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Pesticide Exposure Increases The Incidence Of Low Birth Weight (LBW) In Agricultural Areas

Nadhira Faza[1], Reza Novita[1], Dian Trisnawati[1], Enggal Hadi Kurniyawan[1]*, Alfid Tri Afandi[1], Dicky Endrian Kurniawan[1], Kholid Rosyidi Muhammad Nur[1]

[1]Faculty of Nursing, Universitas Jember, Indonesia

*Correspondence:
Enggal Hadi Kurniyawan
Email: enggalhadi.psik@.unej.ac.id

Abstract

Introduction: The involvement of pregnant women in agricultural activities causes pregnant women to be exposed to chemicals contained in pesticides, which will have an impact on the health of pregnant women, especially on reproductive health, which can pose a risk of low birth weight babies. This study aimed to determine the relationship between pesticide exposure and the incidence of low birth weight in agricultural areas.
Methods: This research was conducted using the literature review technique; the literature search process used three databases, including Google Scholar, PubMed, and Science Direct, with a publication range from 2020-2024.
Results: Pesticide exposure in female farmers influences a determinant of LBW, namely participation in agricultural activities; some articles found that there was no relationship between pesticide exposure and the incidence of LBW; this is because the participation of mothers in agricultural activities is mostly not too long so that the intensity of pesticide exposure in the majority of mothers is still low, in addition, exposure non-organophosphate pesticides had more impact on skin problems in infants rather than low birth weight.
Conclusions: Pesticide exposure during pregnancy influences the incidence of LBW; the role of nurses is needed in raising awareness of farmers and their families such as the use of personal protective equipment, managing pesticides according to standards, avoiding direct contact with someone who is bound by pesticides, and storing pesticides out of reach.

Keywords: low birth weight (LBW), pesticide, agricultural

Introduction

Health development constitutes a critical component of national development, aiming to foster public awareness, desire, and capacity to achieve optimal health outcomes (Mariya et al., 2021). A key indicator of a population's health status is the infant mortality rate (IMR), which reflects broader socioeconomic and healthcare challenges (Eltayib & Chan, 2023). Among the factors influencing IMR, low birth weight (LBW)—defined as a birth weight below 2,500

grams—plays a significant role (Jana et al., 2023; Faqih et al., 2025). LBW and preterm births account for 60–80% of neonatal deaths globally, underscoring the urgency of addressing its determinants to improve maternal and child health outcomes (Wastnedge et al., 2021; Andini et al., 2023).

The etiology of LBW is multifaceted, involving biological, environmental, and socioeconomic factors (Islam et al., 2024). Sundani (2020) identified maternal knowledge, parity, nutritional status, antenatal care frequency, and maternal work duration as key contributors. Notably, prolonged maternal work hours—particularly exceeding five hours daily—emerged as the most dominant predictor of LBW (Andrade & Gil, 2022). This finding is particularly relevant in agrarian communities, where pregnant women frequently engage in labor-intensive agricultural activities, including pesticide handling, increasing their exposure to harmful chemicals (Kumar et al., 2025).

Agricultural work during pregnancy often involves direct contact with pesticides, from mixing ingredients to field application (Colopi et al., 2023). Pesticides, chemical compounds designed to control pests, are widely used to enhance crop yields (Jain et al., 2022). However, their indiscriminate use poses severe health risks, particularly to vulnerable populations like pregnant women. Chronic or acute exposure to these toxins can disrupt maternal health, affecting reproductive outcomes and fetal development (Fucic et al., 2020; Kurniyawan et al., 2024).

The adverse effects of pesticide exposure on maternal and fetal health are well-documented. Chemicals in pesticides may cross the placental barrier, interfering with fetal growth and development (Gupta & Gupta, 2021). For instance, organophosphates and other active ingredients have been linked to intrauterine growth restriction, a leading cause of LBW (Pan et al., 2023). Additionally, maternal exposure to pesticides has been associated with complications such as preterm labor and placental abnormalities, further elevating LBW risk (Lin et al., 2023; Putri et al., 2024).

