INCREASED INCIDENCE OF STUNTING DUE TO PESTICIDE EXPOSURE IN AGRICULTURAL AREAS

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Abstract

Children who grow up in agricultural areas have a risk of experiencing stunting or developmental disorders due to exposure to pesticides, which can be one of the factors for stunting. This study aimed to determine the side effects of pesticide exposure on the incidence of stunting in agricultural areas. The method used in writing this research is a literature review using keywords on Google Scholar "Stunting," "Petani," AND "Pestisida" and on PubMed and ScienceDirect using the keywords "Stunting" AND "Farmer OR Agroindustry" AND "Pesticide." According to the data analysis of several studies, the results show that pesticide exposure can affect the synthesis and metabolism of thyroid hormones and affect child growth and development. Research also states that agricultural activities carried out by mothers who work as farmers have an impact on child growth and development. The conclusion is that pesticide exposure can increase the incidence of stunting in agricultural areas caused by a disrupted thyroid TSH receptor (TSH-r) so that TSH inhibits thyroid hormones. Nurses as educators have an essential role in raising awareness of the risk of stunting in agricultural areas and reducing pesticide exposure, as well as improving parenting and good nutrition for children in the community
Keywords: *Stunting;, Farmer; Pesticide*

INTRODUCTION

Farming is a job that utilizes biological resources carried out by humans to produce food, industrial raw materials, energy sources, and environmental management to meet the needs of life using modern and traditional equipment. Meanwhile, agriculture is a human activity that produces materials humans need from vegetable and animal products[1,2]. The agricultural sector is the primary source of Indonesia's food security, but even so, issues related to malnutrition in farmers' children are still rife, one of which is stunting. Children who grow up in agricultural areas have a risk of stunting or growth and development disorders due to pesticide exposure, which can be one factor that contributes to stunting[3].

Stunting is a disorder of the child's growth and development process due to chronic malnutrition and repeated infections. Stunting is caused by long-term malnutrition, usually from pregnancy to the age of 2 years. Stunting in children in agricultural areas can also be closely related to the use of pesticides in the farming process[4]. Pesticides are materials that are used to eradicate pests. Pesticides are chemicals that are included in the Endocrine Disrupting Chemical (EDCs) group, where this material will interfere with the function of thyroid hormones, such as changing the structure of the thyroid gland, the function of the thyroid gland, disrupting the synthesis, secretion, transport, binding, and elimination of thyroid hormones. So this will interfere with the growth and development of the child's body[5].

Pesticides in agricultural areas are usually used to deal with pests that attack the plants grown by farmers. The use of pesticides is due to the need for knowledge of farmers who lack the impact of the dangers of pesticides for farmers. So, education is needed to increase farmers' knowledge regarding the dangers of pesticides for child development and how to reduce pesticides such as pesticide use[6]. Reducing the use of pesticides in rice fields can also be done by planting the hydroponic method[7].

