insulin resistance. Hypertension may appear for several years in these patients before diabetes mellitus appears. Hyperinsulinemia enhances the pathogenesis of hypertension by decreasing sodium excretion in the kidneys, stimulating activity and tissue response to the sympathetic nervous system, and increasing vascular surrounding resistance through vascular hypertrophy. The active management of hypertension (<130/80 mmHg) reduces the development of macrovascular and microvascular complications.

Pesticides on the body can cause various negative effects on health. Several studies have identified these effects, and found to affect various organ systems, especially the nervous system according to Wiadi (2017). There are various factors that can increase blood pressure. Factors that can trigger high blood pressure are behavioral factors such as unhealthy food, tobacco use, physical activity and use of hazardous substances, metabolic factors such as obesity, diabetes, and excess fat in the blood and cardiovascular disease factors such as coronary heart disease, stroke, and kidney disease (WHO, 2013).

Apart from these basic risk factors, environmental toxic substances including pesticides can also affect new risk pathways such as inflammation and oxidative stress. Environmental poisons can be considered as an important risk factor for cardiovascular disease. There is a relationship between pesticide exposure and cardiovascular outcomes, there is a contribution of pesticides to cardiovascular disease (Wahab, A., et.al. 2016).

Agriculture is the sector that absorbs the most labor in Indonesia. In increasing agricultural yields, it is necessary to complete agricultural facilities including agricultural equipment, artificial fertilizers and chemical additives including pesticides (Ministry of Agriculture, RI, 2013). Farmers tend to use pesticides not according to indications of pest

control, but rather to use them continuously without regard to indications for their use.

The use of excessive and uncontrolled quantities of pesticides will pose a risk of poisoning to farmers. The effects of pesticides depend on the dose of pesticides, the length of time of exposure and exposure modification factors such as the use of Personal Protective Equipment according to Hohenadel K (2011). There is a significant relationship between age, sex, years of service, and the use of personal protective equipment with the incidence of hypertension (Louisa, 2018). There is a relationship between the history of exposure to pesticides with farmers' blood pressure found that farmers with abnormal cholinesterase levels have a 2-fold increased risk of systolic pressure (Zulfania, 2017).

The community has been working as farmers for around 10-30 years with a spraying time of around 2-8 hours / day. Farmers spraying do not use masks and headgear when working with reasons not comfortable and are not accustomed.

The Juhar Community Health Center Monthly Report is known that in October 2018 there were 135 cases of hypertension. Based on interviews with health complaints to 30 farmers, information is obtained that there are 4 people who have narrowed heart arteries, 9 people have high blood pressure (hypertension), 6 people have diabetes mellitus, and 8 people have Hb levels (hemoglobin) in under normal. In addition, all farmers interviewed had other health problems such as itching, low back pain, dizziness, fatigue and weakness, and some farmers experienced complaints of frequent urination at night. Therefore, researchers want to examine whether there is a relationship between pesticide exposure with the incidence of hypertension in farmers in Juhar District, Karo Regency.

2 RESEARCH METHOD

This type of research is quantitative research with cross sectional design. Research that emphasizes the measurement or observation of data at one time is carried out on the dependent variable and the independent variable. Research locations in Juhar sub-district, Karo District, from January to May 2019. The population in this study were all farmers living in Juhar District, with a sample of 35 farmers.

Data Collection Methods Using Primary data obtained from interviews with respondents using questionnaires to obtain data on pesticide exposure

and blood pressure checks of respondents. Blood pressure measurements were performed by Juhar Community Health Center nurses using a Spigmomanometer. Secondary data were obtained from data from the Juhar District Health Center in Karo District, Karo District Health Office, North Sumatra Province Health Office and other supporting data in this study.

Analyzed univariately to get a picture presented in the form of a frequency distribution table, bivariate is conducted to determine the relationship between two variables, namely the independent variable and the dependent variable using the statistical test, Chi-square test, multivariate is done to determine the strength of the relationship between the independent variable and the dependent variable using the Logistic Regression test.

