



Meta-Analysis Study Of Risk Factors Exposure To Farmers In Java Island

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Abstract

The biggest risk factor for exposure to pesticide is the farmer, the farmer has a dual position for poisoning, they can be the perpetrator and the sufferer. The use of pesticides in agriculture often causes health problems, it is estimated that 1 to 5 million cases of health problems due to pesticides occur in the world each year, with deaths reaching 220,000 people due to the use of inappropriate doses and carried out continuously. This study aims to explain the factors related to pesticide exposure and health problems in farmers in Java. This study was a systematic meta-analysis was used the M.Sopiyudin Dahlan application. 28 of the 148

articles met the criteria for analysis. Presentation of data was use forest plots with statistical models random effect models. The combined prevalence ratio (PR) showed that there was no significant relationship between long spraying (PR 1.13 95% CI:0.78-1.63), spraying time (PR 0.62 95% CI:0.34-1.11), pesticide dose (PR 1.12 95% CI:0.86-1.47) and pesticide mixing (PR 1.13 95% CI:0.78-7.12) with health problems in farmers. On the other hand, there was a significant relationship between working period (PR 1.19 95% CI:1.03-1.54), spraying frequency (PR 1.42 95% CI:1.04-1.94) and the used of PPE (PR 1.26 95 % CI:1.06-1.50) with health problems in farmers. Pesticide exposure factors related to health problems were working period, frequency of spraying and use of PPE.

Keywords: Pesticide exposure, Health problems, Meta-analysis studies

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Introduction

Pesticides are toxic chemicals used to control nuisance bodies or nuisance plants in the agricultural and plantation sectors, the number of pesticides currently circulating and permitted has reached 2,810 formulations for agriculture and plantations (Pupuk & Pestisida, 2013). The use of large doses of pesticides and carried out continuously will cause several losses, including pesticide residues that will accumulate in agricultural products, pollution in the agricultural environment, decreased productivity, poisoning in animals, poisoning in humans which has a negative impact on health. Humans will experience poisoning both acute and chronic which can lead to death (Kishi, 2002).

It is estimated that 1 to 5 million cases of health problems due to pesticides occur in the world each year, with deaths reaching 220,000 people due to the use of inappropriate doses and carried out continuously. Health problems that occur include nervous system disorders such as headaches, dizziness, paresthesia, tremors, discoordination, seizures, and inhibition of the acetylcholinesterase enzyme which interferes with movement organs (body balance disorders). Circulatory disorders such as anemia and hypertension. Disorders of pregnancy and fetal development such as low birth weight (LBW) and spontaneous abortion. Respiratory tract disorders such as obstructive pulmonary disease and impaired liver function (Agustina & Norfai, 2018).

Pesticide poisoning is one of the most common public health problems in developing countries. It is estimated by the World Health Organization (WHO) that about 18.2 per 100,000 agricultural workers experience work-related pesticide poisoning worldwide. In addition, more than 168,000 people die from pesticide poisoning each year, with most of them coming from developing countries (Ssemugabo et al., 2017).

The number of studies on risk factors for pesticide exposure with health problems can be used to prevent and control health problems due to pesticide exposure, especially in Java. One study is not strong enough to generalize to the population, so several studies are needed on risk factors for pesticide exposure so that the conclusions drawn have stronger power.

Meta-analysis is a form of method that can estimate the combined effect of several studies that have been carried out (Nasution, 2015).

This study aims to explain the factors related to pesticide exposure and the relationship with health problems in farmers in Java Island based on the results of the combined effect calculation of the meta-analysis.

Methods

This type of research is an meta-analysis, namely research that uses studies that already exist and have been used by other researchers that are carried out systematically and quantitatively to obtain accurate conclusions (Nasution, 2015). Broadly speaking, there are 4 phases in the article selection process, namely identification, screening, eligibility and inclusion in the criteria.

This analysis does not distinguish between reference and language sources. The article search strategy uses keywords: pesticide exposure factors, health impact, between 2011 to 2021 in



Java. Sources of articles are obtained from online databases, namely Google Scholar, Science direct, Scopus and Springer. After obtaining a number of articles, a check is carried out to see if there are the same or duplicate articles. If a similar article is found, the article is removed. The next stage is a feasibility study according to the inclusion criteria. The inclusion criteria used were: articles containing variables of working period, duration of spraying, time of spraying, frequency of spraying, spraying dose, mixing of pesticides, use of PPE; the research was conducted on the island of Java; articles published between 2011 and 2021; articles in Indonesian and English; and research using cross sectional method. Meanwhile, the exclusion criteria for this study were research articles that were not available in full or in full text.