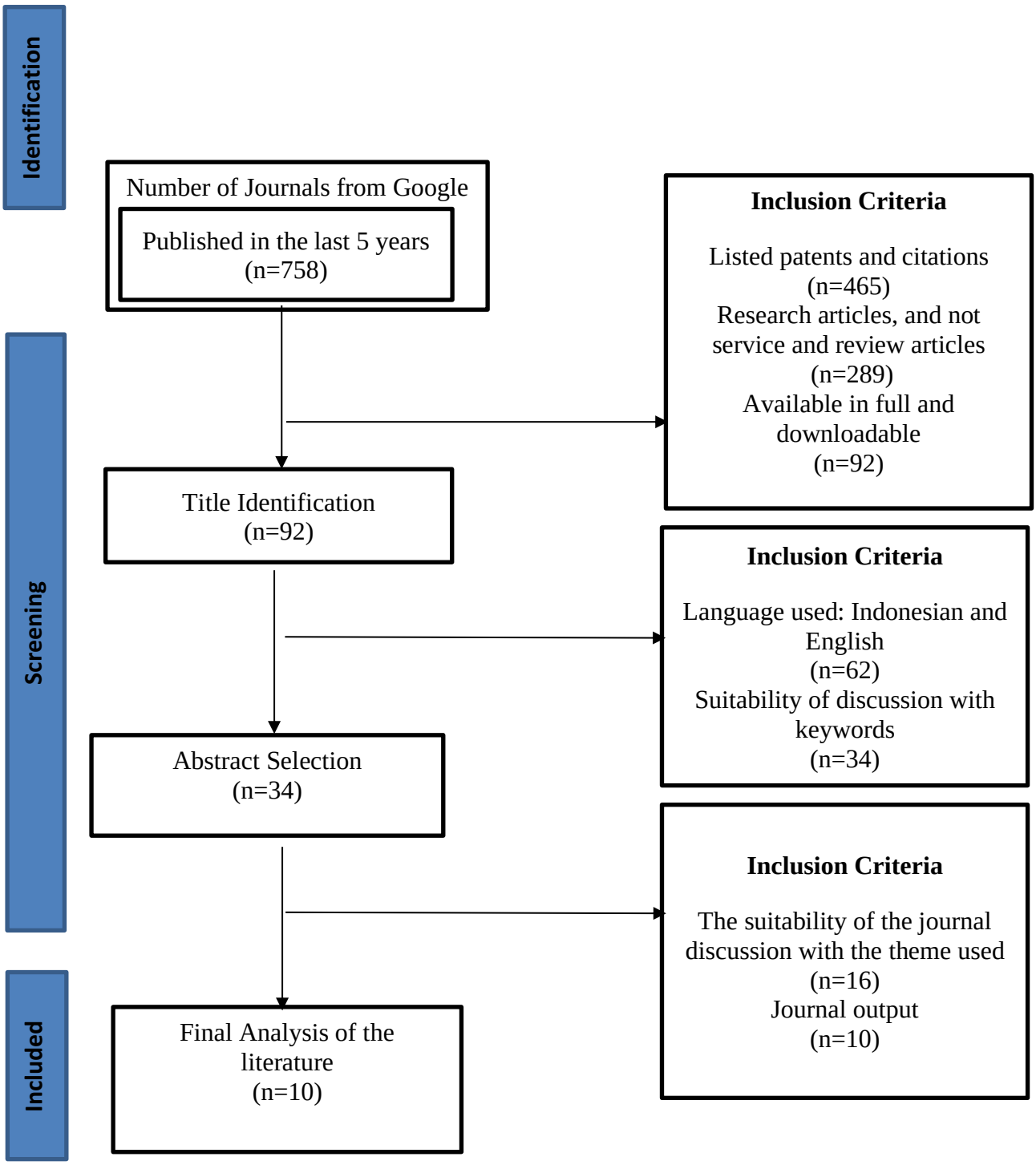
METHOD

The method used in this research is to use literature review to find sources of articles in the form of research as review material to answer a predetermined problem. All articles that have been determined will be summarized using the same references, including the year of publication, article title, method, sample, and results. The results of the summary will then be analyzed to find similarities and differences from the research in the article and then draw a conclusion that will be the output of this article.

The journal search began on May 05, 2024, through the Google Scholar, ScienceDirect, and PubMed databases. The keywords used in Google Scholar are "Stunting," "Petani," AND "Pesticide." While the keywords used in PubMed and ScienceDirect are "Stunting" AND "Farmer OR Agroindustry" AND "Pesticide". The inclusion criteria used are journals published in the last five years, available in full and can be downloaded, have complete patents and citations, are research articles, speak English and Indonesian, and discuss according to the specified keywords. The exclusion criteria are journals published over the last 5 years, namely 2019, do not have complete citations and patents, are not research articles, are not available in full and cannot be downloaded, the language used is not Indonesian, and English does not include complete keywords. The outcome of the journal does not match the topic.

The journal search process began by identifying journals according to the specified keywords and found 2,312 from 3 databases: Google Scholar, PubMed, and Science Direct. Then, 758 journals published in the last 5 years were selected. After collecting eligible journals, further selection was carried out to eliminate and then select journals according to the inclusion criteria, including listed patents and citations (465), then selected articles that are research articles, not devotion and reviews (289), available in full and can be downloaded (92) which are then included in the identification of selected titles. Then, screening of the selected titles was carried out; as for the number of journal articles carried out, journals using Indonesian and English were obtained (62), and from 62 journal articles sorted out the suitability of the discussion was sorted out (34). Then, from the 34 journal articles, abstract identification is carried out, and selection of topics for the specified topic is

carried out (16), and finally articles that have outcomes that are by The topics (10) are sorted out, which are then analyzed for review.