Beyond immediate birth outcomes, pesticide exposure during pregnancy may have long-term consequences for child development. Studies indicate that prenatal exposure correlates with impaired neurodevelopment, including delayed motor skills and cognitive deficits in children under three (Wei et al., 2023). These findings highlight the intergenerational impact of occupational hazards in agricultural settings, where protective measures for pregnant workers are often inadequate (Atinkut et al., 2022).

In agrarian societies, cultural and economic factors often compel pregnant women to participate in farming despite the risks (Spencer et al., 2022). Limited access to education,

healthcare, and alternative livelihoods perpetuates this cycle, exacerbating health disparities. Sundani's (2020) research emphasizes that prolonged work hours in pesticide-laden environments significantly heighten LBW incidence, yet preventive strategies remain underprioritized in policy frameworks.

The high contribution of pesticide exposure to LBW underscores the need for targeted interventions (Damiri et al., 2025). Current literature calls for stricter pesticide regulations, improved maternal healthcare, and community education to mitigate risks. However, gaps persist in understanding the dose-response relationship between pesticide exposure and LBW, particularly in low-resource settings where agricultural practices are less regulated (Bliznashka et al., 2022). Quantitative evidence further strengthens the link between maternal pesticide exposure and low birth weight outcomes. In a cross-sectional study conducted in rural Indonesia, approximately 34.7% of pregnant women living in high pesticide-use areas were found to have biomarkers indicating significant pesticide exposure, with 23.5% of their newborns categorized as having low birth weight (LBW) (Sari et al., 2023). Similarly, research in agricultural regions of Thailand reported that pregnant women exposed to organophosphates were 2.6 times more likely to deliver LBW infants compared to non-exposed women (Chanvimalueng et al., 2021). These figures highlight a measurable association between maternal pesticide exposure and adverse neonatal outcomes, reinforcing the urgency for localized public health interventions. Moreover, the high proportion of pregnant women—such as the 34.7% identified in Indonesia with elevated pesticide exposure serves as a critical indicator for prioritizing maternal health surveillance in agricultural communities.

Addressing these gaps requires robust evidence to inform policy and practice. This study employs a literature review methodology to synthesize existing research on the association between pesticide exposure and LBW in agricultural communities. By consolidating findings from diverse contexts, the review highlights actionable insights for reducing LBW incidence and advancing maternal-child health equity (Rahmawati et al., 2023).

Ultimately, this research seeks to contribute to global efforts in achieving Sustainable Development Goal 3 (Good Health and Well-being) by emphasizing the intersection of occupational health, environmental safety, and maternal care. Through a comprehensive analysis of pesticide exposure's role in LBW, the study advocates multisectoral approaches to safeguard vulnerable populations and promote healthier future generations (Kancherla et al., 2022).

Methods

The literature search process used three databases, including Google Scholar, PubMed, and Science Direct, with a publication range from 2020-2024. The search method uses several keywords in Indonesian and English. The literature search in English used the keywords "Association" AND "Pesticide Exposure" AND "LBW" OR "Low Birth Weight" AND "Agricultural". While the search in Indonesia uses the keywords "Hubungan" AND "Paparan Pestisida" AND "BBLR" OR "Berat Bayi Lahir Rendah" AND "Pertanian."

Based on the selection criteria, this literature review was conducted using inclusion and exclusion criteria. The formula for determining inclusion using PICOS (Population, Intervention, Comparison, Outcomes, and Study design). Based on the PICOS technique, the inclusion criteria were 1) The study population is pregnant women working or living in agricultural areas, 2) the Issue of Interest has a low birth weight-related disorder, 3) Comparison between pregnant women who were exposed to pesticides during pregnancy and pregnant women who were not exposed to pesticides during pregnancy, 4) The results showed that pesticide exposure increased the incidence of BLW during pregnancy in women who worked and lived in agricultural areas, 5) Quantitative research design, 6) The year of publication of the articles discussed is at least the last 5 years between 2020-2024, 7) Using Indonesian and English languages. Meanwhile, the exclusion criteria included topics unrelated to the discussion of the research problem, articles using languages other than Indonesian and English, articles that could not be downloaded, and publications that were less than the range of 2020-2024.