To assess the quality, relevance and results of the research articles, using the Critical Appraisal Tools developed by The Joanna Briggs Institute (JBI) with the Checklist for Cross Sectionals (Nursalam et al., 2020). The results of the meta-analysis are presented in a forest plot, which is a description of the effect size distribution of all analyzed research results. The statistical model used refers to the width of the confidence interval (CI), if the combined CI cuts all the CIs of the analyzed research results, the statistical model used is the fixed effect model, but if the combined CI does not cut all the CIs of the analyzed research results, a random effect will be used. To see the homogeneity or heterogeneity of the research which is the source of the analysis, it is seen from the value of I^2 . If I^2 is below 50 percent then all research results are considered homogeneous. On the other hand, if I^2 is above 50 percent, then all research results are considered heterogeneous.

Results

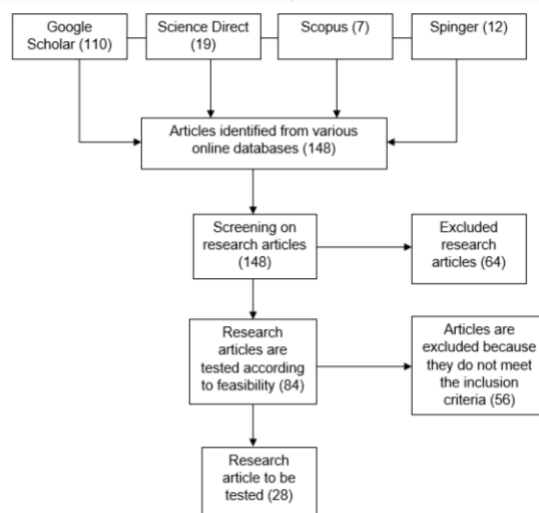


Figure 2 Article Selection Results

Based on search results on online databases, 110 articles were found on Google Scholar, 19 articles for Science Direct, 7 articles for Scopus and 12 articles for Springer, so the total articles



found in all databases were 148 research articles. The articles that have been obtained are then identified based on their titles and the availability of their contents (full text or not). Articles with relevant titles are saved for identification at a later stage, while articles with irrelevant titles are excluded. Articles that are not available in full or full text are also excluded. A total of 64 articles were excluded, so there are still 84 articles left to be further reviewed according to their feasibility. Of the 84 full text articles, the contents were studied in full based on the inclusion criteria that have been previously determined, namely research that aims to look at the factors of pesticide exposure related to health problems in Java. Based on this study, 56 articles were excluded because they did not meet the inclusion criteria, leaving 28 articles. These 28 articles will serve as the object of research in this meta-analysis study.

After the process of selecting and screening articles, the article quality test is then carried out. Of the 28 articles that have been assessed, overall they have a value of 50% with the distribution of articles with the highest quality score of 87.5% as many as 9 articles, with a quality value of 75% as many as 10 articles, and the lowest article quality score of 62.5% as many as 9 articles. Then data extraction is carried out which aims to present important findings in articles that have met the inclusion criteria so that they can be presented in tabular form to present important findings in each research article.

A variable can be concluded to have a significant relationship if the p value < 0.05 . The results of the calculation of the combined effect are presented in the form of tables and forest plots. Forest plot is a graph that presents the results of the meta-analysis calculations. In the forest plot, the effect sizes for each study are represented by circles, while the combined effects are represented by diamonds. In the PR statistic measure, the vertical line that shows no difference in effect is at number 1. The value from the left to the right end of the diamond is the confidence interval value. The end of the left side is the minimum confidence interval value, while the end of the right side is the maximum confidence interval value.

A. Calculation Results Of Combined Effect Of Working Period

Calculation combined effect shows that the variation between studies is heterogeneous because it has $p < 0.05$ and a large I^2 value (76%) so that the combined effect calculation uses a random effects model that produces a p value of < 0.001 and a combined effect size of PR 1.19 (95% CI : 1.03-1.54).

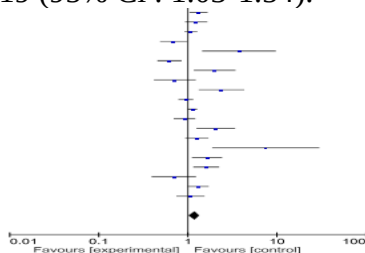


Figure 3 Forest Plot Working Period



Figure 3 shows a visualization of the combined effect of the variable length of service with health problems on farmers which in the confidence interval exceeds 1, so that it is concluded statistically work period is associated with health problems in farmers.