3 RESEARCH RESULTS AND DISCUSSION

Juhar is a sub-district located in Karo Regency which has an area of 23.14 km² with an area of 852 Ha of agricultural land. The population in Juhar District is 2,611 people. Based on data from the Karo Regency Central Statistics Agency (2017), the number of people employed is 1817 with 1578 people (86.84%) working as farmers.

The results showed that there were 27 farmers who had worked for more than 5 years or (22.9%). Farmers who sprayed less than 4 hours / day were 19 people or 54.3%. Farmers spray poorly, as many as 17 people or (48.6%). There were 18 people who were good at using personal protective equipment or (51.4%). There are 21 hypertensive farmers (60%). This is shown in the Table 1.

Table 1: Characteristics of respondents.

Variable	n	(%)
Sex		
Male	22	62,9
Female	13	31,7
Body mass index		
Normal	28	80,0
Obesity	7	20,0
Smoking		
No Smoking	20	57,0
Smoking	15	42,0
Length of work		
≤ 5 years	8	22,9
> 5 years	27	77,1
Spraying duration		
≥4 hour a day	16	45,7
<4 hour a day	19	54,3
Spraying technique		
Not good	22	62,9
Good	13	37,1
Personal Protective Equipment Using		
Not good	17	48,6
Good	18	51,4
Hipertention		
Normal	14	40,0
Hipertention	21	60,0

The analysis of the relationship of the independent variable with the dependent variable showed that there was a relationship between the variable of spraying time, spraying technique, the use of personal protective equipment with hypertension with a p value <0.05, but there was no relationship between working period with hypertension.

The analysis of the relationship between the independent variable and the dependent variable showed that there was a relationship between the variable spraying time, spraying technique, the use of personal protective equipment with hypertension with a p value <0.05, but there was no relationship between sex, body mass index, smoking habits, and length of service with hypertension with p > 0.05. This is shown in the Table 2.

Table 2: Relationship of Individual Characteristics, Working Period, Exposure Time, Spraying Technique, Use of Personal Protective Equipment with Hypertension in Farmers in Juhar District, Karo Regency.

Variable	Hipertention						p	OR
	Yes	%	No	%	Total	%		
Sex								
Male	10	45,4	12	54,5	22	100,0	0,392	1,875
Female	4	30,8	9	69,2	13	100,0		
Body mass index								
Normal	13	46,4	15	53,6	28	100,0	0,203	5,200

Obesity	1	14,3	6	85,7	7	100,0		
Smoking								
No Smoking	6	30,0	14	70,0	20	100,0	0,163	0,375
Smoking	8	53,3	7	46,7	15	100,0		
Length of work								
≤ 5 years	4	50,0	4	50,0	8	100,0	0,685	1,700
> 5 years	10	37,0	17	63,0	27	100,0		
Spraying duration								
≥4 hour a day	9	56,3	7	43,8	16	100,0	0,094	3,600
<4 hour a day	5	26,3	14	73,7	19	100,0		
Spraying technique								
Not good	12	54,4	10	45,5	22	100,0	0,034	6,600
Good	2	15,4	11	84,6	13	100,0		
Personal Protective Equipment Using								
Not good	10	58,8	7	41,2	17	100,0	0,041	5,000
Good	4	22,2	14	77,8	18	100,0		

Multivariate analysis in this study used a logistic regression test. After bivariate analysis of all independent variables, the independent variables are entered into multivariate analysis

with criteria if they have a p value of <0.05 and become an important variable in this study. The independent variables that meet these criteria are as follows in Table 3.

Table 3: Multivariate analysis of hypertension logistic regression among farmers in Juhar District, Karo District.