Picture 1. Literature Review Search Method

RESULT

Stunting is a condition of chronic malnutrition caused by inadequate intake of balanced nutrition that can affect the growth and development of children from infancy to school age. According to Afandi (2023), in a study conducted on school-age children who experienced stunting. There is a relationship between nutritional status and the incidence of stunting in children. Unbalanced nutritional intake will impact children's body mass index, height, cognitive patterns, and productivity levels[8]. In addition, there is an influence of food security on the incidence of stunting in research conducted by Asparian et al. (2020); the results of the blue vat Analysis showed that toddlers with food security in low household behavior were higher (73.1%) experiencing a risk of 4.772 times stunting compared to high household resilience levels (37.5%)[9]. similar to research conducted by Htet et al. (2023), which explained that children with a highly educated mother's status have a high economic level, and food security tends to be less stunted. On the other hand, children who consume food from their own harvest have a higher prevalence of stunting[10].

In addition to nutritional factors, there are other factors, such as pesticide exposure in agricultural areas, which show significant results on the incidence of stunting in line with research conducted by Riana & Widiastuti (2023), where pesticide exposure can affect the synthesis and metabolism of thyroid hormones. Research conducted by Kartini et al. (2019) shows that children who play in agricultural areas and are exposed to pesticides experience a 3-fold higher risk of stunting compared to children who are not exposed[11]. Other research studies also explain the relationship between parental work and pesticide exposure in agricultural areas where children with heavy maternal agricultural activities are more at risk than children with light maternal agricultural activities. This is related to the parenting provided by the mother. Heavy maternal farming activities will inhibit child growth where the mother's effectiveness in caring for children is less and will affect the conditions of nutritional intake that are less considered and the pattern of child development[12].

Agricultural activities carried out by mothers who work as farmers have an impact on child development. Mothers who spend a lot of time in the fields are likely to have their children participate because there is no one to look after at home and children are likely to play in the rice fields. Children who play and indirectly come into contact with soil exposed to pesticides. According to research by Mardiyana et al. (2020), the results show that children who play in agricultural areas will have a 4 times higher risk of stunting compared to children who do not play in agricultural areas. Maternal activities such as preparing pesticides, mixing and spraying pesticides, and washing pesticide spray equipment that are carried out for more than 4 hours affect the risk of stunting. The same research was conducted by Purba et al. (2022). Mothers exposed to pesticides have toddlers who are taken to the fields tend to have stunted toddlers. There is a link to the frequency of exposure to stunting, such as

fertilizing and harvesting a week, but both have not shown significant results. Furthermore, similar to research conducted by Jaacksa et al. (2019), exposure to pesticides in high concentrations of insecticides such as organophosphate insecticide metabolites and nitrophenol 4 can increase the reduction in birth rates and growth retardation in children in agricultural areas, which can cause a decrease in hemoglobin and have low birth weight[13].

Table 1. Literature review result

No	Author Name/ Year	Article Title/ Journal Name/ Volume	Method	Sample	Result	Limitation
1.	Jaacksa et al., 2019	Association of prenatal pesticide exposures with adverse pregnancy outcomes and stunting in rural Bangladesh/ Environment International Journal/133	The study used a cohort method on mothers in rural Bangladesh.	The research sample was conducted on 289 pairs of mothers and children.	The journal article found high concentrations of two organophosphate insecticide metabolites and 4 Nitrifenol on agricultural land, which can be detrimental to birth rates and child growth. Children born in the fourth quartile region may have low hemoglobin levels and tend to have low birth weight.	The limitation of the study is the lack of samples used, so it is less able to detect individual pesticide biomarker relationships.
2.	Kartini, et al., 2019	Pesticide Exposure and Stunting among Children in Agricultural Areas. 10, 17–29/ International Journal of Occupational and Environmental Medicine/Vol. 10 number 1	The research used case group and control group methods	In the study using control cases, as many as 160 children (48 cases and 112 controls) aged 8-12 years	There is a relationship between pesticide exposure and stunting in children in agricultural areas, with a 3-fold higher risk compared to children who are not exposed to pesticides. One of the risks is enteric environmental	In the study, there are limitations to further research that discusses the relationship between stunting and IGF-1 levels related to chemicals.