B. Calculation Result of Combined Effect of Long Spraying

Calculation combined effect shows that the variation between studies is heterogeneous because it has $p < 0.05$ and a large I^2 value (81%) so that the combined effect calculation uses a random effects model that produces a p value of < 0.001 and a combined effect size of PR 1.13 (95% CI : 0.78-1.63).

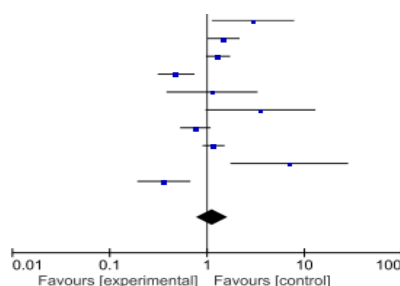


Figure 4 Forest Plot Old Spraying

Figure 4 shows a visualization of the combined effect of the variable duration of spraying with health problems on farmers which in the confidence interval is between line 1, so it is concluded that statistically the duration of long spraying is not associated with health problems in farmers.

C. Calculation Result of Combined Effect of Spraying Time

Calculation combined effect shows the variation between studies is heterogeneous because it has a $p < 0.05$ and a large I^2 value (83%) so that the combined effect calculation uses a random effects model that produces a p value of < 0.003 and a combined effect size of PR 0.62 (95% CI : 0.34-1.11).

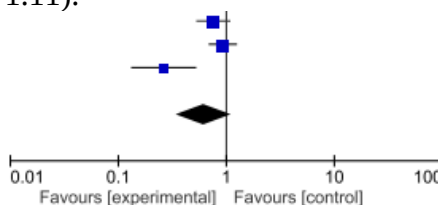


Figure 5 Forest Plot Spraying Time

Figure 5 shows a visualization of the combined effect of spraying time with health problems on farmers which in the confidence interval touches the number 1, so it is concluded that statistically spraying time is not associated with health problems in farmers.

D. Calculation Result of Combined Effect of Spraying Frequency

Calculation combined effect shows that the variation between studies is heterogeneous because it has a $p < 0.05$ and a large I^2 value (84%) so that the combined



effect calculation uses a random effects model that produces a p value of <0.001 and a combined effect size of PR 1.42 (95% CI: 1.04 -1.94).

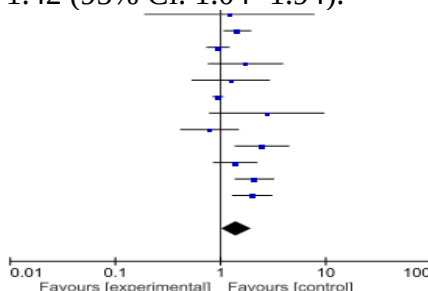


Figure 6 Forest Plot of Spraying Frequency

Figure 6 shows a visualization of the combined effect of the spraying frequency variable with health problems on farmers which in the confidence interval exceeds 1, so that it is concluded that the frequency of spraying is statistically related to health problems in farmers.

E. Calculation Results of Combined Effects of Pesticide Doses

Calculation combined effect shows that the variation between studies is heterogeneous because it has a $p < 0.05$ and a large I^2 value (72%) so that the combined effect calculation uses a random effects model that produces a p value of < 0.001 and a combined effect size of PR 1.12 (95% CI: 0.86-1.47).

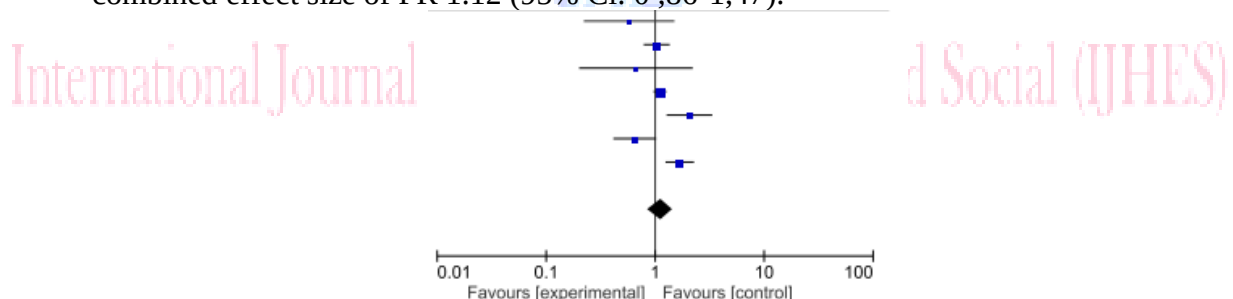


Figure 7 Forest Plot Pesticide Dosage

Figure 7 shows the visualization of the combined effect of pesticide dose variables with health problems on farmers which in the confidence interval is at number 1, so it is concluded that statistically pesticide dose is not associated with health problems in farmers.