Step	Variabel	Koefisien (B)	p	OR	95% C.I.for EXP(B)	
					Lower	Upper
1 ^a	Body mass index	1,676	0,247	5,345	0,313	91,259
	Smoking	-1,240	0,180	0,289	0,047	1,777
	Spraying duration	0,927	0,328	2,526	0,395	16,170
	Spraying technique	2,153	0,042	8,608	1,084	68,331
	Personal Protective Equipment Using	1,230	0,196	3,423	0,530	22,117
	Constant	-4,324	0,161	0,013		
2 ^a	Body mass index	1,784	0,191	5,952	0,410	86,507
	Smoking	-1,358	0,138	0,257	0,043	1,545
	Spraying technique	2,019	0,045	7,534	1,043	54,442
	Personal Protective Equipment Using	1,577	0,077	4,841	0,843	27,784
	Constant	-4,148	0,153	0,016		
3 ^a	Smoking	-1,151	0,176	0,316	0,060	1,676
	Spraying technique	2,011	0,043	7,468	1,061	52,556
	Personal Protective Equipment Using	1,678	0,050	5,353	1,002	28,607
	Constant	-0,456	0,506	0,634		
4 ^a	Spraying technique	1,863	0,045	6,446	1,042	39,895
	Personal Protective Equipment Using	1,586	0,050	4,883	0,999	23,873
	Constant	-0,925	0,125	0,396		
5 ^a	Personal Protective Equipment Using	1,887	0,032	6,600	1,176	37,028
	Constant	-0,182	0,670	0,833		

3.1 Relationship between Gender and Hypertension

In the gender variable, it is known that farmers who are male are 22 people (62.9%) and women are 10

people (31.7%). The results of the analysis of the relationship between sex and hypertension note that there is no relationship between sex and hypertension in farmers in Juhar District with a value of $p > 0.05$ or $p = 0.392$. Based on the results

of this study it is known that men and women can suffer from hypertension and everyone has the opportunity to suffer from hypertension depending on lifestyle and other factors that can be at risk for hypertension.

This study is in accordance with Prasetyaningrum (2014) that men or women are equally at risk of developing hypertension compared to women at age <45 years, but at the age of > 65 years women are more at risk of developing hypertension. The results of this study are not in accordance with research conducted by Amanda (2018) where the results in the study showed a relationship between sex variables with the incidence of hypertension.

3.2 Relationship of Body Mass Index with Hypertension

In the body mass index variable it is known that farmers who have a normal body mass index are 38 people (80.0%) and obesity are 7 people (20%). The results of the analysis of the relationship between body mass index and hypertension can be seen that there is no relationship between body mass index and hypertension in farmers in Juhar District with a value of $p > 0.05$ or $p = 0.203$. Farmers with normal weight and excess weight can suffer from hypertension and if examined more deeply each person has the opportunity to suffer from hypertension depending on lifestyle and other factors that can be at risk for hypertension.

The results of this research are in accordance with Sundari research (2015) showing that there is no relationship between obesity and the incidence of hypertension in Karang Anyar Village with a p -value > 0.05 . The results of the analysis found that the proportion of hypertensive patients who are not obese more than obese hypertensive patients. The results of this study are not in accordance with Estiningsih's (2017) study where the results of the study conducted showed a significant relationship between normal body mass index and excess body mass index in hypertensive respondents.

3.3 Relationship between Smoking and Hypertension

In the smoking habit variable it is known that there are 20 non-smoking farmers (57%) and 15 smoking people (42%). The results of the analysis of the relationship between smoking and hypertension can be seen that there is no relationship between smoking and hypertension in farmers in Juhar

District with a value of $p > 0.05$ or $p = 0.187$. Farmers with active or passive smoking habits can suffer from hypertension and if examined more deeply everyone has the opportunity to suffer from hypertension depending on lifestyle and other factors that can be at risk for hypertension.

The results of this research are in accordance with Rinawang's (2017) research, that smoking is not one of the risk factors of hypertension, based on statistical tests conducted showed that there is no significant relationship between smoking and the incidence of hypertension. The absence of a relationship between smoking and the incidence of hypertension is likely due to hypertension sufferers who have never smoked had a history of exposure to cigarettes or smoke. The results of this research are not in accordance with Sundari's study (2015) which shows that there is a relationship between smoking and the incidence of hypertension in Karang Anyar Village with a value of $p = 0.04$. This is because carbon monoxide in cigarette smoke will also replace oxygen bonds in the blood, resulting in increased blood pressure because the heart is forced to pump enough oxygen to enter the organs and other body tissues.