					dysfunction, oxidative stress, and impaired child growth and development.	
3.	Asparian, et al., 2020	Factors Associated with the Incidence of Stunting in Toddlers Aged 24-59 Months from Farmer Families in the Working Area of Gunung Labu Health Center, Kerinci Regency/ Journal of Academia Baiturrahim Jambi/ Volume 9 No. 9	Research using quantitative methods using cross-sectional design	The population in the study was all toddlers aged 24-59 months in the Gunung Labu Health Center work area as many as 1,422. At the same time, the samples used were 98 toddlers from farmer families taken *using the proportional random sampling* technique.	From the journal article, it was found that the results of stunting that occurred in the Working Area of the Gubung Labu Health Center were 46 toddlers, namely 32.34% and the factors that influenced the occurrence of stunting in children in farming families were low food security factors with an incidence rate of 73.1%, parenting and feeding 55.4%, low household income 54.5%, the number of household members 45.5%, Maternal employment is 50.0%, and maternal education level is 54.3%.	The study did not directly discuss the factors of agricultural activities that can cause stunting, even though all samples taken came from farming families. Limited explanation that children whose mothers work are more at risk of stunting
4.	Purba et al., 2022	The Incidence of Stunting in Toddlers Exposed to Pesticides in Agricultural Areas / Indonesian Environmental Health	This research is a quantitative analytical research that uses a cross-sectional study approach.	The sample of this study was 68 toddlers aged 12-59 months who lived sedentary in North Dempo and South	The results of this study showed that the variable history of pesticide exposure in mothers under five and exposure to toddlers was not significantly	This study has limitations on the percentage of small stunting toddlers at 7.4%; pesticide exposure measurements such as biomarker measurements

		Agency / Vol. 21 No. 3		Dempo Districts. However, because the sampling technique of this study is cluster sampling, the sample size obtained is multiplied by the effect design to 68x2 = 136 toddlers.	related to the incidence of stunting.	were not carried out, and the study design was only cross-divided.
5.	Mardiyana, et al., 2022	Relationship between Pesticide Exposure and Stunting Incidence in Children Aged 2-5 Years in Magelang Regency (Case Study in Ngablak District)/Indonesian Public Health Media/Vol.19 No. 1	The research used conservation analytical methods with case-control studies.	The study used a sample of 94 children aged 2-5 years with criteria of 47 children who were categorized as stunting and 47 children in the normal category.	Children with mothers who work in agriculture, such as mixing pesticides, spraying and washing pesticide sprayers, and children who play in agricultural areas and come into contact with soil that may have pesticide exposure experience a 4 times higher risk of stunting, which can interfere with child growth and development.	In the study, there were limitations to the results presented that did not explain in detail the relationship between the history of involvement of pregnant women with the preparation of spray equipment and spraying pesticides.
6.	Yushananta et al., 2022	Risk Factors of Stunting in Children Aged 6–59 Months: A Case-Control Study in Horticulture Area[14]	This research is qualitative research with a case study conducted in Liwa City, West Lampung	The sample in this study was 160 children aged 6-59 months (120 controls and 40 cases)	The results showed four factors associated with stunting in children aged 6-59 months in agricultural areas. The four factors include	This study states four factors associated with stunting in children aged 6-59 years in agricultural areas, but this study does not