The search for literature articles begins with the identification of predetermined keywords. In the identification stage, 4.840 journals were produced that matched the keywords. The next step is to select by determining the title and range of publications that match the criteria. At the selection stage, 2.221 journals matched the criteria search (Google Schoolar = 1292, Pubmed = 891, Sciencedirect =38) . Furthermore, by selecting titles related to the influence of pesticide exposure on babies' low weight in farms, 576 Journals were obtained that were suitable for inclusion and exclusion. The next stage focused on selection based on the abstract; at this stage, 110 journals were obtained relevant to the criteria. Furthermore, the 110 articles were re-screened in terms of language, research model, and other criteria. Finally, 10 articles were determined to meet the research criteria and could be continued at the analysis stage.

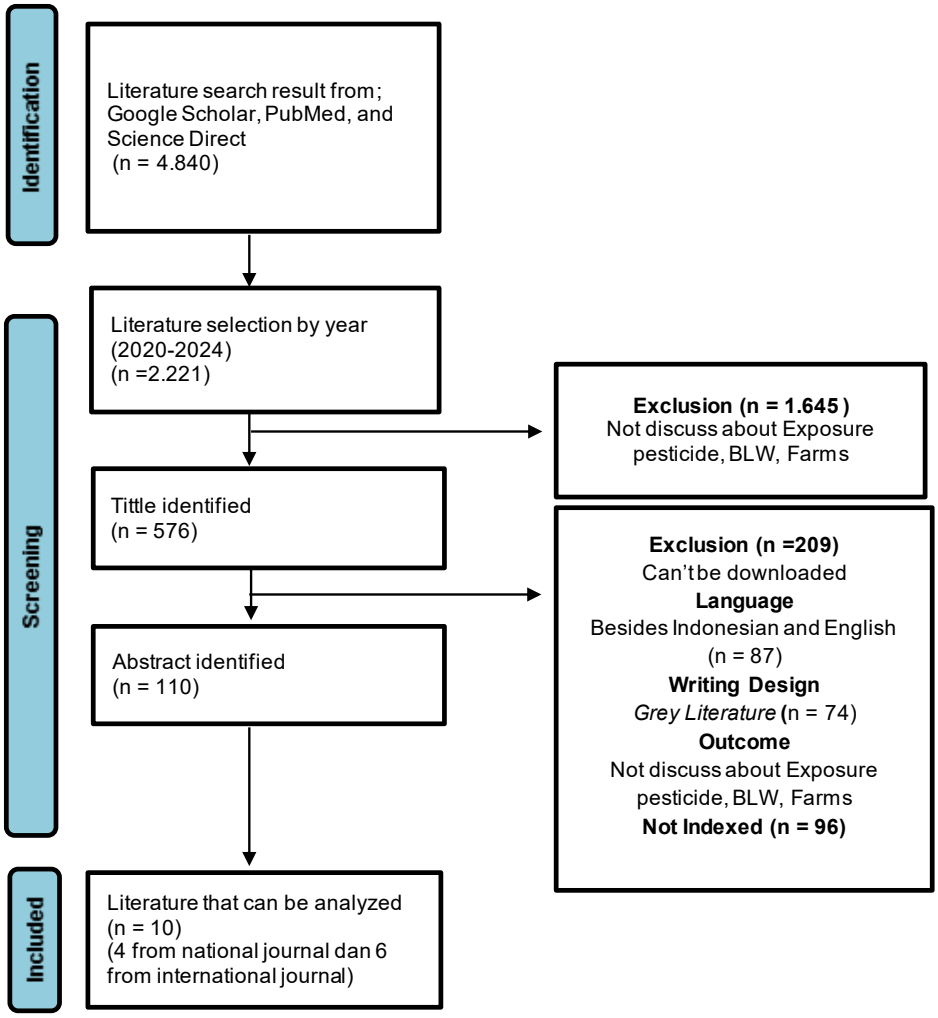

Figure 1. Flow Diagram of Analysis Literature Based on PRISMA

Results

Based on the search results of all articles obtained from 3 databases, namely Google Scholar, Pubmed, and ScienceDirect. Several research designs in the articles used include Cohort-Study, Retrospective, Case-study, and Cross-Sectional. Of all the articles, six showed a correlation between pesticide exposure and LBW, and four explained no significant correlation between pesticide exposure and LBW.

Table 1. Result of Literature Review

No	Author/Year	Article Title/Journal Name/Volume	Sample	Method	Result	Limitation

1.	Suwannakul ., et al (2021).	Prenatal organophosphate exposure can cause adverse birth outcomes in humans. Environmental/ Science and Pollution Research, 28(33),	This study used a sample of 71 pregnant women with the criteria of 18-35 years old, <28 weeks of gestation, and working in agricultural areas.	The research method used a cohort study.	Of the three babies with low birth weight, two also had low height and head circumference. Apgar scores ranged from 8 to 10. However, the results showed that, on average, all birth outcomes were within the normal range.	A single-point urine sample should be collected to represent exposure to organophosphate pesticides rather than repeated samples. Then, urine DAP metabolites are non-specific, so they cannot specifically measure OP pesticides because workers use several pesticides.