3.4 Relationship of Length of Work with Hypertension

In the variable of length of work, it is known that farmers with more than 5 years of service are 27 people or (22.9%) and less than 5 years are 8 people or 22.9%. Based on the analysis of the relationship between work period and hypertension, it can be seen that there is no relationship between work period and hypertension in farmers in Juhar District with a value of $p > 0.05$ or $p = 0.685$, farmers who work for more than 5 years and farmers who have worked less than 5 years are equally at risk for suffering from hypertension depending on the lifestyle of the person, the person's behavior and other factors. Exposure to pesticides does not always directly have a significant impact on the human body without causing sudden pain, chronic poisoning is more difficult to detect because it is not immediately felt and does not cause specific symptoms and signs. However, chronic poisoning for a long time can cause health problems.

Multivariate results showed different results where the duration of spraying had no effect on hypertension with a p value = 0.328.

The results of this study are the same as the research conducted by Maarif (2016) where the results state that there is no significant relationship

between work period and low levels of cholinesterase in farmers because farmers do not carry out agricultural activities continuously, there are times when farmers do not carry out agricultural activities. The length of time needed for cholinesterase levels to return to normal depends on the type and level of poisoning itself. In addition, the level of cholinesterase in the blood can return to normal if it considers good nutritional status.

The results of this research are not in accordance with Louisa's research (2018) which states that there is a relationship between work period and the incidence of hypertension with a p value = 0.017. The longer a person becomes a farmer, the more possibilities for contact with pesticides.

3.5 The Old Relationship between Spraying and Hypertension

In the spraying variable it is known that farmers who sprayed less than 4 hours per day were 19 people or (54.3%) and farmers who sprayed more than 4 hours per day were 16 people or (45.7%). The results of the analysis of the relationship between duration of spraying with hypertension can be seen that there is a relationship between spraying time with hypertension in farmers in Juhar District with a value of $p < 0.05$ or $p = 0.094$ and an odd ratio value of 3.600. Farmers who spray ≥ 4 hours per day will tend to be at risk of experiencing hypertension 3,600 times compared to farmers who spray < 4 hours per day.

Based on interviews, information was obtained that farmers often sprayed on large enough areas and had to be completed within the same time, that is, in 1 day so pests and weeds that interfere with petati plants could be exposed to pesticides simultaneously to avoid pests and weeds resistant to pesticides. Spraying pesticides with a spraying time of more than 3 hours without a break will result in chronic poisoning. Farmers when spraying do not use personal protective equipment so pesticides can be directly exposed to the body of farmers which can increase the risk of exposure.

This study is in line with Prasetya et al, (2017) revealed that the duration of spraying has an influence with hypertension. spraying farmers who exceed the safe time limit then in the long run can have an impact on hypertension. If the spraying time of farmers is still within the safe time limit of 1-3 hours, then poisoning due to pesticides can still be reduced, usually symptoms of pesticide poisoning appear after 4 hours of exposure. The longer the farmer is exposed to pesticides, the greater the risk that the farmer will experience poisoning. The

results of this study are not in accordance with Louisa's research (2018) which states that there is a relationship between the duration of exposure to the incidence of hypertension with a value of $p = 0.12$.

3.6 Relationship between the Use of Personal Protective Equipment and Hypertension

In the variable of personal protective equipment usage it is known that farmers who use personal protective equipment poorly as many as 17 people (48.6%) and farmers who use personal protective equipment well as many as 18 people or 51.4%. The results of the analysis of the relationship between the use of personal protective equipment and hypertension can be seen that there is a relationship between the use of personal protective equipment and hypertension in farmers in Juhar District with a value of $p < 0.05$ or $p = 0.041$ and an odd ratio value of 5,000. Farmers who use personal protective equipment poorly will tend to be at risk of hypertension 5,000 times compared to farmers who use personal protective equipment well.