			Regency, by comparing previous exposure between stunting (cases) and non-stunting (control) children.		birth length, low birthweight, nutritional intake, and access to sanitation.	discuss how agricultural activities such as spraying pesticides can increase the incidence of stunting.
7.	Okidi et al., 2022	Disparity in prevalence and predictors of undernutrition in children under five among agricultural, pastoral, and agro-pastoral ecological zones of Karamoja sub-region, Uganda: a cross-sectional study[15]	This research used a cross-sectional design and was conducted in pastoral, agro-pastoral, and agricultural agroecological zones in the sub-region Karamoja was located in the northeastern part of Uganda between October and December 2019	The study took 240 households. Then 13-14 households in Maroto Regency, 24 households in Kotido Regency, and 22-23 households in Kaabong with each household more than one toddler who met the research requirements, namely 6-59 months old.	The prevalence of underweight, stunting, and wasting ranges from 36 to 58% but varies by agroecology in peak age, ranging from 6 to 37 months. Caregivers washing hands after using latrines (P = 0.005) and diarrhea in two weeks (P< 0.001) increased the likelihood of stunting only in pastoral agroecology, whereas storage of cereals in sacks and barns in agro-pastoral zones was associated with reduced likelihood of underweight (P<0.001 and P=0.014) and stunting (P=0.011 and P=0.018), respectively.	First, the small sample size of respondents used in each agroecology limits the generalizability of this study. Second, district elections with malnutrition rates are highest in each agroecological zone as well may limit the generalizability of research findings in different locations of the Karamoja region.
8.	Alkhair et al., 2023	The Relationship between Maternal	This research is quantitative research	The sample in this study was 191 children	This study's results show a significant relationship	This study states that there is a significant relationship

		Agricultural Activities and the Incidence of Stunting in Children Aged 2-5 Years in Sai Village / PREPOTIF Journal of Public Health / Vol. 7 No. 3	with an observational analytical approach with a cross-sectional study design.	aged 2-5 years.	between agricultural activities and the incidence of stunting in children aged 2-5 years in Sai Village, with a value of p = 0.000.	between agricultural activities and the incidence of stunting in children but does not discuss clearly what kind of agricultural activities can increase the incidence of stunting in children aged 2-5 years.
9.	Htet et al., 2023	Socio-economic and agricultural factors associated with stunting of under 5-year children: findings from surveys in mountains, dry zone and delta regions of rural Myanmar (2016–2017)	The research used repeated cross-sectional panel surveys from 2016-2017	Samples were taken from two cities. Twenty villages were selected from each village. Then, thirty households with children under five in each village to reach 1,200 households per region. Then, 15 households were obtained from categories according to population size	Overall, stunting prevalence increased from 40·4% In the first round, it was 42.0%, and in the second round, At In the second survey, stunting was highest in all survey rounds in the State of China (62·4%). Its prevalence is low in children under 1 year of age, but tends to increase in children 2 years old and older. Prevalence of stunting in children lower if the mother is highly educated but tends to be more height if the mother is short in stature (<145 cm).	This research should be carried out until the latest year, 2023. Surveys conducted from 2016-2017 have not been sufficient to ascertain the prevalence of stunting. So, further research is needed to update the data. The sample in Myanmar's three states was broad enough to limit the ability to generalize research findings in different locations.

10.	Riana & Widiastuti, 2023	The Relationship between Iodine Exposure Intake and Pesticide Exposure with the Incidence of Stunting in School-Age Children in Sukawening Village, Ciwidey District/ Journal of Health Sciences/ Volume 17 No.1	The research used quantitative methods with a cross-sectional design. Primary and secondary data types. Food consumption data was collected through interviews using the SQFF (Semi-Qialitative et al.) method. Questionnaires were distributed through posyandu cadres in the research area.	The population in the study was all children aged 6-12 years, Sukawening Village, Ciwidey District, Bandung Regency, with as many as 31 people. The sampling technique is *purposive sampling.*	From the journal article, it was obtained that the results of stunting that occurred in Sukawening Village, Ciwidey District, Bandung Regency, as many as six people amounted to 19.4%. Then, the results that showed the effect of less iodine intake on the incidence of stunting were three people, namely 9.6%, while the results of stunting events related to pesticide exposure were six people, namely 19.4%.	Based on the research findings that state the relationship between the incidence of stunting and pesticide exposure, it is not further discussed whether pesticide exposure is at risk of causing higher stinting during the child's growth or mother's pregnancy.

DISCUSSION

Stunting is associated with past nutrient inadequacies and is a chronic nutritional problem. Lack of nutritional intake can limit children's growth potential[8,16]. In addition to inhibiting children's growth potential, stunting also has an impact on children's intellectual decline, decreased immune function, and impaired combustion system. Stunting is influenced by various factors such as unbalanced nutrition, the nutritional status of the mother before, during, and after partus, short maternal posture, too close a distance between pregnancies, and pregnancy in adolescence. Indirect factors are sociodemographic and environmental factors[3].