2.	Lubis, F. H (2020)	Analysis of Risk Factors of Pesticide Exposure in Pregnancy with Low Birth Weight (LBW) Incidence in Padangsidimpuan City in 2019 / Journal of Public Health & Nutrition, e-ISSN: 2655-0849 / Vol. 3 No.1	The participants were split into two categories: one comprising 25 farmers who had previously experienced low birth weight (LBW), referred to as the case group, and 25 farmers residing in the vicinity of the case group members but without a history of LBW labeled as the control group.	This research design using case-control studies is below experimental and cohort studies but more potent than cross-sectional studies.	Risk factors for pesticide exposure that are proven to be associated with the incidence of LBW in Padangsidimpuan include the occupation of pregnant women associated with pesticides, the completeness of personal protective equipment (PPE) when doing activities in the field, and the place where pesticides are stored.	The limitation of this study is that the sample is not directly mentioned in the method. In addition, there is an unsynchronized p-value between pesticide storage and the incidence of LBW in the discussion and conclusion, which makes it a little confusing.
3	Sundani, I (2020)	Factors Related to Low Birth Weight (LBW) Incidence in Shallot Farmers in Ketanggungan District, Brebes Regency, Central Java Province in 2017 / Jurnal Ilmiah Indonesia, e-ISSN: 2548-1398 / Vol. 5 Num. 6	The sample used 120 mothers with infants less than 1 year old	This study is quantitative with a case-control design with a retrospective approach	A total of 30 mothers (25%) in the low birth weight group and 90 mothers (75%) in the control group were not low birth weight; five factors dominantly influenced the mothers to experience low birth weight, the length of work factor was the most dominant	The limitation of this study is that it does not present statistical test results and analysis results in tabular form, so it is a little tricky to understand.