The results of this study note that more than 50% of farmers use personal protective equipment well, but there are still many farmers who do not wear long sleeves and long pants, there are still minimal farmers who always use masks when spraying, in the application of pesticides still very few use gloves hands when mixing or when spraying. Pesticides are generally contact poisons, so the use of personal protective equipment for farmers when spraying is very important to avoid direct contact with pesticides.

3.7 Relationship of Spraying Technique with Hypertension

In spraying technique variables, it is known that farmers who are not good at spraying are 22 people (62.9%) and farmers who are good at spraying are 13 people or (37.1%). The results of the analysis of the relationship between spraying techniques with hypertension can be seen that there is a relationship between spraying techniques with hypertension with a value of $p < 0.05$ or $p = 0.034$ and an odd ratio value of 6.600. Farmers who spray poorly will tend to be at risk of experiencing hypertension 6,600 times compared to farmers who spray well.

This result is strengthened by multivariate analysis in which the spraying technique variable has an influence on hypertension with a value of $p = 0.043$.

In this study it can be seen that more than 50% of farmers apply spraying techniques in the unfavorable category. Farmers when spraying do not pay attention to correct techniques such as not walking backward in spraying, do not pay attention to the direction of the wind, and do not pay attention to spraying time. The application of pesticides is often sprayed, which allows the liquid pellets to drift, deviating from the application. The distance traveled by the liquid granules depends on the size of the granules. Grains with a radius smaller than one micron can be considered as gases whose infinite velocity settles, while grains with a larger radius will settle faster.

This study is not in accordance with research conducted by Agustina (2018) where there is no relationship between the management of pesticides with the incidence of hypertension with a value of $p = 0.959$.

Multivariate results obtained from the use of personal protective equipment have no effect with a value of $p = 0.05$. The results of this study are in accordance with research conducted by Louisa (2018) there is a relationship between the use of personal protective equipment and the incidence of hypertension with a p value = 0.015. The use of personal protective equipment on farmers is very important to avoid direct contact with pesticides. The use of personal protective equipment can reduce the possibility of direct contact with pesticides so that the risk of pesticides entering the body through the respiratory, digestive and skin areas can be avoided.

$$p = \frac{1}{1+e^{-y}}$$

$$p = 84,4\%$$

Based on the above equation it is known that if farmers with spraying techniques have the opportunity to experience hypertension by 84,4% and hypertension caused by other factors not included in this research variable by 15,6%.

4 CONCLUSIONS

4.1 Conclusion

There was a relationship between the spraying technique ($p = 0.034$), the use of Personal Protective Equipment ($p = 0.041$) with hypertension, while the

length of service had no relationship with hypertension. Spraying techniques have the opportunity to experience hypertension by 84,4% and hypertension caused by other factors not included in this research variable by 15,6%.

4.2 Suggestion

The public health center has an active role in providing education and knowledge to farmers about the dangers and impacts of pesticide use. Create programs aimed at monitoring the health of farmers by conducting periodic checks. Being considered by the Health Service and the Agriculture Service to make policies and programs related to the use of pesticides properly and in accordance with procedures.

Farmers are expected not to spray more than 4 hours/day to avoid over-exposure to pesticide chemicals so that farmers avoid pesticide poisoning. Farmers are expected to pay attention to spraying techniques, pay attention to wind direction and walk backwards in spraying and using personal protective equipment in full such as using long-sleeved clothes, long pants, masks, gloves, hats and boots.