One of the environmental factors that is a problem for children with stunting is in agricultural areas. Rural activities that tend to farm make parents ignore the nutritional needs of their children. A study conducted by Asparian et al. (2020) explained that factors associated with stunting in toddlers aged 24-59 months are low food security, parenting

food, low household income, number of household members, maternal employment, and low maternal education level. This is also supported by research found in the article Okidi et al. (2022), where other factors that cause stunting are feeding parenting, family economy, and low maternal education and sanitation factors. However, the article added an explanation that sanitation factors and low birth weight also influence stunting. Males tend to be more susceptible to stunting because they are more prone to low body weight.

A study by Htet et al. (2023) found that stunted children were born from short mothers, and children with wealth had a lower risk than those who consumed their crops. In contrast, research conducted by Yushananta et al. (2022) states that there are four factors for the incidence of stunting in children aged 6-59 months, namely, birth length, LBW, nutritional intake, and access to sanitation.

Indonesia is an agrarian country; of course, most of the population works as farmers to make a living, even though it has adverse effects on children's health, such as pesticide exposure and poor parenting. This is in line with the research results by Alkhair et al. (2023) on the relationship between maternal agricultural activities and the incidence of stunting in children aged 2-5 years, which found that maternal agricultural activities affect the incidence of stunting. This is due to the inhibition of parenting, which indirectly affects children's nutritional conditions and development. In addition, pesticide exposure is a dominant factor in the incidence of stunting aged 2-5 years. In contrast to the research findings of Jaacksa et al. (2019) that low hemoglobin levels in infants in agricultural areas and low birth weight that pesticides interfere with child growth and development.

The research conducted is also in line with what was found in the article by Mardiyana et al. (2022), which states that maternal farming activities affect the incidence of stunting in children aged 2-5 years. The mother's farming activities have a great opportunity for pesticide exposure because her activities are directly related to pesticides, such as preparing pesticides, mixing pesticides, spraying, and washing spray equipment. This study also explains the reasons why children can be at risk of stunting, one of which is because the child is still young. There is no one to look after at home, so the mother accompanies her child while working in the agricultural field without any special supervision. Children are left to play with water, soil, leaves, and pesticide packaging. These activities allow children to be exposed to pesticides and have a 4 times higher risk of disrupting their growth and development due to the duration of activities on the farm.

Similar research was also conducted by Riana & Widiastuti (2023), which further emphasized pesticide exposure's effect on stunting incidence. Pesticides can affect the synthesis and metabolism of thyroid hormones through several mechanisms. The article states that the first mechanism is through the thyroid TSH receptor (TSH-r), which is disrupted so that TSH inhibits thyroid hormones. Second, pesticides can inhibit the activity of

the enzyme deiodinase type 1 (D1), which catalyzes the conversion of T4 to T3. Thirdly, due to the shape of the chemical structure of pesticides that are similar to thyroid hormones, they bind to TSH-r in target cells. The fourth pesticide stimulates the activity of the D3 enzyme. As a result, the body experiences a deficiency of the active thyroid hormone (T3).

Supporting statements are also found in research conducted by Kartini et al. (2019), who found that the incidence of stunting is 3 times higher in children exposed to pesticides, which disrupts their growth and development. Of the several studies, only one is different, namely the findings of Purba et al. (2022), which explain that pesticide exposure in mothers and children does not affect or have a significant relationship to the incidence of stunting. This difference is a new finding that not all stunting is influenced by pesticides, even though the conditions are in agricultural areas.

CONCLUSION

Stunting is a chronic nutritional problem caused by insufficient nutrient intake in the past. Unbalanced nutrition, maternal nutritional status, agricultural environment, and pesticide exposure contribute to stunting. Agricultural activities in rural areas hinder good parenting and increase the risk of pesticide exposure in children. Pesticide exposure is believed to have a significant influence on stunting through thyroid hormone disruption. However, research shows that not all cases of stunting are affected by pesticide exposure. Therefore, efforts are needed to raise awareness of the risk of stunting in agricultural areas, reduce pesticide exposure, and improve parenting and good nutrition for children in the community. Nurses, as educators, have an important role in raising awareness of the risk of stunting in agricultural areas, reducing pesticide exposure, and improving good parenting and nutrition.

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