					cause that influenced the incidence of low birth weight.	
4	Soesanti, F.,et al (2020)	The effect of non-organophosphate household pesticides exposure during pregnancy on infants birth sizes and growth rate: A cohort study. BMC Pregnancy and Childbirth, 20(1), 1–8.	The study resulted in 284 samples of mothers and infants who were respondents.	Use the method of a prospective cohort study.	There was no association between exposure to non-organophosphate pesticides and the incidence of low birth weight. However, exposure to non-organophosphate pesticides had more impact on skin problems in infants.	There are limitations to this study; first, it did not collect information on the possible illegal use of organophosphate pesticides. Secondly, the study was not robust enough to explore the possible effects on infant growth in the first 6 months of life.
5	Matsuki, T., et al (2020)	Association Between Prenatal Exposure to Household Pesticides and Neonatal Weight and Length Growth in the Japan Environment and Children's Study / International Journal of Environmental Research and Public Health / Vol. 17 No. 4608	Pregnant women with the criteria of living in the study area, understanding Japanese, and having the ability to complete the questionnaire totaled 93,718 mothers.	The method used in the article involved collecting data on pesticide exposure during pregnancy through questionnaires. Multiple correspondence analysis (MCA), hierarchical cluster analysis (HCA), and ANCOVA were used to evaluate the relationship between pesticide exposure levels and birth outcomes.	There was a significant association between fumigation insecticides and reduced birth weight, as well as between the frequency of exposure to some pyrethroid-based pesticides and reduced newborn length growth, although the impact was negligible.	The inability to identify the actual chemicals contained in each pesticide based on the study design. Additionally, the study's reliance on self-reported questionnaires for pesticide exposure data may introduce recall bias and potential inaccuracies in reporting.

6	Xu, Q. et al (2020)	Pyrethroid Pesticide Exposure During Early Pregnancy and Birth Outcomes In Southwest China: A Birth Cohort Study / The Journal of Toxicological Sciences (J. Toxicol. Sci.) / Vol.45, No.5, 281-291	Pregnant women were recruited during their initial prenatal screenings at public hospitals in Kunming City from February 2017 to March 2017, typically conducted at 11–14 weeks of gestation; the final analysis comprised 447 women, including those with live births (n = 433), cases of stillbirths/fetal deaths (n = 4), spontaneous abortions (n = 2), fetuses with congenital abnormalities (n = 4), and chromosomal abnormalities (n = 4).	This study uses a prospective birth cohort study of the role of pesticide exposure in early pregnancy on fetal development.	Findings suggested that elevated urinary levels of total PYRs were significantly linked to increased birth weight, birth length, and gestational age, along with a reduced risk of small for gestational age (SGA). However, premature rupture of membranes (PROM) and hypertensive disorders complicating pregnancy were identified as risk factors for decreased birth weight, birth length, and gestational age.	The study's limitations include a relatively small sample size for specific outcomes (e.g., LBW: n = 17; premature birth: n = 28) and potential confounding factors, such as interactions between metabolites, which may have influenced the results, leading to the conclusion that there is no significant relationship between total PYR levels and LBW or premature birth.
7	Widyawati., et al (2020)	The Relationship between Pesticide Exposure and Umbilical Serum IGF-1 Levels and Low-birth Weight: A Case-control Study in Brebes, Indonesia / International Journal of Occupational and Environmental Medicine, doi: 10.15171/ijoem.2020.1809 / Vol. 11, Num.1	The sample used 58 babies: 29 LBW babies in the case group and 29 in the control group.	Use method design in a case-control study.	There was an association between pesticide exposure in pregnant women and the incidence of LBW; maternal involvement in agricultural activities before pregnancy was shown to be a risk factor for babies born with LBW.	The limitation of this study is that IGF-1 levels were only measured once. Therefore, the temporal relationship and the cause-and-effect relationship cannot be examined as an intervening variable / intermediate fetal growth and development disorders due to pesticide exposure can be studied better.