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REFERENCES

- Agustina, F., Suhartono., & Dharminto., 2018. Hubungan pajanan pestisida dengan kejadian hipertensi pada petani hortikultura di Desa Gerlang Kecamatan Blado Kabupaten Batang. *Jurnal Kesehatan Masyarakat (e-Journal)* Volume 6, Nomor 4, (ISSN: 2356-3346).
- Amanda, D., 2018. Hubungan karakteristik dan obesitas sentral dengan kejadian hipertensi. *Jurnal Berkala Epidemiologi*, Volume 6 Nomor 1 (2018) 43-50.
- Badan Pusat Statistik Kabupaten Karo., 2017. Kabupaten Karo dalam angka tahun 2018. Berastagi : Badan Pusat Statistik.
- Estiningsih, HS., 2012. Hubungan indeks massa tubuh dan faktor lain dengan kejadian hipertensi pada kelompok usia 18-44 tahun di Kelurahan Sukamaju Depok tahun 2012. FKM UI, Depok.
- Hohenadel, K., Haris, SA., McLaughlin, JR., Spinelli, JJ., Pahwa, P., Dosman., ... Blair, A., 2011. Exposure to

- multiple pesticides and risk of non-hodgkin lymphoma in men from six canadian provinces. *International Journal of Environmental Research and Public Health*. 14(1): 2320-2330.
- Kemetrician Kesehatan., 2013. Hipertensi, pusat data dan Informasi Kementerian Kesehatan RI. Jakarta Selatan.
- Kemetrician Kesehatan., 2018. Hipertensi membunuh diam-diam, ketahui tekanan darah anda. Jakarta.
- Louisa, M., Sulistiyani., & Joko, T., 2018. Hubungan penggunaan pestisida dengan kejadian hipertensi pada petani padi di Desa Gringsing Kecamatan Gringsing Kabupaten Batang. *Jurnal Kesehatan Masyarakat (e-Journal)* Volume 6, Nomor 1, Januari 2018 (ISSN: 2356-3346).
- Maarif, MI, Suhartono, & Yunita DNA., 2016. Studi prevalensi keracunan pestisida pada petani penyemprot sayur di Desa Mendongan Kecamatan Sumowono Kabupaten Semarang. *Jurnal Kesehatan Masyarakat (e-Journal)* Volume 4, Nomor 5, Oktober 2016 (ISSN: 2356-3346).
- Prasetyaningrum, YI., 2014. Hipertensi bukan untuk ditakuti. Fmedia, Jakarta
- Riset Kesehatan Dasar., 2013. Badan penelitian dan pengembangan kesehatan Kementerian RI tahun 2013. Jakarta.
- Riset Kesehatan Dasar., 2018. Badan penelitian dan pengembangan kesehatan Kementerian RI tahun 2018. Jakarta.
- Sundari, L, & Bangsawan, M. 2015. Faktor-faktor yang berhubungan dengan hipertensi. *Jurnal Keperawatan*, Volume xi, no. 2, Oktober 2015. Issn 1907 – 0357.
- Wahab, A., Hod, R., Ismail, NH., & Omar, N., 2016. The effect of pesticide exposure on cardiovascular system: a systematic review. *International Journal of Community Medicine and Public Health* Wahab A et al. *Int J Community Med Public Health*. 2016 Jan;3(1):1-10.
- Wiadi, IN., & Muliarta, IM., 2017. Fluktuasi tekanan darah dan efek performa neurobehavior pada paparan pestisida organofosfat jangka panjang pada remaja di daerah pertanian. *E-Jurnal Medika*. Vol. 6 No. 4, April 2017, Hal 63-72 ISSN: 2303-1395.
- World Health Organization., 2013. A global brief on hypertension(silent killer, global health crists). Switzerland. 2013.
- World Health Organization., 2013. Effects of human exposure to hormone-disrupting chemicals examined in landmark un report. *Saudi Med J* 2013; Vol. 34 (3).
- Zulfania, KD., Setiani, O., & Dangiran, HL., 2017. Hubungan riwayat paparan pestisida dengan tekanan darah pada petani penyemprot di Desa Sumberejo Kecamatan Ngablak Kabupaten Magelang. *Jurnal Kesehatan Masyarakat (e-Journal)*. Volume 5, Nomor 3, Juli 2017 (ISSN: 2356-3346).