F. Calculation Result of Combined Effect of Pesticide Mixing

Calculation combined effect shows that the variation between studies is heterogeneous because it has $p < 0.05$ and a large I^2 value (74%) so that the combined effect calculation uses a random effects model that produces a p value of < 0.001 and a combined effect size of PR 1.13 (95% CI: 0.78-1.72).

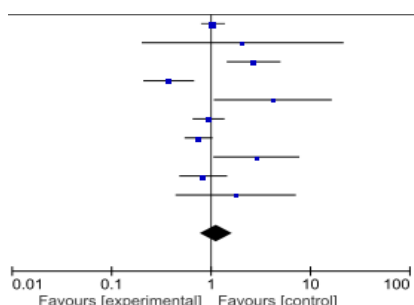


Figure 8 Forest Plot Mixing Pesticides

Figure 8 shows a visualization of the combined effect of pesticide mixing variables with health problems on farmers which in the confidence interval is at number 1, so it is concluded that statistically pesticide mixing is not associated with health problems in farmers.

G. Calculation results of the combined effect of the use of PPE

Calculation combined effect shows that the variation between studies is heterogeneous because it has $p < 0.05$ and a large I^2 value (80%) so that the combined effect calculation uses a random effects model that produces a p value of < 0.001 and a combined effect size of PR 1.26 (95% CI: 1,06-1,50).

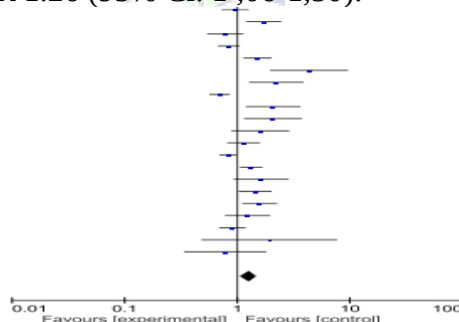


Figure 9 Forest Plot Use of PPE

Figure 9 shows a visualization of the combined effect of the variable use of PPE with health problems on farmers which in the confidence interval exceeds 1, so it is concluded that statistically the use of PPE is related to health problems in farmers.

H. Recapitulation of Meta Analysis Results of Pesticide Exposure Factors with Health Problems in Farmers

Table 9 Recapitulation of Meta Analysis Results of All Variables

Variable	p-value	PR 95% CI	Description
Working Period	<0.001	1.91 (1.03-1.54)	Significant
Long Spraying	<0.001	1.13 (0.78-1.63)	Not Significant
Spraying Time	0.003	0.62 (0.34-1.11)	Not Significant
Spraying Frequency	<0.001	1.42 (1.04-1.94)	Significant
Pesticide Dosage	0.001	1.12 (0.86-1.47)	Not Significant



Pesticide Mixing	<0.001	1.13 (0.78-7.12)	Not Significant
PPE use	<0.001	1.26 (1.06-1.50)	Significant

Table 9 shows the reapplication of the results of the meta-analysis of all the variables studied. Of the 7 variables studied, 3 variables significant to health problems in farmers and 4 variables were not significant to health problems balance disorders, hypertension and LBW.

Discussion

Relationship of Working Period with Health Problems

The working period is the length of time a person works as a farmer. The results of the meta-analysis showed that the working period with health problems in farmers show a significant relationship because Working period is one of the factors that can affect pesticide exposure to enter a person's body and pose a risk to health. The longer the working period as a farmer, the more frequent contact with pesticides, so the risk of exposure to pesticides is higher (Witcher, 2020).

The results of the calculation of this combined effect are in line with the primary research conducted by Samosir et al., (2017) which showed that there was a relationship between a person's tenure and nervous system disorders on the body balance of horticultural farmers in Ngablak District with $p = 0.036$ (Samosir et al., 2017). This result is strengthened by research conducted by Zulfa (2019) which shows that the variable of tenure is a risk factor for liver dysfunction in female farmers with p -value 0.015, r -value = 1.221 (95% CI 1.039-1.434) (Amin et al., 2019).