8	Rizkika, A., et al (2023)	Low Birth Weight Related Factors at Kertek 2 Public Health Centre Wonosobo Regency Amerta Nutrition / Vol. 7 No.1	The sample in the study was all babies born at the Kertek 2 Health Centre, Bondowoso Regency, in 2020, a total of 396 with the inclusion criteria of babies born alive, single birth babies, mothers having a complete MCH book, and mothers having their Hb levels checked in the third trimester.	This research is quantitative research using a cross-sectional study.	The study found that pesticide exposure had no association with LBW, with a p-value of 0.398. The absence of this relationship in this study is due to the low pesticide exposure intensity in most mothers.	The limitations of the article include not addressing the potential impact of genetic factors on low birth weight.
9	Rahmawati, A., et al (2023)	The Relationship between Pesticide Exposure in Pregnant Women and the Incidence of LBW at the Sawangan 1 Public Health Centre, Magelang Regency / Proceedings of the 3rd Borobudur International Symposium on Humanities and Social Science 2021 / Atlantis Press	The population in this study were 366 mothers with live births in the last 1 year in the work area of the Sawangan 1 Health Centre. The samples needed in this study were 25 people for the case group and 25 people for the control group	This research is quantitative research with an analytical observational character with a case-control approach	The study found a significant relationship between pesticide exposure in pregnant women and the incidence of low birth weight (LBW) babies. Exposed pregnant women were twice as likely to give birth to LBW babies compared to those not exposed	The study did not consider other potential confounding factors that could influence the relationship between pesticide exposure and low birth weight, such as socioeconomic status or other environmental exposures
10	Hardiana, A., et al (2021)	The Effect Of Pesticide Exposure On Onion Farmers On The Event Of LBW In Sembalun District / The International Journal of Health, Education and Social (IJHES) / Vol: 4 Issue: 11	The study population consisted of 91 mothers engaged in shallot farming, each with toddlers aged 1-2 years registered at the Sembalun Health Center.	The research employed an observational analytical method with a cross-sectional study design.	Result pesticide exposure, particularly the use of personal protective equipment (PPE), is the most significant factor influencing the occurrence of low birth weight (LBW)	The limitation of this study is that the inclusion and exclusion criteria in determining the sample are not explicitly explained in the methods section.

Discussion

Agronursing, a specialized field integrating agricultural health and nursing practices, is critical in addressing the intersection of occupational hazards and maternal-child health outcomes in rural communities (Nur et al., 2024). Pregnant women engaged in agricultural activities often face prolonged exposure to pesticides, which has been linked to increased risks of low birth weight (LBW) due to disruptions in fetal growth and placental function. Agronursing professionals focus on mitigating these risks by providing targeted prenatal education, advocating for safer workplace practices, and promoting awareness of pesticide exposure's detrimental effects (Rosyidah et al., 2024). For instance, nurses in agrarian settings may emphasize the importance of protective equipment, reduced work hours during pregnancy, and adherence to safety protocols when handling pesticides (Musta'adah et al., 2024). By bridging the healthcare and agricultural sectors, agronursing aims to empower women with knowledge and resources to minimize exposure, thereby reducing LBW incidence in vulnerable populations (Kurniawan et al., 2023).

Furthermore, agronursing contributes to systemic change by advocating for policies that protect pregnant agricultural workers. This includes pushing for stricter pesticide regulations, improved access to prenatal care, and community-based interventions tailored to the unique challenges of rural life. Sundani's (2020) findings on prolonged maternal work hours as a dominant LBW risk factor align with agronursing priorities, highlighting the need for workplace accommodations such as modified duties or maternity leave for pregnant farmers. Through interdisciplinary collaboration with public health officials, agronomists, and policymakers, agronursing fosters environments where maternal health is prioritized, ultimately safeguarding both current and future generations from the intergenerational impacts of pesticide exposure (Wulandari et al., 2024; Maharani et al., 2025).

According to research conducted by Lubis (2020), it was found that several risk factors for pesticide exposure were proven to be associated with the incidence of LBW in Padangsidimpuan, including the work of pregnant women associated with pesticides, the completeness of personal protective equipment (PPE) during activities in the fields, and the place where pesticides are stored. Meanwhile, according to Sundani (2020), five dominant factors influence the mother to experience low birth weight, where the length of work is the most dominant cause that affects the incidence of low birth weight. Mothers with a length of work of more than 5 hours have an 8 times chance of experiencing low birth weight due to some mothers being involved in agricultural activities and direct contact with mothers and pesticides. In a study conducted by Matsuki et al. (2020), it was found that the frequency of exposure to almost all pesticides did not affect birth weight and length. However, there was a

significant association between fumigation insecticides and decreased birth weight and between exposure to some pyrethroid-based pesticides and decreased newborn length growth, although the impact was negligible. These results suggest that prenatal exposure to household pesticides, especially those containing pyrethroids such as mosquito coils, may negatively affect fetal and infant growth. The maximum significant difference between the unexposed and exposed groups was 11.55 g in birth weight related to insecticide fumigation and 0.06 cm in birth length related to mosquito coils/nets.