The results of this study are consistent with the theory that the longer a person is a farmer, the more likely it is to come into contact with pesticides and the higher the risk of health problems for farmers. The level of exposure to pesticides cannot be felt directly because it is cumulative and affects the length of work experienced (Isnawan, 2013).

Relationship of Long Spraying with Health Problems

Spraying time is the time required to spray the pesticide in hours/day. The results of the meta-analysis showed that the duration of spraying with health problems in farmers did not show a significant relationship because the length or duration of exposure to pesticides is closely related to the area sprayed. The narrower the area to be sprayed, the shorter the exposure to pesticides will be. Farmers with larger areas will be exposed to pesticides longer, this will cause more pesticides to be exposed to the body or enter the body, which can cause poisoning. Based on the results obtained from the articles that have been analyzed, most of the farmers work on their own land which is not too large, so the spraying time is usually 1 hour in the morning or evening.

The results of the calculation of this combined effect are not in line with the primary research conducted by Indrayani (2020) which showed that the only variable based on the results of statistical analysis showing a relationship with the incidence of MCI in tobacco farmers was the variable duration of pesticide spraying. The duration of spraying is closely related to the duration of pesticide exposure. The danger of pesticide exposure will increase with increasing dose and duration of pesticide exposure. The longer a pesticide is left on the skin, eyes, or the longer a pesticide is inhaled, the more damage it does to the body (Rosa, 2020).



Efforts that can be taken as an action to prevent health problems are to reduce the duration of spraying and pay attention to the interval of time of spraying pesticides in a week to avoid exposure to more pesticides into the body, considering the dangers of pesticides have a huge impact on health and the environment.

Relationship of Spraying Time with Health Problems

Spraying time is the time that shows when farmers spray pesticides, between morning, afternoon and evening. A farmer who sprays must pay attention to the right time to spray, to minimize the incidence of organophosphate pesticide poisoning (Suparti & Setiani, 2016).

The results of the meta-analysis showed that the duration of spraying with health problems in farmers did not show a significant relationship because the combined results of respondents from 3 articles, obtained the total number of respondents as many as 255 respondents. A total of 79 respondents (30.98%) sprayed at the wrong time (during the day) with the number of farmers experiencing health problems 30 farmers (11.76%).

The results of the calculation of this combined effect are in line with the primary research conducted by Nella (2016) which showed that the time of spraying can also contribute to the incidence of anemia in farmers. However, the results showed that there was no significant relationship between the time of spraying and the incidence of anemia where the time of spraying showed a p-value of 1,000 (Arwin & Suyud, 2016).

The results of the calculation of this combined effect contradict the theory that spraying time which is carried out in the afternoon/evening is expected to increase the risk. Given that during the day, the frequency of occurrence of erratic airflow and at higher speeds becomes more frequent. In addition, during the day/evening, the sun is hotter, allowing sweat to escape and widening the pores. Dilated skin pores allow pesticides to enter through the skin (Fikri et al., 2012).

Efforts that can be taken to prevent health problems for farmers who are accustomed to spraying in the afternoon/evening should be given an understanding of the magnitude of the risk of exposure to pesticides when spraying at that time. Then farmers are also directed to apply the action of spraying in the direction of the wind.

Relationship of Spraying Frequency and Health Problems

Spraying Frequency is the amount of pesticide used in times/day. The results of the meta-analysis showed that the frequency of spraying with health problems in farmers showed a significant relationship because the longer you work as a farmer, the more frequent you are in contact with pesticides, so the risk of pesticide poisoning is higher.

Based on research conducted by Hidayah (2020) the frequency of pesticide spraying is proven to have a relationship with the incidence of hypertension with p value = $0.016 < (0.05)$. Farmers who sprayed >2 times/week had a 1.7 times risk of developing hypertension compared to farmers who sprayed 2 times/week. Farmers spray 3-5 times per week on the grounds that it is the rainy season and so that the planted plants are not damaged by disturbing pests, so that this can reduce farmers' losses (Witcher, 2020).

These results can be influenced by the large number of farmers who spray more than 2 times a week. If farmers spray for a long period of time, the pesticide attached to the body will also increase



so that health problems occur by the pesticide if prevention or washing is not immediately carried out after activities with pesticides. Contact that is not too frequent can reduce the risk of anemia in farmers (Hidayatullah et al., 2020).