In a study, Widyawati et al. (2020) found an association between pesticide exposure in pregnant women and the incidence of LBW by showing that maternal involvement in agricultural activities before pregnancy was proven to be a risk factor for LBW. Agricultural activities such as pulling grass and repelling pests in the same field where farmers spray crops with pesticides can expose pregnant women to chemicals. These chemicals cause disturbances in the synthesis, metabolism, secretion, and elimination of hormones in the body that are useful for maintaining homeostasis of the reproductive process. Hormones that can be disrupted include IGF-1, which can decrease and become a risk factor for LBW. Mothers with a history of pesticide exposure had lower IGF-1 levels than mothers not exposed to pesticides. This is supported by research conducted by Rahmawati et al. (2023), which states that the involvement of women during pregnancy with agricultural activities can cause exposure to pesticides. Chemicals from pesticides can interfere with fetal growth and development, so the baby has a low birth weight. However, other factors can affect the weight of newborns besides environmental factors and pesticides, such as maternal age, amniotic fluid, multiple pregnancies, and chromosomal abnormalities. In research, Hardiana et al. (2021) also agree that pesticide exposure affects the incidence of LBW. In addition, several other factors, such as how pesticides are stored, the dose of pesticides, and the use of personal protective equipment, can affect the occurrence of LBW.

However, based on research conducted by Xu et al. (2020), the results explain that the levels of total PYRs have a significant relationship with birth, including an increase in birth weight, birth length, gestational age, as well as a decrease in the risk of small for gestational age (SGA) babies. However, there were several other risk factors, such as PROM or premature rupture of membranes and hypertension, that led to the possibility of decreased infant weight and length and gestational age. Fisher's test analysis in the study found that women who used pesticides (within 6 months before pregnancy) were more likely to have a fetus with congenital abnormalities. It was also found that pesticide use was an independent risk factor for congenital abnormalities. In addition, Soesanti et al. (2020) research found that babies born to mothers

exposed to household pesticides during pregnancy had a lower head circumference at birth than babies born to mothers not exposed to household pesticides, especially those not exposed to mosquito pesticides.

The body weight of infants born to mothers exposed to household pesticides was lower but not statistically significant, and there was also no association between exposure and aspects of growth, including weight gain, length gain, HC gain, and weight-to-length gain rate. However, exposure to non-organophosphate pesticides had more impact on skin problems in infants. In a study conducted by Rizkika et al. (2023), it was also found that there was no relationship between pesticide exposure and the incidence of LBW. This is because the participation of mothers in agricultural activities is mostly not too long, so the intensity of pesticide exposure in most mothers is still low. Most mothers who work on farms do not participate in pest and pesticide spraying activities because male farmers have carried out these activities. This is in line with research conducted by Suwannakul et al. (2021), which showed that although there were newborns with 4% lower body weight, 8% lower body length, and 15% lower head circumference compared to the reference in Thailand, no statistically significant association was found between these birth outcomes and organophosphate pesticide metabolites in maternal urine. This could be because workers wear more than one piece of PPE while doing farm work. The study's limited sample size may have led to insufficient statistical power to identify such associations.

Conclusion

Pesticide exposure during pregnancy has an influence on the incidence of LBW in addition to the adverse effects of pesticide exposure, such as reduced head circumference, skin irritation, and impaired fetal development. Nurses are needed to increase the awareness of farmers and their families, such as using PPE, managing pesticides according to standards, avoiding direct contact with someone bound by pesticides, and storing pesticides out of reach.

Author Contributions

All authors have contributed to completing this study.

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Conflict of Interest

None

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