Efforts that can be made as a preventive measure against health problems in farmers should be minimized or reduced the frequency of spraying, and after making contact with pesticides immediately take self-cleaning actions and balanced with the use of complete PPE during the spraying process.

Relationship of Pesticide Dosage and Health Problems

Pesticide dose is the amount of pesticide dissolved in 1 liter of water. The results of the meta-analysis showed that the pesticide dose with health problems in farmers did not show a significant relationship because the amount of pesticides are not related to balance disorders, it could be due to the way of spraying that is done well where farmers at the time of spraying always pay attention to the direction of the wind, pay attention to the time of spraying and the environmental temperature when spraying is still relatively safe (Samosir et al., 2017).

The results of the calculation of this combined effect are in line with the primary research conducted by Samosir (2017) which showed that the significant value was 0.789, which means $p > 0.05$, so there is no relationship between dose and disturbances in the body balance of horticultural farmers in Sumberejo village, Ngablak district, Magelang (Samosir et al., 2017). This is probably because farmers want to get fast results in eradicating pests and plant growth so that they do compounding with the addition of a predetermined dose. The addition of the dose becomes more concentrated if inhaled through inhalation can be risky to health and over time in the long term continuously can cause nervous disorders, one of which is balance disorders.

Efforts can be made as a preventive measure against health problems in farmers because the dose of pesticides directly affects the danger of pesticide poisoning, therefore in mixing pesticides for spraying, farmers should pay attention to the dose or dose listed on the pesticide label. Pesticides that have high killing power in use at low doses cause fewer disturbances, when compared to pesticides with low killing power but with high dosage.

Relationship of Pesticide Mixing and Health Problems

Mixing pesticides or the number of types of pesticides is the number of types of pesticides used by farmers in every spraying of crops (Yuniastuti, 2018). The results of the meta-analysis showed that mixing/type of pesticide with health problems in farmers did not show a significant relationship because the mixing of pesticides is usually done by husbands or fathers directly in the fields before they spray, so there is no pesticide exposure to pregnant women from the process of mixing pesticides.

The results of this study are supported by research conducted by Miftah (2016) which states that there is no relationship between mixing pesticides and the incidence of LBW in the working area of the Ngablak Health Center and Pakis Health Center (Fatmawati & Windraswara, 2016).

The results of calculating this combined effect show that there is no correlation between mixing / types of pesticides with health problems in farmers, this is because farmers rarely mix three or



more types of pesticides, at most they only mix two types of pesticides, namely carbamates and organophosphates (Vutrianingsih et al., 2020).

Efforts that can be taken as a precautionary measure to prevent health problems for farmers due to mixing/types of pesticides, are not mixing or mixing various types of pesticides because the large number of types of pesticides used during spraying will cause a greater poisoning effect when compared to the use of one type. pesticides because the toxicity or concentration of pesticides will be stronger so that it will give greater side effects.

Relationship of Use of PPE with Health Problems

Personal protective equipment is completeness in the use of tools to protect oneself in order to avoid direct contact with pesticides in every spraying practice (Yuniastuti, 2018). Pesticides enter the body in various ways, including through inhalation or skin penetration. Therefore, the best ways to prevent poisoning are to provide protection for these parts. Equipment to protect body parts from exposure to pesticides when spraying is called personal protective equipment, or so-called protective equipment (Amalia, 2019).

The results of the meta-analysis showed that the use of PPE with health problems in farmers showed a significant relationship because farmers pay less attention to contact poison or the entry route for pesticides, especially through the skin, farmers do not use essential PPE such as gloves and masks which can cause pesticides to be directly touched by the skin.

The results of the calculation of this combined effect are in line with the primary research conducted by Lubis (2020) which showed that there was a significant relationship between the completeness of personal protective equipment (PPE) used when working in the fields with the incidence of LBW in Pijorkoling Village, namely with a p-value of 0.002 (Lubis, 2020). This result is reinforced by Samosir's research (2017) which shows that farmers who use incomplete PPE have a more than 2.5 times risk of experiencing balance disorders compared to farmers who use complete personal protective equipment (Samosir et al., 2017).

Efforts that can be made as a preventive measure against health problems in farmers should use complete personal protective equipment (PPE) according to standards, including long-sleeved shirts covering the neck, trousers, respirators, plastic gloves, protective eyewear, headgear, and shoes. boot.

Conclusion

The results of the meta-analysis of external factors that are related to and become risk factors for health problems in farmers include working period, frequency of spraying and use of PPE.



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